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IV International Soybean Processing and Utilization Conference
III Congresso Mundial de Soja (Brazilian Soybean Congress)

February 29 to March 5, 2004
Foz do Iguassu, PR, Brazil

Abstracts of contributed papers and posters

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Foreword

Soybean has been and will continue to be a major source of 'well being' of populations in different regions of the world. Soybean use has increased worldwide for many purposes, including human nutrition and health, table oil, livestock feed, and many other industrial uses.

The scientific and technological developments in most regions have increased soybean production and yield, and all the sectors involved with the entire soybean production and processing chain have responded accordingly to comply with the demands of a globalized economy. Furthermore, there have been many initiatives towards soybean production systems that are also ecological and socially sustainable to counteract environmental degradation, especially in those systems where soybean is intensively grown over large areas.

The many benefits of soybean, such as its use for human nutrition and health, have been widely explored in many countries in Asia, but, as a whole, have been underexplored in other world regions. The scientific and technological developments in this area and in other areas of soybean utilization have also increased exponentially in the last decade towards exploiting the full benefits of this "golden grain" and expanding the use of these benefits to a greater number of persons in many countries.

This publication offers a unique oportunity for the participants to become acquainted with the most up to date research related to soybean production, processing and utilization, encompassing specific areas of each of these aspects, providing original research presented as contributed papers (oral presentations and posters). In this context, this publication contains 128 abstracts of oral (volunteer) and 544 abstracts of poster presentations, totaling 672 papers, which report information important to the participants. We hope that all the up to date information provided in this document will have a positive impact on the further improvement of soybean production, processing and utilization and that it is used and disseminated by the participants to their different countries, for the benefit of humankind.

Flavio Moscardi
Chair, WSRC VII, ISPUC VII, and
BSC III Chair, Continuing Committee for WSRC

Mercedes C. C. Panizzi
Chair, Continuing Committee for ISPUC

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ABSTRACTS

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ISPUC

C001. Retrospect and prospect to development of China's brewing condiment industry

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I. Retrospect to the industry development in the past five years - "Food makes life; flavor makes food." as the old Chinese saying goes. With the development of economy, people's living standard improved from having enough food and clothes to being well off, which gives rise to new demands of brewing condiments at all levels. Owing to these new demands, production volume of soy sauce, vinegar, sufu and other products in china's brewing condiment industry increased with annual growth rate of approximate 10% during the past five years. Here are the main characteristics of industry development during. 1. Production volume presents continuous increase; 2. Producing condition and technology experiences constant improvement; 3. Certain progress had been made in product structure adjustment, and scale of sorts shows a speedy expansion. At present market, the increase of production volume of such traditional condiments as soy sauce, vinegar, sauce, sufu is limited, while new types of condiments emerged endlessly. Therefore, the need of product structure adjustment becomes more and more obvious. Following are ten aspects deserving special emphasis in the future product development: (1) Production of slap-up traditional condiments; (2) Production of condiments and dehydrated materials for instant noodles; (3) Production of compound condiment; (4) Production of condiments for instant food; (5) Production of condiments for processing meal, fish and seafood; (6) Production of condiments for processing all kinds of snacks; (7) Production of condemns for deep frozen food; (8) Production of condiments for western style instant food; (9) Production of new type of monosodium glutamate; (10) Production of all kinds of food additive and raw material for food industry use. 4. Industry structure and enterprise organization adjustment speeds up; 5. However, the problems in China's brewing condiment industry should not be ignored, they are: (1) The scale of enterprises is small; the scale profits has not been developed yet; (2) The management level varies from one to another; production technology is relatively backward; (3) Low product quality and overflowing of counterfeiting endanger the industry development. II. Prospect and analysis of supply and demand in domestic and foreign market: 1. Condiment industry processes 24 billion RMB market share; 2. From the occupation ratio per capita, condiments are faced with a wide market; 3. Analyzed in direct psychological point of view, condiments enjoy a wide market; 4. Seen from the perspective of food processing industry, condiments enjoy a wide market. II. Comparison of technology level of the main product in the brewing condiment industry between domestic and abroad. III. The prospect to the development of brewing condiment industry in the next five years: 1. More kinds of Chinese food will match into international market, condiment industry is no exception; 2. In the next few years, brewing condiment industry increased with annual growth rate of more than 10%; 3. As people's living standard improves, the condiments will develop towards the trend described as "more diverse, more nutritious, more compound"; 4. High and new technology will be used to accelerate the combination between and tradition process and modern process; 5. More and more multinational corporations will enter China's condiment markets and the competition will be sharper.

C002. Novel polymeric materials from soybean oil

R.C. Larock

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Iowa State University, Ames, Iowa U.S.A.

The Larock group at Iowa State University has developed a very simple procedure for the synthesis of industrially promising biopolymers ranging from elastomers to hard composites by the cationic copolymerization of soybean oil and styrene plus divinylbenzene. Other natural oils, like corn, tung, and fish oils can also be employed in this process. The starting materials are readily available, renewable and inexpensive. These thermoset polymers possess good thermal and mechanical properties and some unique properties, like excellent dampening of sound and vibration and shape memory properties. Their synthesis, characterization, properties, and potential applications will be discussed.

C003. New dimensions of soybean insect management in India

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Use of chemical insecticides with fast knockdown effect for insect control has always remained farmers' first preference. Having relied solely on chemical insecticides for about last 20 years, they are now facing problems of insecticide resistance in insects, minor insects becoming major insect-pests, insecticides losing their efficacy etc. To cope up with these problems, a new thrust has been given to insect management in soybean. Insect resistance/tolerance has been made mandatory in varietal development programmes. Several insect resistant sources have been identified through large-scale field screening followed by laboratory screening - DS 396, TGX 855-53D (for defoliators), MACS 124 (for stem fly - *Melanagromyza sojae*), L 129 (for girdle beetle - *Oberiopsis bravis*) etc. These insect resistant sources have been used in breeding programmes and the resulting generations are being tested in hot spots for their reaction against target insect and for yield attributes. Bio-insecticides based on *Bacillus thuringiensis* and *Beauveria bassiana* have already been tested and recommended to the farmers. With the Integrated Pest Management (IPM) technology demonstrated under real-farm conditions, the farmers could harvest about 500 kg/ha more yield than with their own practices and earned a net profit of over Rs. 2200 per ha. Emphasis is also being given to exploit the potential of naturally occurring bio-control agents like - parasites, predators, insect pathogens, insectivorous birds etc. Chitin inhibitors viz. Diflubenzuron and Lufenuron have been found to be highly effective against lepidopterous defoliators and safe to natural enemies. Among newer chemical insecticides thiamethoxam 70 WS, thiamethoxam 25 WG and ethofenprox 10 EC against white fly, *Bemisia tabaci*, methomyl 40 SP and Lambda cyhalothrin 5 EC against *Helicoverpa armigera* have shown great potential in suppressing damaging populations of major insect pests of soybean.

C004. New Sources of resistance to leaf defoliators in some advanced breeding lines of soybean in India

C. Bharadwaj[1]; A.N. Sharma[2]; C.T. Satyavathi[3]; P.G. Karmakar[4]

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Tobacco caterpillar [*Spodoptera litura* (Fab.), Lepidoptera: Noctuidae] is one of the major insect pests of soybean causing severe defoliation and yield losses in India. Studies were undertaken in controlled laboratory conditions (a 26 ± 1°C and 75% relative humidity) based on leaf feeding data from multiple choice test (MCT) and no-choice test (NCT) tests. The soybean genotypes studied include germplasm accessions and some advanced breeding lines developed from them at N. R. C. for Soybean, Indore, India. Field tests were also undertaken to identify some of the promising lines. The findings of this study indicate that suitable screening of the genotypes for resistance to defoliators is essential to identify the type of resistance and also keeping in view the location specific cropping pattern, a suitable programme to develop varietal cafeteria approach. Data on per cent leaf area consumed by II nd instar *S. litura* larvae in MCT showed significant differences for genotypes over the two years of study. TGX 855-53D a germplasm line from Taiwan showed a high degree of resistance in MCT with 17% test area eaten while in NCT it gave complete susceptibility with 90% test area eaten indicating an antixenosis (non preference type) of reaction. This can be used as a source for developing defoliator resistant lines. Identification of L 129, a source of resistance to girdle beetle that showed moderate to high resistance against tobacco caterpillar in both the years of study is of significant importance as this can be used as a source for multiple pest resistance. There is a significant variation among the genotypes for leaf consumption in NCT, but in general had a higher per cent of leaf area eaten than MCT, implying that under controlled conditions and in no choice conditions *S. litura* larva are voracious feeders indicating the importance of varietal cafeteria approach. DS396 had given a stable performance with a very good resistance to *S. litura* larva under both the conditions of testing indicating its potential as a source of resistance to defoliators in regions where monoculture is in vogue. Use of DS 396, TGX855-53D and L129 in pre breeding would also broaden the base of soybean varieties as these represent a diverse source of germplasm compared to the well-used set of Bragg, Lee, Clark 63 and Davis. Among the 78 (IVT-30, AVT-16 and Breeding lines-32) lines screened, MAUS 144, KB 165, SL 599, TS 128-5, TS 148, Himso 1569, MACS 798, MACS 754, DS 228, DS 97-12 showed resistance against defoliators. The Maximin-minimax method identified NRC 37 and MAUS 47 as resistant and high yielding.

C005. Eco-friendly management of lepidopterous pests in soybean

R.H. Patil; K.A. Kulkarni; S. Lingappa; P.V. Patil; G.T. Basavaraja

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A field experiment was conducted for two years for 1998-2000 to study the seasonal incidence, bio-efficacy on defoliator *Spodoptera litura* and pod borer *Cydia ptychora* mass production of *Nomuraea rileyi* and also its compatibility with pesticides in soybean eco-system. The mycopathogen occurred in epizootic form on *S.litura* in soybean between 31st and 38th with peak activity in 34th and 35th standard week. The treatment effect due to *N.rileyi* became visible at 7 DAS and its superiority was more evident at 14 DAS. In soybean the pathogen inflicted significantly higher reduction of *Spodoptera* larvae at higher concentration ($2.4x10^8$ conidia/l) at 14 DAS. Rice and barely were the most suitable substrate for quicker and better mass multiplication of *N.rileyi* with $1.22x10^8$ and 1.17×10^8 conidia per g of substrates after 20 days of inoculation. Fungicides, in general, proved highly toxic to mycopathogen inhibiting 82.71 per cent of spores from germination when compared to insecticides (53.99 % inhibition) and weedicides (21.50% inhibition). Among fungicides, cyperconazole and triademefon were comparatively safer permitting 69.42 and 65.89 per cent conidia to germinate, respectively.

C006. Identification and inheritance of resistance to leaf feeders in soybeans

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According to a field survey during 1983-1984 and 1992-1994, 49 insect species from five orders, i.e. Coleoptera, Hemiptera, Homoptera, Lepedoptera and Orthoptera, were identified to be leaf feeder insects (LFI) for soybeans in Nanjing, China and bean pyralid [*Lamprosena indicata*? (Fabricius)], mugwort looper [*Ascotis gelenaria* (Schiffermuller et Denis) and cotton worm [Prodenia litura (Fabricius)] were clarified to be the most important pests. Fifty one resistant or susceptible soybean entries screened out from 6724 accessions were evaluated for their resistance to LFIs in field in terms of their defoliation percentage and to cotton worm in net room in terms of both plant response and insect response (antibiosis). There existed significant difference in the resistance of soybeans among varieties, dates and years, and also significant interactions between varieties and dates, and between varieties and years. The accessions highly resistant to LFIs in field and to cotton worm alone in net room in terms of plant response and those highly resistant to cotton worm in terms of antibiosis were screened out for breeding purposes. The three sets of accessions were not consistent. The mechanism of resistance to leaf-feeding insect was mainly antibiosis in comparison with ovipositional preference. For plant response to LFIs, the results of joint analysis of multiple generations of P_1, F_1, P_2, F_2, $F_{2:3}$ of the crosses N21297 × N1178-2-2 and N21266 × N23860 showed a two major gene plus polygene mixed inheritance model with heritability values of major gene (h_{mg}^2) being about 81 ~ 94% much greater than those of polygene (h_{pg}^2) which were only 0 ~ 12%. While for plant response to cotton worm alone in net room, there also showed a two major gene plus polygene mixed inheritance model but with h_{mg}^2 67 ~ 98% and h_{pg}^2 0 ~ 25%. For insect response (larvae weight), the results of $F_{2:7:8}$ RIL populations of the two crosses showed also a two major gene plus polygene mixed inheritance with h_{mg}^2 51 ~ 69% and h_{pg}^2 22 ~ 24%. Whether the two major genes detected for plant response and insect response were in a same genetic system should be further studied.

C007. Effect of rutin on the biology and physiology of *Anticarsia gemmatalis* from strains of susceptible and resistant to the *Ag*MNPV

G.C. Piubelli[1]; C.B. Hoffmann-Campo[2]; F. Moscardi[2]; M.C.N. de Oliveira[2]

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Flavonoids in general have been related with plant protection against different sources of stress. Rutin (quercetin 3-*O*-rutinoside) is a flavonol identified in soybean resistant genotypes and it is known to play an important role on plant defenses against defoliating insects. Nevertheless, some authors have reported that rutin can also interfere with the nuclear polyhedrosis virus (NPV) infections. Experiments were carried out to evaluate the effect of rutin on two strains of *Anticarsia gemmatalis,* susceptible (S) and resistant (R) to the *A. gemmatalis* Multiple NPV (*Ag*MNPV). Since eclosion, larvae from both populations were fed on a diet without (control) or with rutin (0.65% and 1.30%) addition. At the end of second instar, larvae were weighed and individualized on the same diet and observed daily until reaching the pre-pupae stage. Analyse of covariance (ANCOVA), followed by bicoordinate utilization plots, was used to remove the effect of feeding time from consumption and weight of pupae and to separate pre- and post-ingestive effects of rutin on *A. gemmatalis* growth. Larval mortality rates were higher when R larvae were fed on 1.30% rutin-

diet (97.9%), compared to the controls. Larvae from R and S populations that fed on diet with 0.65 and 1.30% of rutin, respectively, showed the same mortality rates (74.7%). Initial and final pupal weight, consumption, frass, lipid and development time of *A. gemmatalis* were all negatively affected by rutin, mainly in the R population. Consumption of the insect remained affected by diet (treatment), after removing the effect of feeding time by ANCOVA. Comparing control-diet insects, those from S population consumed more rapidly a larger amount of food than those from R population. Insect growth and the amount of frass produced depended on an interactive relationship between the amount of food eaten (covariate) and the treatments. Digested food and weight of pupae, as covariates, also affected the weight of pupae and the amount of lipid, respectively. Post-ingestive effect was observed on larvae from both populations when rutin was added to the diet, probably as a result of insect failing to detect this substance on the diet. Nevertheless, R larvae notably were more adversely affected by rutin than the S population, even in the lowest concentration of the flavonoid (0.65%). Results indicate that resistant soybean genotypes containing rutin may be an useful tool to break resistance of *A. gemmatalis* to *Ag*MNPV, although additional studies involving a second *A. gemmatalis* generation have to be carried out for a complete elucidation of this fact.

C008. An overview of the program for use of a Nucleopolyhedrovirus of *Anticarsia gemmatalis* in soybean and recent achievements to improve the program

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The velvetbean caterpillar, *Anticarsia gemmatalis*, is the key defoliating insect of soybean from northern Argentina to Southeastern USA. In Brazil it is abundant in all soybean growing regions, and demands an average of two insecticide applications per season. In the early 1980's a program for use of a nuclear polyhedrosis virus of *A. gemmatalis* (AgMNPV) was launched by Embrapa Soja and the official extension service of the state of Paraná (Emater-Pr), in the context of a soybean integrated pest management (IPM) program started in the mid 1970's. Currently the biological product based on the AgMNPV is produced by four private companies, through contracts with Embrapa Soja, and used in approximately 2.0 million hectares of soybean in Brazil (ca. 12% of the soybean cultivated area in the country), being the largest program worldwide regarding the use of a microbial insecticide in a single crop. Production of the AgMNPV has been effected mainly in the field, by applying the virus in farmer's fields and collecting dead larvae for further processing as a biological insecticide, with quality control of the final product batches being performed at Embrapa Soja. However, this method of virus production is dependent of biotic and abiotic factors, which influence abundance of the host insect and thus the yield of AgMNPV each season. In the last three seasons the demand for the biological insecticide was 20-30% over of its availability in the market. Previous attempts by private companies to produce the virus under laboratory conditions were not successful due to the high costs involved, mainly insect diet ingredients, insect-rearing recipients and labor, making the final AgMNPV product not cost competitive with chemical insecticides. In this paper, we report a new procedure for commercial production and processing of the AgMNPV under laboratory conditions that results in a final product with lower cost than that of chemical insecticides, which will be a breakthrough to attend the increasing demand for the biological insecticide. One of the companies (Coodetec) is currently implementing successfully the new procedures at commercial level. Furthermore, data on fluorescent brighteners mixed with the AgMNPV indicate that these products may improve the virus formulation by potentializing viral activity against susceptible *A. gemmatalis* larvae and breaking resistance in insects that were selected in the laboratory to high levels of resistance to the AgMNPV. Other important recent developments to improve the program will be discussed.

C009. Genetic enhancement for rust resistance in soybean

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Rust is one of the major diseases of soybean which is known to cause significant yield losses. Most of the popular cultivars are susceptible to rust. Keeping this in view, an investigation was carried out at the University of Agricultural Sciences, Dharwad, India during 1997–2002 with an objective to improve host plant resistance to rust. Three diverse genotypes *viz.*, Ankur, JS 335 and Local black soybean were treated with three doses of gamma irradiation (10, 20 and 30 kR) and ethyl methane sulphonate (0.4, 0.6 and 0.8 %). About 270 families of M_3 generation and subsequently M_4 and M_5 lines were screened for rust resistance. Ten lines confirmed their resistance in field as well as glass house conditions with artificial inoculation. Out of which, three were resistant and seven were moderately resistant compared to highly

susceptible check JS 335 and moderately resistant genotype Ankur. Further, these lines were evaluated for their yielding ability. Among them, four lines were superior to best check JS-335. In the light of this, the mutant derivatives obtained in the present study could be regarded as significant achievement as far as rust resistance breeding is concerned.

C010. Breeding for resistance to sclerotinia stem rot (*Sclerotinia sclerotiorum)* in soybean

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Current soybean varieties express only partial resistance to sclerotinia stem rot, with one of the highest levels shown in the cultivar NK S19-90. Our objectives were I) to develop elite germplasm with increased resistance to this disease and II) to identify quantitative trait loci (QTL) for resistance, that could be used in marker assisted breeding. In order to accomplish these objectives we crossed NK S19-90 to plant introduction (PI) 153.282, which had previously been identified for its high resistance and agronomic similarity to NK S19-90. One hundred and seventy four F_4-derived lines from this cross were field tested over two years at three locations: East Lansing and Sandusky, Michigan and Urbana, Illinois. Data were taken on agronomic traits and resistance to sclerotinia stem rot. Resistance was rated on 30 plants per plot and recorded as a disease severity index (DSI) ranging from 0 = no symptoms to 100 = most severe symptoms. The disease occurred in 2002 only in Sandusky and Urbana with a mean DSI of 1.7 and 1.3, respectively, and in 2003 only in East Lansing and Urbana with a mean DSI of 6.3 and 30.7, respectively. Disease ratings from 2002 were disregarded due to low DSI values. For both 2003 environments genotypic variance for DSI was significant (alpha = 0.05) within each environment and across environments. There was a significant genotype x environment variance (alpha = 0.05). The heritability estimates were 31% in East Lansing, 68% in Urbana, and 35% across both environments. Yield was determined in Urbana, 2002, since it was a test with low disease incidence indicated by mean DSI. The genotypic variance for yield was significant (alpha = 0.05) and the heritability was 76%. Out of the 27 lines that were identified as more resistant than NK S19-90, 15 lines had yield similar to NK S19-90 at an experimentwise alpha of 0.1. Among these 15 lines, there was one line that was more resistant than NK S19-90 across tests. This suggests that we were able to increase resistance to sclerotinia stem rot without significant yield drag. The entire population is being genotyped using simple sequence repeat (SSR) markers to map resistance QTL. Currently a total of 273 polymorphic SSR markers have been identified and results of the QTL mapping study will be presented.

C011. Inheritance of resistance to *Cercospora sojina* Hara of many races in soybean

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Cercospora sojina Hara is one of the most important diseases which has caused huge loses in soybean production of Heilongjiang province. It was proved that resistance breeding is the most efficiency method in controlling this disease. Owing to the high adaptability and variability of *Cercospora sojina* Hara, there are many different races existed together in the nature field. Therefore, the resistance breeding must be done in a dynamic condition. Five resistance-susceptible crosses had been planted in Xiangfang Farm in Harbin (in artificial inoculation) and in Yagou Test Sit nearby Harbin (in nature infection) respectively, in order to study the inheritance and selection of resistance to *Cercospora sojina Hara* in the two places. The resistance of parents and F_2 populations were largely affected by the weather conditions due to the resistance differences between different years being larger than that between different places. In any case, the resistance of F_1 was nearly entire dominant and, in F_2 populations, large amount of resistant and susceptive individuals superior to their parents were separated. The resistance of every generation went down as it went to the next higher generation (from F_1 to F_4). Selection effects showed that the selection of F_2 individuals was effective for F_3 lines planted in Xiangfang but in Yagou. From the distributions of F_3 populations showed that there was no difference between choosing F_2 groups of LTPG being 0 and 10 for F_3 populations in Xiangfang. But in Yagou condition, it was entirely different between choosing F_2 plants of LTPG being 0 and 10 for F_3 populations and the best choice was LTPG being 0. Usually, under several physiological races of *Cerospora Sojina* Hara existed condition, the inheritance of resistance to this disease is controlled by equal-effect polygene. While high resistant parent 'Dongnong 9674' and other sensitive parents were used to make the resistance-sensitive combinations in this experiment, the resistance to *Cerospora Sojina* Hara had appeared the significant marjor gene effect. When P_1, P_2, F_1, F_2, B_1, and B_2 six generations were used to study and estimate the gene effects, Major genes of resistance to *Cerospora Sojina* Hara were identified and the genetic parameters were also estimated in three combinations. The inheritance of genes resistant to this disease was

fitted to the major gene and polygene mixed inheritance model or two gene loci inheritance model. The estimation of genetic parameters indicated that the additive, dominance and epistasis effects were existed and played an important role in the resistance to *Cerospora Sojina* Hara. It is meaningful in soybean resistance breeding to frogeye leaf spot.]

C012. Study on resistance and it's inheritance to toxin of *Cerospora sojina* Hara in soybean

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Toxin of *Cerospora Sojina Hara* produced by mycelium of the pathogen can do harm to soybean plant. In this paper, 50 varieties and 1 resistance-susceptible combination were used to study the resistance and the inheritance of resistance to the toxin of *Cerospora Sojina Hara*. In the resistance study, 50 varieties with 10 replications for 10 races test were planted in the field. Before the inoculation, 2 leaves in same leaf age from the same plant of the same position were sampled to do the toxin test. The leaf stalks were put into water for absorbing enough water before test. 50 soybean varieties were soaped into toxins of 10 races respectively, with two duplications in each treatment. Leaves were weighted before the toxin treatment and after that. Then (in July), *Cerospora Sojina Hara* of 10 races was inoculated on the every replication (every replication for one race) of the 50 materials with the concentration of 3~5 spores every visual field under 10□10 microscope. The data were gathered after 15 days of the inoculation (LTPG)[2]. Compared with the results from field under inoculation conditions, the average coincidence rate of the toxin test is 62.37%. The resistance of soybean to toxin was different in different varieties, and the toxin had different toxicity in different races. The dewater ratio and the degree of withering of leaves could be used as the two indexes for resistance evaluation. Although the toxin test had the characteristics of stability and repeatability, in the testing process, it was not as the same as the spore infection in the artificial inoculation or induced by nature. So it could be used as an assistant method. In the inheritance study, P_1□P_2 and F_2 generations from the resistance-susceptible combination of Dongnong 91212□susceptible□□Dongnong 9674□resistant□were used for the inheritance study of resistance to toxin. 100 individuals from F_2 and P_1, P_2 were randomly chosen and numbered for toxin test and inoculation test of Race 7. The inheritance of soybean resistance to the toxin of Race 7 in tested cross was proved being controlled by a pair of dominance gene. Owning to the features of convenience, the toxin appraisal method can be used for many purposes.

C013. Evaluation of soybean cultivars for partial resistance and tolerance to *Phytophthora sojae*

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Phytophthora root rot (PRR) caused by *Phytophthora sojae* M.J. Kaufman and J.W. Gerdemann is a major soybean disease in the United States. It causes pre- and post-emergence damping off, and root and stem rot. Race-specific resistance has been the primary means to control this disease; however, new races that defeat the race-specific resistance genes arise and erode the effectiveness of the resistance. Another type of resistance is partial or non-specific resistance, which enables plants to reduce the severity of symptoms and the extent of pathogen colonization. Tolerance is the ability of plants to produce near normal yields under severe disease pressure. Partial resistance and tolerance may underlie race-specific resistance in some genotypes and may explain differences in field responses to *P. sojae* among cultivars containing the same race-specific genes. Sixteen maturity group (MG) II and III soybean cultivars were selected to determine if there were differences in tolerance or partial resistance to different isolates of *P. sojae*. Fifteen cultivars with race-specific *Rps 1k* gene and one with the *Rps 1c* gene, as confirmed by hypocotyl inoculation with a set of *P. sojae* pathotypes with known virulence formula (VF) (Schmitthenner, 1985). An inoculum layer test (Walker and Schmitthenner, 1984) was used to test partial resistance (root weights compared to non-inoculated controls) with different *P. sojae* isolates: race 1 (VF 7), race 28 (VF 1a, 1c, 1d, 1k, 2, 3a, 3b, 3c, and 4), race 30 (VF 1a, 1b, 1d, 1k, 2, c, 4,5,6, and 7), and a mock-inoculated control. Out of the 16 cultivars tested, all had race-specific resistance to race 1, eight and three cultivars with Rps1k were susceptible to races 28 and 30, respectively, based on the hypocotyl reaction; however they had partial resistance based on root reactions. In the field, tolerance and partial resistance measured by plant height were evaluated by comparing cultivars with seed-treated or not treated with the fungicide mefenoxam in experimental plots infested or not infested with *P. sojae* inoculum. Height of plants in plots inoculated with races 1 and 3 were significantly higher on average than plant in plots inoculated with races 28 and 30, and mock-inoculated and non-inoculated controls, indicating a high level of plant infection in the field test. There were no significant differences among 13 cultivars for plant height between plots planted to fungicide seed-treated or not treated for plots inoculated with races 28 and 30, suggesting that many of the cultivars were partially resistant. The analysis of yield data to measure tolerance to *P. sojae* is in progress. In conclusion, some commercial cultivars with *Rps 1k* appeared to either have partial or unidentified race-specific resistance to infection by *P. sojae* races 28 and 30, which might be exploited in soybean breeding programs.

C014. QTLs conferring resistance to race 4 of soybean cyst nematode in soybean ZDD2315 mapped based on soybean public molecular linkage map

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Soybean Cyst Nematode (SCN, *Heterodera glycine* Ichinohe) is one of the most economically destructive diseases of soybean. Among the physiological races, SCN race 4 is the predominant race and the most damaging soybean pathogen in China. The advent of molecular markers and quantitative trait locus (QTL) mapping approaches in the last decade gives an efficient alternative to study the mechanism of resistant to SCN. It will be considerable significance to accelerate the research of SCN-resistance breeding. A population of 253 $F_{2:3}$ families, which were generated from a cross between ZDD2315, a local germplasm of Shanxi province which is high resistant to SCN race4, and Jinbean23, a releasing cultivar and susceptible to SCN race4, was used for molecular marker identification. According to the linkage group A and G of published soybean molecular linkage map, total 20 SSRs were adopted in this research. Eight SSRs (Satt038, Satt309, Satt610, Satt187, Sat_141, Satt315, Satt632, Sat_162) were identified in $F_{2:3}$ populations. A hundred of ISSR markers were used to screen resistance to SCN Race 4 by means of bulked segregant analysis (BSA). One ISSR marker (UBC811) was identified to be highly related to SCN resistance. One morphologic agronomic trait, seed coat, was also investigated in F_2 population. The result showed that black seed coat (BSC) is separated by expected ratio of 3:1, and can be predicted as a recessive allele in controlling seed coat color. By means of complicated interval mapping, three new QTLs had been mapped to soybean linkage A and G, respectively, conferring resistance to SCN Race 4. *rhg-R4g1* is one mapped QTL on linkage group G and is 2.0cM away from Satt610 marker. *rhg-R4a1* and *rhg-R4a2* are two QTLs, which is 0.2cM away from Sat_162 marker and 1.6cM from BSC marker on linkage group A, respectively. Gene actions of *rhg-R4a1*, *rhg-R4a2* and *rhg-R4g1*, are partly dominant, dominant and overdominant, respectively. The sum of variation of 3 QTLs is 33.33%. In the case of the SSR markers, Satt610 and Sat_162 were used as identification markers in forty-one soybean varieties. Seven of them had the special resistant banding patterns. The result shows that Satt610 and Sat_162 makers are associated with loci conferring SCN Race4 resistance, and they would be utilized in marker-assisted selection to assistant identification resistance-disease character of SCN.

C015. SCN resistance QTL: confirmation testing and associated effects on agronomic traits

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Many quantitative trait loci (QTL) that confer resistance to soybean cyst nematode (SCN) have been mapped in soybean. However, the effect of only a few of these QTL have been confirmed and the regions where these QTL map have not been tested for their effect on agronomic traits. This information is critical to breeders when they develop SCN resistant cultivars through marker-assisted selection. The goal of our research was to study the effect on SCN reproduction and agronomic traits of the genetic regions where four SCN resistance QTL map. The QTL include *rhg1* and a second QTL on linkage group (LG) J from PI 88788, and resistance QTL on LGs G and E from a *Glycine soja* resistance source. The effects of these regions were tested using near-isogenic lines (NILs). In the PI 88788 background, the NILs were developed from F_4 or F_6-derived lines that were segregating for one or the other QTL region. Plants from these selected lines were individually threshed to form the NIL populations. For the *G. soja* source, the QTL were backcrossed four times (BC4) into the background of a soybean experimental line. In greenhouse tests, the resistance alleles from all four QTL were associated with greater resistance than the susceptible alleles. Lines with the resistance allele had a female index that was 123 less for the *rhg1* QTL, 13 less for the LG J QTL, 47 less for the *G. soja* QTL on LG G, and 42 less for the *G. soja* QTL on LG E when compared to lines carrying the susceptible allele. Lines in the *rhg1* and the two *G. soja* populations were tested with a HG type 7 SCN population and the LG J populations were tested with a HG type 1.3.5.6.7 population. In field trials with low SCN pressure, a significant reduction in yield was observed among lines that carried the resistance allele at *rhg1* compared to the susceptibility allele in a 1980's era SCN source. In contrast, there was no significant association between the *rhg1* region and yield in a 1990's era SCN resistance source. This suggests that the yield drag some breeders believe is associated with SCN resistance is diminished for *rhg1* in new cultivars. Under high SCN pressure, the *rhg1* resistance allele from both the 1980's and 1990's era sources was associated with greater yield and a reduction in SCN reproduction in some environments. The resistance allele for the LG J QTL was associated with less yield than the

susceptibility allele in field locations with low SCN pressure. In field locations with moderate SCN pressure, the *G. soja* SCN resistance QTL allele on LG E was associated with greater yield than the susceptibility allele, whereas the SCN resistance QTL on LG G was not associated with yield. We do not know whether the significant agronomic effects associated with these QTL are the result of the resistance QTL themselves or linked genes.

C016. QTL associated with seed protein concentration from three sources of high protein

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Protein accounts for approximately 40% of the dry matter and nearly three-fourths of the value of the soybean seed. Protein concentration in most commercial soybean cultivars has not increased over the past 60 years of soybean breeding in the U.S. primarily because of the negative relationship between protein concentration and seed yield. Identifying specific loci that influence protein concentration will be important in understanding the genetic relationship between protein concentration and seed yield. Determining the genetic variation among sources of high protein may be critical for efficiently increasing the level of protein concentration. The objectives of our research were to identify QTL associated with seed protein concentration and determine if these loci were different among three sources of high protein: HHP, L69-183, and PI 82278. HHP is a high protein experimental line with an unknown *G. soja* accession as the source of high protein. The high protein parent of L69-183 was Sioux introduced from Hokkaido, Japan in 1929. PI 82278 was introduced from Korea in 1929. Each source of high protein was crossed to the cultivar Williams and high protein F_4 lines were selected. These lines were crossed to Williams 82, a backcrossed derived line from Williams with the Rps_1^k allele for Phytophthora rot resistance, and high protein F_5 lines were selected. These selected lines were backcrossed to Williams 82 and individual F_2 plants were harvested to create 120 random BC_2F_3 lines from each donor parent. The random lines plus the parents were grown in 2 replications at 3 locations for 2 years. The protein concentrations of the donor parents of the final backcrosses were 474, 496 and 503 mg g^{-1} dry matter for the Sioux, *G. soja* and PI 82278 sources, respectively. The protein concentration of Williams 82 was 437 mg g^{-1} dry matter. The range in protein concentration in the three populations of experimental lines varied from 51 to 69 mg g^{-1} dry matter. Approximately 100 SSR loci were polymorphic between the donor and recurrent parents. Each line will be genotyped using the polymorphic SSR markers. Markers linked to loci affecting protein concentration will be identified.

C017. Mapping yield QTL's from a population derived from exotic soybean germplasm

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Exotic germplasm is an important source to improve elite soybean germplasm traditionally used as a source of single genes for trait improvement. Less successful has been their use to improve yield and other agronomic characteristics. The objective of this study was to map yield QTL's introgressed from exotic germplasm. A $F_{4:6}$ population (n = 150) derived from a cross between an elite soybean cultivar and an exotic soybean line was evaluated for agronomic traits. This included date of maturity, yield, seed protein and oil content, in replicated field trials at two locations. SSR markers that span the 20 linkage groups of the soybean genome were screened for parental polymorphism. Polymorphic SSR markers were then screened against the $F_{4:6}$ population. Single marker ANOVA and interval mapping were used to detect SSR markers associated with yield and agronomic traits and to detect QTL's introgressed from the exotic germplasm. The results of this study will be presented.

C018. Metabolic flux analysis of sucrose metabolism into protein, oil and starch in soybean seeds

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Soybeans are a major source of raw materials for animal feeds as well as other food and industrial products. As such, an increase in specific chemical components in the seed could render them commercially even more valuable. To design a seed with desired traits, it is necessary to understand clearly how the flow of carbon through metabolic pathways producing those traits is controlled. Metabolic flux analysis (MFA) has been used effectively to quantify intracellular metabolite fluxes in simple biological systems. Stoichiometric MFA quantifies intracellular fluxes using metabolite balances. Flux analysis in plant cells is considerably more complex, however, because

organelle compartmentation, futile cycling of metabolites, and replenishing anaplerotic reactions necessitate additional system constraints beyond the list of biochemical reactions. Our approach to provide additional constraints for flux quantification utilizes bondomer analysis derived from a combination of 13C-carbon labeling experiments and Nuclear Magnetic Resonance (NMR) spectroscopy. Two dimensional Heteronuclear Single Quantum Correlation Spectroscopy (2D-HSQC) and TOtal Correlation SpectroscopY (TOCSY) analyses were performed to evaluate the 13C:12C ratios of each carbon atom in the amino acids derived from protein extracts of immature cotyledons grown in vitro. A comprehensive mathematical model was developed to relate the 13C:12C data for each atom to its most probable metabolic precursor and catabolite. The resulting metabolic flux map of carbon metabolism was evaluated as a single compartment model including primary reactions of central metabolism and synthetic pathways leading to each proteinogenic amino acid. Comparison of NMR peak intensities for experimental and simulated data was used to validate the model. The flux through anaplerotic reactions varied proportionately with culture temperature to provide more OAA and pyruvate to accommodate greater rates of protein synthesis at high temperature. A difference in the experimental and simulated data for isotopomer distributions of hydrolyzed sugar molecules also suggests a compartmentation step in the initial stages of sucrose metabolism within the reaction network. These analyses provide, for the first time, a set of analytical solutions for flux values through key metabolic pathways from sucrose to amino acids. This metabolic flux map is ideally suited to assess the metabolic basis for the effects of environmental conditions, genetic manipulations, and management practices on observed changes in carbon partitioning into valuable seed components.

C019. Silencing soybean allergens using a model developed for peanut allergens

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Soybean and peanut are legumes known to trigger IgE-mediated allergic reactions in hypersensitive population. Three proteins have been identified as allergens in soybean (Gly m1, Gly m2, Gly m3) and 6 in peanut (Ara h 1, Ara h 2, Ara h 3 or 4, Ara h 5, Ara h 6, Ara h 7). Peanut allergy is responsible for the majority of severe food-induced anaphylaxis reactions and affects an estimated 1.1% or about 4.4 million Americans and an increasingly greater number of people worldwide. Yet, to date there is no cure for peanut nor soybean allergies and complete avoidance is the best management strategy. The long-term goal in our laboratory is to develop and foster the utilization of a transgenic hypoallergenic peanut. Preliminary experiments performed using the biolistic transformation protocol prove feasibility of concept in down-regulating major allergens Ara h 1, Ara h 2, and Ara h 3. PCR and Southern analysis revealed the stable integration of the transgene in the peanut genome. Northern Analysis confirmed the stability of the transgenes, a prerequisite to silencing. Similarity between peanut and soybean allergenic proteins invite using the peanut silencing model in soybean. For example, peanut allergen Ara h 1 encodes a 63.5 kDa protein which shares approximately 40% homology with soybean vicilins. Peanut allergen Ara h 2 shares 39% amino acid homology with soybean conglutinins and peanut allergen Ara h 3 share 62% - 72% homology with soybean glycinins (legumins). Sequence alignments and transformation construct designs are being proposed, using the strategy proven with the peanut silencing model.

C020. Production of γ-linolenic and stearidonic acid in transgenic soybean

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Polyunsaturated fatty acids (PUFAs) have attracted much interest because of their increasing number of nutraceutical and pharmaceutical applications. Two examples of PUFAs used in this way are γ-linolenic acid (GLA) and stearidonic acid (STA). GLA and STA are the delta-6 desaturation products of linoleic acid and α-linolenic acid, respectively. We recently introduced the *Borago officinalis* L. 6 desaturase (gene under the control of the seed-specific promoter ß-conglycinin, into soybean via *Agrobacterium*-mediated transformation employing a two T-DNA binary system. This strategy permitted the recovery of marker-free transgenic soybean lines that harbored only the 6 desaturase cassette. A T_3 homozygous, marker-free transgenic line designated 420-5, grown under greenhouse conditions, was evaluated in the T_4 generation under field conditions. Average GLA levels of T3 seeds in the greenhouse ranged from 29.8% to 34.1% and STA levels ranged from 3.7% to 5.1%. Under field conditions, at the T_4 generation, GLA levels averaged 23.7% to 30.4%, while average STA levels were observed at 2.1% to 2.9%. We are currently exploring avenues to enhance the STA component of the seed

storage lipids by dual expression of the *B. officinalis* L. 6 desaturase combined with an *Arabidopsis* ω-3 desaturase (FAD3) gene. These avenues include the introduction of the FAD3 gene by sexual crossing of a FAD3-transgenic soybean line with the 420-5 line, re-transformation of line 420-5 with the FAD3 gene and co-transformation of wild type soybean with genes encoding both a 6 and an w-3 desaturase.

C021. Characterization of *Fusarium solani* f. sp. *glycines* using pathogenic, molecular and genomic approaches

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Fusarium solani f. sp. *glycines* (*Fsg*) causes soybean sudden death syndrome (SDS). Over the last 6 years, an international collection of *Fsg* isolates has been established and maintained at the National Soybean Pathogen Collection Center (http://nspcc.cropsci.uiuc.edu). *Fsg* isolates grew slowly and appeared reddish light blue to dark blue on potato dextrose agar medium. Cultures produced macroconidia and chlamydospores. All isolates caused SDS symptoms in the greenhouse pathogenicity tests, but there was a significant difference ($P < 0.05$) among isolates for foliar disease severity, shoot and root dry weights. A protein with an estimated molecular mass of 17kDa and designated as FISP17 for *Fsg* -induced stress protein was identified in stem exudates of soybean seedlings root-infected with *Fsg*. Molecular relationship between *Fsg* and other *F. solani* isolates was analyzed based on the sequence of mitochondrial small subunit (Mt SSU) rDNA. All *Fsg* isolates had identical sequences in this region. Two major lineages were found in *F. solani* non-SDS causing isolates in view of the nucleotide similarity, and presence and absence of insertions. A polymerase chain reaction (PCR)-based method was developed to detect DNA of *Fsg*. Two pairs of primers were designed based on the Mt SSU rDNA and the translation elongation factor 1-α gene. *Fsg* DNA was detected in field-grown soybean roots and soil by conventional and real-time quantitative PCR. Molecular variability of *Fsg* was detected using amplified fragment length polymorphism (AFLP) analysis. To identify *Fsg* and soybean genes preferentially expressed during infection, a normalized directionally-cloned cDNA library was constructed from cultured *Fsg* and *Fsg*-infected soybean roots. *Fsg* and *Fsg*-infected soybean mRNAs were differentially tagged at the 3'-end for sequence identification. The normalized cDNA library was then subtracted with the cDNA prepared from non-inoculated healthy soybean roots. Over 2,000 randomly selected cDNA clones were sequenced and 1,940 expressed sequence tags (ESTs) were generated. Of these, 1,124 (57.94%) of the ESTs significantly matched entries in the National Center for Biotechnology Information non-redundant protein database. A comparison of other available fungal genome sequences using tBLASTX revealed that there were 904 hits to the *F. graminearum* genome while 459 hits to the *Ustilago maydis* genome. There were 633, 692, and 707 hits to *Aspergillus nidulans, Magnaporthe grisea*, and *Neurospora crassa* genome sequences, respectively, when using BLASTX. Gene annotation using the Gene Ontology classification system is in progress. Additional EST analysis will provide information on *Fsg* gene expression during the infection of soybean roots. The *Fsg* genomic research is in collaboration with researchers at the Keck Center, University of Illinois.

C022. Establishment of system for induction of maintainable and proliferative somatic embryos and plantlet regeneration in soybean

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Soybean has been one of the most important sources of edible oil and plant protein for human being. However, research of tissue culture and genetic transformation in soybean is extremely difficult. The receptor used for gene transformation is mainly immature cotyledon and cotyledon node. Since getting immature cotyledon was limited by season, the system establishment of proliferation and maintenance for embryogenic tissue (callus) is really significant in soybean. In this paper somatic embryogenesis and maintainable and proliferative somatic embryos were induced. Meanwhile, the effect of factors on inducing maintainable and proliferative somatic embryos and embryo germination were researched with the important commercial genotypes of soybean in Northeast China. Cotyledons of soybean were cultured with medium MS (Murashige and Skoog 1962) plus 20mg/L 2,4-dichlorophemoxyacetic acid (2,4-D) at 25 with dark condition in order to induce somatic embryogenesis. The induced somatic embryos were subcultured and proliferated in medium MS plus 0,2,5,10,20 and 40mg/L 2,4-D in dim light. Furthermore, subcultured and proliferative somatic embryos were induced to germinate in 6 kinds of media. Four repeats were set for each treatment. The germinating somatic embryos developed into plantlets in MS medium. It was found that the suitable concentration of 2,4-D for proliferation of somatic embryo was from 10 to 20 mg/L in dim light. The frequency of somatic embryogenesis and frequency of proliferative and subcultured somatic

embryos were varied depending on different genotypes of soybean. The medium added with activated carbon was benefit in germination of somatic embryos. Germinated plantlets could flower and pod normally. R_0 plants could be obtained even after proliferation and maintenance in solid medium for more than one year. A successful system of rapid, maintainable and proliferative somatic embryos for a long time in solid medium was established.

C023. Study on transgenic soybean expressing α-tocopherol at high-level

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Tocopherol, commonly known as Vitamin E, is an essential antioxidant for human health. Epidemiological evidence indicates that vitamin E supplementation is required for the normal metabolism of muscle, central nervous system, etc. Increasing daily intake of vitamin E results in decreased risk for cardiovascular disease and cancer, improvement of immune function, and prevention of a number of degenerative disease processes in human body. Of the 4 naturally occurring tocopherols, α-tocopherol has the highest vitamin E activity (100, 50, 10, 3 percent relative activity for α,β,γ,δ-tocopherol, respectively) and is preferentially absorbed and distributed throughout the body. Plant oil is the main dietary source of tocopherols. However, α-tocopherol is present only as a minor component while its biosynthetic precursor, γ-tocopherol, is present at high level. In soybean oil, α-tocopherol and γ-tocopherol account for 7% and 70%, respectively, in the tocopherol pool. γ-tocopherol methyltransferase (γ-TMT) catalyzes the methylation of γ-tocopherol to form α-tocopherol. Therefore, increasing the expression of γ-TMT in oilseed crops through gene engineering will elevate α-tocopherol levels and therefore increase the nutritional value and the stabilization of plant oil. After cloning the gene □*BoTMT*□of γ-TMT from *Brassica oleracea* and characterization of its function in prokaryotic expression system, the plant constitutive expression vector pBin-TMTL for *BoTMT* was constructed on the basis of binary expression vector pBin438. Soybean cultivars "Jilinxiaoli No.1" and "Zhongzuo Green Soybean No.1" were transformed by co-cultivating explants of cotyledonary nodes with *Agrobacterium*-harboring pBin-TMTL. The regenerated kanamycine-resistant transformants were analyzed by PCR, Southern blot and Western blot. The results showed that *BoTMT* was integrated into soybean genome and expressed at translational level. HPLC analysis of the seeds of transgenic plants showed an increase in the level of α-tocopherol. Screening transgenic plants expressing α-tocopherol at high level is on the way. We are going to combine foreign γ-TMT gene with high oil and free lipoxidase background to breed soybean varieties with high α-tocopherol, high-oil and low beany favor.

C024. *H2B*: a new constitutive plant promoter for soybean transformation

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The activity of the maize *H2B* promoter has been characterized in the monocotylenous plants - wheat and maize. In these crops, the *H2B* promoter drives the expression of marker genes to strong, constitutive levels (Rasco-Gaunt *et al.*, 2003, Plant Cell Rep. 21:569-576). Encouraged by these results, we have tested the promoter in soybean. The activity of the *H2B* promoter was evaluated using the *gus*A reporter gene and a mutated (acetolactate synthase) *als* selectable marker gene. The mutated *als* gene confers resistance to sulfonylurea herbicides. The use of histochemical GUS and MUG assays to monitor the levels of expression of the *gus*A reporter gene under the control of the *H2B* promoter demonstrated constitutive gene expression at levels 2- to 3-fold greater than that of the CAMV 35S promoter. Transgenic plants carrying the *als* gene driven by the *H2B* promoter exhibited resistance to chlorsulfuron herbicide. These results suggest that the *H2B* promoter is a true plant promoter able to drive the expression of transgenes in both monocotyledonous and dicotyledonous plants.

P001. Rapid measurement of phytate in soy products by mid-infrared spectroscopy

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Soybean contains 1-3% phytate that is a common component of grains and legumes. Since phytate forms insoluble complexes with minerals, reducing the availability of them, it is usually regarded as an antinutrient. On the other hand, a recent research indicates that it has beneficial roles as an antioxidant and anticarcinogen (Minihane & others, 2002, Int. J. Food Sci. Technol. 37:741-748.). Phytate is also known to affect to tofu curdling (Saio & others, 1969, Agr. Biol. Chem. 33:36-42). Because the quality of tofu depends mainly on its physical properties, phytate is important on tofu making process. In this study, the rapid measurement of phytate from soybean and its various products such as soy flour, defatted meal, soymilk and tofu was investigated using Fourier transfer infrared spectroscopy (FT-IR) with an ATR accessory. IR absorption of phytate was observed from 1200 to 900 cm^{-1}, but saccharide and protein in the soybean also had IR absorption in the same region. So it was difficult to measure the phytate content in soy products directly by IR measurement because IR absorption of phytate was much smaller in same region as those of abundant saccharide and protein. Therefore, the separation of phytate from these components was investigated. Trichloroacetic acid (TCA) was used for deproteinized. Calcium Chloride ($CaCl_2$) was added to potassium phytate solution contain neutralized TCA, phytate was precipitated completely by addition of calcium more than six-times mole of phytate. This result indicated the method was effective to separate phytate from protein and saccharide. The procedure of phytate measurement was described below. All samples were deproteinized at first by addition of TCA. The deproteinized supernatant was mixed with NaOH and $CaCl_2$ solutions, and phytate was precipitated as calcium salt. The precipitate was dissolved in citrate buffer (pH 6.0) and then used for IR measurement. The absorbance at 1070cm^{-1} correlated well with the phytate content of the each sample. Standard solution of phytate was prepared from calcium phytate dissolved in the citrate buffer. The measurement of phytate can be done rapidly by FT-IR with an ATR accessory and gives high reproducible values. Phytate measurement by the IR method is a more simple and rapid method than that by the conventional one.

P002. Rapid quantitative analysis of major components in soymilk by using Fourier-transform Infrared Spectroscopy (FT-IR)

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Soybean foods, such as soymilk and tofu, are popular in some Asian countries. The quality of tofu, which manufactured by curdling soymilk with coagulant (magnesium chloride and so on), depends largely on the major component contents (protein, lipid, and sugar) in soymilk. Therefore, Fourier-transform Infrared Spectroscopy (FT-IR) on attenuated total reflectance (ATR) sampling was used for the rapid quantitative analysis of the major components (protein, lipid, and sugar) in soymilk. Since Mid-infrared spectroscopy shows specific absorption of each functional groups of each molecule, it is possible to determine the amount of each component without complicated statistical computation. The determination of protein content was performed by using amide II absorbance at wavenumber 1545cm^{-1} for protein, ester absorbance at 1745cm^{-1} for lipid, and C-C & C-O absorbance at 1000cm^{-1} for sugar. Soy-protein was prepared by the method of Thanh et al. (Thanh et al., 1975, Plant physiol., 56, 19-22). The absorbance of amide II band (1545cm^{-1}) had a high correlation with the quantity (%: w/w) of soy-protein in soy-protein solution ($R^2>0.99$). Soy-sugar was prepared as a saccharide mixture with equal weights of sucrose and stachyose. The absorbance of C-C & C-O band (1000cm^{-1}) had a high correlation with the quantity (%: w/w) of soy-sugar in soy-sugar solution ($R^2>0.99$). When the calibration curve is obtained by changing concentration, it had no problem about protein and sugar because of solubility in water. However, the preparation of the calibration curve for the calculation of lipid content was difficult in same techniques as those of protein and sugar. Soy-lipid is dispersing in the form of oil-body. Therefore, we tried to reconstitute the oil-body by ultrasonic treatment (Tzen and Huang, 1992, J. Cell Biology, 117, 327-335). Soy-lipid was prepared as reconstituted oil-body formed by adding soybean oil to defatted soymilk and then doing ultrasonic treatment (5min). Defatted soymilk was

prepared from hexane-defatted soybean meal (Ono, et al. 1996, Biosci. Biotech. Biochem., 60, 1165-1169). Reconstituted oil-body formed by ultrasonic treatment was identified by Laser diffraction particle size analyzer. Reconstituted oil-body was formed by ultrasonic treatment from the mixture of soybean protein (7S and 11S globulins) and soybean oil. The absorbance of ester band (1745cm^{-1}) had a high correlation with the quantity (%: w/w) of soybean oil added in soymilk (R^2>0.99). The content of major components in soymilk prepared from 14 species soybeans were measured by FT-IR on ATR sampling and by chemical analysis. In these results, the values by FT-IR method were nearly equal to the values by chemical analysis. Thus, simple and rapid quantitative analysis of the major components of soymilk, including the preparation of the calibration curve, was achieved by FT-IR on ATR sampling.

P003. Screening of soybean varieties lacking subunits, the nutritional and processing properties of soybean with different content of β subunit

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Analyzed the composition of soybean protein subunits of more than 1000 soybean varieties, obtained the varieties lacking A_3,A_5,γ,β subunits and used them as experimental materials in this study. We studied the protein state during preparing soymilk using lacking or of low content β subunit soybean varieties, the results showed the particulate protein content in this soymilk significantly higher than the common, and with more sensitive reaction to calcium chloride. And showed the effect of the β subunit on soybean processing properties.

P004. 7S new subunit characterization for protein improvement and regulation

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Quality breeding of soybean storage protein has been promoted and progressed for Tofu, Natto, vegetable and soymilk etc. in Japan. New varieties with high quality have been released in the market such as KTI less, lipoxygenase less, alpha subunit less, high 11S ß0 low 7S cultivars. However, more new protein constitution and nutritional cultivars are desired according to the development of agriculture production and healthy life. For the protein quality improvement 11S and 7S subunits constitution and variation are very important. We have surveyed and analysed soybean storage proteins on 7S and 11S subunits. Although Japanese breeders and researchers have various subunit variations, for example, alpha- and betaß0subunit deficient variant line. However, that strain expressed lethality after the germination. By the extensive exploration and search, the specific beta-subunit deficient line has been found. The genetic behavior by the crossing experiment shows two linked genes controlling the beta-deficiency (Thanh et al, 2003). The progenies from the strain and crossing gave beta-reduced and beta-nll lines or individuals, indicating the hypothesis is correct. In alpha- and beta- linked deficient variant line, we found the segregation into normal, beta-reduced, alpha- + beta- null and alpha- null types. Tight linkage between two alpha- and beta- subunits genes is shown by the experiment. However, our result suggested the possibility of the segregation out new beta- subunit null line from the progenies like alpha-null type. As we can supposed new gene existence or structure, molecular analyses have been performed using two 7S related specific variant lines. As the results we found that the existence of alpha- and beta-gene (s) with one base change in the beta- specific region in the alpha- and beta- subunit line and beta- null line (Liu et al., 2003). Our two lines on 7S variation could be controlled in the prompter region or other mechanism. We are further studying on the structure of the related structure for promoter region of the 7S gene family and methylation sites etc.

P005. The identification technique of soybean lipoxygenase

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The grass-bean flavor of soybean food stuff is related to lipoxygenase (Lox). In processing, the physical or chemical methods are used to remove the undesirable flavor and odor of soybean food stuff, but these methods often lead to some insolubility of soybean proteins, and decrease the quality of protein. So it is necessary and urgent to select and develop mutant soybean by genetic study. Lipoxygenase lacking mutants (triple - null or double - null) soybean could improve nutritional quality and functionality of soybean products. There are four known electrophoresis types of soybean seed lipoxygenase (Lox). The Lox isozymes have their own biochemistry characteristic. IEF-PAGE helps us to identity Lox isozyme type and mutants. We modified the techniques about making gel and staining the gel for improving the resolution and reducing the experiment cost .The GelBond PAG sheet was replaced by normal glass plate .Use suitable enzyme staining solution. The

tests attained remarkably results and reduced cost. Thus, a technique for identifying Lox lacking mutants was developed, that was rapid and more accuracy.

P006. Isoflavones and minerals present in soybean [*Glycine max* (L.) Merrill] dietary fiber from cotyledons

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Soybean dietary fiber is the insoluble material obtained after the processing of protein isolate by aqueous extraction of the defatted soy flour. This extraction form is considered to provide the most pleasant products to the consumer. Isoflavones are a group of 12 phenolic compounds that belong to the group of flavonoids and are present in legumes, mostly in soybeans. Classified as phytostrogens they are characterized by a structure composed of two benzene rings linked to a third ring by carbon 3 and their concentration vary with the soy variety and environment factors at the crop location. The soybean grains have approximately 5% ash and most of the minerals are in the form of sulfates, phosphates and carbonates. The objective of this work was to identify and to quantify the isoflavones and minerals present in soybean dietary fiber obtained from cotyledons. Two forms of the dietary fiber were analyzed: one without additional processing after the aqueous extraction of the proteins (original) and the other milled for particle size reduction. The isoflavones were extracted with ethanol and acetic acid and analyzed in HPLC with a reverse phase column. Identification was by comparison of retention times and quantification was by external standardization (area of the peak) using as references standard solutions of the various compounds. The minerals were determined after sample mineralization at 550°C and solubilization in hydrochloric acid and then analyzed in ICP (inductively coupled plasma spectrometer) using argon as fuel. Five of the 12 possible flavonoids were found in the samples with minor variations. In the original sample were identified and quantified genistin (11.1 mg/100g), malonyl-genistin (5.9 mg/100g), daidzein (10.2 mg/100g), acetil-genistin (10.5 mg/100g) and genistein (7.8 mg/100g). In the reduced particle sample were identified and quantified genistin (10.2 mg/100g), malonyl-genistin (5.2 mg/100g), daidzein (13 mg/100g), glycitein (7.4 mg/100g) and genistein (10.1 mg/100g). Genistein is the compound most studied as having a series of beneficial health effects occurred in concentration equivalent to occurrence in soy grain (generally from 2 to 7 mg/100g). In both samples were quantified phosphorus, potassium, calcium, magnesium and sulfur as macrominerals and zinc, manganese, iron, copper, and boron as microminerals.

P007. Fatty acids composition of the Argentinean soybean evaluated in different latitudes and planting dates

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The soybean is the most important production in the country with 35,273 million tn in the 2002/03 crop. The growing area comprises from 23° SL in the north to 39° SL in the south. The soybean oil typically contains 11% palmitic, 4% stearic, 24% oleic, 54% linoleic and 7% linolenic acid. The fatty acids composition is important to estimate the oil quality. Varying the oil composition is possible to achieved improved as those high oleic and low linolenic acid. This fatty acid has been associated with poor flavor and low stability of oils. The objective of this study was to evaluate the influence of latitude, planting date (PD) and maturity group (MG) on the fatty acids composition of the argentinean soybean. Three locations were considered: Reconquista (29°11' SL), Marcos Juárez (32°41' SL) and Balcarce (37°45' SL), three PD: October, December and January and six MG from III to VIII. The analyses were made in a gas chromatograph for fatty acid composition according to AOCS (1998). Saturated fatty acids (palmitic and stearic) were relatively constant over regions, while significant variations were observed among environments, PD and MG for the unsaturated acids. In Reconquista the linolenic content was increased from 5.7% to 8.2% and the linoleic from 46.6 to 52.3% since the earliest PD to the latest. The oleic is the desirable fatty acid and it decreased from 29.3% to 21.9% in the latest date. In Marcos Juárez the linolenic also was increased from 7.0% to 9.0% and the linoleic from 51.8% to 53.2% for the last PD. The oleic acid decreased from 23.0% to 19.9%. In Balcarce an increment was also observed in the both linolenic and linoleic from 7.7 to 11.2% and from 52.5 to 55.3% respectively and the oleic acid decreased from 22.2 to 17.6% in the considered dates. In the first PD the oleic content was increased and decreased linolenic and linoleic in the three locations. The composition of the fatty acids was also modified with the latitude. The linolenic increased from 7.0% (29°11' SL) to 8.0% (32°41' SL) and to 9.4% (37°45' SL) and the linoleic was increased from 49.1% to 52.2% and to 54.0%. The oleic acid decreased for the highest latitude, passing from 26.2% (29°11' SL) to 21.9% (32°41' SL) and to 19.8% (37°45' SL). In longest MG the linoleic and linolenic were increased and the oleic decreased. In general was observed that the oleic content was increased while linolenic and linoleic acids decreased in the

lowest latitude, in the shortest MG and in earliest dates (October), associated with higher daily temperatures during seed development.

P008. Performance of cultivars and pure lines of food-type soybean to the trait grain cooking time

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Long cooking time for soybean seeds hinders their regular human consumption as a rich source of protein. The objective of this research was to study the performance of cultivars and pure lines of food-type soybean for the trait grain cooking time. Thirty-four soybean genotypes were assessed having been cultivated in the field in the agricultural year 2002/2003 on the School Farm of the Londrina State University (Londrina, Paraná, Brazil) situated at 23° 22'LS and 51° 10'Long. A completely randomized block design was used, with three replications. One plot consisted of one 3m long line with space of 0.9m between rows. The seeds were stored in a cold chamber at 13°C and analyzed three months after harvest. The cooking time was measured using a modified Mattson machine. The technique consisted of determining the cooking time by the percentage of grains cooked in the machine (50%). After imbibetion the 25 seeds were placed in individual capsules in the modified Mattson machine, that consisted of 25 vertical rods, with a 90 grams weight on each grain, whose points rest on the soybean seed during the test. The machine is then taken to a recipient containing boiling distilled water. With time, the rods fall and perforate the grains. After the fall of the 13th rod the sample is considered cooked. The time taken from immersion of the machine in boiling water until the fall of the 13th rod was considered as the sample cooking time. The low CV% values (4,5%) indicated good experimental accuracy and that the methodology used in the assessments was suitable. The average was 38 minutes. The cooking time ranged from 25 minutes for the EMBRAPA 48 genotype to 67 minutes for the Londrina XI genotype. This variability can be used to obtain cultivars for human consumption with important decreases in cooking time.

P009. Influence of gamma irradiation on the texture profile of soy protein isolate gels

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Gamma irradiation is used to reduce losses caused by microbial deterioration and insect damage, subsequently reducing the use of chemical fumigants. In the case of soybean, known for its functional and technological potential, the main objective of the use of irradiation is in bean disinfestations. The ability of soy protein to form gels on heating is considered to be an important functional property, the formation of this gel being the result of an equilibrium between intermolecular forces, disulphide bonds, hydrogen bridges and hydrophobic and Van der Waals interactions. The contribution of each type of bond and interaction depends mainly on the protein concentration and characteristics of the medium such as pH, ionic strength and combinations of other components such as lipids and carbohydrates. During gamma irradiation, the hydroxyl radical formed reacts especially with the proteins leading to polymerization, the rupture of hydrogen bridges and disulphide bonds and, in many cases, the formation of aggregates. Thus, considering its use as a functional ingredient, an evaluation of the effect of irradiation on the process of gel formation by soy protein isolates is important. The objective of this study was to evaluate the influence of the application of gamma irradiation in soybeans, on the texture profile of the protein isolate gels obtained from these beans. The soy protein isolates (SPIs) were produced in the laboratory from defatted flour obtained from the irradiated beans (0; 2.5; 5.0 and 10.0 kGy). Conformational and structural changes in the proteins were evaluated by thermal analysis using differential scanning calorimetry (DSC) and by determining the free sulphydryl groups (SH). 14% Protein dispersions at pH 7.0 were heated at 90°C for 30 minutes, cooled to 8°C and maintained at this temperature for 12 hours to obtain the gels, whose texture profiles were evaluated using the parameters of hardness, cohesion, gumminess and elasticity in a TA-XT_2 texturometer, Stable Micro Systems (SMS). The values for enthalpy (DH) of the SPIs decreased with increase in irradiation intensity of the bean treatment, from 4.72 J/g in non-irradiated beans to 4.54 J/g in beans irradiated at 5 kGy. Higher enthalpy values are associated with higher percentages of native or less denatured protein. The number of free sulphydryl (SH) groups decreased with increase in irradiation dose, from 23.73 uMSH/g in the protein of SPIs from non-irradiated beans to 13.21 uMSH/g in that from beans irradiated with 10 kGy, indicating the formation of disulphide bonds. Hardness (120.87; 123.50; 125.27 and 170.64 g), cohesion (0.82; 0.86; 0.88 and 0.90) and elasticity (0.89; 0.90; 0.93 and 0.94) of the isolate gels all increased with increase in the intensity of the irradiation suffered by the beans. However the parameter gumminess (5.68; 5.65; 3.74 g) decreased in the isolate gels with increase in the irradiation dose of the beans from 0 to 5 kGy. The results suggested that gamma irradiation of soybeans caused structural alterations in the proteins resulting in isolate gels with distinct texture profiles.

P010. Chemical and sensorial characterization of cheeses type ricotta obtained with five varieties soy (*Glycine max* L. Merrill) using different seasonings

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This work had as the main objective to produce a soy cheese, ricotta type, with sensorial and nutritional characteristics of good quality. Cheeses were prepared with five different varieties: BRS 216, BRS 232, BRS 213, BRS 155 and CD 202. For each variety two cheeses were prepared, one of them was submitted to thermal treatment and the another one was not, getting a total of ten samples of cheese. Each soy cheese was tasted by a team of ten taster, who made use of a structered scale of 9 points (1 = extremely bad; 9 = excellent), taking into consideration their sensorial characteristics. Among the studied cheeses the one that obtained the largest acceptance was that with the variety BRS 155 with thermal treatment. It was also verified that there were differences in the result of the cheeses depending on the use of the thermal treatment and on the variety with which they were prepared. From this result three samples of cheese ricotta type were made with the variety BRS 155 and with thermal treatment to which different seasonings were added such as: salt, salt + fine herbs and shoyo to be submitted to the preferably pilot test. In the preferably pilot test the hedonic scale was used preferably (1 = I disliked very much; 9 = I liked very much) with 200 non trained taster. On it was verified that the cheese in which was additioned the fine herbs showed the best sensorial characteristic. It was accomplished chemical determinations in the grains and in the soy cheese.

P011. Processing pasta with soy flours

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Pasta is a food product widely consumed in Brazil due to easy preparation and low cost. The objective of this study was to develop a good quality pasta which included soybean flour (in addition to wheat flour) on its formulation, as an strategy to supply a more nutritive and healthy diet for the Brazilian people. *Fusilli* type pasta was produced with 20% of three different soybean flours. Flour 1 was a commercial soy flour; flour 2 was an oriental type soy flour - *kinako*, obtained by toasting and grinding the grains; and flour 3 was obtained from hydrothermally treated, dried, toasted and grounded grains. Two formulations were tested according to: (A) 20% soy flour, 80% wheat semolina and 45% water and (B) 50% wheat semolina, 30% wheat flour, 20% soy flour, 30% water and 20% whole eggs. These six pasta samples were evaluated through sensory analysis by 45 panelists. Both formulations with soybean flour 1 were significantly preferred, due to fine particles (micronization process), light color and mild flavor of commercial soy flour, that makes possible to obtain pasta similar to the conventional one, made with wheat flour. These two selected samples were then submitted to a mass acceptability test with 164 panelists and both of them were well accepted. Proximate composition of formulations A and B showed an increase on protein and lipid content and reduction on carbohydrate content, although calorie value was similar to the conventional pasta. However, formulation A showed superior technological quality comparing to formulation B and the conventional pasta, so it was defined as the best one.

P012. Biologically active components of soybean sprout as functional food

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Soybean as a functional food contains several biologically active components, high quality protein and fat. The isoflavones of soybean products have drawn much attention recently because of estrogenic, antifungal and antibacterial activities. Also, it has been known for centuries among Koreans that the soybean sprout has the anti-hangover function and the main components of the soybean sprout extract were found to be asparagine. In the current study, we intend to improve the isoflavones and amino acid analysis method in soybean and soybean sprout and investigated the content according to variety, growing condition and part. The ultimate object of this study is that use in the functional breeding programs by screen the varieties of high content on the base of this method and extract condition after this. In the case of isoflavones, Adequate extraction was attained with Methanol/water (80:20 v/v) maintained at 80 □ for 15 hr. Analysis of isoflavone and amino acid in soybean were performed by high-performance liquid chromatography with PDA detector or Fluorescence detector after derivatised using the Accq-tagTM kit. Isoflavone content was the highest in soybean sprout root and higher in soybean sprout than seed. The total amino acid content ranged from 278.89 to 616.10□/g and was the highest in soybean sprout cotyledon. As a result of isoflavone analysis of genetic resourses, the content of isoflavone was higher in genetic resourse with disease tolerence than others.

P013. Identifying the preferred flavour and sweetness level of flavoured soymilk by the consumer

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Brazil is the second biggest world soybean producer, and has its production growing every year. Soymilk is a very nutritious beverage and highly recommended to both adults and children, mainly in Brazil where the malnutrition is a serious problem in specific areas. Despite the health benefits of the product, the soymilk flavour is not very well appreciated by western consumers. Several countries, including Brazil, have dispensed efforts trying to develop a product with adequate sensory characteristics to consumer. This study aimed at identifying the most preferred soymilk flavour and sweetness level in order to make available a liked product to the target population. Preliminary studies carried out with 80 individuals who go and consume natural products found in special Brazilian groceries have identified the strawberry, chocolate and apple as the potentially adequate flavours to be used in the soymilk flavouring process. In the subsequent step, three formulations of each of the referred flavours were produced by varying the level of the sugar (4, 5 and 6%). The nine formulations plus a commercial sample available in the Brazilian market were evaluated by 100 consumers who were used to drink soymilk, yielding 10 samples in the study. The samples were evaluated regarding the preference using the seven-point hedonic scale, varying from "disliked very much" to "liked very much". The samples presentation order has followed a complete balance design and were monadically offered to participants. This study was carried out inside the Cobal-Humaitá in the Rio de Janeiro city. The data were analysed using the Internal Preference Mapping. The results have shown that the first and second dimension accounted for by 45% of the variance. The preference direction has revealed the chocolate and strawberry flavoured soymilks with the highest sugar levels as the preferred products.

P014. Soy and Brazil nut beverage preference among Brazilian consumers

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Despite the recognised soymilk nutritional value, a low product consumption is observed among western consumers, due to the beverage flavour. Studies have been developed in several countries in the world trying to improve the soymilk sensory characteristics, in order to pleased the consumer. Brazil nut is a nutritious seed and highly appreciated by the Brazilian population. It has a nice flavour and an adequate nutritional characteristics mainly in terms of sulphur amino acids. The product development using a combination of those two Brazilian raw materials - soybean and Brazil nut - would benefit the consumer, because it would make available an adequate product in terms of both sensory and nutritional properties. This work aimed at evaluating the soy and Brazil nut beverage consumer preference, developed at Embrapa Food Technology, pasteurised and sterilised. One hundred people aged between 18 and 65 year-old, and who liked soymilk took part in this study. The data collection was carried out inside the Cobal-Humaitá facilities, located in the Rio de Janeiro city. The beverage production followed the procedures developed at the Embrapa Food Technology using the whole and filtered soymilk added of 40 and 30% of Brazil nut milk, respectively. Sugar (3%) and salt (0.2%) were also included in the beverages. The beverages were evaluated by consumers after pasteurisation and sterilisation treatment. Thus, the four soybean and Brazil nut beverages were evaluated regarding the preference using the seven-point hedonic scale, varying from "disliked very much" to "liked very much". The samples presentation order has followed a complete balance design and were monadically offered to participants. The data were analysed using the ANOVA and Tukey test to check difference between means. The results have shown no difference ($p > 0.05$) in terms of preference among the kind of thermally treated beverages in either the whole soymilk product or the filtered one. This result has demonstrated that the sterilisation treatment did not damage the sensory product characteristics. Further shelf-life studies are recommended in order to investigate the product during the storage time.

P015. Sensory shelf-life of soy and Brazil nut beverage

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The soybean and its products have been consumed by individuals concerned about their life quality, because

those people value the health benefits resulted from a health diet. The soymilk has high nutritional value and it is popular in several eastern countries. Epidemiological studies have confirmed the soybean role on some kinds of cancer prevention, menopause symptoms release, and other benefits observed in populations habituated to consume soybean and soybean products. However, soymilk is only appreciated by a minority of the Brazilian population, and efforts have to be done to increase its consumption. Several alternatives have been adopted to reach an improvement on soymilk sensory characteristics. The addition of Brazil nut milk was successfully demonstrated in the consumer beverage preference made from those two raw materials. However, the sensory stability of the product during the storage time has to be evaluated. This study aimed at investigating the sensory characteristics of soy and Brazil nut beverage during its shelf-life. The filtered soy beverage with 30% Brazil nut milk was prepared and esterilized in 268mL glass bottle container at Embrapa Food Technology. The bottles were kept in BOD chambers at 5 and 25°C, and evaluated after 15, 45, 75, and 105 days of storage. Seven selected and trained assessors took part in this study. The following sensory attributes were evaluated: characteristic appearance, characteristic aroma, Brazil nut aroma, rancid aroma, consistency, characteristic flavour, Brazil nut flavour, and rancid flavour. They were evaluated using non-structured scales which varied from 1(weak) to 9 (strong). The attributes rancid aroma and flavour varied from 0 (absent) to 9 (strong). The trained panel received 30mL of the beverage in three digit number plastic coded cups, served at room temperature, inside the sensory booths. The sample presentation order was balanced, and each assessor evaluated each sample twice. The data were analysed using ANOVA. The results have shown that only few sensory attributes were affected during the product shelf-life. The Brazil nut aroma was perceived stronger in the products kept at 5°C, showing once more, the effect of temperature on the sensory properties. The beverage appearance was also affected by the temperature after 75 days of storage. Further studies are recommended after a longer time of storage.

P016. Evaluation of soybean genotypes for consumption *in natura* as *edamame*

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Utilization of soybean as "edamame", which is a very popular food product in Japan, consumed as an appetizer, could be a healthy and easy way to consume soybean, among Brazilians. As "edamame", soybean is harvested at stage R6, when grains are totally developed but immature (green). In this stage, grains present good, mild and sweet flavor, proteins, vitamins A, C and E, fibers and minerals. Some quality criteria are needed for this type of product, such as weight of 100 seeds (equal or higher than 20g), intense green pods, with sparce gray pubescence and mild flavor. The objective of this study was to evaluate lines with potential uses as germplasm source to breed varieties for "edamame" utilization. Eight genotypes from Asian Vegetable Research Development Center - AVRDC (AGS-333, AGS-334, AGS-335, AGS-351, AGS-353, AGS-354, AGS-355, AGS-356), six vegetable type lines, introduced from the University of Florida (F83-8000, F83-8207, F83-7864, F82-5812, F83-7977, F85-11346), and two lines from Embrapa's breeding program (BRM95-50570, BRM94-52273), were evaluated. Lines BRM94-52273, F83-7864 and F83-8000 presented the highest yields, 2575 kg/ha, 2686 kg/ha and 2631 kg/ha, respectively. Lines F83-8207, F83-7977 and F85-11346 presented the highest weights (43.2g, 41.0g and 41.3g, respectively) for 100 immature seeds. Results from this evaluation allowed selection of lines BRM94-52273 and F83-8000, which showed high yield and good agronomic characteristics, and line F85-11346, which showed superior weight of 100 immature (40.3g) and mature seeds (24.4g). These genotypes are good available genetic sources for breeding soybean varieties for "edamame" utilization, in Brazil. Among the genotypes from the AVRDC, AGS-351 and AGS-354 showed good adaptation to Londrina, Paraná State, Brazil, and have potential for utilization as germplasm source. The other genotypes introduced from AVRDC, were very susceptible to lodging, shattering, and oidium disease.

P017. Effect of priming treatment for aged soybean seed on the growth and quality of sprout

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Soybean sprout is very popular and important four-season vegetable in Korea. They culture soy-sprout spaying water on the seeds in special facilities like deep containers or vessels and 7-12cm sprout products can be obtained after 4-6days. For the production of soy-sprouts with higher quality seed vigor is the most important factor. To improve seed vigor priming treatment technique has been applied mainly for the small seed vegetable crops. This study was conducted to identify the applicable possibility of priming technique, osmoconditioning, for the seed of sprout-soybean and its effects on the growth and quality of

soy-sprout. Two Korean cultivars for soy-sprout vegetable, Eunhakong and Myongjunamulkong were used. Artificially aged seed lots with 62-78% germination rate were primed and compared with non-primed aged and non-aged normal ones. Seed lots were primed for 3days with -1.0MP polyethylene glycol 8000 solution at 25□. Growth and several chemical compositions of soy-sprout were measured and analyzed. Texture in maximum cutting force of sprouts was measured using shearing blade and horizontal round probe of rheometer. Priming treatment on aged seed lots highly increased germination rate and percentage of normal marketable sprouts. Total length of sprout, root length and fresh weight of sprout were increased after priming treatment compared with non-primed ones. However the diameter of hypocotyls was not affected by priming treatment. After priming treatment on aged soybean seed lots, water and crude ash contents were increased due to the enhancement of sprout growth. Crude protein content of sprout in primed aged seed lot was lower than that of non-primed one. Crude-oil content of sprouts did not show significant difference between primed and non-primed seed lots. Vitamin C content of sprout of aged seed lot was higher than that of non-primed seed lot, however it was lower than that of vigorous non-primed seed lots. Cutting force of sprout hypocotyls was not significantly affected by priming treatment in aged soybean seed. And that of most sprouts of primed seeds were lower than that of vigorous non-primed seed lots.

P018. Influence of curdling agents and soybean cultivars on tofu production

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Soybean and soybean products are good sources of proteins and polyunsaturated fatty acids, and have a potential to improve the human nutritional status due to their nutritional and functional compounds, which can help to keep good health conditions for humans. In Brazil, however, the consumption of soybean and soybean products such as tofu is limited mainly due to its astringent flavor. Soybean quality for food processing includes gel strength of tofu, soybean flavor and color. The aim of this assignment was to investigate the effects of cultivars and curdling agent on gelling properties for tofu production. In this study one breeding line (BRM94-52273) and thirteen cultivars (BRS 155, BRS 156, BRS 183, BRS 184, BRS 185, BRS 212, BRS 213, BRS 214, BRS 215, BRS 216, BRS230, BRS231 and BRS 233) developed by the breeding program of Embrapa Soybean, and three curdling agents: gluconolactone, magnesium chloride anhydrous ($MgCl_2$) and calcium sulfate dihydrate ($CaSO_4.2H_2O$) were evaluated for tofu production. Gel strength of tofu (firmness) was measured in a Shimadzu Texture Analyzer - EZ Test Series. Tofu samples, which presented higher firmness, were submitted to sensory analysis. This analysis was accomplished with 80 non-trained panelists. Cultivar BRS 155 showed highest firmness (1.719 N) when treated with gluconolactone. Cultivar BRS 212 treated with $MgCl_2$ showed firmness of 1.010 N and firmness value of 0.584 N. when it was treated with $CaSO_4$. For sensory analysis the chosen samples were those which obtained high values of firmness with each one of the curdling agents (BRS 155/ gluconolactone, BRS 212/$CaSO_4$ and BRS 212/$MgCl_2$). Results of tofu curd sensory analysis indicated that BRS 212 treated with $MgCl_2$ had the highest acceptance, around 77,5%.

P019. Assessment of different soybean varieties in the tofu yield, quality and waste generation

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With the increase in the consumption of soybean products due its functional properties and the release of new varieties with favorable characteristics to the use in the human feeding, we tried to assess three varieties of soybean, at BR-36 produced by the organic systems, at BRS-213 and BRS-216 (produced by conventional systems), in the yield, in characteristics physical-chemical (proteins, lipids and ash) and in the generation of solid waste and wastewater. For these determinations, methodologies of EMBRAPA were used for obtaining the tofu (soybean curd) and quantification of the wastes, and methodologies of the Adolfo Lutz Institute determinations of the physical-chemical characteristics (proteins, lipids and ash). The results showed that variety BR-36 and BRS-216 had better yield not differing among them (257 and 246 g of tofu/100g soybean respectively) than the variety BRS-213 (214 g of tofu/100g soybean). In the production of wastewater and solid waste the variety BR-36 produced smaller amount in relation to varieties BRS-216 and BRS213. In relation to the physical-chemical characteristics, there was not significant difference among the three assessed varieties being the results around 81 to 83% for moisture, from 7,0 to 8,5g for proteins, from 4,3 to 5,6g for lipids and from 1,0 to 1,4g for ash.

P020. Effect of soy protein sub-unit composition on tofu quality

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Tofu making involves a complex interaction of many factors, including chemical composition and physical attributes of the soybean and processing techniques and conditions. In making tofu, soymilk is heated to cause protein dissociation and a coagulant is then added to form a protein matrix, which gives the tofu its firmness and hardness. The quantity and quality of the protein in the seed is therefore the major biochemical component influencing soybean quality for tofu production. The principal storage proteins in soybean are glycinin (11S) and β-conglycinin (7S), which account for about 70% of the total seed protein. β-conglycinin is a glycoprotein which has a trimeric structure and consists of three sub-units, α, α', and β. Glycinin is a hexamer composed of an acidic (A) polypeptide linked by a disulfide bond to a specific basic (B) polypeptide. Glycinin has five sub-units, divided into Group I ($A_{1a}B_2$, $A_{1b}B_{1b}$, A_2B_{1a}), Group IIa ($A_5A_4B_3$) and Group IIb (A_3B_4). While the effects of isolated 11S and 7S proteins on tofu quality have been evaluated, there could be significant effects of the sub-unit composition on other seed components, particularly other proteins. We have developed a series of near isogenic soybean lines differing in seed storage protein sub-unit composition. Kinugoshi, or silken tofu, was made from these lines using a constant 18:1 water:protein ratio, to insure that differences in tofu quality would be related to protein quality, rather than protein quantity in the seed. Two types of coagulant, glucono-delta-lactone (GDL) and calcium sulfate were used. The tofu made from these lines was evaluated for firmness and hardness using an Instron Texture Measuring System to determine the effects of protein sub-unit composition on tofu quality. We will report on the effects of specific sub-unit composition on tofu yield and quality.

P021. A screening test for silken tofu hardness suitable for genetic lines

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The objective was to provide an assessment of the tofu making potential of breeding lines that would be rapid and would require a small amount of grains. Small batches of tofu are made in pill bottles and the hardness of the resulting tofu is measured with an Instron Texture Analyzer. The coagulant chosen is food grade $MgCl_2$ as it readily dissolves in water. Soybean protein content is read with an NIR whole grain analyzer so that each line is extracted based on protein content. Soybeans (25g) are soaked overnight and rinsed thoroughly; before grinding with a Polytron, water is calculated to maintain a water to protein ratio of 18:1. The slurry is filtered to remove the okara and the resulting soymilk is read for color and deactivated with a short heat treatment before storage at 4°C. Tofu is made the next day and stored overnight at 4°C. Tofu hardness is read directly in the pill bottle the following day as maximum peak force under compression. Two field replications from crop year 2002 of the Ottawa Elite Food Soybean test were processed from five locations for seventeen different genetic lines. Average grain protein content for the genetic lines ranged from 38.9% to 45.7%. Soymilk protein content was on average 4.5% ± 0.2 . Tofu hardness varied between 0.1515N to 0.2040N for the genetic lines. Statistical analysis showed that, for tofu hardness, the main source of variability was genotype; there were no location or field replication effects and no interactions between genotype and location. While the regression between grain protein content and tofu texture was significant, the $r^2 = 0.26^{**}$ was low. One person can easily process 60 samples over 4 days starting with dry soybeans. This tofu test will allow discrimination between lines with similar protein content but potentially different protein quality. It is intended as a screening tool for a breeding program to identify early generation lines with potential for tofu making.

P022. Use of molecular techniques to differentiate the *Diaporthe/Phompsis* complex

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The *Diaporthe/ Phomopsis* complex comprises at least four distinct fungi, all of which cause important diseases in soybean: *Diaporthe phaseolorum* var sojae, var caulivora, var meriodinales and *Phomopsis longicolla*. The taxonomy of this species is complex and has been difficult and controversial mainly because the species show considerable variation for morphological characters, growth and pathogenicity. Cultures representing the four species were collected from three states in the north and three states in the southern USA. Three to five cultures were obtained from each state. Isolates were characterized morphologically to determine the cultural characteristics. Pure isolates were grown in broth culture for two weeks, filtered, freeze dried and ground to a fine powder. DNA was isolated using specialized fungi kits. Molecular markers were developed from preliminary RAPD screening that could differentiate among the four distinct fungi. The application of these markers to a wide range of isolates as well as other molecular identification techniques is presented.

P023. PCR-RFLP identification of *Diaporthe/ Phomopsis* within the soybean area in Argentina

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Morphological identification of *Diaporthe/Phomopsis* isolates has been historically difficult to carry out, since the characteristics utilized are often too variable to establish the appropriate taxonomic rank. Therefore, different methodologies have been attempted in order to overcome this problem. Bioassays are rather labor-intensive and time-consuming; serological procedures (ELISA) have also been attempted, but are not routinely used in seed-testing labs for fungi. Among molecular techniques, RAPD analysis has proved an important tool for the evaluation of genetic variation. Lack of robustness intrinsic of RAPD markers, however, difficult their validation and this, in turn, precludes the use of this marker system for taxonomic identification. Polymerase chain reaction (PCR) coupled with restriction fragment length polymorphism (RFLP) of the ITS region has proved a very reliable methodology which depicts taxon-specific banding patterns for the *Diaporthe/Phomopsis* species complex. The main goal of this work is to validate the PCR-RFLP approach as a taxonomic tool for a wide range of field samples in Argentina. Additionally, this study aims at analyzing the distribution of *Diaporthe/ Phomopsis* with regards to possible epidemiological implications. Fifty samples from different hosts and geographic regions within the soybean production area in Argentina were subjected to morphological and PCR-RFLP analysis of the ITS region. The hosts analyzed were soybean, alfalfa, sunflower, red clover (*Trifolium pratense*), birdsfoot trefoil (*Lotus corniculatus*) and bermudagrass (*Cynodon dactylon*). Our results show that morphological and molecular identification were coincident in all cases, thus validating the use of the PCR-RFLP analysis of the ITS region as a good taxonomic tool. Moreover, the banding patterns for most of the samples were similar to those obtained by previous authors (Zhang et al., 1997) except for some minor mutations (one 20 bp deletion and one point mutation giving rise to the loss of a restriction site). With regards to geographic distribution, *Diaporthe phaseolorum* var. *caulivora* has been until now detected in only on soybean isolates from Balcarce (37° 45' S) up to Marcos Juárez (39° 41' S). The other taxa were distributed throughout the entire soybean production area: *Diaporthe phomopsis* var. *meridionalis* was found in isolates obtained from red clover, alfalfa and birdsfoot trefoil. *Phomopsis longicolla* was identified on alfalfa and on five wheat seeds from Gobernador Crespo (Santa Fe). Such a finding might be an indication of a *Phomopsis longicolla* strain which evolved a new pathogenic ability after years of the same soybean/wheat rotation system. This is, to our knowledge, the first report of a pathogenic *P. longicolla* strain on wheat, at least for this country.

P024. Pathogenicity, molecular analysis, and cercosporin content of Brazilian isolates of *Cercospora kikuchii*

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The fungus *Cercospora kikuchii* is involved in defoliation of soybean plants, and is normally associated with

Septoria glycines in late season. No genetic resistance has been described. The screening of resistant genotypes requires previous knowledge of the fungus. This work was undertaken to evaluate pathogenic and genetic diversity among isolates of *Cercospora kikuchii* from different areas of Brazil. Seventy-two isolates obtained from purple stained seeds showed differences in phenotypic variation. Comments from the literature associated other *Cercospora* spp. with purple stain, indistinguishable from those produced by *C. kikuchii*. Moreover, cercosporin content and rate of colony development was higly variable among isolates. A strong correlation was found between cercosporin content and virulence. Genetic differentiation among and within populations was observed based on 86 RAPD loci. RAPD analysis permitted clustering all isolates into 6 groups. No relationship was identified between isolates and geographic origin or cercosporin content. The sequences of the intergenic spacer region (ITS1-5.8S-ITS2) from 14 isolates chosen according to the previous clustering analysis, were determined by the dideoxy chain-termination method and the chromatograms basecalled by PHRED. High quality sequence fragments (PHRED score >20) showed high similarities to the GenBank accession no. AF291708 sequence, proving that all isolates used belong to the species *C. kikuchii*. It is clear from this work that populations of *C. kikuchii* are pathogenically, genotypically and geographically variable. Moreover, *C. kikuchii* has great phenotypic variation and cercosporin could be a good parameter for choosing a good isolate for screening resistant or tolerant cultivars. Considering that this pathogen is easily transmitted by seeds it is not surprise to find the same haplotypes in different regions. Migration could be favoured by infected seeds as demonstrated by the clustering analysis.

P025. Evaluation of pure lines of selections from the cultivar UFVS-2007 for the resistance to the stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*)

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The stem canker, caused by the fungus *Diaporthe phaseolorum* f. sp. *meridionalis*, is a disease that affects the soy cultivation originating great grain losses. Reaching 40% of the soy areas in the states of Goiás, Mato Grosso and Mato Grosso do Sul, with levels of damage, varying of insignificantly 100% of loss. The cultivar UFVS-2007 came from the cross-breeding between FT-Cristalina (susceptible) and Doko (resistant) accomplished at the Federal University of Viçosa - MG, it is indicated for the Central Region of Brazil, produced 4286 Kg ha^{-1}, in a general media of four essays taken in Itiquira - MT, in the agricultural years of 1998/99, 1999/00 and 2000/01. In this work, it was evaluated ten pure lines selected from of the cultivar UFVS-2007, with the objective of evaluating them according to the level of tolerance to the stem canker. The Conquista and FT-Cristalina cultivars were used as a resistance standard and susceptibility to the stem canker, respectively, being evaluated with and without inoculation. The experiment was taken under green house conditions, in the period from 06/june to 06/august of 2003. The tests were conducted in vases with four plants. Each vase was considered as a replication in the entirely random plot design with eight replications. The fungus was multiplied under laboratory conditions and inoculated to the plant, using the toothpick method. A favorable humidity condition was maintained, using an automatic nebulization system, in the first 20 days, being eliminated after the first evaluation (10 days after inoculation), after installing the fungus in the plant. The temperature varied from 15 to 44 °C. The used methodology for the evaluation was based on imputing the plant visual note 1(healthy plant) to 5(dead plant) and the visual note of lesion 1 (without lesion) to 5 (with lesion > 4cm). For the final evaluation, it was used a scale 1(R), 2(MR), 3(MS), 4(S), 5(AS). In the specific conditions where this work was developed, it can be concluded that: a) the ten pure lineages UFVS-2007, all the plants presented as resistant in all replications. The cultivar Conquista also presented the same behavior. The FT-Cristalina cultivar showed 100% of susceptible plants. It is also concluded that the artificial inoculation method under green house conditions was efficient for the evaluation of the pure lineages and cultivars about the reaction on the stem canker.

P026. Morphological, molecular and pathogenic analysis of soybean sudden-death syndrome isolates in Argentina

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Sudden-death syndrome (SDS) of soybean (*Glycine max* (L.) Merr.) was detected in Argentina initially during 1991-1992 in the Pampas Region and 1993 in the Northwest Region. In the present study, soybean plants with typical SDS foliar and root rot symptoms were

collected during the 2000/01, 2001/02 and 2002/03 growing seasons in central and southern areas of the Santa Fe Province and north of Buenos Aires Province. Pure cultures were established on potato dextrose agar supplemented with streptomycin (PDAS) from taproot tissue and blue sporulation on the exterior of taproots. Eight fungal isolates that grew slowly, developed bluish pigmentation and produced abundant conidia were selected for morphological and molecular characterization, and pathogenicity tests. Morphological and phylogenetic analyses demonstrate that two distinct species within the *Fusarium solani* species complex, *F. virguliforme* and *F. tucumaniae,* are responsible for SDS in Argentina. Morphologically, the five isolates of *F. tucumaniae* were differentiated from the three isolates of *F. virguliforme* based on the production of longer 4-septae sporodochial conidia in the former species and the production of comma-shaped sporodochial conidia in the latter. Molecular phylogenetic analysis of DNA sequences from multiple loci confirmed the morphology-based identifications. This is the first report of *F. virguliforme* in Argentina and outside of North America. Koch´s postulates for both species were confirmed in 2003. Soybean cvs. Ripley, A-6445 RG and Pioneer 9492 RR were inoculated in greenhouse tests with each of the isolates using the soil infestation method. Isolate 171 *F. virguliforme* provided by J. Rupe (University of Arkansas, Fayetteville) was used as a positive control. All eight argentine isolates produced foliar SDS symptoms 15-25 days after inoculation. Uninoculated negative controls remained symptomless. This data supports the hypothesis (Aoki, O´Donnell, Homma & Lattanzi, 2003, Mycologia 95(4) 660-684) that these pathogens appear to have evolutionary origins in South America.

P027. *In vitro* antagonistic activity of *Streptomyces* strains against soybean sudden-death syndrome isolates

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Sudden death syndrome (SDS) of soybean has become a serious threat to soybean production in Argentina. Symptoms on soybean plants are interveinal chlorosis and necrosis on leaves, and root rot,. Two distinct species within the *Fusarium solani* species complex, *F. tucumaniae* and *F. virguliforme*, are responsible for SDS (Aoki, O'Donnell, Homma &. Lattanzi, 2003, Mycologia 95(4) 660-684). Fungicide application is a usual practice in the fight against plant diseases. Biological control, the induction of natural plant defenses and crop biotechnology are promising alternatives to fungicide treatment in an integrated pest management. Seed treatment with a biological agent would be a useful tool for controlling this disease, caused by a soilborne fungus. Several microorganisms like *Bacillus, Pseudomonas, Trichoderma, Gliocladium* and *Streptomycetes* have shown antagonistic activity against *Fusarium solani*. Our experiments were carried out to evaluate the in vitro antagonistic activity of *Streptomyces* strains against SDS isolates. For the isolation of *Streptomyces* strains from soil samples, the Panthier's method was used. Nine *Streptomyces* isolates, which previously showed inhibitory effect against toxigenic fungi, were proved against five strains of *Fusarium tucumaniae* from Argentina and one of *F. virguliforme*, isolate 171, provided by J.Rupe (University of Arkansas, Fayetteville, USA). Fungal strains were grown on synthetic nutrient agar plates for 5 to 7 days at 28°C and conidia were harvested in sterile distilled water and diluted to 4 x 10^6 conidia/ml. Each *Streptomyces* isolate was streaked on potato dextrose agar plates. After 48 hours of incubation at 28 °C, fungal suspensions were spread on the same plate. The presence of inhibition zones was registered in 5 days. Measurements were repeated six times and were statistically analized using an ANOVA for a balanced factorial design and a Tukey's multiple rang test. *Streptomyces* C 202 and C 208 demonstrated high efficacy against all strains of *Fusarium* in the experiments "in vitro".They produced inhibition zones of 15.58 ± 3.03 mm and 6.39 ± 1.50 mm, respectively. The inhibition effect produced by C 202 was significantly higher ($p<0.001$) than the other *Streptomyces* isolates. Potential use of these microorganisms as biocontrol agents will be proved in experiments in greenhouse chambers. This fact might be very important in the development of a strategy of biological control of phytopathogenic fungi. This procedure by itself or as part of integrated control, may play a significant role in the stablishment of a sustainable and competitive agriculture.

P028. Soybean sudden death syndrome (*Fusarium solani*) controlled in greenhouse by inoculation with antagonistic bacteria

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The soybean sudden death syndrome (SDS), caused by *Fusarium solani* f. sp. *glycines* (FSG), is a disease that has grown in importance in Brazil. Besides a few tolerant cultivars, no agricultural practice has been successful in reducing the impact of the disease. The

present study aimed to evaluate the effect of soybean seed inoculation with bacteria antagonistic to FSG upon the control or attenuation of SDS symptoms. Eighteen bacterial strains, most of them *Pseudomonas spp.*, were tested under greenhouse conditions. The strains were grown in trypticase soy agar, one tenth of the strength (0.1X TSA), at 28 ± 1 °C, for 24 to 48 h. The bacterial cells were harvested, suspended in 0.1*M* $MgSO_4$ (pH 7,0) and the optical density adjusted for an absorbance of 0.55 at 600 nm. In each pot containing 3 kg of the A horizon of an Eutrorthox ("Latossolo Vermelho Perférrico eutrófico"), were sown six seeds of soybean cv. "BRS 156" inoculated with each one of the strains and 18 sorghum seeds with mycelia of FSG ($3,2x10^5$ CFU $seed^{-1}$). For the inoculation, the seeds were immersed in the cell suspension of each strain or into sterile 0.1 *M* $MgSO_4$ pH 7.0 (nonbacterial control). There was also a nonbacterial control with soil non-inoculated with FSG. Each treatment was replicated seven times in a completely randomized design. Fifteen days after the emergence, plants were thinned to two per pot. The plants were harvest at 30 days after sowing when the following evaluations were made: plant height, root and shoot dry weight and number of nodules. The data were analyzed by ANOVA and treatment means were separated by the Duncan's test ($\alpha = 0.05$). The presence of the fungus in the soil reduced the shoot and root dry weight in 16,5 and 17,8 %, respectively, when the bacteria were not inoculated. In the presence of the fungus and bacteria, some strains protected the plants and the symptoms were virtually absent. In those cases, the development of the plants were very similar to the ones in the control without the fungus. The best strains are currently being tested in field trials.

P029. Race determination of the causal agents of soybean stem canker

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Stem Canker is one of the soybean major diseases caused by the fungus complex *Diaporthe/Phomopsis.* Even with the integration of many useful means of control, the utilization of resistant cultivars is considered the most economic alternative control to this disease. The objective of this research was to determine races of the causal agents of soybean stem canker. The experiment was constituted of a 6x3 factorial arrangement of treatments, consisting of: six soybean cultivars (the resistant EMGOPA 313-RCH, Liderança and Conquista, and the susceptible Nova Bragg (BR-6), Seridó (BR-28) and IAS-5) and three fungus isolates (two from the Triângulo Mineiro region and one from North of Paraná State). The experimental design utilized was a randomized-block with four replications. The evaluations were made through the count of dead and alive plants, and plants with and without symptoms. It was calculated the percent of plants in each category and afterwards the data were transformed to arcsin $\sqrt{x}/100$, except for the counts of plants with and without symptoms. The analysis of variance and of the means was performed using the software SANEST, along with the Tukey test at 5% and 1% probability levels for the means. It was identified through the data collected, in the Uberlândia (M.G) region, a differential interaction between soybean cultivars and fungus isolates, which indicates variability in the pathogen population. This is the first account of the occurrence of physiologic races in this fungus population in Brazil.

P030. Reaction of soybean genotypes as to stem canker resistance

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Stem Canker is one of the soybean major diseases caused by the fungus complex *Diaporthe/Phomopsis.* Even with the integration of many useful means of control, the utilization of resistant cultivars is considered the most economic alternative control to this disease. This research aimed at the evaluation of soybean genotypes originated from the UFU (Federal University of Uberlândia) Soybean Breeding Program as for their resistance to stem canker. Genotypes previously selected for their agronomic characters were utilized in this study. As the susceptible check treatment it was used the cultivar IAS-5 while EMGOPA 313-RCH was the resistant one. The genotypes were sown in pots and at the V1 stage it was inoculated the pathogen by means of the tooth pick method. The experimental design used was a randomized-block with two replications and each of them was comprised of one pot with five plants. It was evaluated the following variables: lesion size, percent of dead plants and percent of alive plants with and without disease symptoms. Afterwards it was calculated the area below the disease progress curve (ABDPC) for the variables: lesion size, dead and alive plants. The experiments allowed the identification of resistant as well as susceptible genotypes to this disease.

P031. Isoflavonoids role in defense mechanisms associated with *Glycine max - Diaporthe phaseolorum* var. *meridionalis* interaction

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Isoflavonoids are phenylpropanoid compounds very common in the legume family. Their function as antimicrobial phytoalexins had been proposed for several plant-pathogen interactions. The objective of this work was to determine the role of isoflavonoids in compatible and incompatible interactions, established by the infection of susceptible and resistant soybean genotypes, respectively, with the fungus *Diaporthe phaseolorum* var. *meridionalis*, DPM, causal agent of the soybean stem canker disease. Soybean cultivars Tracy-M (*Rdm1* and *Rdm2* genes) and RA-702 (susceptible genotype) were inoculated in the greenhouse with the DPM isolate CE109 by inserting a piece of mycelium into a wound made with a scalpel in the hypocotyl. Seedlings without wound, or wounded but without fungal mycelium, were used as controls. Plant samples were collected at 6, 10, 24, 36 and 48 h after inoculations, and separated into root, stem, cotyledons (with cotyledonal node) and leaves. Plant tissues were extracted with 80 % ethanol and the isoflavones daidzein and genistein, and their derivates, were quantified by HPLC on a reverse phase C18 column in a gradient of 0 to 55 % acetonitrile in water at pH 3. Daidzein and genistein, and some of their derivates, were present before infection or wound in both cultivars, and in all plant tissues analyzed, meaning that these compound function as phytoanticipins. After 24 h, wounded increased the basal levels of one or the two compounds (and/or their derivates) in cotyledons and roots of RA-702 and Tracy-M, and in stem tissues of RA-702 only. When comparison was made between inoculated and wounded treatments, increments were only observed in inoculated cotyledons and root tissues, for Tracy-M and RA-702, respectively. However, when inoculated Tracy-M (resistant) and RA-702 (susceptible) cultivars were compared, higher levels of daidzein were only observed in root and hypocotyl tissues of RA-702. Additionally, neither daidzein nor genistein inhibited the fungus growth when *in vitro* assayed. These results do not allow a clear conclusion about the role of these compounds in the defense mechanism for this particular plant-pathogen interaction.

P032. Comparing measuring methods using the sensitivity ratio: an application to resistance screening in soybeans

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Disease resistance in a crop is often the most cost effective management strategy, especially for the producer. Screening methods are an important component in finding effective disease resistance. Sclerotinia stem rot of soybean presents a challenge in finding partial resistance in dry beans, due to the aggressiveness of the pathogen. More than a dozen techniques have been published which claim to effectively screen for *Sclerotinia sclerotiorum* resistance. Many of these different disease resistance screening methods use different scales and are most commonly compared statistically by the coefficient of variation (CV), root mean square error (RMSE), standard deviation and confidence intervals. However, these statistical measures are not scale independent and thus should be avoided for comparing screening methods. The sensitivity ratio (SR), is a scale independent statistical quantity that is useful for comparing the technical merit of different methods for measuring a physical, chemical or biological property. The objectives of this research are: 1) introduce the concept of the SR, 2) apply the SR to two resistance screening methods with two different scales (cut stem and detach leaf tests), and 3) use the SR to compare leaf lesion area measurement by digital imaging and hand measure methods utilizing the same scale. When compared to the RMSE or the CV, the SR ordered methods differently and thus casts doubt upon using these standard precision statistics to compare different screening methods. Consequently, we suggest that the sensitivity ratio should be used whenever it is necessary to compare two or more measuring methods, e.g. visual canopy porosity assessment, leaf area index and diffuse non-intercepted radiation.

P033. Powdery mildews of soybean and weeds in Brazil: identification by the ribosomal DNA sequences

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Powdery mildew, an obligate plant parasite, is very common on soybean and weeds that grow around soybean fields. Some species are associated with specific hosts from the same botanical species while others are able to infect a wide range of hosts. Soybean

plants along with *Sonchus oleraceus, Emilia sonchifolia, Taraxacum officinale* and *Bidens pilosa* are all severely infected by powdery mildew. Mycelium was collected with a small brush and transferred to new plants from the same host and kept inside a transparent plastic cage. Colonies that developed on the new leaves were washed with distilled water and the mycelium concentrated by centrifugation was used for DNA extraction using CTAB procedure. Sequencing was performed by the chain-termination method using the ABI Big Dye Terminator Cycle sequencing kit v 2.0 on an ABI PRISM model 3100.DNA sequencer. Sequences were aligned with the Clustal V package. The data demonstrated that all soybean isolates (3) belong to the species *Erysiphe diffusa* (Cooke & Peck) U. Braun & S. Takamatsu, formerly *Microsphaera diff*usa. Isolates from sunflower, *Sonchus oleraceus*, and *Emilia sonchifolia* belong to the species *Golovinomyces cichoracearum* (DC.) V. P. Heluta, while isolates from *Taraxacum officinale* Wigg. were infected by *Podosphaera fusca* (Fr.) U. Braun & N. Shishkoff. The sequence of the rDNA spanning ITS1, 5.8 S gene, and ITS2 for isolates from *Bidens pilosa* could not be identified solely by the sequence. Two species, *Neoerysiphe cumminsiana* (U. Braun) U. Braun and *N. galeopsidis* (DC.) U. Braun shared high homology with the sequence: 100% and 97%, respectively, which suggests requirement of additional morphological analysis. So far there is no report of occurrence of *Neoerysiphe* spp. on *Bidens pilosa* excepting for an invali1d record in Cuba (Amano, K. Host range and geographical distributions of the powdery mildew fungi. Japan Scientific Society Press, Tokyo, Japan, 1986).

P034. Reaction of soybean genotypes grown in Ipameri, GO, Brazil to powdery mildew, downy mildew and end of season diseases in the agricultural year 2002/03

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The soybean is considered very important to the Brazilian economy because it is one of the major exportation products. However, yield losses are common, mainly due to diseases like powdery mildew (Microsphaera *diffusa*), downy mildew (*Peronospora manshurica*) and end of season diseases (*Septoria glycines* e *Cercospora kikuchii*). The use of resistant cultivars is the basic control method of soybean diseases in Brazil. For this reason, the present research was carried out to evaluate the agronomic characters of twenty four genotypes from the soybean breeding program of Departamento de Produção Vegetal - FCAV / UNESP / Jaboticabal, grown in field conditions, at Fazenda Lago Azul, Ipameri / GO / Brazil. Besides the agronomic characters, we determined the reaction of these genotypes to naturally occurring diseases. The cultivar BRSMG 68 (Vencedora) was included as pattern cultivar. The statistical design was randomized blocks with four replications. Plots were made up of two 0.45m spaced 4-meter lines. Between each experimental plot, one line of the cultivar FT-Estrela (highly susceptible to powdery mildew) was soughed aiming to uniformize the inoculum of *Microsphaera diffusa.* The evaluation of downy mildew infection was performed pre-flowering. Powdery mildew and the end of season diseases were evaluated at the soybean development stages R4 or R5, depending on the genotype. The evaluations were made in three points of each plot, using the grading (0 to 5) proposed by Yorinori (1997, Oidiosja.Doc, 13p), according to the percentage of infected leaf area. After determining the level of infection, resistance reactions were attributed to each genotype, also adopting the method proposed by Yorinori (1997, Oidiosja.Doc, 13p). The low infection levels of powdery mildew, downy mildew and end of season diseases allowed classifying the genotypes as resistant, just as the cultivar BRSMG 68 (Vencedora).

P035. Reaction of soybean cultivars grown in Jaboticabal, SP, Brazil to powdery mildew, downy mildew and end of season diseases in the agricultural year 2001/02

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The soybean complex has been very important to Brazilian trade, being outstanding when compared to most of the other major Brazilian crops. However, its yield potential has been compromised by diseases and many other factors. Many control methods are recommended, but the most efficient is the use of resistant cultivars. It is important that researches bring information about the behavior of cultivars all over the country. This work aimed to evaluate the reaction of 22 soybean cultivars grown in field conditions to diseases. The experiment was carried out at FCAV/UNESP, Jaboticabal - SP, in the agricultural year 2001/02. The statistical design was randomized blocks with four replications. Plots were made up of four 0.45m spaced 5-meter lines. The diseases verified were those of end of season, (Septoria glycines e Cercospora kikuchii), powdery mildew (Microsphaera diffusa) and downy mildew (*Peronospora manshurica*). The evaluations were made using the grading (0 to 5)

proposed by Yorinori (1997, Oidiosja.Doc, 13p). After determining the level of infection, cultivars were classified according to their reaction. The cultivars resistant to *Microsphaera diffusa* were MG/BR-46 (Conquista), BRSMG 68 (Vencedora), IAC 19 and IAC 8-2; The moderately resistant were IAC 18, BRS 133, M-SOY 7501, RB 605, Foster IAC, M-SOY 6101, Engopa 316 and Embrapa 59; The susceptible were IAC 22, CD 209, BRS 156, KI-S 702 and KI-S 801; and finally, the highly susceptible were IAC 15-2, IAC 20, Embrapa 48, CD 201 and IAC Foscarim-31. All cultivars have shown to be resistant to *Peronospora manshurica*. The cultivars IAC 15-2, IAC 18, IAC 20, Engopa 316, BRS 156, IAC 8-2, IAC 19, BRSMG 68 (Vencedora) and MG/BR-46 (Conquista) were resistant to the end of season diseases while BRS 133, RB 605, IAC 22, Foster IAC, M-SOY 6101, CD 209, Embrapa 59, KI-S 702 and IAC Foscarim-31 behaved as moderately resistant and M-SOY 7501, Embrapa 48 and CD 201 as susceptible.

P036. Reaction of soybean genotypes grown in Jaboticabal, SP, Brazil to powdery mildew, downy mildew and end of season diseases in the agricultural year 2002/03

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The soybean represents 60% of the world's production of oil-rich seeds. It is composed of about 40% proteins, 20% oil, 24% carbohydrates, 5% fibers and 4% minerals. Brazil is world's second top producer and is one of the major exporters of soybean derivates. Among the factors limiting the soybean yield are the end of season diseases (*Septoria glycines* e *Cercospora kikuchii*), powdery mildew (*Microsphaera diffusa*) and downy mildew (*Peronospora manshurica*), which have been occurring every year all over Brazil. Under severe conditions, the end end of season diseases can reduce tne productivity more than 20%. For Powdery mildew, this reduction can be higher than 35%. High downy mildew infection levels have been found, especially at early stages of the so-called "safrinha". The most effective and economical control method is the use of resistant cultivars. It is important that the evaluation of the agronomic characters in developing cultivars include the reaction to different diseases. This research aimed to evaluate the reaction of 24 soybean genotypes from the soybean breeding program of Departamento de Produção Vegetal of FCAV / UNESP / Jaboticabal to the end of season diseases, powdery mildew and downy mildew in field conditions. The cultivar BRSMG 68 (Vencedora) was included as a pattern. The experiment was carried out in Jaboticabal, Brazil. The statistical design was randomized blocks with four replications. Plots were made up of two 0.45m spaced 4-meter lines. Between each experimental plot, one line of the cultivar FT-Estrela (highly susceptible to powdery mildew) was soughed aiming to uniformize the inoculum of powdery mildew. The evaluation of downy mildew infection was performed pre-flowering. Powdery mildew and the end of season diseases were evaluated at the soybean development stages R4 or R5, depending on the genotype. The evaluations were made using the grading (0 to 5) proposed by Yorinori (1997, Oidiosja.Doc, 13p), according to the percentage of infected leaf area. Resistance reactions were attributed to each genotype depending on the infected leaf area. The results show that most of the genotypes are resistant to the diseases studied. The genotype JB 95 130025 behaved as moderately resistant to powdery mildew and to the end of season diseases, while JAB 11 is susceptible to powdery mildew. The cultivar BRSMG 68 (Vencedora), used as pattern, showed to be resistant to powdery mildew, downy mildew and end of season diseases.

P037. Reaction of soybean cultivars to the powdery mildew in crops under different environmental conditions

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The powdery mildew (*Microsphaera diffusa*) can cause variable losses depending on the variety and environmental conditions. The use of resistant cultivars is the most effective and economic control method. Information about the reaction of cultivars must be continuously brought to farmers, so that they can make use of the benefits of this method. One of the parameters evaluated in breeding programs is the reaction of developing cultivars to the powdery mildew. Aiming to study the viability of selecting soybean genotypes resistant to the powdery mildew in fall/winter, field and greenhouse experiments were conducted in two dates, spring/summer and fall/winter. Eight cultivars known as resistant to the disease were tested. The statistical design of the field experiment was randomized blocks with four replications. Plots were made up of two lines of four meters. One line of the cultivar FT-Estrela, classified as highly susceptible to the powdery mildew, was soughed between plots, to uniformize the pathogen inoculum. The statistical design of the greenhouse experiment was also randomized blocks with four replications. Each plot was made up of one vase with five plants. The evaluations were made through the grading (0 to 5) and the reaction classes attributed according to the

level of infection as proposed by Yorinori (1997, Oidiosja.doc, 13p.). The results show that the growing conditions of fall/winter did not allow the detection the reaction classes of resistance and moderate resistance, especially in the greenhouse experiment, since even the resistant cultivars showed high levels of infected leaf area, being therefore classified as highly susceptible.

P038. Reaction of soybean genotypes to the powdery mildew in spring/summer and fall/winter crops

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Soybean genotypes resistant to the powdery mildew (*Microsphaera diffusa*) have been selected at FCAV/UNESP, Jaboticabal, SP, over the last years. For this, experiments were carried out in field conditions in spring/summer for several agricultural years. These experiments were arranged in randomized blocks with three or four replications, depending on the agricultural year. Experimental plots were made up of two lines of four meters with one line of the cultivar FT-Estrela, classified as highly susceptible to the powdery mildew. The evaluations of the infection levels were made in the stages R_5 or R_6, depending on the cycle of each genotype through the grading (0 to 5) proposed by Yorinori (1997, Oidiosja.doc, 13p.). The reaction classes were also attributed according to the level of infection as proposed by Yorinori (1997, Oidiosja.doc, 13p.). The results showed that in spring/summer conditions the infection levels have been low in the studied genotypes through many years. The genotypes that have behaved as resistant in spring/summer were studied in fall/winter conditions in the agricultural year 2002/03. One experiment was conducted in an irrigated area of FCAV/UNESP - Jaboticabal, following the randomized blocks design with three replications. One line of the cultivar FT-Estrela, classified as highly susceptible to the powdery mildew, was also soughed between plots. The evaluations were made using the same method of the spring/summer experiments. The genotypes that had showed resistance to the powdery mildew in spring/summer crops, generally behaved as highly susceptible under fall/winter conditions.

P039. Reaction of soybean cultivars grown in Jaboticabal, SP, Brazil to powdery mildew, downy mildew and end of season diseases in the agricultural year 2002/03

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The soybean crop is in large expansion in Brazil. Diseases are present especially when associated to favorable conditions, in general high temperatures and humidity, causing yield losses sometimes higher than 20%. Information about the reaction of cultivars to the main local soybean diseases can help farmers in choosing resistant cultivars or in planning fungicide applications. The aim of this research was to evaluate the reaction of 22 soybean cultivars to the end of season diseases (*Septoria glycines* and *Cercospora kikuchii*) and to powdery mildew (*Microsphaera diffusa*) and downy mildew (*Peronospora manshurica*) using the percentage of infected leaf area. The experiment was installed at the teaching and research farm of Faculdade de Ciências Agrárias e Veterinárias/UNESP/Jaboticabal-SP, in the second half of November 2002. The statistical design was randomized blocks with four replications. Plots were made up of four 0.45m spaced 5-meter lines. After thinning out, 17 plants were left per meter. The following cultivars were studied IAC 24, IAC 18, IAC 23, BRS 133, M-SOY 7501, BRS 184, IAC-22, EMBRAPA 48, CD 208, BRS 134, BRS 154, CD 209, CD 205, BRS 156, BRS 137, CD 201, IAC 8-2, IAC 19, V-MAX, M-SOY 8001, MG BR 68 (Vencedora) and MG/BR-46 (Conquista). The evaluations were made when plants reached the stages R_5 or R_6, using the grading (0 to 5) proposed by Yorinori (1997, Oidiosja.Doc, 13p.) according to the level of infection, as follows: 0 = no symptoms; 1 = from trace to 10% of infected leaf area (AFI); 2 = from 11 to 25% of AFI; 3 = from 26 to 50% of AFI; 4 = from 51 to 75% of AFI and 5 = from 76 to 100% of AFI. After determining the level of infection, cultivars were grouped according to their reaction. Grades from 0 to 2 were considered resistance reaction (R); 2.1 to 3 moderate resistance (MR); 3.1 to 4 susceptibility (S); and 4.1 to 5 high susceptibility (AS). The results showed that the cultivars IAC 23, BRS 184, BRS 137, IAC 8-2, IAC 19, V-MAX, M-SOY 8001, BRS MG 68 (Vencedora) and MG/BR- 46 (Conquista) are resistant to powdery mildew. Some cultivars showed to be resistant to the end of season diseases, namely IAC 23, BRS 137, IAC 8-2, IAC-19, V-MAX, BRS MG 68 (Vencedora) MG/BR 46 (Conquista). Low downy mildew infection levels were observed in all cultivars, which were considered resistant.

P040. Calcium/calmodulin effect on spore germination and appressorium formation in *Colletotrichum truncatum*

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The effect of physicochemical signals such as hydrophobicity of hard contact surfaces on germination of spores of *C. gloeosporioides, C. trifolii* and *C. graminicola* is well known in the literature. Also, the effect of calmodulin a ubiquitous Ca^{+2} receptor protein has been mentioned for its action on both spore germination and appressorium formation. A similar study was undertaken with *C. truncatum* a pathogen involved with antrachnose in soybeans and responsible for significant losses to the farmers in the central regions of Brazil where moisture and temperatures are typically higher during the growing season. The effects of different surface wettabilities on spore germination and appressorium formation were evaluated using glass slides, PVC shrink film, eppendorf tubes and 7% agarose. $CaCl_2$ (1 mM), glucose and maltose (100 mM), yeast (1%), neomycin (100 µM) and EGTA (calcium chelator, 10 mM) were tested to confirm effects observed on different species of *Colletotrichum* and other fungi. The data showed that germination was higher on glass slides (100%), followed by PVC shrink film (96%), agarose (68%) and eppendorf tube (2%). The percentage of appressorium formation was higher on PVC shrink film (84%), followed by glass slides (56%), agarose (33%) and ependorf tubes (3%). Spore germination and apressorium formation were not connected according to these data. The carbon sources used and exogenous $CaCl_2$ had an important effect on increasing spore germination and appressorium formation. The highest germination (98.5%) and appressorium formation (85.6%) was obtained with yeast, followed by glucose (64.3%, 56.7%), maltose (60%, 48.6%) $CaCl_2$ (56%, 47.3%) and water (40.3%, 33.2%). The role of Ca^{+2} could be observed when the concentration in the suspension was reduced through the use of a chelating agent (EGTA): spore germination and appressorium formation were 6.33 and 4.1%, respectively. The effect on Ca^{+2} was evaluated with the addition of neomycin, a compound that acts on the inhibition of phospholipase C (PLC), an enzyme also associated with spore germination and appressorium formation. The spore germination and appressorium formation were 1% and 0.55%, respectively, after addition of neomycin to the spore suspension. This report confirms that *C. truncatum* behaves like other species of *Colletotrichum* in relation to the stimuli of spore germination and appressorium formation, steps necessary for infection.

P041. Effect of culture media and temperatures upon the growth and sporulation of *Fusarium solani* f.sp. *glycines*, causal agent of the soybean root red decay

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Fusarium solani f.sp. *glycines*, a soil pathogen, is the causal agent of the soybean red decay, also know as sudden death syndrome (SMS). This disease is relatively new, and was found in Brazil for the first time in the harvest 1981/82, in the cultivar UFV-1 in São Gotardo/MG. However, the causal agent was only confirmed years later, in 1996. In the harvest 1999/00 SMS affected over 2 million hectares in 99 Brazilian municipalities, causing losses of about 53 million dollars. As the first tries to grow the pathogen showed high needs and variability an experiment was installed with the objective of knowing the effect of three culture media (oat flour, corn flour and BDA) and two temperatures (22 °C and 28°C) upon the growth and sporulation of the pathogen. Pattern-sized fragments of the colonies were transferred to Petri dishes containing these media. Fragments were positioned in the center of dishes. Dishes were then kept in a germination chamber with temperatures adjusted to 22°C and 28°C, under a 12-hour photoperiod. The statistical design was completely randomized with 10 replications. Each plot was made up of one Petri dish. Growth evaluations were performed weekly through diameter measurements with a ruler. After the fourth evaluation, when colonies reached the size of the dish or practically stopped growing, sporulation analyses were made. After preparing conidium suspensions by adding 5ml of distilled water per dish, conidia were counted in a Neubauer chamber. Each plot was submitted to forty countings. The results of growth and sporulation were submitted to ANOVA using the F test. The comparison of means was made through the Tukey's test. The results show a tendency of better development and production of conidiospores in the media composed of oat flour or corn flour at 28°C. However, growth was found to be slow in all media. At 28 days, colonies in general did not reach the size of the dish and showed very slow growth. This slow mycelium growth in the medium of corn flour, as well as its opacity, made impossible the first evaluation of the dishes incubated at 22°C and did not permit good precision in the following evaluations. In general, mycelium growth was less vigorous in the media BDA and corn flour and more vigorous, cotton-like, in the medium oat flour.

P042. Viability of the detached leaf technique to study the reaction of soybean to *Fusarium solani* f. sp. *glycines*: Inoculation through the toothpick and disc on leaf methods

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The sudden death syndrome affected more than 2 million hectares in 99 Brazilian municipalities in the harvest 99/00, with losses estimated to be around 53 million dollars. After the harvest 1996/97 this disease spread and reached from Rio Grande do Sul to Maranhão, being the most affected states Rio Grande do Sul, Santa Catarina, Paraná, Mato Grosso, Mato Grosso do Sul, Goiás e Minas Gerais. Growing a detached leaf is a methos used to study the reaction of hosts to many pathogens. Aiming to study the viability of the detached leaf technique and the reaction of soybean genotypes to *Fusarium solani* f. sp. *glycines*, we carried out this experiment with the cultivar FT-Estrela, classified as susceptible to the disease. The detached leaves were obtained from plants grown in a greenhouse and were prepared as described by Centurion & Kimati (1994, Summa Phytopathologica 20:174-178). Leaves were incubated in a germination chamber. The temperature was adjusted to 28°C and the photoperiod to 12 hours. After rooting, the detached leaves were inoculated, through two methods. The first consists of introducing a toothpick colonized by the pathogen to the leaf petiole and the second is made up of putting a disc (colony) of the pathogen on the leaf. Three isolates of *F. solani* f. sp. *glycines* with morphologically different colonies were tested. After the inoculation leaves were kept at 22°C, 25°C and 28°C in a 12-hours photoperiod. The statistical design was completely randomized. Four evaluations were performed, using the grading proposed by Yorinori (1997, Oidiosja.Doc, 13p.). Data were submitted to ANOVA using the F test. Means comparison was made through the Tukey's test at 5% of probability. By the fourth evaluation we found no difference between the two methods. Significant differences were found among the isolates, being 1cb and 3ccr responsible for the highest infections. The highest infection was observed at 22°C, which was significantly different from 25°C. No significant differences were found to the interactions method x isolate, method x temperature, isolate x temperature and method x isolate x temperature.

P043. Viability of the detached leaf technique to study the reaction of soybean to *Fusarium solani* f. sp. *glycines*: inoculation through the toothpick method

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The sudden death syndrome (SMS) was first observed in the harvest 1981/82 in São Gotardo (MG). After the harvest 1996/97 this disease spread widely, reaching from Rio Grande do Sul to Maranhão. The reaction tests of cultivars have been used in seedlings, generally under greenhouse conditions. Because of its practicality and economy the detached leaf technique has been employed in plant pathology. With the objective of determining the viability of the detached leaf technique to study the reaction of soybean genotypes to *Fusarium solanium* f. sp. *glycines*, we carried out this experiment using two soybean cultivars, namely MG/BR - 46 (Conquista), classified as resistant, and FT-Estrela classified as susceptible to this disease. Detached leaves from plants grown in a greenhouse were prepared as described by Centurion & Kimati (1994, Summa Phytopathologica 20:174-178) and put in Petri dishes containing a cotton layer covered with moist filter paper. Leaves incubation was performed in a germination chamber with the temperature adjusted to 22°C and the photoperiod to 12 hours. After rooting, the detached leaves were inoculated introducing a toothpick with the pathogen in the petiole. Leaves were then kept at 24°C with a 12-hours photoperiod. The statistical design was completely randomized with 10 replications. Two evaluations were made, using a 0 to 5 grading (0 = no symptoms or darkening around the toothpick; 1 = partially wounded petiole; 2 = totally wounded petiole; 3 = totally wounded petiole, clorosis and/or necrosis of the leaf base; 4 = totally wounded petiole, clorosis and/or necrosis in 25-50% of the leaf area; 5 = totally wounded petiole, clorosis and/or necrosis in 50-100% of the leaf area). Data were submitted to ANOVA using the F test. Means comparison was made through the Tukey's test. The analyses of the results showed that there were significant differences among treatments at the first evaluation. FT-Estrela showed the highest infection level if compared to MG/BR - 46 (Conquista) and control. Even with the presence of symptoms in MG/BR - 46 (Conquista), there was no significant difference to the control. At the second evaluation FT-Estrela was significantly more infected than the control. The cultivar MG/BR - 46 (Conquista) did not differ from the other two treatments. These

results are promising and the improvement of the method can make it suitable for studying the reaction of genotypes to the sudden death syndrome.

P044. Identification methods for resistance in soybean to *Fusarium solani* f. sp. *glycines*, under greenhouse conditions

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Sudden death syndrome (SDS) caused by *Fusarium solani* f. sp. *glycines* has became one of the most important diseases in soybean due to significant yield losses and control limitations. Control has been possible by means of resistant genes. This work aimed to identify efficient methods of inoculation to assess the genetic resistance of genotypes of soybean to SDS. Two experiments were arranged in a randomized block design (RBD). The former consisted of six treatments and 12 replicates and the latter, six treatments and 16 replicates. Each plot was constituted of a plant pot containing one plant of the cultivar FT Estrela, witch is highly susceptible to SDS and another plant of the cultivar Conquista, which is moderately resistant. The plants were assessed in relation to incidence and severity of SDS, on every three days, for fifteen days, starting from the fifteenth day of emergence. From the data obtained, the area under the disease progress curve (AUDPC) was estimated for the treatments. The inoculations with grains of sorghum and corn were the most effective in causing the appearance of the disease, in the first experiment. Inoculations with corn kernels were the most effective method in causing the disease, in the second experiment. However, only the inoculation with corn kernels permitted a separate reaction of genotypes in relation to SDS resistance, according to Tukey test ($P<0,05$), in both experiments. Thus, the inoculation with corn kernels can be recommended to reaction assessments of soybean genotypes to SDS under greenhouse conditions.

P045. Effect of field inoculation methods, irrigation treatments and soil compaction on the occurrence of soybean sudden death syndrome

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Sudden death syndrome (SDS) is a mid to late season fungal disease caused by *Fusarium solani* f. sp. *glycines* (FSG) that can cause severe losses to soybean (*Glycine max* (L.) Merr.) yields. Selection for SDS resistance in the field is difficult because of the sensitivity of symptom development to environmental factors. In addition, the occurrence of SDS in a field is unpredictable and the disease is often not present when the experiments are conducted. Artificial inoculation methods have been routinely used in the field and the efficiency of these methods is unclear. Two experiments were carried out to evaluate the effect of field inoculation methods as well as the effects of compaction and irrigation treatments on SDS leaf symptom occurrence. For both experiments, the research plots were rated for date of maturity, plant lodging, plant height, seed yield, and SDS foliar symptom. The disease incidence (DI, 0-100%) and disease severity (DS, 1-9) were taken at the R6 growth stage, and the disease index (DX; 0-100) was calculated as (DI x DS)/9. The irrigation/compaction experiment was conducted in 2002 following RCBD in a split-split-plot arrangement. The compaction treatments were the main plots, the five irrigation treatments were the sub-plots and the two cultivars were the sub-sub-plots. For each irrigation application, 7.6 cm of water was applied. The treatments were: 1) natural rain; 2) irrigation at the V3 growth stage; 3) irrigation at V7; 4) irrigation at V3 and V7 and 5) irrigation at V3, V7 and R4. Because no significant ($P<0.05$) compaction effect on DX was observed in 2002, a compaction treatment was not included in the 2003 experiment. Across the two years and both cultivars, increased disease was observed with more irrigation treatments. Irrigation treatment 5 produced a greater DX (13.03) score than any other treatment. We can conclude that irrigation (moisture) is an important factor in SDS field studies. No significant irrigation effect was observed across years for any of the agronomic traits. The second experiment was carried out in 2002 and 2003 following a RCBD in a split-plot arrangement, using inoculation methods (8) as main plots and cultivars (3) as sub-plots. The inoculation methods were: FSG infested sorghum seeds 1) broadcasted and incorporated into the soil 2) placed below the seed at planting and 3) planted in the furrow with the soybean seeds; FSG infested oat seed 4) broadcasted and incorporated into the soil; FSG infested popcorn 5) placed below the seed at planting and 6) planted in the furrow with the soybean seeds; 7) FSG liquid inoculum injected below the seed bed and 8) noninoculated control. Significant differences in DX scores were observed among the treatments with the FSG infested sorghum placed below the seeds ($DX = 17.04$) and popcorn planted in the furrow with the soybean seed ($DX = 13.37$) treatments resulting in the greatest disease. Significant differences in yield among methods were observed only for the susceptible cultivar.

P046. Use of resistance and fungicides in the control of seedling diseases of soybean over diverse environments in Arkansas

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Soybean stands and plant vigor can be significantly reduced by soilborne seedling pathogens leading to lower yields or requiring replanting. Most seedling diseases are caused by three groups of pathogens; *Pythium* spp. and *Phytophthora sojae, Rhizoctonia solani,* and *Fusarium* spp. Damage from these pathogens is often associated with cool wet conditions, but some are active under warm conditions. Poor seed quality also can increase seedling diseases. Recently, we have identified a soybean cultivar, Archer, that has resistance to *Pythium* spp. The potential of this resistance to prevent stand loss in the field is not known, but will depend on, as does fungicide selection, which pathogens are causing seedling disease. A series of field experiments were conducted at five locations in Arkansas, three planting dates (mid-April, mid-May, and mid-June), and with and without simulated rainfall, flooding at emergence. Treatments were two cultivars, high and low seed quality, and fungicide seed treatments. The cultivars were Hutcheson (Pythium-susceptible) and Archer (Pythium-resistant). Low quality seed lots of each cultivar were derived by artificially aging high quality seed. Broad spectrum and specific fungicide seed treatments were included; metalaxyl, carboxin + PCNB, fludioxonil, and carboxin + thiram + metalaxyl. Fungicides seed treatments resulted in increased stands at all locations, 12 of 26 and 21 of 29 tests in 2001 and 2002, respectively, demonstrating that fungicides are probably needed across the state. Fungicide seed treatments were effective at all planting dates, but were more efficacious in April and May than in June. Fungicide seed treatments were effective twice as often with Hutcheson than with Archer. Archer had lower root discoloration in 13 of 47 comparisons with Hutcheson, while metalaxyl only reduced root discoloration in 1 of 48 comparisons. The resistance in Archer appears to be effective in the field and may help prevent stand loss if incorporated into cultivars adapted to Arkansas. Flooding usually reduced stands, but fungicide seed treatments were as effective in non-flooded asrsus flooded situations. While flooding shortly after planting is still an important factor reducing stands, these results demonstrate that flooding is not necessary for seedling disease stand reductions and that stand losses are being experienced under normal planting and emergence conditions. All three fungicides were effective at increasing stands with carboxin + thiram + metalaxyl being almost twice as effective as metalaxyl or carboxin + PCNB alone. This evidence suggests that there is more than one pathogen group causing seedling disease. However, the effectiveness of metalaxyl and the resistance in Archer suggest that *Pythium* spp. are probably an important part of soybean seedling disease complex.

P047. Effect of planting date and soybean cultivar on the development of sudden death syndrome, caused by *Fusarium solani* f. sp. *glycines*, in Tucumán, Argentina

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Sudden death syndrome (SDS), caused by *Fusarium solani* f. sp. *glycines*, is one of the most important soybean diseases in Tucumán as well as in other provinces of northwestern Argentina. Several practices are recommended to manage the disease, including the use of resistant cultivars. The objective of this study was to evaluate the effect of planting date on the development of SDS in cultivars differing in resistance to the disease. This field test was conducted in the 2002/03 growing season in La Invernada, Tucumán. Six commercial cultivars (Maturity Groups IV to VIII) were planted on three dates (11 December, 20 December, and 7 January) in a field where high levels of the disease had been observed in previous years. The experimental design was a randomized complete block with 3 replications. Plots consisted of four, 6-m rows, spaced 0.5 m apart. Evaluations were carried out, starting at growth stage V1, every 15 days until the appearance of SDS foliar symptoms, and weekly thereafter. To analyze the data a Disease Index (DI) was calculated, based on the Maximum Incidence (MI) and its corresponding Severity (S), according to the following formula: DI = (MI x S) / 5. Incidence was determined as the percentage of diseased plants in the plot, and the Maximum Incidence was the highest incidence observed in each plot during the season. Severity was estimated using a 0 to 5 scale, where 0 = no foliar symptoms, and 5 = >70% of the foliar area with chlorosis or necrosis. All cultivars had the MI in R6. For all cultivars the highest DI was observed in the plots with the first planting date, although there were significant differences among them. Differences among cultivars were not as marked for the second and third planting dates. Some cultivars, such as A 7636 RG (MG VII) and A 6401 RG (VI), had low DI values, with no significant differences among the 3

dates. Qaylla RR (VII), Munasqa RR (VIII), A 8100 RG (VIII), and AW 4902 RR (IV) showed the highest DI for the first date, with no significant differences among cultivars. AW 4902 RR had one of the highest DI in the first date (16.5), but low DIs in the second and third dates (2.3 and 2.4, respectively). No significant differences were observed between the DI values of the first and second dates for A 8100 RG, although the DI for the third date was significantly lower. DIs for Munasqa RR and Qaylla RR significantly decreased from the first to the third planting date. These results indicate that less disease occurred as planting was delayed, and that the extent of this reduction was influenced by the soybean cultivar.

P048. Evaluation of soybean cultivars for their reaction to sudden death syndrome, caused by *Fusarium solani* f. sp. *glycines*, in Tucumán, Argentina

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Sudden death syndrome (SDS), caused by *Fusarium solani* f. sp. *glycines*, is a disease of increasing importance in soybean crops of northwestern Argentina (NWA). One of the most effective disease management strategies is the use of resistant cultivars. The objective of this study was to evaluate the reaction to SDS of commercial cultivars available in NWA. A test was conducted during the 2002/03 growing season in La Invernada, Tucumán, in a field where high levels of the disease had been observed in previous years. Twenty-four commercial cultivars, from Maturity Group (MG) IV to IX, were evaluated using a randomized complete block design with 3 replications. Plots consisted of four 6-m rows spaced 0.5 m apart. Evaluations were carried out, starting at growth stage V1, every 15 days until the appearance of SDS foliar symptoms, and weekly thereafter. To analyze the data a Disease Index (DI) was calculated, based on the Maximum Incidence (MI) and its corresponding Severity (S), according to the following formula: DI = (MI x S) / 5. Incidence was determined as the percentage of diseased plants in the plot, and the Maximum Incidence was the highest incidence observed in each plot during the season. Severity was estimated using a 0 to 5 scale, where 0 = no foliar symptoms, and 5 = >70% of the foliar area with chlorosis or necrosis. In most cultivars first foliar symptoms appeared between R1 and R3, and only two of them showed symptoms before flowering. All cultivars showed the MI between R5 and R6 with an average severity of 3.5. Cultivars were ranked according to a Disease Grade (DG) scale, from 1 to 5, which was established by grouping the DIs. In this DG scale, 1 = no disease; 2 = DI from 0.1 to 9; 3 = DI from 9.1 to 15; 4 = DI from 15.1 to 30; and 5 = DI greater than 30. Three cultivars were classified as DG 4, nine cultivars as DG 3, and eleven as DG 2. None of the cultivars showed DIs corresponding to DG 1 or 5. These results confirm the differential response of soybean cultivars to SDS. The data also show that there are cultivars available in the region with acceptable levels of resistance to the disease. The use of a DG scale, which uses a disease index based on maximum incidence, was considered to be useful for evaluating cultivar reaction to SDS under natural conditions.

P049. Nature of resistance to Pythium damping-off and root rot in the soybean cultivar Archer

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Pythium damping-off and root rot can be a serious problem on soybean in Arkansas. This seedling disease is especially important in alluvial soils with poor internal drainage used for rice and soybean production. Recent research at the University of Arkansas demonstrated that the flood tolerant soybean cultivar Archer demonstrated resistance to several *Pythium* spp. including *P. aphanidermatum*, *P. irregulare*, *P. vexans*, HS-group, and *P. ultimum* when compared to Hutcheson, a popular cultivar. The resistance in this cultivar was effective in stand establishment and long-term assays. Zoospore assays indicated that exudates from Archer were less attractive to zoospores than exudates of Hutcheson. Chemical analysis of exudates indicated that Archer contained less sugars than Hutcheson. Archer continued to demonstrate resistance when exudates from Hutcheson seed were placed on Archer seeds. The resistance in Archer also was evident following inoculation by either placing hyphae directly on the seed or injecting hyphae into hypocotyls when compared to the susceptible cultivar, Hutcheson. These findings suggest differences other than exudates were important in resistance. Archer is known to have two resistance genes for *Phytophthora sojae* (*Rps* 1k and 6). It was speculated that these genes might play a role in resistance in Archer to *Pythium* spp. Therefore, a set of differential cultivars containing specific resistance genes for *Phytophthora sojae* were planted in vermiculite infested with *Pythium aphanidermatum* and assessed by a disease index, stand count, percent seed rot and percent damping-off. Among the differentials, the

cultivar Williams 82 (*Rps* 1k) demonstrated resistance to *P. aphanidermatum* similar to Archer. *Rps* 3c also demonstrated some resistance, but significantly less than *Rps* 1k. Further assays with isolines that contained *Rps* 1k and *Rps* 3c reiterated the resistance in both of these genes. Hypocotyl injections of cultivars containing these genes also demonstrated the association between *Rps* 1k and *Rps* 3c with resistance to *Pythium* spp. This study suggests the Phytophthora resistance gene *Rps* 1k is important in the resistance of Archer to Pythium damping-off and root rot.

P050. Study on pathotoxin produced by *Phytophthora sojae*

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Phytophthora root rot caused by *Phytophthora sojae* is a very serious disease for soybean production in the world. In this experiment, the optimal pathotoxin production factors, extraction, purification, bioassay and the characteristic of physical chemistry of the pathotoxin produced by *Phytophthora sojae* were systematically investigated. The main results were as follows: 1) Some optimal production factors of pathotoxin produced by *Phytophthora sojae* were studied. The most suitable conditions were in Fries liquid medium in that pH was 6-7 under the static and semi-light at 25-28 for 10 days; 2) The best extracting method of the pathotoxin produced by Pmg was to use the weak polarity organic solvent, especially ether. The rude crystalline of the pathotoxin was obtained by continuous extraction by ether; 3) The bio-activity of the rude pathotoxin was determined by the seedlings with cutting roots and the vitro leaves, and the former material appeared the same symptom as those with the hypocotyl inoculation and the latter material brought the small spots on it; 4) The main component of the pathotoxin produced by *Phytophthora sojae* was preliminarily thought as a kind of glycoprotein, and the content of the protein and glucose was measured by anthrone-chromometry and bovine serum albumin. The experimental results showed that the toxin activity of protein was stronger than that of glucose after the pathotoxin was hydrolyzed by protein hydrolytic enzyme and the glucose hydrolytic; 5) The pathotoxin was separated to 5 components by silica gel thin-layer chromatography and the Rf values were 0.23 0.56 0.59 0.67 and 0.78. The virulence of the components was different and the strongest virulent component was that with Rf 0.78.The leaves treated by the component with Rf 0.78 had many spots and water immersion symptom. The order of the virulence of the components was Rf 0.78>0.67>0.59 0.56>0.23. This result indicated that the component with relatively small molecular weight had much more virulence than that with relatively big molecular weight.

P051. Latent infections in laves and pods of soybean

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Diseases caused by fungi, virus, bacteria and nematodes limit soybean production in Argentina with an annual estimated loss of approximately 10%. *Septoria glycines*, *Cercospora kikuchii*, *Diaporthe phaseolorum* var. *sojae* and *Colletotrichum* spp. are common fungi in soybean crops of Entre Ríos. Latent infection (LI) is defined like the absence of symptoms during a specific length of time, until they are evident, in response to environmental conditions or plant ontogeny. Also, LI is a specialized parasitism relationship where parasite coexists with host during a prolonged period of time with a minimum damage for the latter. Finally, LI is interpreted as a tolerance type of host to pathogen. Latent infections have been detected in 23 hosts and associated with 13 fungi species. Latent infections can be detected by quick, simple and cheap methods and can be considered when estimating soybean production, quality seed and ideal targets for chemical intervention. The objective of this work was to determine several microorganisms and LI frequency, in leaves and pods of MG IV to VIII soybean cultivars. During 2001/2002 cropping season, disinfected disks of asymptomatic tissues of cultivars DM 4800 RG, María 55 RG and A 6445 RG were cultivated in PDA 2% and bean agar. On leaves, isolated microorganisms were: bacteria (51,9% at R2), *Alternaria* (46,3% at R6), *Cladosporium* (18,5% at R4), *Bipolaris* (5,6% at V10-R1), *Colletotrichum* (1,9% at V10-R1), *Fusarium* (1,9% at R2 and R6) and *Epicoccum* (1,9% at V10-R1 and R6). In pods (R6) we detected *Alternaria* (100%), *Fusarium* (56,7%), *Phoma* (30%), *Epicoccum* (30%), *Cercospora kikuchii* (26,7%), *Bipolaris* (13,3%) and *Colletotrichum* (6,7%). During the 2002/2003 season, we isolated high percentage of bacteria (48,2%), *Alternaria* spp. (74%), *Phomopsis* spp. (17,4%), *Fusarium* spp. (12,4%), *Drechslera* y *Bipolaris* spp. (3,2 y 1,8%) and *Colletotrichum* spp. (2,8%) on leaves. Last year, lower levels of *Phomopsis*, *Fusarium* and bacteria were recorded on DM 4800 RG, A 6445 RG and A 8000 RG; conversely, a higher percentage was found in María 55 RG and Mercedes 70 RG. Dextrose Potato Agar 2% or Bean Agar resulted adequate media to detect latent infections by fungi.

P052. Pathogenicity of *Macrophomina phaseolina* isolates from soybean

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Soybean Charcoal Rot, caused by *Macrophomina phaseolina* is a widespread disease in the soybean cropped area in Brazil. This work aimed to evaluate the pathogenicity of three isolates of *M. phaseolina* from infected soybean plants collected in Balsas, Maranhão; one from Bom Jesus, Piauí and one from Humaitá, Amazonas. The inocula was prepared by transferring PDA discs containing fungi structures (0.5mm in diameter) to PDA plates with toothpick pieces disposed on the medium, and incubated during 14 days at 25 ± 2°C. Soybean plants cv. MSoy 9010 cultivated in greenhouse (4 plants/pot) were inoculated by introducing a colonized toothpick piece into the plant stem. The pathogenicity of isolates was evaluated by the average of plant death. The results showed a large variance on pathogenicity of the isolates, ranging from 6.25%, 68.8% and 75% for the isolates from Maranhão, respectively; 43.8% for the isolate from Amazonas and 87.5% for the isolate from Piauí.

P053. Effect of burial depth on germination and viability of sclerotia of *Sclerotium rolfsii* Sacc.

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Sclerotium rolfsii Sacc. is a necrotrophic soil borne plant pathogen persists in the soil in the form of sclerotia. Survival of fungal sclerotia under natural conditions is affected by many environmental and biotic factors. Sclerotia survive well at or near the soil surface but survive poorly if buried in the soil. Experiments were carried out to study the effect of burial depth on germination and survival of sclerotia. Burial depths affected viability and germination of sclerotia. Per cent germination and viability declined gradually however, the best viability was found at a depth of 7 to 9 cm for six months as it retains more moisture for a longer period as compared to the upper surface, which also exposed to the sunrays. Soil depths differed significantly from one an other. There was a significant difference in viability of sclerotia at different month intervals also. The sclerotia remain viable up to 30 months but the viability was inversely proportional to the period of storage. There were two types of sclerotial germination i.e. eruptive (erupting of mycelium throughout the sclerotium) and hyphal (growth of individual hyphal strands from the sclerotium) however, there was no definite relationship between the type of sclerotial germination and burial depth or buried time. Many of the non-germinating sclerotia were found to colonize by *Trichoderma* spp. The sclerotia produced on natural food base and on artificial media germinate eruptively and faster, while stored sclerotia germinate slowly by both eruptive and hyphal. The hyphal germination was only 0.1-0.3%. The time of germination increased with increasing time of storage and finally after a period of time the viability was lost.

P054. Effect of Soybean-Oat-Soybean System on populacional dynamic of *Fusarium* spp.

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Crop succession might influence pathogen survival in the soil. Climatic factors, edaphic conditions and plant host can determine *Fusarium* spp. distribution. These pathogens have great capacity of persistence in soil and multiplication in harvest residues. Dynamic population analysis of *Fusarium* spp. was carried out from soil collected four times: April/2001 (after soybean), October/2001 (after oat), April/2002 (after soybean) and October/2002 (after turnip + oat + *Vicia*). The colony forming unity (CFU).g^{-1} was estimated based on soil suspensions placed on petri dishes containing Nash and Snyder Modificated Media (NSMM). Soybean-oat-soybean system increased populations of *Fusarium solani* f. sp. *glycines* and *F. oxysporum*. Population of *Fusarium solani* f. sp. *glycines* (SDS causal agent) increased considerable on oat tillage, which should be considered as inefficient for SDS management as a crop rotation. However, association of turnip + oat + *Vicia*, decreased population of *Fusarium* spp.

P055. Effect of plant nutrition on the severity of soybean foliar disease and on seed pathology

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The nutritional unbalance and the low fertility of the soil is known to influence plant and seed health, turning them more susceptible to pathogens. Brown Spot

caused by *Septoria glycines* and Leaf Blight caused by *Cercospora kikuchii* may cause yield losses up to 20% in the soybean crop. The objective of this study was to evaluate the severity of these foliar diseases in field conditions, as affected by 40 different soil fertilizers treatments, as well as to observe the sanity of soybean seeds (cv. BRS Sambaíba). The treatments consisted of different amounts of simple superphosphate (SSP), triple superphosphate (TSP), KCl, $ZnSO_4$, $MnSO_4$, $CuSO_4$, H_3BO_3, $Na_2MoO_4.2H_2O$, $CuSO_4$, $FeSO_4$ e $3MgO.4SiO_2.2H_2O$ applied on the soil (broadcast) and incorporated at 15cm, prior to soybean planting. Disease severity (percentage of infected leaf area – i.l.a.) was evaluated when plants reached the R6 development stage. Soybean productivity and seed pathology were evaluated in the laboratory. The treatments without potassium (KCl) showed higher disease severity (39.5% i.l.a.), when compared to complete check plus nitrogen (19.5% i.l.a.) and complete check (20% i.l.a.). On the other hand, plants grew on the absence potassium manure showed low productivity (2718 $kg.ha^{-1}$), when compared to complete check plus nitrogen (3649 $kg.ha^{-1}$) and to complete check (3618 $kg.ha^{-1}$). It was observed no difference among treatments regarding to the incidence of *Aspergillus flavus*, *Aspergillus* sp., *Fusarium* sp., *Cladosporium* sp., *Rhizopus* sp., *Penicillium* sp. and bacteria. Storage fungi were observed in all treatments, while the other seed pathogens were present on some but not on all treatments.

P056. Effects of soybean rust (*Phakopsora pachyrhizi*) on health leaf area duration, and its relationships with yield of soybean

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Soybean rust caused by *Phakopsora pachyrhizi* is one of the most important diseases in Brazil and is a threat to soybean cultivation by causing substantial yield losses. Epidemiological studies in many parts of the world have shown a narrow relationship among health leaf area duration (HAD) and yield. To a better understanding of the damage caused by soybean rust, a field research was carried out in a soybean winter crop to evaluate some epidemiological aspects of this disease. Health leaf area duration (HAD) showed significant effects on the number of seeds per plant, on the 1000 seed weight, and on yield. However, it was not showed significant effect on the number of pods per plant, and in the number of not filled pods per plant. The area under disease progress curve (AUDPC) showed significant effect only on 1000 seed weight and on yield, although with less precision than HAD. The fungicides from triazol group and the mixture of triazol with strobilurin showed the best control of soybean rust. It was concluded that the reductions in soybean yield by soybean rust is caused by a reduction on HAD, which reduces the number of seeds per plant and the 1000 seed weight.

P057. Comparative analysis of expressed sequences in the soybean rust pathogen *Phakopsora pachyrhizi*

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Phakopsora pachyrhizi Sydow is an obligate fungal pathogen that causes the soybean rust disease. Unidirectional cDNA libraries were constructed in the plasmid pSPORT1, using mRNA isolated from three different stages of the life cycle of the pathogen. mRNA was isolated from *P. pachyrhizi* urediniospores germinating on a water surface for 16 h and from infected soybean leaf tissue at 6-8 and 13-15 days post inoculation. Intercellular hyphal growth and sporulation peak at 6-8 and 13-15 days, respectively. A total of 18,000 expressed sequences tags (ESTs) were generated from the three stage-specific cDNA libraries. The ESTs were analyzed for redundancy within and among the three libraries, and were classified according to putative function based on similarity to known proteins. These ESTs will provide insight into the biochemical and physiological processes that are necessary for infection, survival and reproduction.

P058. Occurance of soybean rust (*Phakopsora pachyrhizi*) and its control in south Brazil

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The soybean rust (*Phakopsora pachyrhizi*) was detected at first time in RS, at season 2001/02. Located at the south of Brazil, this state grows around 3,7 million soybeans has. That season coincided with the pré-co-

mercial introduction of new fungicide Opera®, a combination of strobilurin and triazole - Pyraclostrobin + Epoxiconazole, 133 + 50 g/l, respectively. Several demonstratives areas were installed, all over this region. At some of these areas, on the unsprayed plots besides, was observed a quickly lose of soybeans leaves, causing anticipate harvest, since 14 days before treated areas. It was the soybean' rust beginning. At one of these areas, located in Passo Fundo, by the researchers L. Costamilan and P. F. Bertagnoli, Embrapa-Wheat and J. T. Yorinori, Embrapa Soybean, were obtained loses of 23% at the variety BRS 153 and 46% at the variety BRS 154. At this area, only soybean rust was detected. Opera® was applied at the grow stage R4, at the beginning of pod formation, without rust symptoms. The disease was detected at the unsprayed, 48 days after treatment. Since this date, we started to evaluate the Opera's performance on soybean rust, at several other situations, searching the best timing of its spraying, installing a lot of trials before and after de rust occurrence, and also comparing with commercial results. At one of these searches, last season, at the city Santo Augusto, variety RS 10 (large cycle), we compared some treatments, in applications at two times: R3 - end of flowering, without symptoms; and 25 days after, at grow stage R 5.2, with 4% of rust attack; Treatments: 1 - untreated; 2 - Opera, 0,5 l/ha; 3 - Tebuconazole, 100 g ai/ha; 4 - Difenoconazole 63,g ai/ha; 5 - Miclobutanil 63,5 g ai/ha and 6 - Difenoconazole + Azoxystrobin 37,5 + 50 g ai/ha; The results of the first set showed Opera with 16% higher yield than the average of the other treatments and 41% more than untreated; At the second set, Opera showed 12% more than the average of the other treatments, and 31% higher than untreated. At the 2° set, there were differences into the other treatments. These results confirm better results of early applications, before rust beginning. But, even by the presence of the disease over soybeans leaves, Opera's perform remains firm. On commercial areas, last season, made majority at the end of flowering - R 2- R 3, at rate 0,5 l/ha, the Opera's performance was the same, that confirm its very good control of soybean rust, with increasing of the yield. A few areas, with large cycle varieties, also treated by flowering, when reached grow stage R 6-7, showed new rust symptoms, but other application in this situations didn't bring results. So, as conclusion, all results confirm the consistence position of Opera® with only one application of 0,5 l/ha, at the end of flowering, to control soybean rust, besides other diseases. To the next season, mainly on large cycle varieties, suggest to make a monitoration of rust incidence, and to repeat other application, in case of hard severity before a pod empty.

P059. Occurrence of Asian Soybean Rust on irrigated fields in Maranhão, Brazil

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The Asian Soybean Rust (ASR) caused by the fungus *Phakopsora pachyrhizi* is the most important disease in Brazilian soybean production currently. First reported in 2001 in South America, the disease spread to many Brazilian fields in 2003, with a potential of yield reductions up to 75%. In the state of Maranhão, Northeast Brazil, it occurred at harvesting time of the 2003 growing season, causing no damages. At irrigated fields for seed production in the municipalities of Balsas and Riachão, during the period from May to October, it was observed some incidence of ASR, with different levels of severity. Farmers adopted chemical control as soon as the disease were observed in the field, spraying fungicides like Pyraclostrobin + Epoxiconazole, Tebuconazole, Difenoconazole and Azoxystrobin. Disease severity was estimated as perceptual of infected leaf area (i.l.a.). The plant development stage and the weather conditions were also registered. For diagnosis confirmation, the presence of uredia and urediniospores were checked with stereomicroscope on samples of leaves hold in humid chamber for 24 hours at room temperature. Late chemical control resulted in high disease severity rates on soybean cvs. BRS Jiripoca (40% i.l.a.), BRS Sambaiba (25% i.l.a.) and DM Nobre (25% i.l.a.). Preventive control shows low severity rates on cvs. BRS Tracaja (5% i.l.a.), BRS Uirapuru (2% i.l.a.), BRS Pati (1% i.l.a.), BRS Pintado (1% i.l.a.) and BRS Pirarara (1% i.l.a.). An increase on ASR severity was observed about 5 days after a rainy day of 15mm. The air temperature varied from 21°C to 35°C during the growing season.

P060. First report of "Asian" Soybean Rust in Bolivia

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"Asian" rust (*Phakopsora pachyhrizi*) was the most feared disease to affect soybeans in the Western Hemisphere. Since its first detection in South America (Argentina, Brazil and Paraguay in 2001) severe losses have been reported in Brazil and Paraguay. Its spread to the other soybean producing countries in the American Continent is just a matter of time. Bolivia grew about 511 thousand hectares of soybeans during the Summer and 194 thousand hectares in the Winter of 2003. The first occurrence of rust in the country was noticed on the Winter crop, on July 30, 2003, in

the Province of Ichilo, Yapacani, State of Santa Cruz. A field of approximately 3 ha of cultivar Sayubu, at growth stage R1 had about 55% of leaf area infected. The field was sprayed with fungicides and later weather condition was not favorable for further disease development or spread to neighboring fields. A new focus was later found on August 30 at Chané, North of Santa Cruz de la Sierra, on 30 ha of cultivar Tucunaré, at growth stage R5.2. The disease severely affected a patch of about 3 ha. In the most affected portion of the field 100% of the leaf area was infected, gradually decreasing away from the patch. Application of fungicide pyraclostrobin + epoxiconazole (66.5g + 25.0g a.i./ha), at the rate of 0,5 L c.p./ha, controlled the disease where severity was still low (yield of 2,768.30 kg/ha) but no control was noticed where disease was already severe (yield of 957.10 Kg/ha). Though sprayed, yield difference between low and severe rust areas reached 65.4 % and days to harvest maturity differed by 21 days. Throughout the Winter season rust was found on almost all soybean fields but yield losses were not apparent, due to later occurrence and fungicide sprays.

P061. Epidemy and control of Asian soybean rust in west Bahia

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The Asian rust (*Phakopsora pachyrhizi*) in soybean (*Glycine max*) is nowadays one of the most important diseases in the crop. The objective of this crop is to show an epidemy of this disease in the soybean crops in West of Bahia, in the 2002/2003 season. Mainly in the planting done between the second half of November/2002 and first half of December/2002, the disease has occurred epidemically. In preliminary tests, with the objective of controlling the disease, it was applied, right after the first symptoms appearance with the objective of evaluating the loss of grain yield in the Msoy-8411 cultivar, because of the disease, were conducted trials with 8 fungicides [epoxiconazole (50g/L) + piraclostrobim (133g/L); epoxiconazole (125g/L); metconazole (90g/L); tebuconazole (200g/L); difenoconazole (250g/L); fluquinconazole (250g/L); azoxystrobim (250g/L); propiconazole (125g/L) + trifloxystrobim(125g/L)] in different dosages, totalizing 15 treatments. The applications were made in 03/10/03 and 03/28/03, with terrestrial sprayer in the vasion of 150L/ha and 18 meters strip, in stadiums R5.1 and R5.4, respectfully. In physiological maturation it was harvested and tracked all the plants of 3 sampplings of 4m2 per treatment, correcting its humidity. According to the variancy analysis, there was a significant difference at 1% level, between the treatments average. The treatments that have shown a better result against the rust were epoxiconazole + piraclostrobim in the dosage of 0,5 e 0,6 L/ha, producing 43,90 and 42,18 sack/ha, respectively. Those were followed by epoxiconazole (0,3 L/ha) with 39,01 sack/ha, metconazole (0,5 and 0,6 L/ha) with 38,55 and 38,18 sack/ha, respectively. In the order followed by tebuconazole (0,5 L/ha) with 38,18 sack/ha, epoxiconazole (0,2 L/ha) with 37,90 sack/ha, propiconazole + trifloxystrobim (0,4 L/ha) with 37,17 sack/ha, epoxiconazole + piraclostrobim (0,3 e 0,25 L/ha) with 37,21 and 37,01 sack/ha, respectively. Metconazole (0,4 L/ha) com 36,66 sack/ha, azoxystrobim (0,2 L/ha) with 32,93 sack/ha, fluquinconazole (0,25 g/ha) with 32,93 sack/ha, difenoconazole (0,2 L/ha) with 31,86 sack/ha and the control with 17,48 sack/ha.

P062. Chemical control of soybean rust (*Phakopsora pachyrhizi*)

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The rust is one of the recent worries in the soybean crop, causing significant losses which can compromise the activity. The control through the use of fungicides is na emergencial measure to reduce losses. The present work has had the objective of evaluate the fungicides efficiency, aiming to give more options to the grower. The experiment was conducted in 2002/2003 season in West Bahian Region, in which was shown large losses with productivity reduction ranging from 10 to 40 % in commercial crops. The treatments, at that time conventional in that region, has shown inefficiency to the rust, which has dropped productivity and crop yeld. The introduction of new active principles and mixtures, mainly estrubirulines + triazols, has contributed for a smaller loss in face of the disease. To evaluate yield loss because of rust, there were conducted trials with applications that some growers have used in the 2002/2003 season, with the active principles Difenoconazole (250g/L), Azoxystrobin (25g/L), Fluquinconazole (25%) in doses and mixtures used in the region, compared with mixture applications of estrubilurines + triazols [Epoxiconazole (50g/L) + Piraclostrobim (133g/L) and Propiconazole (125g/L) + Trifloxystrobim (125g/L). There were made 3 application areas with these fungicides, with a flow of 20L/ha and strip of 16 meters, in the FT-106 soybean variety (stadiums R2, R5.1 and R5.4). In the physiological maturation were harvested and tracked all plants from 3 samples of 4m2 per treatment. By the variancy analysis, there was a significant difference at the level of 1%, among the treatments average. The treatments were: [difenoconazole + azoxystrobim (150mL + 150mL)] +

[fluquinconazole (250g) + [propiconazole + trifloxystrobim (400mL)]; [fluquinconazole(150g)] + [fluquinconazole (250g)] + [propiconazole + trifloxystrobim (400mL)]; [epoxiconazole + piraclostrobim (500mL)] + [fluquinconazole(250g)] + [difenoconazole (300mL)]; [propiconazole + trifloxystrobim (400mL)] + [propiconazole + trifloxystrobim (400mL)] + [propiconazole + trifloxystrobim (400mL)] e [epoxiconazole + piraclostrobim (500mL)] + [epoxiconazole + piraclostrobim (500mL)] + [propiconazole + trifloxystrobim (400mL)]. The average productivity was 50,56, 40,83, 51,11, 56,81 e 61,94 sack/ha, respectively.

P063. Effect of tetraconazole on the Asian rust of soybean in 'Águas Frias', GO, Brazil

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The Asian rust (*Phakopsora pachyrhizi*) is one of the most important soybean (*Glycine max*) diseases. This disease was reported recently in Central Brazil and its intensity has increased since then. The goal of this study was to evaluate the effect of fungicides on rust severity (% of affected leaf area), and on soybean ('Embrapa 313') defoliation (%) and productivity (kg/ha). One experiment was conducted in 'Águas Frias', GO, Brazil, from 10/12/2002 (Sowing) to 20/5/2003 (Harvesting). The pulverization (200l/ha) of the fungicides was made in 21/3/2003 (soybean growth stage R 5.1-5.2) using a CO_2 costal sprayer with a 2m wide spraying bar with four nozzles. The experiment was designed in a completely randomized block with 14 treatments and four replications. The fungicides applied in the test were: check (no fungicide), chlorothalonil 720g/l (1440 and 1800g a.i./ha), tetraconazole 125g/l (37.5, 50, 75, and 100g a.i./ha), tetraconazole 100g/l (30 and 50g a.i./ha), tetraconazole 100g/l + chlorothalonil 720 g/l (30 + 720 and 30 + 1080g a.i./ha), Pyraclostrobin 133g/l + Epoxiconazole 50g/l (66,5 + 25g a.i./ha), tebuconazole 200g/l (80g a.i./ha), and difenoconazole (75g a.i./ha). The fungicide treatments significantly ($P < 0.05$) reduced rust severity and defoliation compared to check. Rust severity on soybean decreased from 80% (check) to 28.1-56.3% (fungicides). Soybean defoliation decreased from 96.8% (check) to 32.5-73.8% (fungicides). Productivity of soybean was higher in most of the treatments with fungicides (2373-2813 kg/ha) compared to check (1988 kg/ha). Tetraconazole 100g/l ('Domark 100CE') and tebuconazole were similarly efficient in reducing rust severity and soybean productivity loss.

P064. Tetraconazole fungicide in the control of soybean rust on three severities levels

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The soybean rust, caused by *Phakopsora pachyrhizi*, is the most important disease in this culture currently in Brasil. Genetic resistance is the ideal method to control this disease, but there are not commercial cultivars with this feature to be used in Brasil. The chemical control is very important to the integrated disease management success. Experiment was carried out to evaluate the effect of four doses of the tetraconazole fungicide with three severities of the soybean rust, at São João da Aliança-GO, Brasil. The treatments and the doses of the chemical products ($a.i.ha^{-1}$ - g) were: 1. Test; 2. Tetrac. - 30,0; 3. Tetrac. - 40,0; 4. Tetrac. - 50,0; 5. Tetrac. - 60,0; 6. Tetrac. - 30,0 + Mineral oil - 400,0; 7. Tetrac. - 30,0; 8. Tetrac. - 40,0; 9. Tetrac. - 50,0; 10. Tetrac. - 60,0; 11. Tetrac. - 30,0 + Mineral oil - 400,0; 12. Tetrac. - 30,0; 13. Tetrac. - 40,0; 14. Tetrac. - 50,0; 15. Tetrac. - 60,0; 16. Tetrac. - 30,0 + Mineral oil - 400,0. The treatments 2 to 6 were applied with the rust severity around 5 % (R 4), the treatments 7 to 11 were applied with the rust severity around 10 % (R 5.1) and the treatments 12 to 16 were applied with the rust severity around 17 % (R 5.3). The experiment was set up as a randomized blocks design, with 4 repetitions. The treatments 2 to 10 were better in the control of the soybean rust. Less defoliation was gotten with the treatments 2, 3 and 5; followed by 4, 6, 7, 8, 9, 10, 11 and 16. Higher yields were gotten with the treatments 2, 3, 4, 5, 7, 8, 9, 10 and 11. Results showed that all treatments were efficients to control soybean rust, but better results were gotten when the severity was around 5 %. When the severity was around 10 % the best treatment was the one with the higher dose. On the severity around 17 % there had evolution up to 22,63 %. The application of tetraconazole fungicide at the stage R 4 provided yield increase of 104,52 % (treatment 2) and at the stage R 5.3 the increase of yield was 24,56 %. Soybean rust control provided less defoliation and higher yield. The tetraconazole fungicide was not toxic to the soybean culture.

P065. Evolution of soybean rust (*Phakopsora pachyrhizi*) on the states of Goiás, Federal District and Tocantins, and reaction evaluation on lines and soybean cultivars

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Soybean rust caused by *Phakopsora pachyrhizi* is one of the most important diseases in the world, being identified by the first time in Brazil in may/2001 at Paraná state. Since its occurrence in Paraná, soybean rust has spread very fast to other states of Brazil. During 2001/2002 summer crop, soybean rust was not identified at Federal District and Tocantins state, but it was identified at five counties at Goiás state. During 2002/2003 summer crop, soybean rust was identified at Federal District, Tocantins and in more than fifty counties of Goiás state. During 2003 winter crop *Phakopsora pachyrhizi* was identified at Formoso do Araguaia area (Tocantins state) in soybean fields irrigated by water table elevation, and at Goiás, Mato Grosso and Maranhão state under fields irrigated by central pivot. From 501 soybean cultivars and 2023 lines evaluated for resistance to *Phakopsora pachyrhizi*, none showed resistance to this fungus, but differences in severity were observed among lines and cultivars.

P066. Influence of the final cicle diseases control and of the storing temperature in the respiratory rate of the soy seeds

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The presence of fungus and the temperature are factors that influence the seeds respiratory process. With the elevation of the respiratory rate, it occurs a bigger loss of dry matter and of the physiologic quality of the seed. The objective of this work was to verify the influence of different treatments for the control of the final cicle diseases of the soy (FCD) the temperature in the respiratory rate of the stored soy seeds with a medium value of 11,0% of humidity. The used seeds in this experiment were the ones from cultivar MG/BR ("Conquista") harvested in the 2002/2003 crop, in Frutal-M.G. During the culture crop, the plants suffered the following treatments: Control, Benomyl, KCl, KCl + Benomyl and KCl + Azoxystrobin (+ Nimbus). The plantation manuring was of 350 Kg ha^{-1} of the formulation 00-20-20; the KCl was used in covering, with a dose of 30 Kg ha^{-1}, in the 35th day after emerging (VE); and the fungicides were used with a tractorized pulverizer in the stage R5.2 using a recommended dosage by the manufacturer in the volume of 200 L ha^{-1}. To determine the respiratory rate, the grains were weighed and distributed in glass pots with a volume equal to 630 mL. Later, the pots containing the grains were hermetically closed with a lid with septum and stored under the temperatures of 20 and 30 °C in three repetitions. To quantify the concentration of CO_2, a segmented flux analyzer was used; for this, a remotion of 5 mL of intergranular air of the interior of the pots was accomplished, with the help of a syringe, after 24 hours. Using the equation of the perfect gases and the dry matter of the product, it obtained the respiratory rate of the grains in milligrams of CO_2 Kg^{-1} dry matter h^{-1} and the following loss of dry matter (%). The results of the analysis of variance didn't indicate to have a significative effect among the treatments over the respiratory rate of the seeds in each evaluated temperature. However, the higher medias of respiratory rate were observed in the treatments that the KCl wasn't used. It was observed by the "t" test a higher respiratory rate for the seeds stored under 30 °C, it is explained because of the elevation of the metabolism.

P067. Effect of *Colletotrichum dematium* var. *truncata* and *Phomopsis sojae* in the production and sanity of soybean seeds

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The anthracnose, caused by *Colletotrichum dematium* var. *truncata,* and the pod and stem blight, caused by *Phomopsis sojae*, are one of the principal problems that affect the formation of the beans and the largest responsible for the discard of seed lots produced in the savannahs. The objective of this work was to evaluate the effect of these pathogens on the production and sanitary quality of soybean seeds. Seeds of the varieties Conquista and Liderança were used in the experiment, that was done in randomized blocks in factorial outline 2x4, being 2 varieties and 4 treatments (a block inoculated with *C. dematium* var. *truncata* - isolated no. 1, other with *P. sojae,* the third one with *C. dematium* var. *isolated truncata* - isolated no. 2 - and a control treatment). The pathogens were cultivated in

plates of Petri containing BDA. Four inoculations were accomplished by aspersion (inoculum containing 10^5 conidia/ml) starting from the flowering and the beginning of formation of the beans. In the end of the cycle of the culture, the seeds were picked manually, in the central area of each parcel (11,25 m^2), and thrashed. The production evaluations showed that, for the variety Conquista, the control treatment presented the largest production values (1390,6g), being the smallest value observed for the block inoculated with *Colletotrichum* isolated no. 1 (551,9g), followed by *Colletotrichum* isolated no. 2 (1105,1g) and *Phomopsis* (1147,6g). For the variety Liderança, the largest production was observed in the treatment with *Phomopsis* (1169,9g), followed for the control (942,1g), *Colletotrichum* isolated no. 2 (842,9g) and *Colletotricum* isolated no. 1 (428,7g). The sanity analysis by the filter paper method with 200 seeds without treatment and 200 with superficial disinfestation (sodium hipoclorite 1% for 3 minutes) showed that, besides the inoculated fungi, the seeds of all the treatments presented higher infection rates for *Fusarium* sp. and *Phomopsis* sp. With relationship to *Colletotrichum*, it was only observed in high values in the variety Liderança, in the treatment that received the isolated no. 1 (29% and 25%, without and with disinfestation, respectively), showing that there are differences among isolated of a same fungi. It was also verified that in the 2 varieties this same treatment was what it presented the smallest productions, could be an indicative of the prejudicial effect of the pathogen on the production.

P068. Longevity of fungi in soybean germplasm in long-term storage conditions

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Healthy germplasm conservation is fundamental to safeguard collections during storage in order to assure the distribution and use of sanitary high quality material. The Soybean Base Collection (*Glycine max*) is maintained and stored in chambers at the Embrapa Genetic Resources and Biotechnology following the International Plant Genetic Resources Institute objectives and orientation (IPGRI, 1994). These chambers keep the germplasm at -18°C, with no humidity control, in aluminium foil bags hermetically closed. These seeds are previously dried at 6% to 7%. High germination rate (80%) and more than 1500 seeds for the accessions are required for long-term conservation. Germination and health tests are performed at the beginning of the storage and monitoring tests are accomplished periodically. Viability tests are essential to seed banks as a way to control genetic erosion during storage. Pathogens longevity in stored seeds is possible because the storage conditions to maintain seed viability are also beneficial to most of the pathogens survival. A batch of 156 soybean accessions, stored for 22 years, was analysed by the standard blotter test method to detect fungal incidence. Randomized samples taken from 10% of the stored soybean accessions were incubated on damp filter papers in sterilized gerboxes and maintained in Percival chambers at 23+/-2°C, under ultra-violet lamp, alternating 12h light and 12h dark. Seeds were accurately examined for the presence of fungi after 8 days of incubation. A significant amount of saprophytic fungi was detected and, although they are not pathogenic, can cause serious seed deterioration. *Aspergillus flavus*, *Aspergillus niger*, *Cladosporium* sp., *Chaetomium* sp., *Epicoccum* sp., *Eurotium* sp., *Penicillium* sp., *Mucor* sp., *Rhizopus* sp., *Trichotecium* sp., were some of them. Among the pathogenic fungi could be found *Alternaria* sp., *Cercospora kikuchii*, *Colletotrichum* sp., *Drechslera* sp., *Fusarium* sp., *Pestalotia* sp., *Phoma* sp., *Phomopsis* sp. It was also observed that germination rate was not affected after this long storage period. The fungi longevity in long-term stored seeds is evident, and for this reason more detailed studies about penetration, colonization and the location of inoculum in seeds is relevant in order to improve germplasm management.

P069. Effect of salicylic acid in plant of soybean (*Glycine max* (L.) Merrill under two types of soils under conditions of deficit water

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The readiness hydric and the movement of water for the seeds are very important for the germination, initial growth of the system radicular and emergency of the plant, being those factors influenced by the potential metric of water of the soil, texture and area of contact of the soil. The objective of this work went evaluate to efficiency of the salicylic acid in the process of development of soybean plant under two soil types in conditions of deficit water. The experiment was accomplished in the chemistry laboratory of UNEMAT, where it was used the oxisols red yellow eutrophic and latosols red yellow dystrophic soil. These soils were conditioned in glasses plastic where them received the seeds of soybean uirapuru variety. The same ones were submitted the pre hydration by one hour in solution of salicylic acid in the concentration of 2,0 mM and in pure water (witness). The treatments used were the following: soils in different levels of water (saturated soil, soil in the field capacity, soil in deficit water for 7° and 14° days after emergency, with and without salicylic acid. Experiment are carried in random blocks

design, with four repetitions of 20 seeds for treatment using couple checks (2 X 4). The evaluations were accomplished to the 7° and 14° day after sow for obtaining of percentage of total germination, the root length and seed leaf. To the 7° day it was not observed differences significant for none of the appraised characteristics. However to the 14° days, it was observed significant increments in the length of the root length and seed leaf for the treatments with salicylic acid, for both soil; even so the latosols presented higher the root length lengths and seed leaf for all the appraised treatments.

P070. The salicylic acid effect in the germinative performance of the soybean (*Glycine max* (L.) Merril) seeds

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The term seeds vigour is determined by the ability of it in germinate and survive during the inicial period of the plant growing and development. The hydric availability and the water movement are very important to the germination, inicial growth of the root system and emergency of the plant, these factors are influenced by the hydric soil potential, texture and the area of contact in the soil. The main purpose of this paperwork was to value the salicylic acid efficiency in the soybean seeds germinative performance. For that, it was used the uirapuru soybean, pre hydrated in acid salicylic solutions in the concentration of 0,5mM; 1,0mM; 2,0mM and 3,0mM and pure water (eyewitness) which were sown in plastic cups filled with arenaceous and red earth soil texture. The cups were stowage in the lab, at the temperature of about 32°C, and the soil was kept in the country capability. The experimental delineation used was fully peradventured, with four repetitions of 20 seeds per treatment. The evaluations were made on the 5° and 7° day after the sowing to obtain the total germination percentage, germination percentage in the first counting, the root length and seed leaf. It was observed that increasing concentrations until 0,2mM, there wasn't any denotative effect in the soybean germination, and at the concentration of 3,0mM of salicylic acid, caused a denotative decreasing in the germination. However, it was observed denotative increasing in the root length in the concentrations of 2,0mM.

P071. Evaluation of bioprotectants for soybean seed treatment

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The use of bioprotectors applied to seeds has raised the interest of the international community because of the hazards of chemical treatments to the environment. During the growing season of 2002/03, effects of 18 biological agents and three standard fungicides were evaluated on seedling emergence in the field, in Londrina, PR. Seeds of 'BRS 133' soybean cultivar were treated in plastic bags in the laboratory and sown in the field. Plots were 5 m long, with four rows and the seeding rate was 20 seeds per meter. The experimental design was a randomized complete block design (RCBD) with four replicates and the means were compared using the Tukey test at 5% level of probability. Of the three fungicides, the best seedling emergence (63,8%) was achieved with carbendazin (30g i.a) + thiram (70g i.a.) / 100 kg of seeds, followed by carboxin (50g i.a.) + thiram (50g i.a.) and metalaxyl (10g i.a.) + fludioxonil (35g i.a.), with 44,8% and 27.2% of seedling emergence, respectively. With bioprotectors, seedling emergence varied between 13,4% and 2.8%, whereas with untreated seeds (control) it was 4.4%. The results showed that the bioprotectants did not protect well the seed when there is inadequate soil moisture for germination and seedling emergence. Therefore, biological seed treatments could be used in organic soybean farming or in small farms, where sowing is usually done under adequate conditions of soil moisture content. However, for large commercial fields, it would not assure seed protection in the soil against seed rotting organisms, e.g. *Aspergillus* spp., that are very frequent under stressed soil moisture conditions.

P072. Dynamics of the soybean seed development

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After the fertilization, the growth of soybean seed inside the pod cavity follows a pattern oriented to determine the physical definitive shape of the mature seed. This growth may be not visibly observed within the pod although its growth reaches an important length. At the same time, the different pods distributed in the

plant may present a different evolution of seed growth development. The high seed moisture content during their development make possible their evaluation by radiographic analysis allowing to study the evolution of their size and physical shape along time. The objective of this work was to study the dynamics of the soybean seed development by radiographic and photographic digital images. One plant of the crop was randomized selected for each reproductive stage from the onset of flowering (R2). The pods of the four upper nodes of the plant containing completed developed trifoliolate leaves were analysed by X-rays with the aim to study the presence or the absence of seeds, their growth pattern inside the pods and its number, size and shape. The radiographic digital images were compared with their corresponding photographic digital images to establish a radiographic pattern that permit to characterize the different growth stages. In the R4 stage, pods of approximately 2 cm of length showed by radiographic digital images that the relative seed size inside them was of approximately 10% with respect to the pod length. In R5 stage, with pods of 2.7 cm it was 16%. In R6 stage with pods of 2.8 cm the seed size reached the maximum value of 39%. From that time, there were a reduction in the seed size with respect to the pods because of their dehydration, which represent a 28% in R7 with respect to the pods length of 2.9 cm and a 22% in R8 with pods of 3.1 cm. The relationship between pod length/seed size was reduced from R4 to R6 because of the seed filling and it increased from R7 to R8 because of the reduction of the seed size by dehydration. Both in pods with 2 or 3 seeds, those of the distal pod end were the seeds that first reached their maximum size. The X-ray technique allowed to make a radiographic pattern to evaluate the dynamics of the development of seeds inside the soybean pods.

P073. Effect of long term planting of five soybean cultivars on *H. glycines* population

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This study was conducted at Agriculture and Agri-Food Canada, Harrow Research Centre, Ontario, Canada, with the purpose to evaluate the effect of six consecutive plantings of five soybean cultivars on *H. glycines* population. Soybean cultivars originally rated as susceptible (S20-20), tolerant (Harovinton and Hammer), resistant to race 3 (Bell) and resistant to races 1, 2, 3, 5 and 14 (Ina), were planted in pots containing *H. glycines* race 3 field infested soil. Pots were maintained in a greenhouse and plants grown for 40 days, which consisted of each planting period. The variables evaluated were cysts and e eggs from soil, females, eggs/female and males form roots. Cultivars S20-20 and Harovinton produced the highest number of both males and females per gram of root, behaving equally as susceptible cultivars. Hammer and Bell were similar on resistance allowing development of fewer males and females on roots. Ina had the highest level of resistance allowing very poor development of *H. glycines*. Short males were present in all cultivars during all plantings. S20-20 and Harovinton produced less than 10% of short males out of total males. Hammer and Bell presented a percentage between 10 and 20% of short males. On cultivar Ina, short males were more than 30% out of the total. Number of male and female/g of root increased along the six planting periods although the population on Hammer, Bell and Ina remained a lot lower than on S20-20 and Harovinton. Females developing on Harovinton and S20-20 produced more eggs than those developing on Hammer, Bell and Ina. The average egg production was 196 (± 143), 176 (± 165), 88 (± 87), 82 (± 92), 119 (± 103) for S20-20, Harovinton, Hammer, Bell and Ina, respectively.

P074. Role of varietal resistance to the soybean cyst nematode in the development of sudden death syndrome of soybean in field microplots

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Sudden death syndrome (SDS) of soybean is a soilborne fungal disease caused by *Fusarium virguliforme* (syn. *Fusarium solani* f.sp. *glycines*). *Heterodera glycines*, the soybean cyst nematode (SCN), has often been associated with SDS in the field. Although the presence of the SCN is not necessary for disease occurrence, previous studies have shown that co-inoculation with SCN and the SDS pathogen resulted in more rapid and severe disease development. To determine the effect of cultivar resistance to one or both of these pathogens, a 2-years microplot study was conducted at the University of Arkansas in Fayetteville, AR. Four cultivars -Pioneer 9594, resistant to SDS and susceptible to SCN, Asgrow 5603, resistant to SCN and susceptible to SDS, Hartwig, resistant to both pathogens, and Essex susceptible to both pathogens-, were inoculated with the fungus, the nematode, both pathogens, or not inoculated. Percentage of symptomatic leaf area was assessed twice a week after flowering. SDS ratings were highest for Essex followed by Pioneer 9594 and then Asgrow 5603. With Essex and Pioneer 9594, the SCN-susceptible cultivars, SDS was much greater in the co-inoculated plots than the plots inoculated with the fungus alone. In Asgrow 5603, the SCN-resistant cultivar, co-inoculation only slightly enhanced SDS

development. No disease developed in Hartwig in any of the treatments. These results indicate that the field reaction to SDS in cultivars susceptible to SCN may change depending on the virulence of the race of SCN present in the field. Also, they suggest that the varietal resistance to SCN may be important in predicting the performance of soybean cultivars, especially in fields where both pathogens occur simultaneously.

P075. Inhibition of *Heterodera glycines* and *Meloidogyne javanica* nematodes in soybeans by rhizobacteria, in greenhouse trials

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The incidence and damage of nematodes in soybeans has grown in the last years in Brazil. The present study aimed to evaluate the capacity of rhizobacteria, inoculated in soybean seeds, in reducing the incidence and damage of the root knot nematode *(Meloidogyne javanica)* and the cyst nematode *(Heterodera glycines* race 3). Twenty-eight bacterial isolates (most of them *Pseudomonas* spp.) were screened in greenhouse for the control of cyst nematode and root knot nematode. The bacterial isolates were grown in trypticase soy agar, one tenth of the strength (0.1X TSA), at 28 ± 1°C, for 24 to 48 h. The bacterial cells were harvested, suspended in 0.1*M* $MgSO_4$ (pH 7,0) and the optical density adjusted for an absorbance of 0.55 at 600 çm. Three seeds of soybean cvs. 'Lee 68' (cyst nematode) or 'BRS 133' (root knot nematode), inoculated with one of the isolates, were sown in pots containing 3 kg of a sterile substrate. For the inoculation, the seeds were immersed in the cell suspension of each isolate or into sterile 0.1*M* $MgSO_4$ (nonbacterial control). Each treatment was replicated ten times in a completely randomized design. Seven days after sowing, plants were thinned to one per pot and the soil was inoculated with 3,000 eggs of each species of nematode. There was also a nonbacterial control with soil non-inoculated with nematodes. The plants were harvested at 35 days after inoculation with nematodes when shoot and root dry weight and number of nematode eggs (root knot nematode) or females (cyst namatode) were evaluated. The data were analyzed by ANOVA and treatment means were separated by the Tukey's test ($\alpha = 0.05$). Eight isolates significantly inhibited the cyst nematode multiplication. The highest inhibition (56%) was observed when the seeds were inoculated with the isolate LW 2301. Although many isolates inhibited the root knot nematode multiplication, none of them were significantly different from the nonbacterial control with nematode. The highest inhibition (72%) was observed with the inoculation of isolate P 70. Some isolates, inversely, stimulated the multiplication; the highest stimulation (132%) was observed with isolate P 61. This event shows, once more, the complexity of ecological interactions in the rhizosphere. Shoot and root weight were not significantly affected, when compared to the nonbacterial control with nematodes, in either experiments. The best isolates are currently being tested in field trials.

P076. Evaluation of losses caused by the soybean cyst nematode by comparing yield of resistant and susceptible cultivars

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One of the difficulties in the management of the soybean cyst nematode (SCN*), Heterodera glycines,* is the prediction of damages depending on a previously determined population of the nematode in the soil. Studies carried out in Brazil have shown that the critical population level is between 1 and 5 cysts/100 cm^3 of soil. However, many soybean producers are obtaining good yields in fields with populations in those levels and or higher. The objective of this work was to know the effect of the SCN on soybean yield, in various population levels in field sites in the states of Paraná (PR), São Paulo (SP) and Rio Grande do Sul (RS), Brazil. Five experiments were conducted in 2001/02 and nine in 2002/03, in the following localities: Sertaneja (PR), Florínea (SP), Tarumã (SP), Pejuçara (RS) and Espumoso (RS); Cornélio Procópio (PR), Assis (SP), Cruzália (SP). In 2002/03, in Pejuçara, the area was not infested and, in Tarumã, the population was below one cyst/100 cm^3 of soil. The yield of susceptible cultivars (CD 201, CD 202, Embrapa 48, BRS 133, BRS 156, IAS 5, BRS 137, BRS 153 and BRS 154, in Rio Grande do Sul) and resistant cultivars (identified as R1, R2, R3, R4, and BRS 231) was compared. The experimental design was a randomized complete block with 10 treatments and four replicates. The yield and the initial population of cysts and eggs per100 soil cm^3 were evaluated. Egg populations varied among localities from 296 to 1662/ 100 cm^3, in 2001/02, and from 563 to 4062/100 cm^3, in 2002/03. The average yield of the susceptible group and of the resistant group of cultivars was compared using the F test. In general, the yield of the resistant cultivars was higher than the susceptible cultivars. The results showed that SCN reduced soybean yield from 173 to 710 kg/ha, in 2001/02, and from 154 to 676 kg/ha, in 2002/03. Resistent cultivars contributed significantly to minimize the damages caused by SCN, although the detected population levels of SCN were not high. The results obtained in Tarumã and Pejuçara showed that in areas with absence of SCN susceptible

cultivars were as productive as the resistant ones, validating the positive effect of the resistant cultivars in infested areas.

P077. Reaction of soybean cultivars to *Heterodera glycines* race 5

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Thirty-one cultivars of soybean were evaluated for their reaction to *Heterodera glycines* race 5, the soybean cyst nematode. The experiment was conducted in a greenhouse and the nematode population came from infested soils in San Agustín, Tucumán, Argentina. The experiment was arranged in an entirely randomized design with one plant per plot and 7 replications. Each pot held about 250 cm^3 of a 1:2 soil: sand mixture. The cultivar A 8000 RG was used as the susceptible control. Plants of each cultivar were inoculated with approximately 4000 eggs placed into a hole next to the plant. Evaluations were done 28 days after inoculation by counting the number of white females that had developed on each plant. A female index (FI = [{average number of females on the tested cultivar}/{average number of females on the susceptible control}]x 100) was calculated for each soybean cultivar. Reaction of cultivars was determined by the system of classification proposed by Schmitt & Shannon (Crop. Sci. 32: 275-277, 1992): FI = 0-9%, resistant (R); FI = 10-30%, moderately resistant (MR); FI = 31-60%, moderately susceptible (MS); and FI = > 60%, susceptible (S). PI 437654 and Hartwig were resistant (FI = 0%) to *H. glycines* race 5. The remaining cultivars evaluated in this experiment were susceptible and moderately susceptible (FI = 32-127%).

P078. Allelochemical interactions among *Brachiaria plantaginea* and other weeds

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Previous field results obtained in soybean-wheat crop sequences showed a complementary reduction in *Commelina benghalensis* weed seedbank and not on *Acanthospermum hispidum* in areas infested with *Brachiaria plantaginea*. Analysis of the soluble fraction of *B. plantaginea* showed aconitic acid (AA) (95%), ferulic acid (FA) and others (5%). Bioessays were carried out at laboratory with the objective of evaluating effects of the pure AA solutions on seed germination, root and stem length and fungi growth on *C. benghalensis*, *A. hispidum*, including *Euphorbia heterophylla* and *Ipomoea grandifolia* seeds. Pure solutions doses of 0.00, 0.25, 0.50, 1.00 and 2.0 mM were prepared with agar 0,5% and poured into plastic boxes with cover. Seed species were sterilized externaly with hipochloride 2%, sown in the boxes and kept in germination chamber for 12 days. Allelopathic effects of AA were observed reducing germination rate and length of root, mainly of *C. benghalensis* as comparet to *A. hispidum*; at 2,0 mM of AA there was also a reduction in germination rate, in radicular and in stem growth of *E. heterophylla* and *I. grandifolia*. Additionally AA stimulated the growth of endophytic fungi on the seed surface of *C. benghalensis*, determined as *Fusarium solani* (red colour), which were also present over non germinated seeds. A different kind of fungi species was highly stimulated to grow on *E. heterophylla*, having a green colour. The compound plays an important role in the seedbank reduction of some weeds, acting directly on germination as an allelopathic substance and as a stimulatory substance of endophytic fungi, as a predator, that also contribute to make seeds unviable. Straw of *alexandergrass* (*B. plantaginea*) presents a high aconitic acid concentration able to affect germination and growth of some evaluated weeds.

P079. Effect of pre and post emergence herbicides on weed flora and productivity of soybean (*Glycine max* (L.) Merrill)

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Soybean (*Glycine max* (L.) Merrill) is extensively grown all over the Madhya Pradesh because of its wide adaptability to varying agro climatic conditions and high market value. Intense weed competition is one of the major constraints for higher soybean productivity entailing into 35 to 50 % reduction in the yields depending upon the species and intensity of weeds as well as stage, of crop weed competition. At times, under regular downpour, deep vertisols become unworkable for mechanical weeding and poor availability of farm laboures for hand weeding makes timely management of weeds quite difficult. Under such situations weed management through herbicides is the only option left. With this in view the efficacy of pre and post-emergence herbicides was evaluated on JS 335 soybean during the rainy seasons of 2000 and 2001 in Vertisols. Maximum weed control efficiency and lowest weed biomass was recorded under two hand weeding (HW) followed by application of imazamox + imazethapyr @75 g a.i.ha^{-1} PoE and quizalofop ethyl

@ 50 ga.i.ha^{-1} PoE. Amongst the pre emergence herbicides S- metolachlor @ 750 ga.i.ha^{-1} performed better than application of alachlor @ 2 kg a.i.ha^{-1} and lower dose of S-metolachlor @ 500g a.i.ha^{-1}.The grain yield of 1622 kg ha^{-1}was recorded with combi product of imazamox + imazethapyr @ 75 g a.i.ha^{-1} PoE, which was significantly on par with two hand weeding (1710 kg ha^{-1}).

P080. Glyphosate herbicide resistance in ryegrass (*Lolium multiflorum* Lam.)

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The glyphosate herbicide is systematically used for weed plant control and for plant coverage management before the crop sewing. The frequent utilization of the same action mechanism herbicides can result in the selection of tolerant weed plant species or even biotypes of resistant plants to those herbicides. The selection of resistant weed plants biotypes to the EPSPs inhibitors herbicides, like glyphosate, is an emergent phenomenon in different agricultural regions of the world, but not yet reported in Brazil. Experiments were carried out in greenhouse condition at Agronomy and Veterinarian School at University of Passo Fundo to evaluate the occurrence of resistance to glyphosate herbicide in ryegrass biotypes. It was utilized two ryegrass biotypes (from Tapejara and Passo Fundo); two stages of herbicide application (at tillering and at ryegrass flowering) and doses of glyphosate (0, 120, 240, 480, 960, 1920, 3840, 7680 and 15360 g a.e. ha^{-1}). The statistical analysis indicated the existence of differences between the tested treatments. In all tested doses, the reduction of the ryegrass plant biomass was always inferior to the in the Tapejara biotype compared to the Passo Fundo one. The regression analysis indicated differences between the biotypes up to the dose of 2880 (6 L ha^{-1} of the commercial product). In the recommended dose for ryegrass control, 1800 g a.e. ha^{-1}, the reduction of dry mass was 50% for the Tapejara biotype and 80% for the Passo Fundo one, in application stage average. These results confirm a new case of glyphosate resistance in *Lolium multiflorum*, and this is the first case of glyphosate resistance reported in Brazil.

P081. Desiccation periods of *Brachiaria decumbens* before sown of soybean in no-till system

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In Brazil the conventional tillage has been exchanged by no till. The main difficulty of producers to adopt these systems is on straw formation in sufficient quantity to cover the entire soil surface with uniform distribution. It's still important the change of the best periods for desiccation these species to avoid the interference in germination of crops. The objective of this work was to study the period of desiccation of *Brachiaria decumbens* and its interference in an emergency and development of the soybean MG/BR46-Conquista. The assay was designed was a completely randomized with four treatments and three replications. The treatments were designed by spray of the herbicide glyphosate (2.5 L ha^{-1}) in different periods of desiccate of the covering vegetable the 28, 14, 7 and 0 days before sown of soybean. The volume of spray boom was 170 L ha^{-1} pressurized by CO_2 the 28 psi with nozzle 11002. It was determined initial and final stand of soybean plants, height and production characteristics. At the moment of sown the straw left by dry matter of *Brachiaria decumbens* has had 8,000 kg ha^{-1}. This quantity was sufficient for the good recovery of the soil surface. On soybean sowed 0 day of desiccate has had lowed stand of plants. Its possible occurred due the stress caused by herbicide in dead of *Brachiaria decumbens*. The probable deliberation of alelochemicals on soil solution could have been the main cause. The same occurred with 28 days before sown, although in this case the reinfestation by covering vegetable during the development of crop enlarged the competitiveness between cover vegetable and soybean by elements few available for both. The best period for desiccate this specie of cover vegetable is between 14 and 7 days before sown of soybean MG/BR46-Conquista. In these periods was obtained the best results to all the parameters studied.

P082. Effectiveness and selectivity of different broadleaf herbicides applied either isolated or as mixtures on weed control in a no-till soybean crop

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The objective of this work was to evaluate the effectiveness and selectivity of different broadleaf herbicides when applied either isolated or as mixtures on weed control in a no-till soybean crop, and to evaluate the effects of treatments on yield and yield components, as well as on agronomic traits. The experiment was carried out at the Gralha Azul Experimental Farm, in Fazenda Rio Grande, State of Paraná, in the 2000/2001 growing season. The experiment was

arranged in a randomized complete blocks design with four replications and 14 treatments. The treatments were: cloransulam-methyl + fomesafen (25,2 + 175 and 33,6 + 125 g a.i./ha), cloransulam-methyl + lactofen (25,2 + 120 and 33,6 + 96 g a.i./ha), cloransulam-methyl + imazethapyr (25,2 + 74,2 and 33,6 + 53 g a.i./ha), cloransulam-methyl + flumioxazin (25,2 + 25 and 33,6 + 20 g a.i./ha), cloransulam-methyl (37,8 g a.i./ha), fomesafen (250 g a.i./ha), lactofen (168 g a.i./ha), imazethapyr (106 g a.i./ha) and two checks, a weed-free and a weedy. At 7, 14 and 21 days after treatments (DAT) a visual evaluation was conducted to assess the effectiveness of weed control. Results showed that the mixtures of cloransulm-methyl + fomesafen (33,6 + 125 g i.a./ha), cloransulam-methyl + lactofen (25,2 + 120 g i.a./ha), cloransulam-methyl + imazethapyr (33,6 + 53 g i.a./ha) and cloransulam-methyl + flumioxazin (25,2 + 25 g i.a./ha) were effective in the control of *Sida rhombifolia* and *Euphorbia heterophylla*. For the latter species, the mixture of cloransulam-methyl + imazethapyr (25,2 + 74,2 g i.a./ha) and treatments with fomesafen, lactofen and imazethapyr applied alone were also effective. All evaluated herbicide treatments were effective in the control of *Bidens pilosa* and *Galinsoga parviflora*. Grain yield as well as yield components were not affected by any of the treatments.

P083. Beginning of weed interference in a soybean Round Up Ready crop

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In soybean, yield losses can reach 80% because of weed interference. Glyphosate is an herbicide that is absorbed by leaves and doesn't persist in soil, so is essential an opportune treatment to prevent yield losses, but it is very difficult to generalize this concept because crop performance depends on complex interactions between several factors such as environmental conditions, crop management, weed community composition and the density of each weed specie. The objective of this experience was to determine the moment at which the presence of a weed community, consisting of grasses as well as broad leaves, starts affecting a soybean glyphosate tolerant crop yield, in order to improve the opportunity of herbicide treatment. This trial was done in the period 2001/2002 and 2002/2003 with a soybean MG IV, A 4404 RR. Treatments consisted of weeded at periodical intervals each 7 - 10 days with applications of a standard 48% glyphosate formulation. A check without weed during all the survey was included. Regression analysis were fitted to a binomial model and showed that weeds interference explained more than 90% of yield variation. Weeds started to interfere as soon as the establishment period (V_e-V_1), and 140 days after emergence, yield losses reached 30%. In this conditions an early treatment, applied not more than 11 days after crop emergence, would be justified.

P084. A single gene determining high level of resistance to powdery mildew in soybean

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Powdery mildew (*Erysiphe diffusa* - Braun & Takamatsu, 2000, Schlechtendalia 4:1-33) was considered a secondary soybean disease prior to 1996, causing some damage only in specific cases like in late sowing crops or winter season crops. However, its importance has increased since 1996/97 season, when soybean crops from the southern to the central Brazilian regions were heavily attacked, provoking significant losses. The presence of susceptible varieties to this disease contributed to increment the use of leaf fungicides, which were extensively applied to prevent losses in the following crop seasons. The fungus ability to quickly develop new physiologic races, increases the complexity around the arduous task to develop resistant varieties. The resistance level presented by the new varieties must be sufficient to avoid the chemical control or, at least, diminish the probability of multiple chemical applications. The use of new genes of resistance to this disease is a priority in the Brazilian breeding program conducted by Embrapa. A soybean line, named BRI98-641, derived from the breeding program for insect resistance, was classified as having a high resistance level. To study the inheritance of this powdery mildew resistant line, crosses were made with the varieties BRS 184, Chapadões, BRS 132, CD 202, Embrapa 48 and BRS 134, totaling six combinations. For each cross, six plants of each parental and three F2 lines derived from individual F1 plants (each one with 40 plants) were planted at greenhouse conditions arranged in a Completely Randomized Design. The plants were pulverized 20 days after sowing, with a suspension obtained after washing infected leaves. Two evaluations were made, determining the infection level on leaves according to a diagrammatic scale. The line BRI98-641 showed only traces of the disease, where the varieties showed different levels of susceptibility. The goodness of fit between the theoretical expected proportion and the observed proportion for resistant and susceptible F2 plants was performed by chi-square test. Segregation pattern of three resistant to one susceptible was accepted for all crosses, indicating that a single dominant gene determine the resistance. The presence

of plants in the F2 generation more susceptible than the susceptible parental observed in all crosses, shows that the resistant gene from the line is placed in a different locus in relation to the genes expressing partial resistance for the varieties. Later assessments on the cross BRI98-641 x Embrapa 48, permitted to separate homozygous and heterozygous resistant genotypes, facilitating the breeding.

P085. Interaction genotype x environment in the reaction of soybean to powdery mildew (*Microsphaera diffusa*)

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With the expansion of soybean, many cultivars with good agronomic performance and adaptation to different environments have been developed. However, when exposed to different environmental conditions, these cultivars sometimes show behavior variations, which can be explained by their photoperiodic sensitivity. This way, the interaction between genotype and environment is of great importance in developing new cultivars (Eberhart & Russel, 1966, Crop Science, v.6, n.1, p.36-40). This work aimed to study the effect of the interaction genotype x environment in the reaction of soybean genotypes to the powdery mildew. Twenty-five soybean genotypes from the soybean breeding program of Departamento de Produção Vegetal - FCAV/UNESP - Jaboticabal, in two localities of São Paulo state (Jaboticabal and Monte Aprazível). The statistical design was randomized blocks with three replications. The level of infection was evaluated in the stages R_1/R_2 and R_5/R_6 according to the grading proposed by Yorinori (1997, Oidiosja.doc.13p.), in which: 0 = no symptoms, 1 = taces to 10% of infected leaf area (AFI), 2 = 11 to 25% of AFI, 3 = 26 to 50% of AFI, 4 = 50 to 75% of AFI, 5 = more than 75% of AFI. After the evaluations, genotypes were classified according to their reactions, also as described by Yorinori (1997, Oidiosja.doc.13p.): grades from 0 to 2.0 corresponded to resistance reaction (R); 2.1 to 3 moderate resistance (MR); 3.1 to 4 susceptibility (S); and 4.1 to 5 high susceptibility (AS). The results show a higher incidence of the disease in Jaboticabal. Most of the genotypes were resistant to the powdery mildew in Monte Aprazível, being the genotypes JB95 - 10037, JB93 - 54323, JB95 - 10038, JB95 - 40026, JB95 20028 and JB95 - 90023-1 the lowest infected. In Jaboticabal the genotypes JB95 - 10038 and JB93 - 54323 showed susceptibility reaction. The other genotypes and the cultivars used as patterns showed high susceptibility reaction. JB 95 - 10038 had the best results in the two regions, and was even superior to two pattern cultivars (MG/BR-46 - Conquista and BRS MG 68 - Vencedora).

P086. Reaction of soybean genotypes to the powdery mildew (*Microsphaera diffusa*), grown in the fall/winter, in the region of Monte Aprazível, SP, agricultural year 2002/03

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The soybean is one of the most important sources (*Glycine max* (L.) Merrill) of protein and vegetable oil. Brazil is responsible for 22% of the world production, grown in 16 million hectares spread in many Brazilian regions (Agrianual, 2003, p. 463 - 510). The expansion of this crop has brought an increasing number of diseases. The disease known as soybean powdery mildew brought severe losses in the harvest 1996/97, of about 40%. Since then, farmers have been given information about the reaction of cultivars to the powdery mildew, and the breeding programs have started to consider the resistance to *Microsphaera diffusa* as another parameter to select new genotypes. The present work aimed to evaluate the reaction of soybean genotypes to the powdery mildew. The experiment was carried out in the experimental área of the "Colégio Técnico Agrícola de Monte Aprazível/SP". We studied Twenty-five soybean genotypes from the soybean breeding program of Departamento de Produção Vegetal - FCAV/UNESP - Jaboticabal. The statistical design was randomized blocks with three replications. Two evaluations of the level of infection were performed in the stages R_1/R_2 and R_5/R_6 according to the grading proposed by Yorinori (1997, Oidiosja.doc.13p.), in which: 0 = no symptoms, 1 = traces to 10% of infected leaf area (AFI), 2 = 11 to 25% of AFI, 3 = 26 to 50% of AFI, 4 = 50 to 75% of AFI, 5 = more than 75% of AFI. After the evaluations, genotypes were classified according to their reactions, also as described by Yorinori (1997, Oidiosja.doc.13p.): grades from 0 to 2.0 corresponded to resistance reaction (R); 2.1 to 3 moderate resistance (MR); 3.1 to 4 susceptibility (S); and 4.1 to 5 high susceptibility (AS). The results show that the genotypes JB95 - 130025 and JB95 - 50021-1 had susceptibility reaction. On the other hand, JB94 - 0310-1, JB94 - 0310-2, JB95 - 100029, JB95 - 40021, JB95 - 50021-2 e JB94 -

0306-2 were moderately resistant. The other genotypes and the pattern cultivars (MG/BR-46 - Conquista and BRS MG 68 - Vencedora) showed resistance reaction.

P087. Reaction of soybean genotypes to the powdery mildew (*Microsphaera diffusa*), grown in the fall/winter, in the region of Jaboticabal, SP, agricultural year 2002/03

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The soybean is an important leguminous plant, shifting Brazil in the world scenarium as the 2nd top producer and 1st grain exporter. Among the factors limiting higher yields is the great number of diseases (Yorinori 1996, Cancro da haste da Soja; Embrapa. Circular Técnica, 14, 75p.). Since the harvest 1996/97 a disease known as powdery mildew has become target of many researches because of yield losses as high as 40%. This way, breeding programs have started to include in their evaluations the reaction to this disease with the objective of selecting resistant genotypes. This research aimed to evaluate the reaction of soybean genotypes to the powdery mildew and was carried out at Faculdade de Ciências Agrárias e Veterinárias - UNESP/ Jaboticabal. Twenty-five soybean genotypes from the soybean breeding program of Departamento de Produção Vegetal -FCAV/UNESP – Jaboticabal. The statistical design was randomized blocks with three replications. Two evaluations of the level of infection were performed in the stages R_1/R_2 and R_5/R_6 according to the grading proposed by Yorinori (1997, Oidiosja.doc.13p.), in which: 0 = no symptoms, 1 = traces to 10% of infected leaf area (AFI), 2 = 11 to 25% of AFI, 3 = 26 to 50% of AFI, 4 = 50 to 75% of AFI, 5 = more than 75% of AFI. After the evaluations, genotypes were classified according to their reactions, also as described by Yorinori (1997, Oidiosja.doc.13p.): grades from 0 to 2.0 corresponded to resistance reaction (R); 2.1 to 3 moderate resistance (MR); 3.1 to 4 susceptibility (S); and 4.1 to 5 high susceptibility (AS). The results show that only the genotypes JB 95 - 10038 and JB93 - 54323 had susceptibility reaction to the powdery mildew. The other genotypes, as well as the cultivars MG/BR - 46 (Conquista) and BRS MG - 68 (Vencedora) behaved as highly susceptible to the disease.

P088. Resistance heritage of the soybean cultivar FT-Cometa to the stem canker (*Diaporthe phaseolorum* f.sp. *meridionalis*)

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In this study,.the resistance heritage to the soybean stem canker of cultivar FT-Cometa was determined. This cultivar was crossed with the susceptible cultivars Bossier, Paraná and IAC-8. The reaction of the progenies F_2 e F_3 to the disease was studied under greenhouse conditions, inoculating the pathogen through the toothpick method. The inoculum was previously grown using BDA medium and the sterile toothpicks were arranged to be equidistant. The inoculation was made when seedlings reached the development stage V1. Inoculated seedlings were first kept in a humid chamber and then transferred to protected environment conditions, under nebulization. The cultivars FT-Cristalina and MG/BR/46 (Conquista) were included in the experiment as patterns of susceptibility and resistance, respectively. To evaluate the reaction of the populations to the stem canker, we counted healthy (PS), infected (PI) and dead seedlings (PM), considering PS and PI as resistant and PM as susceptible. The results were analysed using the X^2 test. The progenies F_2 and F_3, resulting from the crosses between FT-Cometa and Bossier, FT-Cometa and Paraná, and FT-Cometa and IAC-8 resulted in segregation, showing the proportion of 3 resistants:1 susceptible and of 5 resistants:3 susceptibles, respectively in F_2 and F_3. The results show that FT-Cometa has one single dominant gene controlling the resistance to stem canker.

P089. Stem canker resistance and selection for agronomic atributes in F_3 populations of soybean

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Artificial crosses between parentals both resistant and susceptible to stem canker were made, followed by evaluation of the F_3 generations, aiming the selection of segregant populations of soybean resistant to the referred pathogen and with good agronomic atributes. The multiplied and inoculated population (MI), derived from F_2 plants inoculated and resistant to stem canker, as well as the multiplied and non-inoculated population (MN) derived from F_2 plants multiplied in pots , were

grown in the fields where the evaluation took place. From this data, variance analysis and fenotypical correlation calculations were made among agronomic characters. The F_3 (MI) populations showed best average for the agronomic value (VA), loadging (Ac), number of seeds (NS), number of pods (NV), plant production (PS) and number of ramifications (NR).The F_3 (MI) population derived from the cross FT-Cometa x IAC-8 showed best averages concerning mature plant height (APM), first pod insertion (AIV), number of nodes (NN), PS and VA, turning out to be the population which presented best overall results amongst those studied. As for the significant fenotypical correlations, the highest coefficient values were obtained in PS x NV and PS x NS.

P090. Soybean heritance to sudden death syndrome resistance

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Over the past few years yield losses caused by soybean diseases have become more and more serious, demanding the development of new technologies of control. Sudden death syndrome (SDS) is a fungal disease caused by *Fusarium solani* f. sp. *glycines*, that has been considered of great relevance due to the substantial soybean yield reductions and control limitations. Control has been possible by means of resistant genes. This work aims to study screening for resistance to SDS. After being inoculated with the pathogen, soybean plants originated from the crosses of FT Estrela, Ripley, MG/BR 46 - Conquista and PI 520733 besides their parental generations, F_1, F_2 and F_3, including the reciprocals, were assessed in the experiment. Genetic models were adjusted to the means and variances of the generations. Models including significant genetic effects were set only in the crosses containing PI 520733, where the additive effect was predominant. The heredity ranged from average to low. The screening for resistance must be always conducted under controlled conditions and based on progenies, resulting in gains from the early generations.

P091. Evidence of dominance in the genetic control of the soybean resistance to *Fusarium solani* f.sp. *glycines*

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In order to study the genetic control of soybean resistance to sudden death syndrome (SDS) a 5x5 diallel with the F_2 generation, without the reciprocals, was carried out. The following parents were used: Forrest, MG/BR-46 (Conquista), IAC-4, FT-Cristalina and FT-Estrela. The first two cultivars are more resistant to SDS than IAC-4, that is moderately resistant to SDS, and the last two cultivars are highly susceptible. Tests of inoculation were done with the cultivars and three experiments with the F_2 generation (two in 2001 and one in 2002) were carried out, all of them in greenhouses. The fungus was inoculated by three colonized sorghum grains placed at the bottom of the holes at the planting. It was used five-holes/clay pot, and which pot was considered a plot with five plants. In each experiment, 50 single plants of each parent and 150 single plants of each F_2 population were evaluated between 30 and 40 days after emergency by using a scale (1 to 5) based on foliar severity symptoms. The disease incidence and a disease index were calculated for each plot, but the percentage of disease incidence was not adequate to evaluate SDS foliar symptoms in clay pots. In the ANOVAs with data plot average for severity and disease index highly significant differences were detected among the treatments in almost all cases, although the resistant and the susceptible parents did not differ too much. The parents Forrest and Conquista were always more resistant than the others. Cristalina and Estrela were the most susceptible parents, while IAC-4 was unstable. Jinks-Hayman's analysis reaffirmed the environment effect on the genetic control of the resistance to SDS foliar symptoms, which was quantitatively controlled. In the 2001 experiments there was observed only additive genic effects, but in one experiment recessive genes had controlled the resistance, while in the other, in major part, dominant genes had controlled the resistance to SDS. In the 2002 experiment it was detected mainly dominance effects and also some additive genic effects; for the group of parents used, the genetic parameters indicated that: the average degree of dominance showed the presence of overdominance; there were more recessive than dominant genes in the group of the parents; at least three loci or genic blocks that exhibited dominance were responsible for the genetic control of the resistance to SDS; the heritability in the narrow-sense had middle values (0.33 to 0.62), and in the broad-sense had high values (0.90 to 0.96), reinforcing the presence of dominance genic action; and the resistance to SDS was controlled, mostly, by dominant genes.

P092. Inheritance of resistance to Phomopsis seed decay and to purple seed stain in soybean PI 80837

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Phomopsis seed decay (PSD) caused by *Phomopsis* spp. and purple seed stain (PSS) caused by *Cercospora kikuchii* can limit production of high quality soybean seed in the southern United States. Controlling these two diseases has been difficult. Breeding for resistance has produced one PSD-resistant breeding line (MO/PSD-0259) and two PSD-resistant lines (Wrather *et al*, 2003, Plant Dis. 87:529-532). PI 80837, a minor contributor to US cultivar development is reported to be resistant to both PSD and PSS. To better utilize PI 80837, our objectives were: to study the inheritance of resistances to PSD and PSS; to compare the PSD resistance in PI 80837 to that in MO/PSD-0259; to uncover possible linkages between resistance genes for PSD and PSS; and to locate SSR markers for both resistances to aid in selection. Field experiments over two years determined the segregation ratios (R:S) for both resistances in three F_2 populations. PI 80837 was crossed with two PSD- and PSS-susceptible genotypes, 'Agripro 350' and PI 91113, and with the PSD-resistant and PSS-susceptible line MO/PSD-0259. F_3 lines of Agripro 350 X PI 80837 and PI 80837 X MO/PSD-0259 were used to confirm segregation ratios found in the F_2 populations. F_1 and F_1r plants from crosses of 'Agripro 350' and PI 80837 were used to determine if resistances were influenced by cytoplasmic effects. Seed from each plant was bioassayed on potato dextrose agar (PDA) to determine incidences of PSD and PSS. Over both years 'Agripro 350' and PI 91113 had significantly higher incidences of PSD than PI 80837 and MO/PSD-0259, while 'Agripro 350', PI 91113, and MO/PSD-0259 had significantly higher incidences of PSS than PI 80837 ($P=0.05$). Segregation ratios for incidences of PSD and PSS in F_2 populations were not significantly different from a 3:1(R:S), indicating that resistances to PSD and to PSS in PI 80837 are best explained by single dominant genes. In addition, segregation ratios for PSD incidences from the PI 80837 X MO/PSD-0259 F_2 populations were not significantly different from a 15:1 (R:S), indicating that PSD resistance in PI 80837 is genetically different from that in MO/PSD-0259. F_3 line segregation confirmed the characterization of PSD and PSS resistances in PI 80837. Seed of F_1 and F_1r plants from crosses between 'Agripro 350' and PI 80837 had significantly lower incidences of PSD and PSS than 'Agripro 350' and were not different from PI 80837 indicating that both resistances in PI 80837 are under nuclear control ($P=0.05$). Linkage tests and locating SSR markers for both genes are being done to aid in selection of lines with good resistance to both diseases.

P093. Optimizing parental selection for development of mapping populations for identification of QTL's for *Sclerotinia* stem rot resistance and oil and protein contents in soybean using SSR markers

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Sclerotinia stem rot *Sclerotinia sclerotiorum* (Lib) De Bary of soybean [*Glycine max* (L) Merr.] is considered a disease in expansion in Argentina caused by increasing in soybean acreage. Changes of market demands make important breeding of oil and protein contents. Quantitative trait locus (QTL) is an effective approach for studying traits as plant disease resistance and oil and protein contents. DNA-based molecular markers have made it feasible to map and characterize QTLs for these quantitative traits. In soybean would be succesfully to choose parents for development of mapping populations, using SSR markers or microsatellites. These DNA markers display polymorphisms due to diffe rences in the base pair length of the amplified product, with each length representing an allele at that locus. Due to the quantity of SSR's available, the objective of this work was to rank parents pairs that were polymorphic for the most informative SSR markers, so then to choose among the best pairs ranked, those with different *Sclerotinia* stem rot resistance and oil and protein contents, for purpose of QTL's detection in two soybean F2 populations. Seventy four pairs SSR primers distributed over all genome were utilized in 18 soybean cultivars with different *Sclerotinia* stem rot resistance, and 18 pairs SSR primers were used in 12 soybean lines with different oil and protein contents. These primers were chosen by their PIC values (average = 0.56) and spacement among them (20 cM apart) from an Integrated Soybean Linkage Map (Cregan el al., 1998).The size of the alleles produced by each genotype was determined with DNA sequencing gels with a modified sequencing gel formulation (6% [w/v] acrylamide:bis-acrylamide [19:1], 5,6 M ultrapure urea, and 30% [v/v] formamide in TBE buffer) as described by Cregan and Quigley (1997). The quality of a genotype pair (Q_{ab}) as potential parents to develop a mapping population was determined by the proportion of SSRs that were both informative for the general population and polymorphic for the pair. The PIC values were used to generate the Q values (Anderson, 1993) of all 152, 36 and 15 genotype pairs (*Sclerotinia* and oil and protein contents populations, respectively). Twenty out 152, 4 out 36 and 4 out 15 genotype pairs were selected as parents for development of mapping populations because they resulted with high

values of Q (they were polymorphic for the most informative SSRs (high PIC values) and with different response to *Sclerotinia* stem rot and oil and protein contents. By this way, it was possible to diminish the number of initial crosses for development of mapping populations.

P094. Multivariate index based joint scaling test in the estimation of genetic parameters of soybean resistance to frogeye leaf spot

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In general, soybean resistance to a disease is evaluated using measurement on several symptoms. In this work, the joint scaling test based on a multivariate index of these measurements was used to estimate the genetic parameters for soybean resistance to *Cercospora sojina* Hara. Populations derived from two crosses, "Paraná x Bossier" and "Uberaba x Bossier", where Paraná and Uberaba were the resistant parents and Bossier was the susceptible were studied. The parents and their F1, F2, BC1 and BC2 generations from each cross were evaluated for five characteristics associated with the disease, namely: visually evaluated infection degree (ID); lesion mean diameter (LMD); percentage of lesioned leaf area (PLLA); number of lesions per square centimeter (NLC); and disease index (DI). A previous experiment involving seven genitors and their 21 hybrid combinations in a diallel was used to estimate the multivariate function including these five variables to be used as the multivariate index in the present joint scaling test analysis. It was concluded that on both crosses the additive genetic effect was the most important in the determination of the soybean resistance to the disease measured by the multivariate index. Also, on both crosses, at least one type of epistatic interaction (aa, ad or dd) was significant.

P095. Inheritance of resistance of soybean to rust (*Phakopsora pachyrhizi* Sidow)

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Soybean rust was recently detected in Brazil and represent a high hazard to the sustainability of Brazilian crops. Under favorable environmental conditions, the disease can attack the leaves causing premature defoliation and severe yield losses. All the soybean resistance sources, including plant introductions (PI) with the four previously described resistance genes (Rpp1 to Rpp4), a series of other PIs and a group of varieties carrying a single gene derived from soybean variety FT-2, were resistant to the first isolate observed in Brazil. The fungus *P. packyrhizi* is capable of developing new races and infecting resistant cultivars. In the crop season 2002/03, a new isolate broke the resistance conferred by the genes Rpp1 and Rpp3, gene derived from FT-2, and also genes from other PIs. Nowadays, there is no commercial variety resistant to this new isolate of the fungus and chemical control will be extensively used to prevent losses in the following plantings. Studies on the remaining resistance sources will help breeding programs to define their strategies with this disease. Crosses between the resistant genotypes PI200487, PI471904 and GC-001138-29 with susceptible varieties FT-2 or BRS 134 were used to study the inheritance of resistance to the new isolate. Five plants of each parental and 100 F2 plants from each cross were planted in the greenhouse at Embrapa Soybean, Londrina, PR, arranged in a Completely Randomized Design. Plants were submitted to rust spores since their emergency by placing highly infected plants next to the pots. Humidity on leaves was ensured by spraying water six times along the night. Three assessments were made on the single leaf and on the first and second trifolium, respectively, classifying plants according the reaction: RB = "reddish brown" resistance reaction; RT = predominant RB reaction with presence of some TAN lesions; TR = predominant TAN reaction and presence of RB lesions; and TAN = only susceptible TAN lesions. The relative proportions of resistant and susceptible plants in the F2 generation agree with a segregation pattern of a single dominant gene determining the resistance reaction for the three genotypes. Complementary studies are being performed to know if these genes are the same of those described as Rpp2 and Rpp4, which persist resistant to the new isolate.

P096. Screening of soybean lines for resistance to rust

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Soybean (*Glycine Max* L. Merrill) rust (*Phakospora pachyrhizi*) is a major disease worlwide. Following its first report in Uganda and Zimbabwe in 1998, it has since been reported in Nigeria, Cameroon, and Benin Republic. Due to this widespread of this disease, a study was initiated to evaluate the level of resistance among

soybean lines grown in soybean producing regions of Africa. A total of 212 breeding lines including 15 exotic germplasm from Asian Vegetable Research and Development Center (AVRDC) and Uganda were evaluated under natural infestation for resistance to rust in National Cereal Research Institute (NCRI) research farm at Yandev, Benue State (Nigeria). A duplicate set was also evaluated in Obafemi Awolowo University farm at Ife Ife, Osun State (Nigeria) another hot spot for rust in Nigeria. The lines were rated for rust incidence and severity using a 1-5 scale. Rust incidence was low especially at Yandev, where most of the lines were rated within a range of 2.0-2.9. Assuming scores of 1.0-1.9 to be resistant or moderately resistant, 2.0-2.9 (moderately susceptible), 3.0-3.9 (susceptible), and 4.0-5.0 (very susceptible), about 26% of the lines were resistant or moderately resistant at Ife while 74% were in the susceptible range. Corresponding figures for Yandev were 10% and 90% respectively. The lines rated as resistant included some of the Ugandan germplasm and AVRDC germplasm and IITA line TGX 1835-10E. Other IITA elite lines identified to be tolerant in Nigeria included TGZ 1903-12F, TGX 1903-5F, and TGX 1913-3F. All the lines will be screened again in 2003 to confirm the rust reactions observed in 2001/2002 study. The resistant lines could be used as parents in the crossing bloc of many breeding programs.

P097. Evaluation of rust among soybean lines in the state of Minas Gerais

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Soybean rust, a foliar disease caused by *Phakopsora pachyrhizi*, is widely disseminated in the soybean production areas in many countries, including Brazil. The disease can cause severe losses, according to the conditions for pathogen's development. At the moment, no genotypes have been identified among commercial cultivars with satisfactory resistance. The objective of this work was to evaluate the rust resistant level of soybean lines from the breeding program of a cooperative project among Embrapa Soybean, EPAMIG and Triangle Foundation. The lines belong to the various maturing groups, varying from 110 to 137 days to reach complete maturation. The lines, sowed in plastic pots under greenhouse conditions, were inoculated fifteen days after the sowing date with a suspension of 3 x 10^5 spores / mL, using a manual sprayer. Ten days after inoculation, it was evaluated to resistance level, using a scale of one to five (1 = 1% to 10%, 2 = 11% to 25%, 3 = 26% to 50%, 4 = 51% to 75% and 5 > 75%). Two lines, MG/BR99-4611 (medium mature group) and MG/BR99-3313 (late mature group) showed satisfactory resistance to soybean rust. They can be readily useful to the farmers or be available for the breeding program.

P098. Reaction of soybean genotypes to the Asian rust in Cristalina, GO, Brazil

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The Asian rust (*Phakopsora pachyrhizi*) of soybean (*Glycine max*) was reported recently in Central Brazil and its occurrence has increased since then. The goal of this study was to evaluate the reaction of 201 soybean genotypes to the Asian rust in three planting periods (15 / October / 2002; 15 / November / 2002; 1 / December / 2002) in Cristalina, GO, Brazil. In each of the planting periods 12 experiments were conducted with 20 genotypes. The cultivars 'MSoy 8001', 'MSoy 9001', and 'Conquista' were used in all experiments as standard controls. The experiments were designed in a completely randomized block with four replications. There were no evident rust symptoms in the first planting period (15 / October). However, in the second (15 / November) and third (1 / December) planting periods an epidemic of rust occurred. Disease evaluation (stage R.6) was made considering the whole experimental plant plots (8m²) with the following assessment key: (0 = 0% of affected foliar area; 1 = 0.1 - 1%; 2 = 1.1 - 10%; 3 = 10.1 - 20%; 4 = 20.1 - 40%; 5 = over 40%). Genotypes presenting disease index from 0 to 1 were considered highly resistant (HR), from 1.1 to 2 resistant (R), from 2.1 to 3 intermediate susceptible (IS), 3.1 to 4 susceptible (S), and over 4 highly susceptible (HS). Considering an average of the second and third plantings, no genotypes were HR or R, however, most of them (93.5%) were S or HS, and a few ones (6.5%) were IS. The IS genotypes were the following: GT 01-287, GT 01-409, GT 01-392, GT 01-401, GT 01-335, GT 01-352, GT 01-358, GT 01-343, GT 01-324, GT 01-450, GT 01-272, GT 01-335, and GT 01-456. Rust severity on soybean genotypes was higher in the third planting period. For most of the genotypes yield was higher in the second planting period. Considering all 12 experiments with the cv. M-Soy 9001(Susceptible), there was a significant negative correlation between yield and rust severity in the second ($r = -0.601$, $P < 0.001$) and the third ($r = -0.723$, $P < 0.001$) periods of planting.

P099. Conservation of soybean genetic resource and its evaluation by analyzing seed protein profiles

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In many areas of the world the rapid economic development has been accelerating the loss of wild plant species and the loss of useful genetic resources, including soybean. The urgent conservation and correct evaluation of original species is very important to the success of qualities□improvement such as diseases resistances in soybean cultivars. In this work to evaluate the genetic variation of cultivated landraces and wild *Glycineae* species, 626 soybeans cultivars in Mekong Delta, Viet Nam were collected and analyzed to search for genetic variations of 7S and 11S subunits and other components. As a Kunitz trypsin inhibitor (KTI) analyze result, all 185 local cultivars had only one *Ti* ª *Ti* ª genotype and the normal type of 7S conglycinin, but cultivars introduced from foreign countries had 15 *Ti* ᵇ *Ti* ᵇ and 1 *Ti* ᵒ *Ti* ᵒ genotypes and several variations of 7S conglycinin. However, variations of 11S subunits (A_3 and A_4) were higher in soybean landraces than introduced cultivars. According to these data we can suppose that Viet Nam soybean has differentiated independently from a limited number of original soybean cultivars introduced to the country, indicating different features from surrounding countries. Among 185 landraces have two wild *Glycine* relatives called □Dau Han The□ (perennial soybean-related species) and □Dau Hoang□ (another perennial wild species) which contain 7S conglycinin subunit varied and extremely reduced amounts of 11S gycinin. The □Dau Han The□ protein pattern analyzed was different from those of other wild perennial species such as *G. tomentella*, and *G. tabacina*, thus we considered that □Dau Han The□ belongs within a new *Glycineace* species, *G. mekongensis* (Thanh and Hirata). Additionally □Dau Han The□ has creeping stolons that promote dry tolerant, and an apparent resistance to pod borers (*Etiella zinckenella*). The effective utilization and conservation of new soybean original species, like □Dau Han The□ is applicable to improve nutritional quality of cultivated soybeans.

P100. Advance on evaluation of soybean germplasm resources in China

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Soybean is originated in China, where has over 23,000 germplasm preserved in the National Genebank. By using molecular markers, soybean germplasm were evaluated and the progress was made in following fields: (1) Tagging genes of important traits including resistances to soybean mosaic virus (SMV) strain 3 (Zheng et al., 2003), salt tolerance (Guo et al., 2001), and QTLs associated with morphologic traits (plant height, seed weight per plant, pods per plant and nods on main stem) and seed compositions (seed protein content, seed oil content). (2) Fingerprinting core collection and subcollections for the special traits with core SSR markers (Xie et al., 2003; Wang B. 2003) and comparing the genetic diversities among different sowing types (Qiu et al., 2002) and different origins (Cui et al., 2003a,b,c; Xie et al. 2002). (3) Mining alleles with DNA markers associated with important genes including SMV resistance, salt tolerance (Guo et al., 2002), soybean cyst nematode (SCN) resistance (Wang W. et al., 2003; Qiu et al., 2003), and soybean protein subunits (Wang L. et al., 2003). (4) Analyzing genetic variation of germplasm with favorite traits, the genetic diversity of 113 soybean varieties with high resistance to SMV 3 were clustered by using 60 SSR primers. The varieties whose genetic similarity coefficients were small and that were clustered in the different group probably carried the different resistant genes (Mi et al., 2003). (5) Establishing marker assisted selection in develop isogenic lines by backcross breeding. Through the relevant analysis of genetic background recovering ratio, the appropriate marker numbers and selection method in marker-assisted selection were established (Duan et al., 2003). (6) Characterizing the genetic variation of ancestral lines between China and United States (Qiu et al., 1997) and landraces between China and Japan.

P101. Genetic diversity of chinese soybean with extreme agronomic traits from different eco-regions

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In this study, 129 accessions with extreme qualitative agronomic traits were selected based on the traits of growth period, plant height, 100 seed-weight, content of protein, content of oils, and contents of several amino acids from 7 eco-regions of China. They have been analyzed with 50 pairs of SSR primers, which distributed on soybean linkage groups equably. The main purposes of this study were to identify whether the accessions have extreme agronomic traits also have special DNA

fingerprints, and to give theoretical proof for soybean core collection. A total of 561 alleles were detected with averaged 11.2 alleles per locus, and it is much higher than that in Chinese autumn sowing soybeans (7.5 alleles per locus), which has been considered to have higher genetic diversity than any other eco-regions. The average Simpson index (0.74) also suggests the high genetic diversity in the extreme population. According to the SSR fingerprints, 129 accessions can be divided into 6 groups with UPGMA clustering, and the accessions from same eco-region almost can be grouped together except for the accessions from Huanghuaixia soybean, which are almost distributed equably into 6 groups, this maybe indicate that Huanghuaixia soybean is the center of genetic diversity. In order to use the smallest samples to represents the biggest diversity, 23 accessions were deleted according to their similarity coefficients. On molecular level, the remaining 106 accessions represents 100% genetypes of 129 accessions; on agronomic traits, 106 accessions also represents 100% phenotypes of 129 accessions, the averages of qualitative traits have no significant difference; and for quatitative traits, there is also no difference in the frequency of any phenotypes, this suggests that 106 accessions can represent the 129 accessions effectively on both molecular level and agronomic traits. This means that the extreme population also can be condensed for core collection. The novel alleles in the population suggest that this study is surly to be a valuable supplement for soybean core collection. In Nanfangqiu sowing soybean, the accessions that have extreme traits are grouped together separately according to SSR fingerprint, this suggests that the accessions with extreme traits also have different alleles on DNA level, so these accessions should be considered as a special population in soybean core collection construction.

P102. Development of soybean recombinant inbred lines jinf (Jinbean23 × ZDD2315) and evaluation by SSR molecular marker and agronomic traits

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In this research, a soybean recombinant inbred line population including 474 F_{10} progenies was generated by single seed multiple descent (SSMD), which derived from a cross between Jinbean23 and ZDD2315. This soybean RIL population was named as Jinf. Twenty-nine agronomic traits were investigated based on the field recording approaches of conventional breeding program, which was carried out in Fenyang of Shanxi province in summer of 2002. The results indicated that these traits in the RIL population had significant differences. Moreover, the frequency of most traits showed continuous changes and normally distribution and the tremendous transgressive segregation for most traits were also observed in the Jinf population. It is suggested that most traits be quantitative trait and controlled by polygenes. Trait phenotyping analysis shows that all progenies tend to be homozygous. 355 pairs of SSR primers covering the whole soybean genome were employed randomly to reveal the polymorphism between two parents. 212 pairs of them were polymorphic and 213 loci were detected. The polymorphic rate is up to 59.72%. Analysis with polymorphic SSR loci on 118 selected progenies indicated ploymorphic index (PI) tended to be 0.5, varying in the range from 0.375 to 0.500. 160 SSR loci were conformed to the segregation ratio of 1:1. 53 SSR loci in the tested progenies showed segregation distortion. Therefore, heterogeneous rates of SSR loci in 118 tested progenies were in the range of 0-9.32%. Further analysis showed in 118 progenies, 111 RIL progenies tended to be homozygeneous, of which 31 tested progenies were completely homozygeneous and the heterogeneous rate of 7 tested progenies were in the range of 15.31-42.72%. The contribution and distribution of genotypic components in 118 tested progenies were also analyzed. The contribution rate of paternal ZDD2315 was up to 51% and the distribution was normal based on parameters of Skewness, Kutosis and Chi square test analysis. It is illustrated preliminarily that genetic contributions from the parents are closely equals. This study indicated that Jinf be a RIL population with reasonable genetic composition and well suitable for soybean genomic researches such as genetic mapping, molecular tagging and molecular breeding.

P103. Characteristics of Korean local wild soybean (*Glycine soja* Sieb. □ Zucc.) genotypes

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Soybean sprout is one of the very popular vegetables in Korea. We have used small soybean genotypes for bean-sprout products not only because of higher sprout yield index to seed but because of better seed vigor. This study was carried out to obtain basic information and promising materials for the breeding of sprout-soybean by the investigation of seed characteristics and analysis of chemical composition of Korean local wild soybean lines. Total 70 wild soybean and 3 small-seeded *G. max* cultivars were evaluated. Contents of crude protein, crude oil, isoflavone, oligosaccharide,

and fatty acid composition were analyzed. For 100-seed weight of Korean wild soybean lines, 74.3% of 70 lines showed 1-3g range, however, the largest line YWS 151 was 7.0g. Crude protein contents ranged from 35.6 to 47.9%, and 13 lines showed high protein content, over 45%. Crude oil contents of those ranged from 2.8 to 18.0%, mean 10.2%, and 2 low-oil lines showed below 2%. Fatty acid 16:0, 18:0, 18:1, 18:2, 18:3 ranged 11.1- 44.6%, 3.0-11.4%, 11.1-30.6%, 12.4-59.5%, and 1.1-17.3% respectively, and 2 extremely low fatty acid(18:3) lines were selected. Isoflavone contents of those showed 705-4,503ýÿ/g as range, mean 2,025ýÿ/g, and 14 high isoflavone lines over 2,500ýÿ/g were promising ones for the breeding. Oligosaccharide contents ranged from 1.7 to 4.7%, mean 3.0%, and 4 lines less than 2% of oligosaccharide content seemed useful genotype. Korean wild soybean genotypes were classified and clustered into 11 groups using the data of 100 seeds weight, crude protein, crude oil, isoflavone, and oligosaccharide contents, and fatty acid composition. Selected lines seemed promising as genetic resources for breeding; YWS 104 and 189 as the high protein, YWS 28 and 30 as the low-crude oil and low 18:3, YWS 66 as the high isoflavone, and YWS 40 and 41 as the low oligosaccharide.

P104. Web-based soybean varieties information retrieval system

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In India, so far 80 varieties of soybean have been released for cultivation in different eco-geographical regions and states of India. Out of these, 35 varieties are in the seed multiplication chain and every year new varieties are being added to this chain. Information on different aspects of the varieties like notification details, distinguishing morphological characters, area of adaptation, yield potential, resistance to different biotic and abiotic stresses are required by scientists, seed personnel, managers, administrators, extension personnel and farmers. Data regarding these characters was gathered and collated properly to generate the information as required by different clientele/end-users. A Web-based Varietal information system (VIS) containing detailed characteristics and other details of all the released soybean varieties in India has been developed in harmony with the National test guidelines for DUS testing of India. The parlance used is harmonized with that in vogue in the international fora such as UPOV. This package provides detailed information on 39 different morphological characters (including essential or asterisk-marked characters of National test guidelines) for all the varieties of soybean in India. This system will be useful in meeting the emerging needs of new IPR-(Intellectual Property Right) regime. The package is developed to retrieve the required information in a quick, easy and efficient manner. The system has been designed using web-technologies viz. Active server pages (ASP), HTML, JAVA etc. To keep the varietal data in a systematic and an easy-to-retrieve manner, a database has been developed using SQL Server 2000 for the soybean varieties. To facilitate the updation of the data, as and when needed, an accompanying system for varieties data management has been developed using Visual Basic(6.0). The system has been designed to be very user-friendly using GUI tools viz. list-box, combo-box, textbox, embedded pictures etc. It is completely mouse-driven. The user can give his choice for variety selection, character selection, and comparison of varieties and characters and can get the required information with few mouse clicks. The information is made available in the form of comparison tables, colorful pictures, bar graphs, pie charts and reports. The system has provision for expansion to include more characters and varieties that may be released in future. The package can be refined to cater to the requirements for implementation of DUS (Distinctness, Uniformity and Stability) testing of the candidate new varieties for plant variety protection. The package is successfully linked to the NRC for Soybean web-site (www.nrcsoya.com). The system has been designed in such a way that it can be extended to any crop commodity for development of its database, retrieval of information and DUS testing.

P105. Varietal Information Program for Soybean (VIPS)

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The Varietal Information Program for Soybeans (VIPS) is an interactive electronic information system that annually reports the performance and attributes of preferred soybean varieties grown in Illinois. The VIPS searchable database includes six years of comprehensive results from soybean variety trials conducted at 13 Illinois locations coordinated by the University of Illinois Variety Testing Program. More than 70 seed companies submit close to 800 varieties for these trials. In addition, Illinois soybean producers are annually invited to nominate varieties for inclusion in

these trials. The VIPS provides growers with unbiased variety performance data including yield, protein and oil content, as well as important disease resistance information about soybean cyst nematode (including Female Index data for five Illinois HG population types), sudden death syndrome, Sclerotinia stem rot, aphid resistance, soybean rust, green stem, and seed mottling. Variety trial information from both Iowa and Wisconsin is included and searchable with the VIPS and enables soybean growers in northern Illinois to view information for maturity groups and varieties preferred in northern soybean growing regions. The producer-friendly query structure prompts the user to set up queries by year, location, company, maturity group, and to select conventional and/or Roundup Ready® varieties. The data are presented in spreadsheet format, and data columns can be sorted high to low or low to high. Results can be displayed as absolute values or values relative to trial averages, and the customized queries can be downloaded and saved in spreadsheet format for offline reference. Additionally, the VIPS 'Ask-an-Expert' feature provides Illinois soybean growers with direct contact to university experts that will help with farming decisions, and the 'Crop Protection Links' feature enables quick access to many useful soybean-related websites. Annually, new agronomic information for varieties is made available online by November, and soybean growers can search for varieties that are suited to their geographic area and satisfy their special needs for growing conditions, specific attributes, and disease problems. Coordination of VIPS, provided by the National Soybean Research Laboratory, includes an annual survey of Illinois growers to nominate varieties to be included in the state-wide variety trials, assembling university pathologists and nematologists to provide varietal disease data for current yield-reducing diseases, and formatting all data for easy online access for soybean producers. VIPS, viewed at www.vipsoybeans.org, is funded by the Illinois Soybean Checkoff Board.

P106. Sensorial characterization of soybean genotypes

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Of the 52 million tons of soybean produced nowadays in Brazil, about 1% is used directly in human diet. Soybean grain has 40% of protein of excellent quality, being able to be compared with the one of meat. Beyond the nutricional aspect, soybean has the potential to prevent cardiovascular disease, cancer and osteoporosis. The Food and Drug Administration recommends the daily consumption of 25g of soybean protein, in a diet with low indices of cholesterol and saturated fats, to control the cholesterol levels and to reduce the risks of many diseases. One of the limiting factors for the acceptability of soybean is the undesirable flavor caused by the presence of lipoxigenase enzymes. To stimulate the use of soybean in the Brazilian diet it is necessary to develop soybean cultivars without the unfavorable characteristics. Thus, these soybean cultivars can easily be included in daily food. This work had the objective to carry out a sensorial characterization of 19 soybean lines. Ten had yellow tegument and hilum and were derived from at least one parent without lipoxigenase. Nine soybean lines had brown tegument. All of them belong to the germoplasm collection of the soybean breeding program developed by the partnership Embrapa, EPAMIG and Fundação Triângulo, in Uberaba, Minas Gerais State. The soybean cultivar BRS 213, that has no lipoxigenase, was used as standard. The test was based on a scale for flavor that varied from 1 (very bad) to 9 (very good) in a completely randomized design, with seven replications. Three soybean lines with yellow tegument were grouped with the soybean cultivar BRS 213, by the Scott-Knott test ($P<0.05$). Therefore, these lines showed high level of acceptability and have potential to be released especially for human diet.

P107. Development, validation and use of an *Rps1-k* specific SCAR marker

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Marker Assisted Breeding (MAB) has proved a very valuable approach for introgressing single traits into adapted germplasm. However, the integration between breeding schemes and bench work requires molecular markers that meet both cost effectiveness, simplicity and robuestness criteria. In these regards, SSR markers represernt a great step forward compared to RFLP markers. Nevertheless, microsatellites are still a demanding technique, and may not be suitable for MAB tasks unless a great deal of resources are available. Our work is aimed at obtaining an allele-specific Sequence Characterized Amplified Region (SCAR) marker with which several thousand individual plants at each cycle of selection can be screened, without the use of sophisticated equipment. Previously published data points at the occurrence of a retrotransposon insertion (TGMR) specifically associated with allele *Rps1-k* on linkage group N of the soybean genome (Bhattacharyya et al., 1997). This authors also found a RAPD band ($OPRK15_{860}$) with a high degreee of homology with a reverse transcriptase sequence,

located approximately 0,2 cM from the RPS1 locus and specifically associated to the *Rps1-k* allele. We reproduced the *Rps1-k* specific banding pattern for OPRK15 and retrieved information on the TGMR sequence (GeneBank Accession # 496748). Based on those results, one TGMR-specific SCAR marker ($SCAR_{TGMR}$) was designed whith an expected size of 400 bp. $SCAR_{TGMR}$ was optimized until it showed a presence/absence pattern, and resulted specific for resistance sources Williams 82 and Kingwa. $SCAR_{TGMR}$ was then mapped on a F2 population (96 plants) and shown to map in the proximity of the RPS1 locus. As expected, $SCAR_{TGMR}$ presents a dominant behaviour and co-segregates with RAPD band $OPRK15_{860}$ (0,2 ±0,2 cM from RPS1). The marker was further validated against commercial genotypes: the expected 400 bp band was only observed in those varieties known to bear the *Rps1-k* allele. $SCAR_{TGMR}$ is presently being utilized for the characterization of additional cultivars and advanced breeding lines comprising the Soybean Testing Network and for marker assisted selection tasks at our breeding program. $SCAR_{TGMR}$ is presently being optimised in order to obtain a gel-free marker.

P108. Soybean cultivars characterization using microsatellite molecular markers

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Soybean [*Glycine max* (L) Merril] is considered the most important oil crop cultivated in the world. The development of cultivars more productive, stable and better adapted to the different environmental conditions of brazilian regions represent a great contribution on the soybean establishment as one of the main Brazilian crops. However, studies on the genetic basis of Brazilian cultivars reveal that the germplasm used in breeding programs has a narrow base. Nowadays, the interest on genetic characterization for commerciall protection is growing on the breeding programs, as a result of Brasilian Cultivars Protection Law, that establishes that cultivars have distinguishably, homogeneity and stability. As expected, winth the increment of the number of cultivars is increasing, the distinction among them became more difficult, demanding the use of molecular markers. Some markers such as SSR (Simple Sequence Repeats) shows interesting characteristics for these distinguish studies, as the fact of having more than one allele. Therefore, aiming to select microsatellite molecular markers to facilitate the differentiation and characterization process of soybean genotypes, 17 cultivars were selected for molecular , based on AFLP's (Amplified Fragment Length Polymorphism) analysis, in a way of representing the soybean germplasm bank. As a result of the molecular analysis, from the 13 pairs of microsatellite primers tested, 11 showed polymorphism presenting from two to three alleles. This polymorphism allowed the analysis of 26 microsatellite loci and the distinguish of 15 for the 17 soybean cultivars. Thus, these primers demonstrated a great potential on studies for differentiation and characterization of the germplasm bank of Embrapa Soybean, helping the cultivar registers of intellectual protection and also giving genetic support to increase the selection efficiency of superior genotypes.

P109. Direct and indirect selection and index based on sum of ranks to evaluate progress with the selection in soybean F_2 populations

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Brazil is the second top producer and exporter of soybean, producing 50,3 million de tons in the 2002/03. The expressive increases of the world production in the last years are due not only to the increase of the area, but especially to genetic improvement, through the release of superior cultivars adapted to different regions, providing yield increments. In breeding programs, selection is hardened by the complexity of the economically important characters, most highly influenced by the environment. Through of genetic parameters, like heritability and the progress with selection, it is possible to identify superior genotypes among populations and use them in future works. This research was undertaken to estimate gains with the selection through two methods: Direct and Indirect Selection and Index Based on Sum of Ranks (Mulamba & Mock, 1978, Egypt J. Gen. Cytol., 7:40-51). We used an augemented blocks design, with intercalated checks (Renascença, Liderança and Cristalina), seeding 5 m lines, 0.5 m apart. Eight plants per line were selected, totalizing 800 genotypes. The following characters were evaluated: plant height at maturation (APM), first pod insertion height (AIV), lodging (Ac), agronomic value (VA), number of pods per plant (NV), number of seeds per plant (NS) and production per plant (PROD). Variance analysis showed significance (P £ 0,01) for APM, AIV, VA, NV, NS and PROD and P £ 0,05 for Ac. The calculated broad sense heritabilities, were estimated to be 81,1% for APM, 67,2% for AIV, 60,3% for Ac, 84,0% for VA, 72,9% for NV, 77,7% for NS and 79,2% for PROD. The Direct and Indirect Selection method indicated that the selection of one of

the characters VA, NV, NS or PROD brings to higher indirect gains in other characters. This result was expected because of the high correlation among these characters (r @ 0,9), allowing gains of about 50% for PROD, 22% for NS, 20% for NV and 11% for VA. In the Selection Based on Sum of Ranks higher gains were also observed for PROD (51%), NS (23%), NV (20%) and VA (12%), with negative results for AIV (-3%). Using a selection index of 25%, progenies like JAB 02-13/36, JAB 02-13/48, JAB 02-13/20, JAB 02-02/39, JAB 02-01/8 and JAB 02-13/16 were superior among the 200 selected progenies for most of the characters in both methods, being also superior to checks. From the results, it can be inferred that the two methods were efficient to select soybean genotypes.

P110. Genetic behavior evaluation for soybean selection in F_3 families

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Soybean (*Glycine max* (L.) Merril) is nowadays one of the most important cultures in the world, being a prominent source of protein and main vegetal oil source. Economically, it presents itself as a great source of profit to exporting countries, such as the United States and Brazil, top world producers. Great increments in production are needed to fulfill the growing need for food, which can be obtained by superior progeny selection through genetic improvement programs. The selection of those progenies based in important agronomic characters can be helped by genetic parameters, such as heritability, which allows detection of the heritable portion of the total variability present in the population. With that intent, F_3 populations of soybean were evaluated, which had a source of resistance to cyst nematode (race 3), having the progenies selected for resistance with the marker microsattelite Sat-162 (Cregan, 1999, Theor. App. Gen. 98:919-928). The experiment was conducted in the family design with intercalated checks (Renascença, Liderança and Cristalina), being those families represented by one or two 5,0 m rows, depending on seed availability, spaced 0,5m apart. From the progenies that presented resistance by Sat-162 markers, an average of eight plants from each row was selected, having the following characteristics evaluated: Number of days for maturation (NDM), plant height at maturation (APM), first pod insertion height (AIV), lodging (Ac), agronomic value (VA), number of pods per plant (NV), number of seeds per plant (NS) and plant production (PROD). The variance analysis presented significant differences ($P \leq 0,05$) for NDM, APM, VA, NV, NS and PROD, whereas AIV and Ac did not significantly differ, probably due to the high environmental variance observed in the experiment. The calculated heritability varied between 56,9% for NS and 68,5% for NDM, except for the two characteristics the showed problems with the great environmental variance (AIV and Ac). The coefficient of genetic variation (CVg) situated among acceptable limits, with focus on the CVg/CVe which was close to an unity for almost all characters, a result considered ideal for selection (Cruz & Regazzi, 1997, Ed.UFV, 390p). In according results it is possible to conclude that superior genotype selection will be efficient, mainly for characteristics of greater agronomic importance, such as PROD, due to the high heritability observed in most characters and to the favorable relation among CVg/CVe.

P111. Phenotypic stability evaluation through ecovalence for characters of economic value in soybean progenies

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Soybean is one of the most important sources of protein and vegetal oil; furthermore, its culture is an important currency source in the country. Plant improvement aiming to obtain cultivars with high stability associated with expressive values for the economically interesting characters is of great importance in cultivar development. This project's main objective was to evaluate stability in soybean progenies, developed by the improvement program conducted at UNESP/FCAV, through ecovalence in four environments (Wricke, 1965, Zeitschrift Pflanzezzuchtg 52:127-138). The evaluated characters were number of days for flowering (NDF), number of pods (NP), plant total weight (TW), weight of a hundred seeds (WHS), number of days for maturation (NDM), plant height at maturation (PHM), first pod insertion height (FPIH), lodging (L), agronomic value (AV) and number of nodes (NN). The evaluated progenies were JAB99-10, JAB99-16, JAB99-17, JB99-40, JAB99-43 and JAB99-44, having Liderança, Cristalina and Renascença as control. In this method, phenotype stability is measured by the decomposition of the G x E interaction, and therefore analyzing the ecovalence estimates (eco) obtained, noticing that for the NDF character, the progenies with the best eco estimates, or greater phenotype stability, were JAB99-43 and JAB99-44, showing contributions (eco%) of 8,8 and 9,4 in total interaction. Progenies JAB99-40, JAB99-10 and JAB99-43 showed less contribution for the NP character, with and eco % between 11,4 and

12,7%. As for TW the smallest contribution for the G x E interaction was progeny JAB99-40, with 3,5%. For the WHS and NDM characters, the most stable progenies were JAB99-10 and JAB99-43, showing values smaller than the control for WHS. For PHM, progenies JAB99-43 and JAB99-40 presented low eco % (6,1 and 7,7%). As for the FPIH and L, progeny JAB99-16 presented the lowest eco estimates, of 6,38 and 7,48% respectively. For AV and NN, progenies JAB99-43 and JAB99-16 were the most stable. To most of the studied characters (TW, WHS, PHM, FPIH, L and NN) the obtained value as to the progenies' contribution was similar to the controls, therefore indicating possible selection of stable progenies for those characters. Progeny JAB99-40 was considered prominent, for presenting stability for NP, TW and PHM and desirable average values for those characters.

P112. Phenotypic variation in an edamame collection [*Glycine max* (L.) Merr.]

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Thirty-three accessions from the Asian Vegetable Research & Development Center (Taiwan), EMBRAPA (Brazil) and Japan were evaluated for agronomic performance under our environmental conditions. Field evaluations were carried out at the experimental field of the Faculty of Agronomy, UNR (Lat. 33° 01´S) during the 1997/1998, 1998/1999 and 1999/2000, growing seasons, in November and December sowing dates, using two rows plots distanced 0.7 m each. Thirteen phenological and agronomical traits, and four related variables were evaluated. Data were analyzed by principal component analysis, PCA, and cluster analysis following the UPGMA method. Five principal components, PC, together explained 83% of the accumulated variation. First PC explained 30% of phenotypic variation and was mainly associated with number of nodes in primary and secondary branches. Second PC explained 21% of variation and was associated with length of the period from emergence to full pod, and plant height. Third PC explained 12% of the variation and was associated with the ratio of two plus three seeded pods, while the fourth PC was associated with seed weight. Finally, the fifth component explained 9% of the variation and was associated with nodes on the main stem. PCA showed the higher dispersion for Taiwanese genotypes. Brazilian genotypes ordered by PC 3 and PC 5. Japanese genotypes closely ordered by PC 2. Cluster analysis identified six groups, containing between three and eight genotypes each. Clusters 1 and 2, both with eight genotypes, included short cycle and low plant height genotypes. Cluster 3 was formed by the three genotypes with the longest cycle and tallest plants. Cluster 4 was formed by eight genotypes with high two plus three seeded pods ratio and heaviest seeds. Genotypes in cluster 5 were only from Brazil and had the lowest seed weight. Cluster 6 had three genotypes with the lowest two plus three seeded pods ratio. PC and cluster analysis showed that Taiwanese genotypes had the higher variance for the characters studied, meanwhile Japanese genotypes behave as a very homogeneous group. Brazilian genotypes shared characteristics with Taiwanese and Japanese genotypes. Probably different breeding strategies in Taiwan and Japan account for the results obtained.

P113. AFLP polymorphism in edamame [*Glycine max* (L). Merr.]

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Twenty three accessions of Edamame [*Glycine max* (L.) Merr.] from Asian Vegetable Research & Development Center (Taiwan), EMBRAPA (Brazil) and Japan were analyzed by their AFLP profiles, in order to characterize their molecular variability and to compare with their agronomic variability. For each accession, DNA was isolated from pooled leaflets of five plants grown in a greenhouse. using the Genomic Purification Kit (Promega). AFLP analysis was carried out according to the AFLP Analysis System I (Gibco). A total of ten primers and twenty one primers combinations were used for ALFP assays in all genotypes. Three combinations gave blurred bands and were excluded from the analyses. Only polymorphic bands were scored as 1 (presence) or 0 (absence) of the fragment. Genetic similarity for pair-wise combinations was based on Jaccard. A similarity matrix was constructed and subjected to cluster analysis following UPGMA method. Also, genetic similarity obtained from phenotypic variation on the same accessions was compared to the molecular one by Mantel procedure. Analysis of eighteen combinations revealed a total of 11.179 fragments, with an average of 27.6 bands per primer combination among which 4232 fragments (36.7%) were polymorphic across the whole set of genotypes. The total number of fragments detected by individual primer combination ranged from 14 to 41, while the number of polymorphic fragments varied from 3 to 19. Different primer combinations detected different levels of polymorphism ranging from 11.5 to 57.1%. The fragment sizes, compared with standard DNA ones, ranged from less than 100 bp to more than 500 bp. Three out of eighteen primer combination were able to fingerprint 96% of the accessions. These results proved

AFLP useful enough to discriminate among accessions and suggest their use for genotype identification. Similarity coefficients based on Jaccard ranged from 0.395 to 0.931 for all genotypes. The higher similarity was observed between two Taiwanese advanced lines, while the lowest one was between a Japanese and a Taiwanese genotype. The obtained dendrogram showed two clusters and five unique groups of one genotype each. One of the main clusters included seven Taiwanese and one Brazilian accessions, while the other comprised six Brazilian and four Japanese accessions. When pooled, the Brazilian genotypes clustered with the Japanese ones, pointing to some kind of relationship among these origins. All Taiwanese genotypes grouped in a cluster. Accessions from different origin showed different average genetic similarity: it was s=0.827 for the Taiwanese pool, s=0.765 for the Brazilian one, and s=0.706 for the Japanese pool, which showed the greatest divergence. However, the average genetic similarity for the whole sample was s=0.768, showing a relative low genetic diversity, probably due to an ancient selection pressure for the edamame type. The Mantel test allowed comparison of phenotypic and molecular genetic similarities matrix and showed no association between both approaches to characterize variability in different levels ($r_M = 0.142^{ns}$).

P114. Genetic analysis for effects on content and index of protein and oil in soybean seeds

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Analysis of seed, cytoplasm and maternal effects and genotype environment GE effects for content and index of protein and oil of soybean *G. max*ýÿin different environments was conducted by using a genetic model for quantitative traits proposed by Zhu 1997 . Five parents were used in an incomplete diallel cross over 2 years. Protein content (PC) protein index (PI) oil content (OC) and oil index (OI) were mainly affected by genetic main effects, but the total content of protein and oil (TC) was mainly affected by Genotype Environment (GE) interaction effects. Protein content was mainly controlled by cytoplasmic effect, maternal dominance effect, direct dominance interaction effect and maternal dominance interaction effect. For protein index, direct additive effect and cytoplasmic effect were two largest components among total genetic effects. The oil content of soybean seed was mainly controlled by cytoplasmic effect and maternal dominance effect. The oil index of soybean seeds was mainly controlled by direct additive effects, and the secondly were maternal additive effects and maternal dominance effects. For total content of protein and oil, cytoplasmic interaction effects was the largest components among all kinds of genetic effects, followed by direct additive effects and maternal dominance effects. The total narrow-sense heritability for protein content, protein index, oil content, oil index and total content of protein and oil were 45.8%, 39.8%, 61.2%, 56.7% and 43.9%, respectively, with the general heritability values being 39.7%, 39.8%, 50.4%, 29.1% and 14.8%, respectively, and interaction heritability values being 6.1%, 0, 10.8%, 27.6% and 29.1%, respectively. For PC, PI and OC, Cytoplasmic heritability were much more important than seed heritability maternal heritability seed interaction heritability cytoplasmic interaction heritability and maternal interaction heritability. For OI and TC, cytoplasmic interaction heritability and seed heritability were relatively bigger. Cytoplasm correlation for PC and PI, OC and OI are significantly positive. Cytoplasm correlation (r_C) for PC and OC, PI and OC, and PI and OI are significantly negative.

P115. Means and phenotypic correlations in soybean segregating populations

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The aim of this research was to evaluate the alterations of the agronomic characters means amongst the generations F_2, F_3 and F_4 within soybean crosses, and estimate the coefficient of phenotypic correlation amongst these characters in plants of the generation F_4. Each genotype was represented by one line of five meters. Lines were 0,5m spaced and the population density was 25 plants per meter. The following characters were evaluated in the generation F_2: plant height at maturation (PHM), insertion height of the first pod (IHP) lodging (L), number of seeds per plant (NSP), number of pods per plant (NPP), number of nodes (NN), agronomic value (VA), and grain production (GP). The characters PHM, IHP, NSP and GP increased from F_2 to F_3 in all crossings. From F_3 to F_4, the crosses Jab 00-01, Jab 00-02, Jab 00-03 and Jab 00-04 increased the NSP and the cross Jab 00-05 increased the GP. The phenotypic correlation analyses have shown that the characters NPP, NSP, and VA can be employed in indirect selection, aiming to increase grain production.

P116. Heritability and genetic gain in soybean segregant populations

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The main objective of this research was to estimate the heritability coefficient through the parent-offspring regression method (F_3-F_4), as well as to predict the genetic gain in the F_5 generation over F_4 selection. Each genotype was represented by 5 meter rows, 0,5 meters apart from each other and with average density of 25 plants per meter. The evaluated characteristics in both generations were mature plant height (MPH), first pod insertion (FPI), loadging (L), number of seeds per plant (NSP), number of pods per plant (NPP), number of nodes (NN), agronomic value (AV) and grain production (GP). The best heritability estimates were obtained for FPI (0,21) in the JAB 00-06 cross; for MPH (0,29) in the JAB 00-05 cross; NN (0,38), NSP (0,31), NBP (0,75) and GP (0,08) in the JAB 00-01 cross. As to genetic gain prediction in F5 generation the best estimates were obtained in the JAB 00-07 cross for FPI (9,01cm/generation); JAB 00-05 for MPH (6,87cm/generation) and JAB 00-01 for NN (6,00 nodes/generation), NSP (21,91 seeds/generation), NPP (51,99 beans/generation) and GP (5,76 grams/generation).

P117. Genetically modified soybean in Argentina: a yield - glyphosate tolerance trade off

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As part of a larger project investigating eco-physiological traits linked to yield improvement (D.J. Santos doctorate thesis, UNMdP, and PROSOJA national project), we compared the yield of soybean cultivars released in Argentina between 1984 and 2001. The first cultivars genetically transformed for tolerance to glyphosate (GM) where released commercially in 1996-1997. Our comparison thus included conventional cultivars (NGM) released before 1996, dominantly GM cultivars released late in the decade, and both GM and NGM cultivars in the 1996-97 period. Maturity groups of the cultivars in this study spanned from III to VII. We hypothesize that, independently of the maturity group, there was a small reduction in grain yield when glyphosate tolerance was incorporated. We propose that a trade-off was specially notable in the early GM cultivars, but it was rapidly overcame in the cultivars released on 2000/01. We carried out nine field experiments, all with a completely randomized block design and at least three blocks. Experiments 1-6 were sown in Balcarce (37°45' S, 58°8' W, altitude 130 m) in 2000/1 and 2001/2, and included cultivars from maturity groups III to V. Experiments 7-9 were carried out in Paraná (31° 50' S, 60° 31' W, 110 m altitude) in 2002/03 involving the same set of cultivars as in Balcarce (Exp. 7) and cultivars of MG VI (Exp. 8) and VII (Exp. 9). Sowing date was the optimal of each location in all trials; row width was 0.44 m and nutrients, pests, and weeds were adequately managed. Yields were normalized using the trial average as reference, defining relative yields (RY). Both an statistical and a graphic approach were used. Formerly, RY was regressed against year of cultivars release, either for *the pooled* cultivars ("all"), or for *the NGM* or *GM* groups, when number of cultivars was sufficient. Fitness of linear equations obtained from the NGM (or GM) by groups analyses were superior than those from the "all" data. Also, slopes were higher in the NGM's analyses than in the "all" one. Secondly, we plotted each trial RY on year of release, and graphically identified those GM. Again, its apparent that, between the lastly released NGM cultivars and the first released GM's, there was a RY's down step. Only lastly released GMs (those from 2000 and 2001) recovered the RY level that had been achieved at the end of "conventional cultivars' breeding era". When there was not present a 2000/2001 released GM cultivars (MG VI, Trial 7) that recovery was not observed.

P118. Distance of flow in transgenic BR00-69515 and the non transgenic soybean in the Cerrado Region, Brazil

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In order to evaluate the gene flow from the transgenic soybean RR (Round Up ready) to non-transgenic

soybean, an experiment was conducted in Embrapa Cerrados (Federal District, Brazil). Plots with non-transgenic plants, were sowed around a central plot with the transgenic soybean plants (Var. Conquista, line BR00-69515), transformed with the *cp4 epsps* gene, which confers glifosate resistance. The plots were previously identified and the seeds of each plot were separately harvested, counted and sowed to evaluate the resistant plants containing the *cp4 epsps* gene. Plants were sprayed at the third-trifoliate stage with the herbicide glifosate (Round Up) at 2,4 $Kg.ha^{-1}$. Plants that survived were analyzed by PCR. The percentage of natural cross was calculated as the fraction of tolerant plants from the total number of plants. The frequency of cross-pollination between the transgenic line BR 00-69515 and non-transgenic plants were 0,485% (at 1 meter from the central plot). The frequency of cross pollination was dramatically reduced at 2 m from the central plot (0,099 %), and reduced to 0.063%, 0.054 %, 0.021 %, 0.019 %, 0.020 %, 0.009 %, 0.006 % e 0.005 % in each subsequent meter, up to 10 m of the central plot.

P119. Genetic diversity comparison between southern spring-sowing soybean and Huanghuai spring-sowing soybean by using SSR markers

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The eighty soybean varieties were used in this study, which belongs to two ecotypes of Southern spring-sowing soybean and Huanghuai spring-sowing soybean respectively. A Set of 32 soybean SSR markers distributed into 20 soybean linkage groups were used to evaluate genetic diversity between two ecotype soybeans. In all materials, a total of 314 alleles were detected with an average of 9.81 alleles per SSR locus. Of the total alleles, there are 69 specific alleles in Southern spring-sowing soybean, taking 22.9% and 61 specific alleles in Huanghuai spring-sowing soybean (19.4%). In Southern spring-sowing soybeans, 251 alleles were detected with an average of 7.84 alleles. The PIC (Polymorphism Information Content) value varied from 0.43 to 0.90, with an average of 0.74. In Huanghuai spring-sowing soybean, 243 alleles were detected with an average of 7.59 alleles, the PIC value varied from 0.33 to 0.87 with an average of 0.71. This result showed that genetic diversities were similarly. Between two ecotypes, but Southern spring-sowing soybean had lower genetic diversity compared to that in Huanghuai spring soybeans. Genetic similarity coefficient among 80 varieties ranged from 0.123 to 0.940. Independence test indicated that the genetic differentiation on 28 SSR loci (87.5% of the total loci) between these two ecotypes reached significant level and Gst ranged from 0.81% to 13.98% with an average of 3.32%. Showed that the genetic differentiation happens between this two ecotypes but the differentiation coefficient is very low. Through cluster analysis based on the 32 SSR markers, the 80 varieties could be classified into four distinct groups, which mainly corresponded to the Southern spring-sowing soybeans and Huanghuai spring-sowing soybeans respectively. Some Southern spring-sowing soybeans distributed into the Huanghuai spring-sowing soybean and likewise, it may be due to these soybeans from the adjacent places even they belong to the two ecotypes.

P120. Genetic parameters estimates for soybean genotypes in Jaboticabal, SP

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Genetic parameters estimates are of great importance to genetic improvement programs, allowing to take decisions about the most appropriated selection method, which characters have to be selected in the early and advanced stages of a program, as well as the weight to be awarded to each of those characters. The main objective of this research was to estimate the heritability coefficient (h2) and selection gain (SG) in different soybean genotypes developed for the Jaboticabal region. The project was conducted during the agricultural year of 2001/02, in a randomized blocks experimental design, with three replications, using 20 soybean genotypes derived from crosses made at UNESP/Jaboticabal, as well as two commercial varieties used as standard. The materials were sowed in 5 meters rows, which were 0,5 meters apart from each other. Six plants of each plot were evaluated. The characteristics evaluated were mature plant height (MPH), first pod insertion (FPI), number of nodes (NN), number of seeds per plant (NSP), weight of one hundred seeds (WHS) and productivity (P). From the obtained results an estimate of the heritability coefficient was made obtaining 0,78 for MPH, 0,59 for FPI, 0,92 for NN, 0,56 for NSP, 0,73 for WHS and 0,44 for P, all classified from medium to high, since they all ranged from 0,44 to 0,92, indicating good selection possibility. Selection gain was also estimated and the results were 20,13 cm for MPH, 8,17 cm for FPI, 4,08 for NN, 17,65 for NSP, 2,15 grams for WHS and 559,78 grams for P. It can be concluded that there is a possibility of improving the characteristics studied in this project.

P121. Correlation between characteristics in segregant soybean genotypes

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The correlation between characters allows selection orientation as well as genotype improvement for a group of characters and not just for isolated characteristics, so there can be an indirect selection of desirable attributes positively correlated. The knowledge of these correlations, even in a phenotypic level, is of great importance to genetical improvement. When the correlations are positive and of high magnitude, the characters can be considered the only unity of selection. However, the negative correlations usually hinder the simultaneous selection of superior characters in improvement programs. So the objective of this work was to evaluate the behavior of the segregant genotypes of soybean, through an estimate of Pearson's correlations, as a form to indirectly assist selection in the improvement program. The evaluated materials were F_3 generation of segregant genotypes of soybean derived from 3 crosses: IAC-17 X BR-16, Embrapa-48 X Conquista and Embrapa-48 X IAC-17. The agronomic characteristics evaluated were mature plant height (MPH), first pod insertion height (FPI), number of branches (NB), number of seeds per plant (NSP), productivity (P), agronomic value (AV) and loadging (L). Regarding the cross IAC-17 X BR-16 the best correlation obtained was for NSP and NB, NB and P, NSP and P, this last one with a 0,97 value. Characteristics such as AV and NB, NSP and NB, AV and P also showed significant correlation but not of such magnitude. The cross Embrapa-48 X Conquista showed the highest correlation value for NB and P, NSP and P, with a resultant value of 0,93. Significant correlations were also found for NB and NSP, NB and P. As for the Embrapa-48 X IAC-17 cross, the best correlation obtained was for the NSP and P, which was of 0,96. Significant positive correlations were also found for NB and AV, AV and P, P and AV, but of less magnitude. Through the obtained results, it can be concluded that for the quoted characteristics the obtained correlation values were positive and highly significant, which could help in the indirect process of selection.

P122. Genetic divergence in endogamics populations of soybean

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The studies of genetic divergence has been amply used as criteria for parents selection as the genetic divergence is positively associate to the heterosis and the variability of segregant generation. The results obtained in breeding program that give priority the increase of genetic divergence, generally, have been limited, specially, related to grain yield. However, the genetic base of soybean in Brazil is known as narrow, leading to recommendations of parents selection more divergent. The morphologic and agronomic similarity among selected genotypes in different populations is a indicative of a low variability explored in breeding. This work aimed to evaluate the genetic divergence among elite lines, selected in five populations, in special due to the grain yield. Five populations were evaluated: I) CEPS 7716 x Doko RC; II) CEPS 8926 x IAC 8; III) CEPS 8926 x FT Cristalina; IV) Coker 6738 x FT Cristalina $RC4F_4$; V) Agratech 550 x FT Cristalina $RC4F_4$. The experiments were carried out in Viçosa/MG, in 1998/99 and 2001. In the first experiment, the populations I, II and III were in F_7 generation, and the others in F_6. Through Anderson's discriminant analysis, the attempt was to classify the inbred lines in the respective populations, and the results consistency evaluated through discriminant analysis based on principal components. In the first experiment the separation among populations was significant in 50% of the cases. The populations IV and V presented great Mahalanobis' distance compared to the others. In the classification of inbred lines, the error rates to populations, individually, varied from 20% to 60%, resulting in an apparent error rate of 44%. The lower error rates were observed in the populations IV and V. The error rates in the classification of field observations (replications) were superior those obtained with base on averages, showing that the apparent error rate is underrated. The graphic dispersal of the principal components shows the similarity among the populations and the overlap among inbred lines. In the populations IV and V, of major productivity potencial and major variability, inbred lines were selected to the second experiment. In this experiment wasn't observed significant separation between the two populations, though the apparent error rate of discriminant analysis was void. However, in the classifications of field observations (replications) a error rate of 16,67% was obtained, showing again that apparent error rate are underestimated. The discriminant analysis based on principal components was highly according with the apparent error rate. It was observed intense tendency of selection to privilege inbred lines with low divergence from adapted parents and adapted cultivars in opposition to the divergence related to less adapted to the selection region. Thus, there is low divergence

among inbred lines selected from different populations, when the selection is based in the same criteria in every population.

P123. Performance of soybean lines

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In the segregating populations are applied different selection strategics searching for the maximum possible gain. However, it's difficult to obtain a maximum gain in a trait without damaging others also important to the acceptance of new cultivars. Thus, the elite lines should be largely evaluated to the decision of their agronomic value, comparatively to the comercial cultivars (control). When the number of lines to be evaluated is too big, these can be separated in groups to compose several experiments with a lower number of treatments. In each experiment the controls are included, they will be the link to the grouped analysis of experiments. In this work, five populations were evaluated: I) CEPS 7716 x Doko RC; II) CEPS 8926 x IAC 8; III) CEPS 8926 x FT Cristalina; IV) Coker 6738 x FT Cristalina RC4F_4; V) Agratech 550 x FT Cristalina RC4F_4. The experiments were carried out in Viçosa/MG, in 1998/99, 2001 and 2002. In the first evaluation of the populations I, II and III was in F_7 generation, and the others in F_6. The reaction stem's canker (*Diaporthe phaseolorum* f.sp. *meridionalis*) was evaluated in F_8 lines of populations IV and V. The lines were inoculated using infested toothpicks. The homogeneity of means square error and the lack of significance interaction between controls and experiments indicated the viability of grouped analysis and of contrasts between populations for two field evaluations. In the first evaluation, the populations IV and V stand out due to the grain yield and lodging resistance. Due to the cycle and the hight in maturation every populations presented average similars. Thus, they were selections individually in the population IV and V, the six best lines. In the second evaluate the population lines IV stand out due to the grain yield producing on average 2017.3 kg ha^{-1}, while the average of population V was 1844.2 kg ha^{-1}. Comparatively to the population V, the population IV characterized to be lower late maturity, lower hight, to present major number of pods per plant and lower weight of 100 seed and lower number of seeds per pod. Among the six lines of population IV, P.IV - 7 (2416.8 kg ha^{-1}) and P.IV - 6 (2145 kg ha^{-1}) stand out due to for the grain yield. Thus, P.IV - 7 it was stand out the controls CAC 1 (2283.1 kg ha^{-1}) and UFV 19 (2023.4 kg ha^{-1}) and P.IV - 6 was surpass UFV 19, due to grain yield, to surpass still that in this population any line significantly differed from controls. These lines have present still hight and cycle similar to controls CAC 1 and UFV 19. However, the P.IV-7 line was only to present susceptible reaction to stem canker. None of the lines population V significantly differed to UFV 19 (1807.5 kg ha^{-1}) due to grain yield and, only P.V-14 was significantly lower CAC 1 (2462.8 kg ha^{-1}). The six population lines V presented resistance reaction by the inoculation with stem canker.

P124. Soybean cultivars differ in potential yield during ontogeny

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Estimating the potential yield is an important tool for the identification of compensating strategies used by soybean cultivars during the growing season. With such knowledge, it is possible to select cultivars and management techniques to maximize yield. The objectives of this study were to quantify the potential yield of soybean cultivars, at the stages R2 (flowering), R5 (beginning of pod filling) and the yield in R8 (maturity), as well as, to identify patterns of loss of this potential in each cultivar tested. The experiment was carried out at the Estação Experimental Agronômica of the Universidade Federal do Rio Grande do Sul (EEA-UFRGS), in Eldorado do Sul, RS, Brazil, during the growing seasons of 1996/97, 1999/00, and 2000/01. A complete randomized block design, with four replications, was used. The treatments were five soybean cultivars (FT-Saray, IAS 5, IAS 4, FT-Abyara, and FEPAGRO RS-10). The potential yield of the cultivars was estimated considering the yield that would be reached if the plant were able to maintain all the flowers present at flowering (R2), all the reproductive structures (flowers and pods) at the beginning of pod filling (R5) and if all flowers and pods were producing pods and grains up to maturity (R8). The soybean cultivars differ in potential yield in each growth stage evaluated, but these differences are not reflected in the grain yield in R8. There are differences among cultivars in the pattern of loss of the potential yield between growth stages. The number of reproductive structures in R2 and R5 influences the potential yield of the cultivars. The percentage of reduction in the potential yield between growth stages differ among cultivars. The studied methods are important tools for the management of soybean crops, when used to compare the potential yield during ontogeny.

P125. Genetic variability of soybean seed density

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The soybean is the most important source of high quality vegetable protein. Thus, the development of high yielding cultivars with high protein concentration in the seed is a major objective in soybean breeding. The inverse relationship between seed yield and seed protein concentration has limited success in developing soybean cultivars with high seed protein. As seed density is correlated positively with seed protein concentration, selection for high seed density genotypes could provide an efficient way to improve protein concentration without affecting seed yield. It is known that genetic correlation between seed density and yield is low. However, data about genetic variability of soybean seed density are relatively scarce in Brazil. Ten soybean cultivars were studied with the objective to identify genetic variability for seed density. For each cultivar, fifty seeds were random selected to determine individual measures and mass. As the seed shape are approximately ellipsoidal, volume was calculated through the equation: $V = (a \times b^2 \times 3.1416)/6$, where a is the larger diameter and b the smaller diameter of the seed. Seed density was estimated as the mass by volume ratio of the seed. Results showed significant genetic variability for seed density among cultivars. Cultivars Emgopa-313 and Monsoy-8001 presented 1.3042 and 1.3104 mg mm^{-3} density, respectively. While UFV-18 and Monsoy-8800 cultivars presented 1.4322 and 1.4526 mg mm^{-3} density, respectively. These cultivars showed the lowest and highest seed densities. Cultivars Aventis-7003, Monsoy-9001, DM-339, DM-309, Confiança and Suprema presented intermediate seed density. Heritability estimate was 0.94, showing that selection for higher density could be effective.

P126. Effects of crop residue, FYM and inorganic fertilizers on soybean-wheat cropping system

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Field experiments were conducted during 2000-03 at Agharkar Research Institute's experimental farm Hol, Pune, India (18°06'N74°21E) to study the effects of integrated use of crop residue and FYM with varying levels of fertilizer management on yield attributes and seed yield of soybean and wheat. Soybean [*Glycine max* (L.) Merrill] cv. MACS 450 was planted during rainy season and in post-rainy season wheat (*Triticum durum* Desf.) cv. MACS-3125 was planted on the same plots. Wheat and soybean residue @ 5 T/ha were incorporated into the soil before planting of soybean and wheat, respectively. Residue management had significant effects on soybean seed yield during 2nd and 3rd year of experimentation where application of wheat residue @ 5 T/ha + FYM @ 5 T/ha + Zn @ 5 kg/ha recorded significantly higher soybean seed yield. Fertility levels exhibited significant effects on soybean seed yield during all the years where recommended fertilizer dose of 20:80:40 kgs of N, P_2O_5 and K_2O/ha respectively, produced maximum soybean seed yield. Seed oil content and 100 seed weight remained unchanged during all the years. Significantly higher wheat seed yields were obtained due to application of soybean residue + residual effect of FYM + Zn @ 5kg/ha. Similarly, application of recommended fertilizer dose of 120:60:40 kgs of N, P_2O_5 and K_2O/ha respectively, recorded significantly higher wheat seed yield than application of half recommended fertilizer dose and no fertilizer application.

P127. Does nitrogen fertilization increase grain yield in high yielding systems in the south area of Santa Fe Province, Argentina?

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In the south area of Santa Fe Province, in Argentina, when environmental conditions are favourable for crop growth and development, high seed yield, between 4000 to 5000 kg ha^{-1}, is usually observed, even though soils present an important agricultural history and the organic matter content is relatively low. In those systems, biological nitrogen fixation supplies 40 to 50% of total soybean nitrogen requirements, and the contribution of organic matter through mineralization (4% annually) wouldn't be enough to reach crop requirements so as to obtain those yields. Consequently, nitrogen fertilization would merge as an important tool to meet the nitrogen requirements of a soybean crop. The objective of our work is to evaluate soybean response to nitrogen fertilization applied to the soil as well as foliar spraying in different moments of its cycle. During 2002/03 season, three assays were established in commercial crops in central south Santa Fe, on a typical Argiudol soil. The experimental sites: Maciel (M), Classon (Cl) and Las Rosas (LR), were chosen based on some indicators of high yielding soybean crops, and taking into account that no severe stress would affect yield after its selection: fields sowed continuously with

soybean or not, presence of active nodules, no nutrient (P, K or S) limitations and a normal growth at R_3, when treatments were established (95 % or more of intercepted photosynthetically active radiation). Treatments consisted in three nitrogen levels applied to the soil (0, 40 and 80 kg N ha^{-1}) as urea (46% N) and three nitrogen levels as foliar spraying (0, 10 and 20 kg N ha^{-1}) using a foliar fertiliser (20% N), in two moments in the growth cycle: R_3 and R_5. In R_3, before fertiliser application, a nodule sampling was done to determine number and weight, and in R_5 nodule colour was observed to determine its activity. In R_8 yield and its numerical components were determined. Grain yield in the treatment without fertilization were: 3612, 4050 y 4581 kg ha^{-1} en M, LR y C, respectively and there were no significant increments in grain yield or its components when nitrogen was applied to the soil in R_3 as well as in R_5 in the three experimental sites. The treatments that received nitrogen fertilization in R_3 had a lower nodule activity when evaluated in R_5. On the other hand, nitrogen spraying didn't increment grain yield in R_3 as well as in R_5 in all the surveys as it was observed with soil urea applications. The absence of response to nitrogen fertilization in soybean is in agreement with results obtained in the area, in other environmental conditions with lower grain yield. The observed decrease in nodule activity after fertiliser applications may have been compensated by the supply of nitrogen through fertiliser. These results indicated that nitrogen inputs through biological fixation and/or nitrogen mineralization would be enough to obtain high grain yield in soybean, and further research has to be carried out to quantify these nitrogen inputs to make a more reliable nitrogen balance.

P128. Levels and times of nitrogen application in soybean (*Glycine max* (L.) Merrill) crop cultivated in no tillage system

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Nitrogen is a nutrient requested in larger amount by soybean (*Glycine max* (L.) Merrill) crop, because the grains are rich in protein, presenting a medium content of 6.5% of N. The soybean needs of approximately 80 kg N to produce 1000 kg of grains, being the main sources, the soil, through the decomposition of the organic matter, the chemical N fertilizers and mainly the biological nitrogen fixation. In this context, the present work was conducted with the objective of evaluating the effects of levels and times of nitrogen application in the agronomic characteristics of two soybean varieties, cultivated in no tillage system, in a typical area of savannah. The study was developed at Experimental Station of UNESP - Ilha Solteira Campus, located in Selvíria county - MS, Brazil, presenting as geographical coordinates, 20°22'S and 51°22'W and approximately 335m of altitude. The soybean varieties used were: BRS 133 and BRSMS Piracanjuba and the levels of N consisted of 50, 100 and 200 kg ha^{-1}, applied in the stadiums of V4, R2, R5 and 1/2 of the level in R2 + 1/2 in R5. The source of nitrogen used was the urea and a treatment control, 0 Kg of N ha^{-1}, was also evaluated. The sidedressing nitrogen applications were accomplished at respective development stadiums and the used experimental design was the randomized blocks with 4 repetitions. For all treatments, the seeds were inoculated with turf inoculant and treated with fungicides according to recommendations for the crop. The sowing happened in 12/18/02 in area cultivated in the previous years with corn associated to *Braquiaria brizanta* (Sistema Santa Fé). Through the obtained results, it is ended that there is not interaction among the treatments with levels and times of nitrogen application and the appraised varieties; the application of nitrogen, independent of level and time, does not alter significantly the grain yield, height of plants and insert of the first beans and, number of beans for plant; the application of nitrogen in the R5 stadium has been showing to increase the yield grains with larger mass; the largest production of grains (4204 kg ha^{-1}) and the smallest (3474 kg ha^{-1}) was obtained respectively with the treatments 200 kg ha^{-1} of applied N at R5 stadium and 100 kg ha^{-1} of applied N at R2 stadium, while the control yield was 3836 kg ha^{-1}; the BRS 133 variety was shown as the most productive.

P129. Foliar plant nutrition: application time of phosphorus on soybeans [*Glycine max* (L.) Merrill]

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Foliar crop nutrition has been widely used and may constitute a good method to treat In order to generate information to aid technicians and producers in the determination of cultivars to be planted in Lavras Country in summer time. The present work was carried out at the experimental area of Federal University of Lavras, Lavras, MG, Brazil an a Red Latosol (LVdf), in 2002/2003 growing season, to determine soybeans cultivars, as summercrops, for Southern Minas Gerais. The experimental design was a randomized block casualized with three replications. The 45 cultivars (treatments) used in the experiment was: Doko, Pioneira, Virtuosa, Conquista, FT-104, Monarca, Monsoy 108, Monsoy 109, FT-Abyara, Performa, Liderança, Monsoy 8400, Confiança, Splendor, UFV-16, Garantia, Renascença, IAC-19, FT-2000, IAC-21, CAC-1, Monsoy 8411, Suprema, Segurança, Aventis 7002,

Paiaguás, Carrera, Santa Rosa, BRS-Celeste, DM 339, BRS Carla, BRS Milena, BRS MG 68, BR-9 Savana, AV 2056-7, STTE 02, AV. 1043, Monsoy 8866, Monsoy 8329, Monsoy 9010, Embrapa 48, Emgopa 313, Emgopa 314, Tucano, BRS 136. All tested cultivars showed good grain yields, specially BRS MG 68 (4395 kg.ha^{-1}), Paiaguás (3897 kg.ha^{-1}), AV 2056-7 (3780 kg.ha^{-1}), Monarca (3646 kg.ha^{-1}) and FT 2000 (3498 kg.ha^{-1}). Soybean plant and first pod height, taken by harvest time, was in the range of 0,68m to 1,53 m and of 0,08 m to 0,29 m respectively. Lodging induces were also satisfactory for all cultivars tested. Seed quality of the cultivars was avaluated and ranged from 1,6 to 3,6 in a 1-5 scale. Such variation was be atributed to different climatic conditions and processing time the cultivars with different life cycle underswent.

P130. Phosphorus and potassium fertilization at different sowing times in pre-sowing application under a no-tillage system in the soy crop (*Glycine max* (L.) Merrill)

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Recommended dosages of fertilizer for no-tillage cropping systems are based on criteria adopted for the conventional soil preparation. The search for specific techniques to handle fertilization, like the production of dry matter to cover the soil, is required to improve the efficiency of fertilizers and reduce production costs. Adequate handling of phosphate fertilizers should be chosen according to specific characteristics of the soil and culture, among others. It is not possible to adopt general handling practices, ignoring the particularities of the soil in different places. It is necessary to identify chemical, physical and biological characteristics of each soil and incorporate new techniques as the adoption of no-tillage cropping systems and new fertilization techniques, in order to minimize some problems faced at sowing. The experiment was conducted in a Typical Acrustox soil at UFU (Universidade Federal de Uberlândia), in the city of Uberlândia, Brazil from June, 1999 to April, 2002. The purpose of this work was to evaluate the response of soybean (MG/BR-46 Conquista cultivar) to anticipated application of phosphate and potassium fertilizers at pre-sowing, under a no-tillage system. The experimental design consisted of randomized blocks with five treatments and five repetitions. The fertilizers were applied to the soil surface, during the months of July, August, September, October and November (together with the sowing). Magnesium multiphosphate was used as a fertilizer, at the ratio of 00-16-16 (phosphorus with 16% sol. CNA and 8% sol. H2O) in a dosage of 625 kg/ha^{-1}, providing 100 kg/ha^{-1} of K2O and 100 kg/ha^{-1} of P2O5.The following characteristics were evaluated: productivity, levels of P and K in the leaves and soil, height of the first string bean and weight of one hundred seeds. Under the conditions of this experiment, the conclusion was that the application of phosphorus and potassium fertilizers under no-tillage systems, up to five months before the sowing, did not affect productivity, levels of P and K in the leaves, height of the first string bean and weight of one hundred seeds through the same growing season, but caused significant increase on these characteristics as successive crops were grown.

P131. Length of the soybean root system determined by SIARCS and TENNANT methods in different conditions of acidity and phosphorus levels on no tillage system

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The root is the part of plant that reflect with larger intensity the effect of soil acidity. Lime is the practice used in the neutralization of toxic aluminum. In no tillage system, the phosphorus concentration increase can contribute to reduce aluminum toxicity in solution, so that root plant become finer, being deepened in the profile and absorbing more nutrients. The standard method to estimate root length, described by Tennant (1975), has been a lot used by the simplicity, low cost and trustfully, however, it demands time and labor. This method measure the root length using a line grades system, being used a system of line bars, where the roots are positioned. The number of root intercepts is quantified with the horizontal and vertical lines of the bars system by the formula R = N x FC where N = number of intercepts and FC = conversion factor. An alternative methodology for the study of root length is the processing of digital images, denominated SIARCS, developed by EMBRAPA Agricultural Instrumentation, that consists on to obtain root digital images (Crestana, 1994). This methodology has been used by the speed, even so, it is more complex and expensive compared with the standard methodology. In order to to evaluate precision and operacionallity of the SIARCS method, in comparison with the Tennant method, an experiment was used from EMBRAPA-Wheat, in a typical distrofic Red Latosol under no tillage, in Passo Fundo - RS. The area was native field up to 1988, when it became cultivated in the conventional system up to 1994. On this year, the no tillage system was installed, incorporating 1, 6 and 24 Mg ha-1 (1 SMP - pH 6,0) of lime. It was collected from the experiment, non altered samples (PVC) of 10 x 15 cm of soil, in the inter-row of the soybean crop, (3 column/plot). Phosphorus was superficially applied on the columns, the equivalent to 0, 40 and 80 kg ha-1 of P_2O_5, being sowed soybean,

BR-16 variety, that was cultivated by 25 days. It was analyzed the soil chemical attributes, the root length by the Tennant (1975) and SIARCS (Crestana, 1994) methods, and the root ratio. Comparing the obtained results by the two methods, it was noticed that the soybean root length was similar in the columns that didn't receive lime and phosphorus, in conditions of high level of exchangeable aluminum (3,6 $cmol_c kg^{-1}$), what took to the root thickness. Even so, while acidity decreased and phosphorus addition increased, there was reduction tendency in the root ray and larger were the differences among root length determined by the two methods (up to 2,30 times superior for Tennant), demonstrating the low sensibility of the method SIARCS to determine the fine root length of the soybean, underestimating the results obtained by the Tennant method.

P132. Response of the soybean plant (*Glycine max* (L) Merrill) to split applications and different doses of potassium in sandy soil of Brazilian Cerrado

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Due to the continuous use of concentrated formulas with high levels of P and low levels of K in soil fertilization, there has been a gradual exhaustion of soil and more areas with low levels of K have been appearing (Borkert et al., 1993). Leaching of K in soils within the Brazilian Cerrado indicates losses varying from 36% to 48% (Chaves & Libardi, 1995). It has been observed that soil potassium can be exhausted up to a level in which deficiency is not severe or visible yet, but can certainly inhibit grain quality and productivity. One technique to reduce these losses is the application of potassium fertilization split in small dosages. The objective of this work was to evaluate the effect of four dosages of K2O applied at sowing, as well as, the effects of breaking down the 60-kg/ha^{-1} dosage of K2O and applying them at sowing and as surface fertilization to Garimpo and FT-Cristalina cultivars.This research was conducted on Dois Irmãos farm, in Monte Alegre de Minas, MG, Brazil, during the years of 1999/2000, under the following field conditions: Eutric Red Latosol, sandy texture, cerrado phase The experimental delineation was random blocks with nine treatments and three repetitions and the purpose was to determine the effect of the following doses of K: 0, 30, 60 and 90 kg/ha^{-1} of K_2O, applied at sowing, through polynomial regression. At the same time, dosages of 60 kg/ha^{-1} of K_2O were applied at different times as fertilization, at the following ratios: 00P-60C-00F, 20P-40C-00F, 30P-30C-00F, 40P-20C-00F, 00P-00C-60F, 20P-00C-40F, 30P-00C-30F, 40P-00C-20F; and as a control treatment at the ratio of 60P-00C-00F kg/ha^{-1} of K_2O. A significant linear increase was observed in response to a dosage of up to 90 kg/ha^{-1} of K2O applied totally at sowing, The results were: greater productivity, higher plant height, higher height of insertion of the first string bean and higher levels of K in the soil. There was an increasing quadratic effect on the height of plants in response to increasing dosages of K2O. FT-Cristalina cultivar reached an average height (65,75cm) above Garimpo cultivar (55,53 cm). As to the potassium level in the soil, an increasing quadratic effect was observed in both cultivars, in response to the increasing dosages of K2O. At the end of the evaluations, the potassium level observed in the soil was quite higher for FT-Cristalina cultivar comparing to Garimpo cultivar. The use of 60 kg/ha^{-1} of K2O at 45 and 55 days after the emergency (for Garimpo and FT-Cristalina cultivars, respectively) resulted in a significant increase on the number of string beans per plant, a smaller number of empty locules and higher number of seeds per plant. Breaking down the dosages of K2O had significant effects, mainly when the K2O was applied at flowering, when compared to the application only at sowing.

P133. Doses and modes of application of potassium upon soybean crop [(*Glicine max* (L.), Merrill)] under two edafoclimatic conditions in the Minas Gerais State

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With the objective of studying the effect of doses and modes of application of K on yield and quality of soybean seeds, two trials were set up in Lavras (Red-yellow Argilosol, clayey) and Uberaba (Red Latossol, sandy-loam), both of them with low availability of soluble K. The experimental design was randomized blocks with four replicates, in a factorial scheme, encompassing three modes of application (planting, split and top dressing), four doses (40, 80, 120 and 160 Kg ha^{-1} of K_2O) and check, without any K. In Uberaba there was effect of interaction between application modes and K doses on the productivity of grains, since, when the nutrient was applied in top dressing there was effect of dose. However, when the fertilization was made at the planting or split, there was no response to the doses. The application of K, regardless of the dose or mode, increased the grain, oil and protein yields. But seed vigor was affected by the increasing doses of K, independent of the mode of application. In Lavras, the applications of K at planting or split, independent of the dose, increased the grain yield, as compared with topdressing. Oil content was affected by the interaction between doses and modes of application;

the application at planting increasing the oil content and the topdressing and split applications, decreasing the oil content. In Uberaba, the applications of K at planting or split, independent of the dose, increased the leaf contents of N and Ca, and the leaf Ca/K ratio, as compared with the topdressing. In Lavras, the leaf Ca/K ratio was lower when the K was applied in topdressing as compared with the other two modes of application. Also in Lavras the leaf ratio between Ca and Mg was lower when the K was applied in topdressing, as compared with the other two ways of application. In Uberaba the characteristics of the soils after harvest showed increase in the soluble K content and in the percentage of K saturation with the increasing doses of K. The contents of Ca and Mg, the percentage of saturation of them and ratios between Ca and K and between Mg and K decreased with the increasing doses of K. In Lavras, soluble K increased when the K was applied at planting and Mg decreased when K was applied topdressing. Also was observed that the Mg/K ratio decreased with the increasing doses of K.

P134. Critical levels of sulfur for soybean in Brazilian soils

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Modern agricultural technologies, intensive use of fertilizers, without S or with low S content, and improper soil management, lower the organic matter content in soil, changing after S availability. In 1998/99, sulfur fertilization research was conducted at several locations in Brazil: in a alic oxisol (latossolo vermelho-escuro álico) at Ponta Grossa, PR, in a eutrofic oxisol (latossolo roxo eutr+ofico) at Londrina, PR, in a dystrofic oxisol (latossolo vermelho-amarelo distrófico) at Sambaíba, MA, and in a dystrofic oxisol (latossolo vermelho-escuro distrófico) Rondonopólis, MT. The objective was to determine the effects of S on soybean yields and to establish critical levels of S in each soil. The experimental design was randomized blocks, with five S levels (0; 25; 50; 75 and 100 kg ha^{-1}) and the sulfur source was elementary sulfur, with 98% S. In the crop year of 2000/01, in Bom Jesus (PI), in latossolo vermelho-amarelo, an experiment was conducted with five levels of S (0; 20; 40; 80; 120 kg ha^{-1} of S) with three source of sulfur: Simple Superphosphate; Elementary sulfur and Gypsum. From the results, the critical level of S in each soil were determined extract with $Ca(H^2PO^4)_2$ 0,01 M/L and determined using Turbidimetric methods, was: in Londrina and Ponta Grossa the limits were: low <5 mg dm^{-3}; medium 5-10 mg dm^{-3} and high >10 mg dm^{-3} for soil depth at 0-20 cm; and low <20 mg dm^{-3}; medium 20-35 mg dm^{-3}; and high >35 mg dm^{-3} for soil depth at 20 to 40 cm. In Sambaíba, Bom Jesus and Rondonópolis soils, the critical levels were: low <2 mg dm^{-3}; medium 2-3 mg dm^{-3}; and high >3 mg dm^{-3} for depth at 0-20 cm and low <6 mg dm^{-3}; medium 6-9 mg dm^{-3}; and high >9 mg dm^{-3} for depth at 20-40 cm.

P135. Effect of sulfur application on soybean production, in four soil types of Brazil

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Sulfur (S) is an important nutrient very little studied in soybean, which has resulted in the lack of information for the establishment of critical levels in soils and response curves of crops to this nutrient. In fact, soybean occupies extensive areas in Brazil and the addition of fertilizers requires rational recommendations. In 1998/99, sulfur research was conducted at several locations: Ponta Grossa, Paraná, in a alic oxisol (latossolo vermelho-escuro álico) soil, Londrina, Paraná, in a eutrofic oxisol (latossolo roxo eutrófico) soil, Sambaíba, Maranhão, in a dystrofic oxisol (latossolo vermelho-amarelo distrófico) soil, and Rondonopólis, Mato Grosso, in a dystrofic oxisol (latossolo vermelho-escuro distrófico) soil, to determine the effects of S on soybean yield. The experimental design was radomized blocks, with five S levels (zero; 25; 50; 75 and 100 kg ha^{-1}). The source was the elementary sulfur, with 98% of S. The S response curves, across four locations, and year by averages, showed a quadratic response of grain yield, and highest production (3120 kg ha^{-1}) was obtained with 50 kg ha^{-1} of S. The yield of 3115 kg ha^{-1}, obtained with foliar application of S was similar to the best level of S applied to soil, showing this to be a reliable alternative, in case of is S defficiency.

Contributed Papers

ISPUC

C025. Genotypic variation for phytic acid among Indian soybean cultivars and influence of growing location

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Phytic acid, the heat stable anti-nutritional factor and accounts for 80% of the phosphorus in soybean seeds, was determined in eighty cultivars/strains of Indian soybean to identify lines that possess high or low concentrations of phytic acid. It ranged from 28.8-46.4 mg per gm of soy-flour. The highest value was observed in LSb1 while the lowest in MAUS1. The information on influence of growing locations, widely differing in soil types, on accumulation of phytic acid in soybean seeds being scarce, the mature dry seeds of eight Indian soybean cultivars grown over four locations were also evaluated for phytic acid content. Variation in different varieties at different locations ranged from 27.8– 45.0 mg per gram of soy flour. Averaged over eight genotypes, maximum mean value for phytic acid was observed at Pantnagar (29°N) and minimum at Palampur (32°N). These differences in locational mean value for phytic acid may be explained on the basis of physico–chemical characteristics of the soils and environment. The higher mean value at Pantnagar may be attributed to higher soil organic phosphorus, nearly neutral pH, ideal texture and favorable temperature from flowering to maturity. On the contrary, the low value of phytic acid observed at Palampur (32°N), may be because of alfisollic characters of the soil which don't support accumulation of phytic acid in soybean seed grown on them. These soils being acidic in reaction with pH value of 5.5 and being rich in oxides of Fe and Al might have contributed to increased phosphorus sorption and limited biological activity thereby restricting the mobilization of phosphorus in available pool for the uptake by plants. Moreover, the lower maximum and minimum temperatures prevailing from flowering to maturity at Palampur (32°N) than other locations might have also contributed to lower soil temperature leading to poor biological activity resulting in decreased mineralisation of organic phosphorus and hence low uptake of phosphorus by the plants. Locational and genotypic x locational effects were found to be significant ($p < 0.01$).

C026. Utilization of soybean meal by the young chick

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Soybean meal (SBM) is an important source of dietary protein for poultry most of the world. Recent research has shown that both the ME_n and amino acid digestibility of a corn-soybean meal diet fed to chicks increased substantially as the chicks aged. It has been suggested these changes are due to the utilization of soybean meal, which may be poor in the young chick. The objective of these studies was to evaluate the effect of age on the nutrient utilization of soybean meal. In initial studies the ME_n of a corn-SBM diet increased from 2 to 21 days of age from 2,970 to 3,430 kcal/kg. Amino acid digestibility also increased substantially with age. Methionine and lysine digestibility increased from 80 to 92% and 78 to 89% from 2 to 21 days of age respectively. Soybean meal was incorporated into a dextrose-SBM diet to study the changes in it's utilization, assuming dextrose is 100% digestible. The ME_n of soybean meal increased from 2783 kcal/kg at 2 days of age to 3128 kcal/kg at 21 days of age, an increase of over 400 kcal/kg. Lysine and methionine digestibility increased 13 and 17% from 2 to 14 days of age. Starch digestion based on contents collected at the terminal ileum increased from 84% at 4 days of age to 93% at 21 days, but when determined by excreta collections the increase was not as large and only increased from 90 to 95% between 4 and 21 days of age. The change in digestibility of certain oligosaccharides (sucrose, raffinose, stachyose, verbascose) with age was also measured. Little to no change in sucrose digestibility with age was observed based on either ileal or excreta collections. The digestibility of raffinose, stachyose, and verbascose was highest at 4 days of age and generally decreased with increasing age. The determined digestibility values of raffinose, stachyose, and verbascose were higher when based on excreta versus ileal collections. When the digestibility of soybean meal was compared to that of casein it was clear that milk protein in casein is more highly digested than soy protein during the first week posthatching. Other studies have indicated that the ME_n and amino acid digestibility of soy for very young chicks

can be improved by further processing to soy protein concentrate and soy protein isolate and by genetically reducing the antinutritional factors such as trypsin inhibitors and lectins. In addition, the negative effects of undercooked soy products on nutrient digestibility are profound in young chicks, and these products should definitely not be included in their diets. Further research is being conducted to more precisely evaluate these changes in ME_n and amino acid digestibility of soybean meal with age and to develop prediction equations to adjust digestibility based on chick age.

C027. Physical refining and performance of specialty soybean oil

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Soybean processing into oil and meal by the use of extrusion cooking and screw pressing has been recently developed and commercialized. The meal produced by this technology has been proven to be nutritionally superior to the solvent extracted counterpart. However, the viability of the technology depends also on the quality and value of the oil. The oil was shown to contain relatively low levels (0.2%-1.0%) of phosphatides and unsaponifiable matter compared to solvent extracted crude soybean oil. The color, clarity, and flavor of the oil were rated superior to that of solvent extracted oil. Because the oil was extracted by a chemical-free method, it was interesting to investigate refining of the oil also by physical means. This would enable both the oil and meal to be truly natural products. Field level research has lead to successful refining of this oil by de-gumming, bleaching, and deodorizing with fatty acid recovery. A 30 tons/day physical refinery has been built alongside the extrusion and screw pressing facility of a farmer's cooperative. The whole processing facility is dedicated to processing identity preserved soybeans produced by the farmers. The physically refined soybean oil without hydrogenation, is being marketed as specialty oil and is being used as cooking and even as frying oil. The value traits are chemical free processing and the lack of trans fatty acids. The users of the oil in restaurants have reported that the oil has a longer fry life compared to partially hydrogenated liquid frying oil. Customers consuming the products fried in the new oil have reported that the food is less greasy and have better appearance and flavor. In order to validate the anecdotal evidence, a comparative fry life study was conducted with the physically refined soybean oil and partially hydrogenated liquid frying oil. Progressive deterioration of the oil with consecutive frying cycles was monitored by determining free fatty acids, peroxide value, p-anisidine value, absorbance at 520 nm, color, polymerized triglycerides, and oil stability index. It was found that except in the case of the p-anisidine value, the physically refined oil performed better than the partially hydrogenated liquid frying oil. Further studies are needed to elucidate why the un-hydrogenated physically refined oil performed better than the solvent extracted and partially hydrogenated oil.

C028. Promotion of soybean for food uses in India

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Though soybean has established itself within as an integral part of cropping system, particularly in the central part of India, its food uses have been minimal except in the case of edible oil. The research during last one decade has brought forth the beneficial effects of soybean intake on providing health security to human beings. To promote the utilization of soybean for human consumption, a project was executed to impart the knowledge of soybean processing techniques and the health benefits associated with soybean during 2001-02. Under this project a total of 34 training programmes (both on and off-campus) of one-day duration covering 1193 housewives were organised on processing of soybean at household level for food uses. They were trained on preparation of soymilk, soy tofu, soy nuts and soy *pakora* (an indigenous preparing of popular snacks of the area). It was observed that, around 43 per cent of the respondents were aware of consumption of soybean in different forms (soy oil, soy flour and baked soy pods). Among the different categories of women, it was found that majority of women from urban areas had awareness of the usage in popular form like soy flour and soy oil. Interestingly, the rural and tribal women utilized soybean mainly as backed soy pods (at green pod maturity stage) and soy oil. It was found that among the five different ways of consuming soybean for food usage, soy *pakora* and soy nuts were most preferred items and liked by majority (around 50 per cent) of the respondents across the different categories followed by soy milk and green pods boiled in salt water. Very few respondents have given their preference for soy *paneer*, which according to them need some expertise and hard work in processing. It was observed that all the categories of respondents reported that preparation of soy *pakora* was easiest one followed by soy nuts. It may be due to the crispy nature of the preferred products, which suits in the food habits of the Malwa region. These are akin to the snacks and *namkeens* normally consumed in the region.

C029. Saponins in soybean

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Research has shown that saponins from a variety of sources have considerable health benefits such as cholesterol-lowering, cancer-inhibiting and hepato-protective properties. Biologic activity is related to their chemical structures, amount and by association with proteins, isoflavones, lecitin, fatty acids. Soybeans are major dietary sources of saponins and are complex compounds with a diversity of structures and composition depending on variety, plant age, climate and phase of growth. Previous reports had shown that seeds of soybean (*Glycine max* L. Merrill) contain from 0.6% to 6% of saponins. Many kinds of saponins have been isolated from soybean seeds, and their structures have been determined as group A, group B and group E on the base of their aglycone structures (soyasapogenol A, B and E). In this study the composition and content of saponins in the hypocotyl of Brazilian soybean cultivar BRM 52273, was investigated. The determination was performed using High-performance liquid chromatography on reversed-phase. Our results were shown that in seed hypocotyl the level of saponin group B were 1,6 %. The hypocotyl included Ba and Bb(approximately Ba:Bb – 1:3) as the main structures of the group B saponins.

C030. Role of soy (*Glycine max* L. Merrl) and linseed (*Linum ustatissimum)* on glycemic response of selected diabetics

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Twenty type II diabetics were selected and the relevant information like age, sex, food and nutrient intake, anthropometrical measurements, selected clinical parameters etc. were elicited. A common south Indian recipe *viz., adai* (a shallow fat fried breakfast item made with ground rice and pulse mixture) was formulated incorporating defatted soy flour and linseed. The glycemic responses in the patients (control and experimental) on ingestion of standard and experimental *adai* were determined after matching the two for carbohydrate content. Among the selected diabetics majority was above 40 years old and obese. Intake of cereals, pulses, green leafy vegetables, roots and tubers and fruits recorded deficit and intake of milk and its products and fats and oils was more compared to recommendations of Indian Council of Medical Research. Genetic factor was the main etiological factor reported by the selected diabetics. Hypertension, cardiac problems, retinopathy and gangrene were the other complications reported by a few. The defatted soy flour and linseed incorporated *adai* was acceptable, providing more protein, essential fatty acid and fibre than the standard. The mean incremental blood glucose on ingestion of standard *adai was* 64 mg/dl and that of the experimental was 46mg/dl showing the superiority of soy-linseed *adai* in controlling the blood sugar better.

C031. Glycopeptides in soy protein hydrolysates and their effects on proliferation of murine splenocytes

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The objective of the study was to obtain soy glycopeptides from β-conglycinin hydrolydates and to confirm effects of glycopeptides on the proliferation of murine splenocytes by the method of cell incubation in vitro. In addition, the role of carbohydrate chains in the effect was also investigated. In the study two kinds of soy glycopeptides were isolated from hydrolysates of β-conglycinin, from Alcalase and Pronase E with average molecular weight of 1670Da and 1135Da. The carbohydrate content of two glycopeptides was 8.23% and 9.66% respectively. Both of soy glycopeptides had inhibitory effects on ConA-stimulated proliferation of murine splenocytes that determined by MTS/PMS colorimetric assay at 492nm. The degree of inhibitory effect on ConA-stimulated activity reached to 40%~50% at concentration ranging from 50~100μg/ml. When carbohydrate chains in glycopeptides were removed with N-Glycosidase F, the inhibitory effect of glycopeptide derived from Alcalase hydrolysate decreased, but that of glycopeptide from Pronase E hydrolysate changed little. On the other hand, both of glycopeptides showed promoting effects on proliferation of murine splenocytes in absence of ConA. The results indicated that soy glycopeptides had immunomodulatory effects from two aspects.

C032. Soy leghemoglobin production for iron nutrition applications

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Leghemoglobin, a protein present in the root nodules of soy, has significant structural homology to heme proteins in animal food sources, accumulating high quantities of iron at fortificant quality levels. The significantly higher iron bioavailability from heme proteins makes them a desirable iron form for fortification, biofortification or dietary diversification interventions to improve iron status in the over 2 billion people affected by iron deficiency. The objectives of this study were to assess a model system for leghemoglobin production, and to assess its bioavailability. Leghemoglobin can be produced as part of an edamame or forage crop program with harvest pre-maturity, or a soybean crop if harvested at R8 maturity, and using a silo drying system for the beans. Varietal and agronomic changes cause differences in leghemoglobin production and must be considered for optimal yield. The nodules were removed from the root system by a brushing step, rinsed and air or freeze dried for further utilization. The ground nodules were used as a fortificant, providing statistically similar bioavailability ($p<0.05$) to bovine hemoglobin as assessed by the rat hemoglobin repletion slope ratio and hemoglobin repletion efficiency methods. Leghemoglobin can be extracted from the nodules. A crude leghemoglobin extract can be obtained with water, sodium hydroxide 0.1molar, sodium chloride 0.1molar, or Tris-HCl 0.1molar at pH8.1 to obtain extracts of 32%, 41%, 39% and 37% purity respectively as determined by electrophoresis densitometry. Further purification by ammonium sulphate fractionation to obtain the 50-80% saturation protein fraction can provide a leghemoglobin purity between 62 and 75%. A highly pure extract with 85% to greater than 95% purity can be obtained through ion exchange separation on DEAE Sepharose media, eluted with water, with a secondary peak eluted with 0.5molar sodium chloride. The high purity extract shows statistically similar bioavailability ($p<0.05$) to bovine hemoglobin and ferrous sulphate-ascorbic acid 1:20 molar ratio as assessed by the in-vitro Caco-2 cell ferritin production bioavailability method.

C033. Resistance of soybean cultivars to field populations of *Heterodera glycines* in North Carolina

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The soybean cyst nematode (SCN), *Heterodera glycines*, is the most important pathogen of soybean in North Carolina. Cultural practices are the most effective means of managing this pathogen because the majority of SCN resistant varieties are susceptible to the races of this nematode that predominate in the State. Resistant and susceptible cultivars were evaluated for their level of resistance and yield in 14 *H. glycines* infested fields from 1992 to 1999. Resistance derived from plant introduction (PI) 437654 was highly effective against all populations of *H. glycines* evaluated in these experiments. Numbers of cysts per 3 plants 28 days after planting (Cysts 28 DAP) and final egg population densities (Pf) were lower than on other cultivars evaluated. Cultivars derived from PI 90763 were moderately resistant in many of the test fields. Peking-derived resistance to SCN was effective at only two locations. Some resistant cultivars derived from a background of PI 88788 (and Peking) were highly to moderately resistant to races 9 or 14 of SCN, but were not consistently effective against other populations. Cultivars Hartwig or Delsoy 5710 (derived from PI 437654) had low SCN reproductive factors (Rf = egg density at harvest/egg density at planting) of 0.16 and 0.23 compared to an Rf of 1.9 and 2.19 on susceptible cultivars Essex and Hutcheson. In contrast, Rf on cultivars derived from Peking were generally greater than on susceptible cultivars. Resistant cultivars Hartwig or Delsoy 5710 generally yielded more than susceptible cultivars or cultivars derived from other sources of resistance. The initial inoculum level (Pi) and Cysts 28 DAP were related to soybean yield by a quadratic model, but Cysts 28 DAP proved to be better at predicting seed yield than Pi when the majority of cultivars were susceptible. Due to the genetic diversity of *H. glycines* populations with regard to the ability to parasitize resistant cultivars, cultivars with resistance derived from 437654 are needed to improve management of this nematode.

C034. Classifying virulence phenotypes of the soybean cyst nematode, *Heterodera glycines*

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The soybean cyst nematode (SCN), *Heterodera glycines*, limits soybean yields in many production areas worldwide. Since 1970, virulence phenotypes of SCN populations have been classified as races according to a bioassay that includes three soybean lines representing different sources of SCN resistance. In 2002, the HG Type test ("HG" stands for *Heterodera glycines*) was published as an alternative (Journal of Nematology 34:279-288). The HG Type test, like the race test, is a bioassay that gives average virulence phenotypes for SCN populations, but differs from it in the number of resistant soybean lines used for the test (seven) and the mechanism of designating population phenotypes. The HG Type system provides more information on the potential for SCN populations to adapt to, or "break," resistance. In addition, the HG Type designation conveys immediate information on virulence phenotypes and can be expanded to accommodate new resistant lines, modified for Brazil, China, or other countries, or modified for use by soybean producers. The Illinois SCN Type test will be presented as an example of the latter type of modification. The primary limitation of such tests, as with the race scheme, is that they cannot be used appropriately for population or molecular genetic analyses, which require genotypic information. Current studies on molecular assessment of virulence through analysis of genes for virulence will be presented.

C035. Soybean rust in Argentina

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Soybean rust is a destructive fungal disease causing severe losses to soybean crops in several continents. Soybean rust is caused by two fungal species, *Phakopsora pachyrhizi*, (Asian form), and *Phakopsora meibomiae*, (American form). The Asian form is more aggressive and causes more damage than the American form. In Brazil and Paraguay *Phakopsora pachyrhizi* was detected in 2001 and 2002. In Argentina soybean rust was reported in 2002, in the provinces of Chaco and Misiones. During 2003 soybean rust was detected in field trials at INTA Cerro Azul Experimental Station (province of Misiones), and in two fields plots at Gobernador Virasoro (province of Corrientes). The molecular diagnose (PCR) confirmed the presence of *Phakopsora pachyrhizi*, not only on the soybean simples but also on several alternative hosts found in those areas, like Cajan (*Cajanus cajan*), Kudzu (*Pueraria lobata*)

and Mucuna *(Mucura cochinchinesis*). Symptoms of soybean rust may be observed anytime during the cycle of the crop, but they are more evident after flowering. The symptoms progress from lower to upper leaves. *Phakopsora pachyrhizi* is a biothrophic fungus that does not survive on debris, but in live plants and alternative hosts. It primarily spreads by wind-borne spores that can be transported over long distances. Among the alternative hosts of *P. pachyrhizi* are: *Pueraria lobata, Melilotus spp., Lupinus hirsutus, Phaseolus vulgaris, Styzolobium niveun, Vigna unguiculata, Cajanus cajan; Crotalaria, Dolichos, Lablab, Medicago, Pachyrhizus, Rhynchosia*, and *Vicia*. Under cool and humid weather the disease can reach from the initial infection to 90% in three weeks with premature senescence of plants and heavy defoliation reducing the seed size and yields. The losses due to soybean rust are related to the phonological stage of the time of infection and the severity of the symptoms. Although the disease is restricted to the northern region of Argentina, according to the weather conditions recorded by the Weather Station of INTA Pergamino in the northern region of the province of Buenos Aires (Argentina), the climatic conditions during the soybean seasons of the last two years (2002 and 2003) were favorable for the occurrence of soybean rust. The options for the management of the soybean rust are the use of tolerant/ resistant cultivars, and the use of foliar fungicides. Since available commercial varieties are susceptible the only effective tool to reduce yield losses is the application of fungicides.

C036. Present status of soybean rust in India

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Soybean rust caused by *Phakopsora pachyrhizi* Syd., is one of the major diseases of soybean in India. It is distributed in the main soybean growing areas of Karnataka, Maharashtra and Madhya Pradesh and also in north eastern state like Meghalaya. Disease prevailed in severe form on irrigated crop compared to rainfed grown crop. Pathogen was found only in the uredial stage but the telial stage was lacking. In rust endemic areas losses went up to 75 per cent. The presence of uredospores in the air around soybean fields was observed a week before the onset of rust. The auto regression models developed were found accurate and suitable for prediction of uredospore load in the atmosphere. French bean, cowpea, horsegram and dolicho's bean were found as collateral hosts of *P.pachyrhizi.* These hosts, self sown soybean plants and continuous cropping of soybean throughout the year helping the pathogen (in uredial stage) to perpetuate from one season to another season. Early sowing i.e., II FN of may, use of resistant varieties (PK 1029), spray of triazole fungicides *viz.*, hexaconazole, propiconazole, triadimefon and tebuconazole @ 0.1% and break in the continuous cropping of soybean in the rust endemic areas are found to be the effective management practices for rust control.

C037. Studies on source of primary inoculum, survival and reoccurrence of soybean rust in India

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Rust (*Phakopsora pachyrhizi*), which came in prominence in the country after 1993 has been threatening the remunerative status of soybean in some parts of India by causing yield loss in the range of 20-100%. Based on the studies made in recent past a short-term rust management strategy was developed. But looking to the loss from the rust, it becomes inevitable to develop a effective and rational long-term management practices. Making available durable rust resistant varieties is one to the important aspects of the management. To achieve this goal and to make management more effective, it is imperative to have knowledge on the biology and epidemiology of the rust. A multilocational project was therefore taken up to generate such information. Based on 21 surveys made to monitor the rust and observations taken on 44 trap nurseries over the three years in the states of Madhya Pradesh, Maharashtra, Karnataka, Assam and Meghalaya it is inferred that rust appears first and assume severe proportion in the irrigated soybean in the districts of Belgaum in Karnataka and Kolhapur in Maharashtra state, and then to district Sangli (Maharashtra) and other areas of the district Belgaum. This suggests the probability of having primary inoculum source in the nearby bank of Krishna River and its tributaries and not in the northeastern states as speculated earlier. Northeastern states may have other independent source of primary inoculum. Appearance of rust one month later in this region, no continuous cropping and nonexistence of rust in between Maharashtra to Meghalaya state and vast difference in morphology of urediniospores collected from these two states substantiates this fact. During the extensive surveys several weeds and crops were screened. None of these except 15 weeds and crop were found infected with symptoms resembling to rust of soybean. But the causal organism was other than *P. pachyrhizi.* This indicates that in southern India self-sown and winter-sown sole or intercrop soybean in irrigated areas might be harbouring rust pathogen in off-season and acting as a source of primary inoculum for rainy season soybean crop. There may be little or no role of collateral

hosts in the initiation of rust. Surveys also helped in identifying about four hot spot areas in Maharashtra and Karnataka where rust appears first in the 1st week of August and sometimes in July end and subsequent first phase of secondary spread takes place from here to other adjoining areas under favourable climate. Second phase of secondary spread takes place in September as weather again becomes congenial to rust. The analyses of prevailing meteorological factors revealed that a temperature range of 19-23°C minimum, 26-28°C maximum, humidity 83-90%, preponderance of cloudy weather and total rainfall ranging from 27 to 198 mm in Karnataka to 312 mm in Meghalaya favoured rust onset and spread. Frequent foggy mornings during the period are also found favourable to rust (Gupta et. al., 1999). Study clearly indicated that it is not the amount of rainfall but high relative humidity and congenial temperature, which are the main guiding factors for the onset and spread of rust.

C038. Breakdown of rust resistance gene(s) of soybean [*Glycine max* (L.) Merill] in India

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Soybean rust caused by Phakopsora pachyrhizi is one of the economically important diseases of soybean. On account of recent resurgence of rust, substantial yield losses have been experienced. Soybean genotypes differ in their reaction to rust isolates. Genetic basis for rust resistance in PI 200492, PI 230970, PI 462312 and PI 459025 showed that each of the soybean genotypes had a major dominant gene Rpp1, Rpp2, Rpp3 and Rpp4 respectively at different locus. The soybean line PI 459025 was reported to be having a broad type resistance to rust isolates Taiwan-82-2, India-73-1 and Taiwan 72-1. Soybean lines, PI 459024, PI 230971, 239871A, PI 239871B, Tainung-4, TK 5, and Wayne are reported to have additional specific genes for resistance. Earlier studies have indicated that PI 200492 (Komata) was immune and PI 230970, PI 462312 and PI 459025 were resistant to Indian soybean rust isolate (India 73-1). From the last few years it was observed that rust was appearing in these four genotypes. Therefore, all these four lines with designated resistance genes and other two lines PI 459024 and PI 230971 reported to have undesignated known resistance gene along with other line reported to be resistant at Pantnagar (India) have been evaluated at Rust hot spot Ugar Khurd in the state of Karnataka in India for consecutively two years (2002 and 2003). The rust reaction of these lines given by Mean Disease Score (MDS) is PI 200492 = 9; PI 230970 = 4; PI 462312 = 9; PI 459025 = 7; PI 230971 = 5; PI 459024 = 7 and PI 200477 = 7. A perusal of the table reveals that all the lines reported to posses rust resistance genes have succumbed to the rust disease at Ugar Khurd. This clearly indicates that in India new races/isolates are present with altered/ mutated virulence breaking resistance of existing resistance genes.

C039. Chemical control of soybean rust (*Phakopsora pachyrhizi* Syd.) in South Africa

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Since the first report of soybean rust (SBR) in South Africa in 2001 (Pretorius, Kloppers & Frederick, 2001, Plant Disease 85:1288), nine fungicides, mainly triazoles from the sterol biosynthesis inhibitor group, have received emergency registrations for the control of this disease (Nel, 2003, pers. comm.). With the lack of published data for the control of SBR using systemic fungicides, trials were designed to determine the efficacy, residual period, dosage rate, time of application and frequency of fungicide sprays necessary for effective control under South African conditions. Trials were planted at Cedara in December 2001 and November 2002, during the main growing season. The 2001/02 season was characterized by wet and mild conditions early in the season, followed by a mid-season drought. Disease incidence reached 30% in unsprayed plots. The 2002/03 season was characterized by dry conditions throughout the growing season. Disease incidence averaged 10% in unsprayed plots. The low disease incidence in the 2002/03 season resulted in mainly non-significant results among treatments in the fungicide efficacy trials. The 2001/02 season showed significant differences between fungicide sprayed and unsprayed treatments, but no significant differences among triazole fungicides. Although there were no yield differences between triazole and strobilurin fungicides, disease incidence was always higher in the strobilurin-treated plots. Dosage rate evaluations were not effective due to low disease pressure and the trials will be repeated under irrigation in 2003/04. All fungicides tested gave between 13 and 19 days effective control of SBR, supporting the recommended 21-day spray interval. Results showed that time of first application was more important for the strobilurin than the triazole fungicides. The strobilurin had to be applied preventatively, since applications made after the appearance of rust resulted in substantial yield reductions (22%). Yield was not significantly different for the triazole at different treatment times (just before flowering; during flowering; at first signs of disease and at the R5 growth stage). Due to the low disease

pressure there was no significant difference in results whether one, two or three sprays of fungicide were applied. However, sprayed plots yielded better than the unsprayed control plots.

C040. Pattern of molecular genetic diversity in Argentine soybean germplasm

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Successful soybean breeding efforts in Argentina have resulted in the release of more than 340 cultivars in the past 20 years and a continuous increase in genetic gain from selection of more than 1% per year. The introduction, creation and maintenance of genetic diversity played a key role in this success. Moreover, genetic diversity is considered vital for the food security of future generations and as a means to overcome new pests and diseases, to cope with climatic changes and a growing world population, to react to changing consumer demands and to make production more sustainable. In this context, the objective of this work was to characterize the genetic diversity of the Argentine soybean germplasm at the molecular level by means of microsatellites (SSR). To do this, 214 soybean genotypes were used, which represent all the maturity groups (MG) cultivated in Argentina (MGIII to IX) and the private and public breeding programs. These genotypes were analyzed at 30 SSRs loci previously selected by their discriminative ability. Genetic similarities among pairs of genotypes were estimated by Simple Matching Coefficient (SMC). Cluster and Principal Component Analyses were applied to the SMC matrix. The obtained results showed that the level of genetic diversity, measured using parameters such as Number of Alleles per Locus, Polymorphism Index Content (PIC) and Gene Diversity (D), was similar to that reported in other studies using USA soybean germplasm. Genetic similarity among pairs of genotypes (SMC-values) ranged from 0.77 to 0.98. Applying multivariate analyses to the data obtained three well differentiated groups of genotypes were distinguished. The first group, associated to the others genotypes at a SMC-value of 0.78, included genotypes of MG III and IV. The second group, associated to the rest of genotypes at a SMC of 0.85, included varieties of MG VII, VIII and IX. The third group, finally, was composed by genotypes of MG V and VI. These results indicate that soybean genetic diversity in Argentina present a pattern associated to the relative maturity of the different genotypes. This suggests that each of the three groups identified in the cluster analysis has common ancestors and, also, that the usual type of cross in developing new varieties is to cross genotypes of the same MG. It is concluded that it is possible to increase the genetic diversity and the genetic progress by means of planning crosses between genotypes of different MG.

C041. Molecular evaluation of the resistance to *Cercospora sojina* in soybean

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Frogeye leaf spot (FLS), caused by *Cercospora sojina*, is primarily a foliar disease of soybean even though seeds, pods, and stems can also be infected. The incidence of FLS in soybean is dependent on the growing conditions, and the disease is favored by warm humid environments, prevalent conditions in the north soybean Argentinean region. The yield loss from FLS is mainly the result of reduced photosynthetic area an premature defoliation. The Rcs_3 gene, identified in Davis, conferred resistance to all known USA, Brazilian and Argentinean isolates. Other resistance gene was described in Peking (Rcs_{Peking}). This gene had different reactions to the isolates tested with Davis. The SSR marker Satt244 mapped on molecular linkage group J, which is tightly linked to Rcs_3 is also linked to the Rcs_{Peking}. Four alleles were described for this SSR locus in previous works, two corresponding to resistant varieties (Davis and Peking) and two corresponding to susceptible ones (Blackhawk and Lee). These different alleles were reported from mapping experiments, but there is no information about the allelic diversity at this locus and if there exist other allele/s associated with resistance. For this reason, the aims of this study were to determine: (i) the allelic diversity at Satt244 locus in Argentinean and Brazilian germplasm, (ii) if there exist other allele/s associated with resistance, and (iii) the frequencies of the resistant alleles. To do this, 206 genotypes which represent all the maturity groups (MGs) cultivated in Argentina were screened at Satt244 locus. Thirteen alleles were detected at this highly polymorphic locus. Three out of this 13 alleles were associated with resistant genotypes. Two of them were the already described alleles from Davis and Peking. The third was a new allele associated with resistance firstly identified in

the genotype Monte Redondo. It is not known if this new allele for Satt244 associated with resistance is also a new allele for the known resistant genes or a new resistant gene in this genomic region. The most frequent allele associated with resistance was Rcs_3 (fr = 0.17), followed by Rcs_{Peking} (fr = 0.06) and Rcs_x from Monte Redondo (fr = 0.03). These frequencies were not evenly distributed across different MGs. As a matter of fact, they reach a maximum value for MGs VII, VIII and IX which are cultivated in the region with greater incidence of this disease. These results indicate that there exist several sources of resistance to FLS in the Argentinean and Brazilian soybean germplasm and that can be individually traced by molecular markers.

C042. Mapping genes resistant to SMV strains in soybeans

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Soybean Mosaic Virus (SMV) is one of the most serious diseases of soybeans in China. According to a survey in 1999 ~ 2002, the SMV strains Sa, Sc, Sg and Sh identified in early 1980s in lower Changjiang valley were not found again in field, indicating the SMV population in field changed significantly. New strains SC-1, SC-2,.....SC-10 were found and identified from 230 specimens collected from the valleys of middle and lower Changjiang River and Yellow River based on a combined set of differential hosts with nine varieties. Kefeng No. 1 was identified to be resistant and 1138-2 to be susceptible to all the SC-1 ~ SC-10 as well as N1 and N3 from Northeast China. A $F_{2:7:10}$ derived RIL population with 184 families was developed and tagged with 171 RFLP, 60 SSR and 79 AFLP markers. Based on the data, the genetic linkage map was established and compared with Cregan's integrated genetic map, indicating a consistency between the two maps. The RIL population as well as their parents and F_1 inoculated with the six strains, Sa, SC-7, SC-8, SC-9, N1 and N3, to identify their resistant-susceptible response. The results showed that the resistance to each strain was controlled by single dominant gene, and that all the six genes were located on the linkage group D1b + W, and the figure will be presented.

C043. Inheritance and QTL mapping of agronomic and seed quality traits in soybeans

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Two approaches of genetic analysis of quantitative traits were used in the study of inheritance of quantitative traits in soybeans. One approach was segregation analysis developed by Gai et al. (2003), which utilized information from individuals of one or multiple segregating populations as well as their parents based on the principles of major-gene plus polygene inheritance model, mixture distribution, joint maximum- likelihood function, IECM algorithm and Akaike's information criterion and goodness of fit tests. Another approach was QTL mapping with molecular markers. A recombinant inbred line (RIL) population with 201 families derived from Kefeng No. 1 × 1138-2 $F_{2:7:10}$ along with their parents were tested in a randomized block design experiment. The 171 RFLP, 60 SSR, and 79 AFLP molecular markers were used to mark the 201 families. The data of nine agronomic and seed quality traits, i.e. flowering date, maturity date, plant height, number of nodes on main stem, number of pods per node, 100-seed weight, seed yield, oil content and protein content, were analyzed with the segregation analysis procedure of RIL population with parents to detect their genetic system; those data along with the molecular marker data were analyzed with QTL Cartographer V. 1.13g (Basten et al.,1999) to detect their QTL system. The results showed that major gene – polygene inheritance model fitted all the traits except protein content, indicating both major genes and polygenes, not only one of them, were important to the inheritance of the traits. The genetic model for flowering, maturity and number of nodes on main stem was three major genes plus polygenes; that for 100 seed-weight was two major genes plus polygenes; that for plant height, seed yield, number of pods per node and oil content were two linked major genes plus polygenes; however, that for protein content was only polygenes. The results also showed that both procedures could detect the main major genes or QTLs, and therefore, could be used as a mutual check and supplement. The results further showed that the QTLs of the involved traits concentrated on several linkage groups, such as C2, B1, F1, M and N. Finally, the results showed that the experimental sample was not necessary being coincident with the theoretical population according to equality test, symmetry test and representation test, and therefore, the sample should be checked, tested and then adjusted so as to fit the theoretical requirements through deleting the extra-biased families and markers.

C044. Diversity studies in soybean varieties developed for different agro ecological zones of India using AFLP markers

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Accurate and complete descriptions of existing soybean varieties and patterns of genetic diversity could facilitate introgression of diverse germplasm into current commercial soybean genetic base. In View of the PVP and IPR regime, characterization of the plant varieties becomes essential. AFLP markers provide greater capacity for DNA profiling and genome mapping (Vos et al. 1995; van Eck et al. 1995). AFLP markers were employed to assess the genetic diversity among the 72 released soybean varieties in India. Twelve *Mse*-I/*Eco* RI based AFLP primer pairs generated a total of 1319 amplification products of which 1257 were polymorphic with an average number of 54.15 fragments per variety. Jaccard's similarity coefficients were used to study the extent of similarity in soybean varieties released for different agro ecological zones of India. The 72 varieties could be grouped into three distinct clusters. All the varieties suitable to central zone formed one cluster (cluster B), the varieties suitable to northern hilly zone developed from Himachal Pradesh formed another cluster (cluster C) and those not included in the cluster diverse from the main dendrogram. The similarity coefficients of the varieties released for NEZ and CZ are more or less the same in spite of varied number of varieties released for each zone. In CZ, 28 varieties were released from four breeding centers. The varieties developed for this zone are either direct selections from the local material or introductions or crosses made among the native material and introductions, breeding lines with introductions and breeding lines. Among the breeding centers of this zone Jabalpur, Indore and Gujarat had the same level of similarity among the varieties developed from these centers individually.

C045. Identification of core set of AFLP primers for soybean varietal diversity evaluation

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Establishing identity of crop varieties has assumed significance in the post CBD scenario in developing countries in order to protect plant breeder's right and farmer's rights. To complement morphological traits, isozyme analysis and molecular markers have been used for cultivar identification. In comparison with morphological traits, molecular markers have many advantages. Their expression is independent of environmental conditions, a lengthy survey of plant growth methods is not needed and the potential number of markers is nearly unlimited in relation to isozyme and it covers the whole genomic DNA of crop plants. Amplified Fragment Length Polymorphism (AFLP) combines the advantages of both RFLP as well as PCR based markers. Obtaining enough informative markers that are highly repeatable and produce highly polymorphic fragments is always advantageous. Genomic DNA extracted from fresh leaf tissue of 69 released varieties and 3 breeding lines of soybean in India was used for characterization studies using AFLP technique. The number of fragments generated by the primers varied from two (M-CAT/E-ACC) to 70 (M-CTT/E-AGG) with an average of 28.83 fragments per primer while the number of polymorphic fragments varied from one (M-CAT/E-ACC) to 35 (M-CTA/E-ACA and M-CTT/E-AAC). The average PIC value for the primers is 0.246. Selection of core set of primers was done based on the criteria where a minimum of ten fragments were produced per primer, the ratio of polymorphic to total number of fragments produced is greater than or equal to 0.7, PIC value greater than 0.30 and the discrimination index is greater than or equal to 0.21. Twenty two primers were selected based on the above criteria The polymorphic AFLP fragments developed by all the primers and only selected core primers were used separately for constructing the dendrogram in a sample of 25 soybean varieties and the dendrograms were compared through Jaccard's similarity coefficient matrix. The number and composition of each cluster was evaluated to determine how effectively the core primer set assigned the genotypes into the appropriate clusters.. The clustering pattern did not vary with the deletion of the non selected primers in the final dendrogram. The dendrograms produced in both the cases matched almost with 1 or 2 exceptions indicating that the selected core set of primers along with the provision of multiplexing makes the fingerprinting task relatively easy and cheaper. Since the PIC values, EMR and Marker index values of the selected primers are at higher level the reliability of the results obtained by their use stand unaltered.

C046. Random amplified polymorphic DNA (RAPD) variation in Indian cultivars and exotic germplasm of soybean

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Identification and utilization of diverse germplasm, is the key issue in plant breeding for development of potential varieties with broad genetic base. Thorough knowledge of genetic diversity of the crop is necessary for parental selections that maximize genetic improvement. It also facilitates introgression of diverse genotypes into genetic base of released cultivars, which is very narrow. Due to stage specific expression of characters and influence of the environment, morphological diversity estimates are less reliable. Use of molecular markers is considered best for analysis of genetic diversity since there is no effect of stage of development and environment. Availability of large number of polymorphic markers enables precise method for genetic diversity analysis. RAPD markers are one of the fastest, simplest and cost effective of all the available DNA marker system. The genetic diversity among 56 genotypes of soybean comprising 31 Indian cultivars and 25 exotic germplasm from diverse geographic origin was examined using random amplified polymorphic DNA markers. Forty-six primers studied produced a total of 521 fragments, of which 448 (85.9%) were polymorphic. The number of fragments generated per primer ranged from 3 to 16 with an average of 11.4. The size of fragments varied from 250bp to 3000bp among the different genotypes. The polymorphic information content (PIC) for these markers ranged from 0.221 to 0.483. UPGMA-based pairwise Jaccard's coefficient of similarity was used to deduce the relationships among the genetically diverse accessions. The genetic similarity (GS) coefficient for all possible 1540 pairs of genotypes ranged from 0.209 to 0. 856. The dendrogram prepared on the basis of similarity matrix showed distinctness among all the genotypes and delineated the genotypes into two major groups. The genetic similarity coefficient results indicated that the exotic germplasm had more genetic diversity in comparison to Indian cultivars.

C047. Genetic diversity analysis in soybean's progenitor *G. soja* Sieb. & Zucc. and wild perennial species of the subgenus *Glycine* Willd using RAPD and SDS-PAGE

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Soybean (*Glycine max* L. Merrill) is the second major oilseed crop of India. The world average yield of soybean is 2.19 t/ha however the average productivity of India is around 1t/ ha for the last few years. The genetic base of soybean cultivars grown in India is extremely narrow. These are direct introductions from the United States, selections from the introduced germplasm, and single-cross (two-parent crosses) hybrids from land races and selected plant introduction. Soybean's progenitor *G. soja* Sieb. & Zucc. and wild perennial species of the subgenus *Glycine* Willd are the rich source of useful genes. With advances in embryo rescue technique, it has become possible to introgress useful alien gene from these wild relatives to *Glycine max*. Unambiguous, reliable, fast and cost-effective determination of genetic diversity and identification of accessions is essential for effective utilization of plant genetic resources in crop improvement. However there are very few reports on molecular and biochemical characterization of these wild species. With the objective of characterization of a total of 20 soybean's progenitor and wild relative accessions belonging to *Glycine tabacina, Glycine crytoloba, Glycine microphylla, Glycine clandestina, Glycine latifolia, Glycine canescens, Glycine tomentella* and *Glycine soja*, 46 RAPD primers and SDS- PAGE were employed. All of these RAPD primers detected polymorphism among the accessions. A total number of 572 fragments were generated by RAPD primers, out of which 96.5% were polymorphic. The size of fragments ranged from 250 bp -5000 bp. Some specific/ rare bands were also identified. A diagrammatic mode of presentation of DNA fingerprints of these accessions based on 10 of the informative primers was developed. SDS- PAGE generated a total of 40 bands out of which 25 (62.5%) were polymorphic. Cluster analysis based on Jaccard's similarity coefficient using UPGMA was carried out using all fragments generated by RAPD and SDS-PAGE together as well as separately which grouped all the accessions of same species generally together and distinguished all the accessions included in the present study from each other. The genetic similarity coefficient from all possible combination of genotypes under study ranged from 0262 to 0.749 with an average of 0.384. Thus, the generated data by RAPD and SDS-PAGE in this experiment could be utilized in the characterization and identification of accessions, development of biochemical and molecular descriptors and elimination of duplicate accessions from the germplasm collection and their further utilization in crop improvement programme.

C048. Detection of RAPD makers linked to gene *lx1* in soybeans

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Lipoxygenase (EC 1.13.11.12) catalyses the hydroperoxidation of unsaturated fatty acids and polyunsaturated lipids that contain a cis,cis-1.4-pentadiene structure, such as linoleic acid and linolenic acid in soybean seeds. The linoleic acid hydroperoxides are subsequently converted to volatile compounds such as hexanal, which are converted to volatile undesirable flavors in processed soybean protein products. In this study near-isogenic lines of soybean lipoxygenase, which contain genes Lox, *lx1*, *lx2*, *lx3*, *lx1.3*, *lx2.3*, respectively, were used for polymorphic analysis by RAPD technique. Five hundred and twenty 10-mer-oligonucleotide primers were screened, and thirteen primers showed polymorphism among near-isogenic lines. There were six primers (primers $OPG06_{1300}$, $S352_{900}$, $S370_{900}$, $S377_{780}$, $S287_{950}$, $S389_{300}$) showed special polymorphic bands among lines *lx1* and *lx1.3*. Especially, primer S352 presented the stable results in which a 900bp band was found in the lines *lx1* and *lx1.3*, and primer $S352_{900}$ was detected with F_2 generation of cross 96P11 x Century-1. Results indicated that primer $S352_{900}$ could be identified as a RAPD marker linked to gene *lx1* in soybeans, the distance of linkage was 7.6 cM.

C049. Broad bed and furrow method of rainwater management for sustained soybean productivity

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Soybean has established it self as one of the major oil seed crop in India. At present, it covers nearly 6.50 million hectares. Majority of soybean area in India is in Madhya Pradesh and grown on Vertisols and associated soils. By and large the crop is grown under rain fed situations. Extreme variations in rainfall both in time and space (spatial and temporal variations) calls for rain water management strategies for minimizing risk and stabilizing soybean production. Therefore, appropriate soil moisture management strategies to optimize the performance of high yielding improved varieties are the need of the hour. It now calls to view the problem in holistic manner to develop farmers' friendly soil water and crop management technology for harnessing sustainable soybean production. *In-situ* rainwater conservation can be carried out either through land configuration or adoption of suitable tillage practices or through mulching. At NRC for soybean, Indore attempts were made during Kharif of 2002 and 2003 on Sarol series (montmorollinitic, iso hyperthermic, typic chromusterts) to validate broad bed and furrow land configuration system for surface drainage and recharge of soil profile and for reduction of runoff and soil erosion. In this context, an implement was devised for simultaneous creation of broad bed (150 cm width) altered with approximately 50 cm width furrow having a depth of 20 cm as farmers are reluctant to create broad bed and furrow due to short sowing period and prevailing hydro-physical condition. The results of the study revealed that broad bed furrow method of *in-situ* rainwater management provided an 18% yield advantage over flat bed method, which is commonly followed.

C050. Effect of halogenation on soybean seed longivity

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The study was undertaken to evaluate the efficacy of varying doses of halogenation mixture in enhancing soybean seed longivity in ambient storage under sub-tropic conditions. Freshly harvested and well processed seeds of two soybean genotypes (JS 335 and JS 90-41) were shade dried to reduce the moisture content to 8%. Halogenation mixture was prepared by mixing Calcium carbonate and Bleaching powder in a ratio of 1:1. Seeds were treated with varying doses of the mixture with and without Thiram at 0.25% and were stored in Poly-lined Gunny bags in a packing of 20 Kg. seeds under ambient conditions. Preliminary observations were recorded for Seed moisture, Germination, Field emergence, Seedling dry weight, Speed of emergence and Vigor Index. Later bimonthly observations were recorded from the commencement of sowing for the above mentioned parameters. Results indicated that seed treatment with 2 gm halogenation mixture successfully enhanced seed longevity upto fifteen months after harvest. On perusal of the data, seeds treated with 2 gm halogenation mixture and 2 gm halogenation mixture in combination with Thiram at 0.25% had higher Vigor Index and speed of germination. However, seedling dry weight remained unaffected by treatments, but effect on storage duration was significant for all the parameters recorded.

C051. Isoflavone concentration in soybean seeds of plants cultivated under high concentrations of atmospheric CO_2 or O_3

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Since the industrial revolution global atmospheric [CO_2] has been increasing steadily (1.5 µmol mol^{-1} $year^{-1}$) and is expected to increase from 365 µmol mol^{-1} (actual) to 700 µmol mol^{-1} by the end of the 21st century. Tropospheric O_3 concentration is also increasing globally, especially in areas of high pollution. Elevated atmospheric [CO_2] generally enhances photosynthesis by increasing intercellular CO_2 concentration, which decreases photorespiration. Exposure to O_3 generally decreases photosynthesis (Heath, 1994), probably by causing oxidative damage to cell membranes, including thylakoids. Soybean isoflavones are important as potentially bioactive compounds with impact in human chronic diseases like cancer. There is a lack of knowledge as to how changes in environmental atmospheric gas conditions affect soybean seed composition. In order to evaluate the effects of high CO_2 or high O_3 on the isoflavone concentration of soybean seeds, a soybean FACE (Free Air Concentrated Enrichment - SoyFACE) facility situated on an 80-acre field (32 ha; South Farms, University of Illinois at Urbana-Champaign; 40°03'21.3"N, 88°12'3.4"W, 230 m elevation) was used. Seeds of eight cultivars were collected during Summer 2002 at three different parts of the plant at harvesting stage. Results indicate that changes in atmospheric concentration of CO_2 or O_3 can have different effects on the isoflavone concentration in soybean seed depending on the variety evaluated. In general, high CO_2 increased the isoflavone content while high O_3 caused a dramatic decrease in isoflavones.

C052. Agronomic and economic benefits of the corn and soybean rotation

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The beneficial effects of rotating corn (*Zea mays* L.) and soybean [*Glycine max* L. (Merr.)] have been recognized and exploited for centuries as a management practice to increase crop yields. Brown stem rot of soybean, caused by *Phialophora gregata* is one of the most damaging diseases in soybean and is found in all soybean producing areas of the Corn Belt in the United States. The importance of brown stem rot has gradually increased over the years as soybean has made the transition from an occasionally planted crop to a crop annually rotated with corn. Few studies have investigated the long-term effect of the corn and soybean rotation. The responses of corn and soybean to tillage system and rotation sequence were investigated over 15 years. Our objectives were to compare i) yield and economics, and ii) to determine the effect of agronomic practices on the population density of *P. gregata* in conventional and no-tillage systems with different rotation sequences. The rotation sequences were 1st-, 2nd-, 3rd-, 4th-, 5th-year corn or soybean, alternate corn and soybean, and continuous corn or soybean. Interactions of both corn and soybean yield were found with tillage system and rotation sequence. Averaged over years, tillage increased corn yield 9%, but did not affect soybean yield. Both 1st-yr corn and soybean produced the highest yields at 10.8 Mg/ha and 4.0 Mg/ha compared to the other six rotation sequences that averaged 9.3 Mg/ha and 3.6 Mg/ha, respectively. Both 1st-yr corn and soybean produced the highest grower return at $197/ha and $266/ha. Grower return interactions for both corn and soybean were found with tillage system and rotation sequence. Averaged over years, tillage increased corn grower return by $67/ha, but did not affect soybean grower return. Inoculum density of *P. gregata* in both soybean stem residue and in soil was positively correlated with increasing years of continuous soybean culture even though the soybean cultivar planted was rated as partially resistant to brown stem rot. It was concluded that 1st-year corn or soybean and alternating corn and soybean were the most profitable rotation sequences over the last 15 years in Wisconsin. Our data indicated that the population density of *P. gregata* couldn't be reduced to an undetectable level by planting cultivars with current forms of resistance to *P. gregata* despite numerous years with a host plant.

C053. Soybean seed (*Glycine max* (L.) Merr.) - environmental damage as a new problem found in the Topographical Tetrazolium Test for Viability

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A new possible problem was found in soybean seeds based on the Topographical Tetrazolium Test for Viability (EMBRAPA, 1988; INTA OLIVEROS, 1995) showing a crack in the hypocotyl radicle axis without

a differentiation in the cellular breath in the damage. The first problematic situation was to discard the possibility that the damage was being caused during the seed soaking. This hypothesis was rejected as the seed was damaged before it was soaked and also due to the correlation of the viability data and the germination test data. The second problem was that there was no difference at the cellular breath. Finally, the third issue was how to categorize this damage. It was decided to classify it as a different environmental damage, due to the correlation existing between this damage and soybean seed lots harvested in a range of 10 to 12 % moisture. This new problem was studied in a specific soybean variety, received and sized in the same sizing plant. This specific variety arrived at the plant with a range of 10.5 to 12.8% moisture. The Germination Test (GT)(I.S.T.A., 2003) and Cold Test (CT) performed at the entrance of the plant were good (GT = 93% and CT = 92%), and after the material was sized the average dropped about 12% in (GT) and between 18 to 19% in (CT). To discard that this drop of quality could have been caused by pathogenic fungus, the material was treated and then tested again. The results did not show any improvement on seed quality, in fact, it showed a slight drop. Based on these results it was decided to test it with soil sand substrate. In this case the average figures equalled the Germination Test without treatment. To identify the real dropping of seed quality the Topographical Tetrazolium Test for Viability was made. It was found that the only reason for this drop in quality was the new problem classified as a different environmental damage. Finally, those seeds that had this damage in more than a third of the hypocotyl radicle axis did not produce normal seedlings, so they were classified as no viable. As a result of this the germination data correlated with the Topographical Tetrazolium Test for Viability data. As a conclusion it is believed that a further investigation on this possible new damage needs to be continued.

C054. Soil phosphorus stratification and the phosphorus nutrition of soybean

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Stratification of nutrients, observed in soils under continuous no-tillage management, remains an issue. The objective of this study was to evaluate the effect of phosphorus stratification on soybean phosphorus nutrition. The field experiment was carried out on a low phosphorus soil in western Kentucky in 2001 and 2002. The experimental design was a complete factorial combination of two stratification treatments (mixed via moldboard plowing vs. stratified via chisel plowing) at four soil test P (3.5, 4.5, 8.3 and 19.9 ppm P by Mehlich III extraction) levels as main plots, with the absence and presence of in-row P (10 kg P/ha) as subplots. Whole plants were taken at R1 and R5 for tissue P and P uptake. Grain yield and grain P were measured. In general, tissue P, P uptake and grain yield were not affected by soil P stratification. The response to in-row P was more evident at early stages of the crop or at low soil test P levels, where soil P was not stratified. There was little response to in-row P when soil test P was at medium-high levels. Stratified soil P is functionally equivalent to banded P, and is not prejudicial to soybean P nutrition.

C055. A spatial variance approach to the evaluation of phosphorus stratification and soybean phosphorus nutrition

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Stratification of nutrients within the surface soil has been reported to influence their availability for plant uptake. Qualitative depiction of stratification is not sufficient to describe this soil nutrient distribution characteristic. Currently, no methods have been proposed that would result in a more quantitative, scientific, and unbiased description of stratification. We used geostatistical techniques to characterize the degree of P stratification in a soybean – P nutrition research trial. Two stratification treatments were imposed at each of four available soil P levels, with four replications, to give a total of 32 experimental units. Soil test P was determined in 2.5 cm depth increments, to a total of 20 cm. Geostatistical analysis was performed on the soil test P distribution for each plot, after normalizing the data relative to the maximum value observed within each plot. Spatial structural analysis was described by fitting a Gaussian model to variograms for each experimental plot. Sill and range values were determined and analysis of variance indicated that both parameters were significantly influenced by the stratification treatment. Stratification resulted in both greater sill and range values, indicating that there was good spatial structure and greater differences in soil test P values among the sampled depth increments in the stratified soils. The geostatistical parameters were positively related to plant P nutritional indicators, despite being derived from normalized data to remove the influence of absolute soil test P levels. Significant correlation coefficients, between 0.52 and 0.61, were reported for simple linear relationships between either range or sill and either leaf, stem or pod P concentration at growth stage R5. The geostatistical approach will allow investigators to assess the independent effect(s) of various degrees of stratification on nutrient availability.

C056. Biostimulant effect on yield of soybean (*Glycine max* (L.) Merrill)

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The experiment was carried out in the greenhouse of the Experimental Botany Section of the Department of Biological Sciences at ESALQ/USP. Soybean seeds (*Glycine max* (L.) Merrill cv. IAC82) were used, and the biostimulant Stimulate (0.009% of kinetin, 0.005% of gibberellic acid and 0.005% of indolbutyric acid) at the following concentrations, 1.0; 2.0; 3.0; 4.0 and 5.0ml/0.5kg of seeds, and 5.0ml of distilled water/ 0.5kg of seeds as control (concentration zero of Stimulate). The objectives were to evaluate the effects of the Stimulate on crop yield of soybean, in greenhouse conditions, as well as, to establish the product concentration for seed treatment of the product applied by seeds. The experimental design adopted was completely randomized with 6 treatments (concentrations) and four replications. The results were analyzed using regression to the variables that presented at least one difference between the evaluated concentrations. The conclusion achieved at this study was that, for each 1.0ml increments of Stimulate/0.5kg of seeds caused a significant increase of 6.1 grains per plant and 1.3g of grain dry mass per plant until up to the 5.0ml/0.5kg of seeds (157.4 grains and 23.5g, respectively). At the concentration of 5.0ml/0.5kg of seeds it was obtained an increase of 24.3% on grain number and 36.9% on grain dry mass per plant in relation to check (Supported by Stoller of Brazil).

C057. Allelopathic effect of crop residues on soybean

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Soybean, the world's leading oilseed crop stands next only to groundnut in production in India. It is being grown over an area of 5.98 million ha with a production of 6.78 million tonnes, with an average productivity of 1135 kg ha^{-1} (Anon., 2001). Soybean is predominantly grown in *kharif* and can be grown as an early summer crop. This short duration legume (90-100 days) usually rotated with different *rabi* and *summer* crops in the parts of the country. The adoption of multiple cropping has led to a greater production of crop residues on the farm. The recycling of various forms of crop residues has the advantage of converting surplus farm waste into useful products for meeting the nutrient requirements of crops besides maintaining the soil fertility and productivity. However, the decomposition of crop residues of previous crop and release of allelo-chemicals coincides with the germination, growth and development of crops. An investigation was carried out to study the allelopathic effect of different crop residues on soybean in medium deep black soils at Main Agricultural Research Station, Dharwad during 2001-2002 under rainfed conditions. Eleven crop residues were incorporated and compared with no residue control. The growth and yield of soybean increased significantly with maize, sorghum and wheat residues as compared to no residue and other residues. The percent increase in yield with maize, sorghum and wheat was to an extent of 19.5, 17.5 and 15.5 per cent over no residue. Whereas, sunflower, safflower and soybean residues inhibited the growth and yield of soybean as compared to no residue and other residues. Sugarcane, cotton, chilli and sunnhemp residues had no significant influence on growth and yield of soybean as compared control. Nutrient uptake was significantly higher with maize residue followed by sorghum and wheat residue respectively. Significantly higher urease and nitrate reductase activity was noticed with maize residue and this was followed by sorghum and wheat residue. Whereas, sunflower and safflower residues recorded lowest urease and nitrate reductase activity respectively. The incorporation of maize, wheat and sorghum residues showed significantly higher germination, root length, root dry weight, number of nodules and number of leaves and total drymatter production. The greater inhibition of plant growth was observed with sunflower, safflower and soybean residues for soybean. These results demonstrate the allelopathic potential of the residues and suggest that these residues may affect soybean yield due to inhibiting or stimulatory effects of allelo-chemicals present in the residues.

C058. Biological nitrogen fixation of soybean growing in the Cerrados soil of Brazil

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The effect of tillage and cropping history on N_2 fixation of soybean growing in a Purple Latosol (Ultisol) of the Brazilian Cerrados (Savannah-like area) was studied, by comparison of the natural abundance of ^{15}N of actively fixing soybeans and the grass *Panicum*

maximum cv Tanzania or the non-nodulating variety of soybean T201. Treatments encompassed soybean cropped for the first year in an area that was a pasture previously, either with conventional or conservation tillage (no tillage); or in an area that has been cropped with soybean for the previous four years, with a winter fallow or with pearl millet (*Pennisetum atropurpureum*) as a winter crop, with soil tilled either conventionally, mulch-tillage or no-tillage. The standing biomass of plants was collected during the vegetative growth stages, grain filling stage, at ripening (standing biomass, grains and roots up to 20cm depth) and grains at final harvest.Tillage did not have a significant effect on plant dry matter production or N yield during the vegetative stages. However, no-tilled soybean, either as 1st or 5th year crop, showed a higher rate of N_2 fixation (above 50%) than conventionally tilled soybean (bellow 40%). During the grain filling stage all treatments showed similar rates of N_2 fixation (between 60 and 68%), plant production and total N yield. At ripening stage, soybean under conventional tillage had a larger standing biomass than soybean under conservation tillage, that drove a larger amount of resources from bellow-ground, although grain production was not affected significantly. A larger proportion of N from N_2 fixation was allocated to the grains (66 to 82%) than to the standing biomass (51 to 68%) while roots retained the lowest amounts of fixed N_2 (15 to 32%). Cropping history had a significant effect on growth and N sourcing of soybean with reduced yields but increased root development and soil N uptake in the first year after pasture phase. The N balance indicated that the grain harvested would take most of the fixed N away from the system. Continuous cropping of soybean under no-tillage seems to minimize such negative balances of N. Even though, it seems unlikely that commercial soybean with a high N harvest index contribute significantly to improvements of residual soil N fertility in this Cerrados soil.

C059. Response of soybean (*Glycine max*, Merrill) roots to mechanical impedances in conventionally and zero tilled Argentine soils

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Soybean (Glycine max, Merrill) is the most important crop of Argentina, which is cultivated in conventionally-tilled (CT) and zero-tilled (ZT) soils. It is still poorly understood the response of soybean roots to soil physical environments and tillage. Pristine, and CT and ZT field lots cropped to soybean (R3 and R4) were sampled in four sites with different soil Series: Bragado, sandy clay loam (Typic Hapludoll); Ramallo, silty clay loam (Vertic Argiudoll), Peyrano, silty clay loam (Typic Argiudoll), and Yeruá, clayey (Argiaquollic Pelludert). Soil relative compaction (RC = bulk density/soil density in Proctor tests) was always below the threshold limit (0.9) for crop yields. Soil pore volume > 50 mm was always < 0.1 v/v, which presupposes potential aeration constraints both in CT and ZT. The threshold of soil penetration resistance (PR>2 MPa) was only over passed in the CT-Bragado soil (PR> 4 MPa) due to an induced plow layer, and in the CT- and ZT-Ramallo soils (PR>2,5MPa). The vertisolic Yeruá soil was always moist and with low penetration resistances. Despite, soybean roots were only negatively affected in the Ramallo and Yeruá subsoils (> 0.3 m), because of tough Bt horizons ("claypans"). Neither the low macroporosity nor the induced plow pan impeded soybean root growth in any site. This responded mainly to subsoil properties, and non to tillage systems. The isolated use of soil physical parameters, non based on the inspection of soil profiles, can lead to erroneous predictions of the response of soybean roots in the field.

C060. Strategies for soybean as a relay crop, using the CROPGRO model

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Soybean within a relay cropping system presents some particularities: usually the initial soil water content is low, and the planting date is not the optimum. These factors have a strong impact on yield and mean that a soybean crop after wheat is highly dependent on the rainfall during the crop season, principally during the critical period. Selecting the correct cultivar for each region is important because excessively short season varieties will suffer losses from any short period of water deficit, while excessively long season varieties will be exposed to cool temperatures during the grain filling period or to wet conditions during harvest time. To design different strategies for each region, two initial soil available water condition (ISWC) scenarios, of 40% and 65% of maximum available soil water content, were used, with four cultivars of maturity group (MG) III, IV, and V. These cultivars had been previously calibrated and validated at several experimental stations. To analyze the sensibility of ISWC and cultivar interactions on the yield variability, 25 years of historical daily weather data were used in six environments with different soil types and weather conditions. SUR, a user-friendly software interface between CROPGRO and the Windows environment, was developed at Pergamino Experimental Station, and was used as tool for this multi-year and multi-location analysis. This decision tool

allowed the quantification of yield variability, and the estimation of climate risk for each region according to the ISWC levels. Also, it permitted identifying the best combination of cultivar-ISWC for each location. Results show that crop models can be used to improve crop management decisions for any environment using historical daily weather data.

C061. A new model for wheat-soybean double-cropping system using early soybean varieties in the Mid Southern USA

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Soybean-wheat double cropping is an important cropping system in the Mid Southern USA. The objective of this study was to investigate the soybean MGs most suitable and profitable in a double cropping system involving soybean and wheat. Experiments were conducted on mixed-loam soil at Stoneville, Mississippi, from 1999 to 2001. Over 30 soybean varieties from maturity groups (MGs) ranging from late III to late V were involved. Soybeans were planted in late May to early June after wheat was harvested. The data indicated that when wheat was planted in early to mid-October, it could be harvested in late May to early June. The 3-yr average wheat yield was 4066 kg ha^{-1}. Planting date for soybeans was a major factor, which influenced yields from this double-cropping system. The average soybean yield for two out of three years (data from one year was not included due to adverse climatic conditions) was over 3024 kg ha^{-1} for all MGs. Though the yields of early maturing soybeans such as late III and early VI were relatively profitable, the highest yielding MGs were from late IV and early V. Even at very low crop sale prices (wheat at \$0.11 kg^{-1} and soybean at \$0.18 kg^{-1}), the double-cropping system was profitable. Although the late MGs, such as late V, had high yield potential, there were many unfavorable weather problems associated with the late season growth, especially during seed maturation and harvest. It is recommended that soybean MG selection for this system should be based on both wheat harvest time and soybean planting date. If the soybean is to be planted after mid-June, early MG soybeans should not be used, due to their limited yield potential at those planting dates. However, using late MGs for late planting (after mid-June) would result in late harvesting, often under unfavorable harvest environment. This would further affect wheat planting date and soybean planting the next season. Therefore, MGs from late IV to early V planted before mid-June should be the best combination for this double cropping system.

P136. Impact of soy incorporation on the glycemic response in selected normal and diabetic adults

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General information, history of the disease, dietary pattern, etc. were collected from 50 NIDDM. Soy incorporated Indian breakfast items *viz.*, soy *dosai* and soy *uppma* were formulated matching for carbohydrate content with the respective standard recipes to study the glycemic response in selected normal and diabetic adults. A majority of 62 per cent of the selected diabetics was obese. About 64 per cent reported the onset of diabetes in the age of 36 – 45 years. Many reported genetic background as the causative factor. Hypertension and hyper cholesterolemia were reported by 12 % and 8 % respectively. The mean food intake except cereals and milk and the nutrient intake except calories of the selected diabetics were high when compared with the recommendations of Indian Council of Medical Research. The formulated recipes were highly acceptable, rich in protein and low in energy, carbohydrate and fat when compared with the respective standards. The mean postprandial glucose of diabetics after ingestion of **wheat *dosai*** recorded 171.5 mg / dl and that of **soy *dosai*** recorded only 162.4 mg / dl. The mean rise in blood glucose in **diabetics** was 49.6 mg / dl on **wheat *upma*** ingestion and only 20.1 mg / dl on **soy *upma*** ingestion. In normal adults no significant differences in the glycemic responses were observed.

P137. Influence of soy (*Glycine max* L. Merrill) and linseed (*Linum ustatissimum*) on the Lipid profile of selected dislipidemics

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Ten dislipidemics were selected and relevant information was collected. Whole soybean *sundal* (pressure cooked and seasoned Indian snack item) and linseed incorporated *idly podi* mix (a dry powder of roasted pulse mixture to be mixed with soy oil and used as a side dish) were formulated to supply PUFA as per the recommendation of FAO/WHO (ω6:ω3 = 5:1 to 10:1). Supplementation was carried out for 1 month and the impact of supplementation on the lipid profile was studied. Among the 10 selected dislipidemics 8 were males and 2 were females. Most of them were 50-70 years old and obese. Deficit in the intake of almost all the food items was observed when compared to the recommendation of Indian Council of Medical Research except fats and oils, the restriction of which is a must for dislipidemics. Deficit was observed in the intake of calories, protein, fibre and foods rich in antioxidants. Five male members out of 8 were alcoholics and 4 were smokers. Diabetes and hypertension were the other complications reported. Fifty per cent of them were under average risk category and 40 under moderate risk category of developing heart disease. Only 10 per cent recorded no risk. Soy *sundal* and linseed *idly podi* mix with soy oil were acceptable providing more protein and essential fatty acids with w6:w3 ratio of 8:1. Statistically significant reductions in serum triglycerides (from 220.4 to 199. 3 mg/dl), LDL (167.6 to 148.5 mg/dl) and VLDL (44.1 to 39.8 mg/dl) and an increase in HDL (43.2 to 45.4 mg/dl) were observed on supplementation of soy - linseed recipes thereby reducing the atherogenic ratios, proving the positive impact of supplementation.

P138. The influence of a soybean beverage on the formation of lipid plaque in the rabbit aorta

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Soybean based diets have been related to the control of the development of atherosclerotic plaque, mainly due to the action of the isoflavones by way of mechanisms which include the inhibition of cellular adhesion, alterations in the activity of growth factors and inhibition of the proliferation of the cells involved in the formation of such injuries, not forgetting their antioxidant properties against LDL peroxidation, an important risk factor in the pathogenesis of arteriosclerosis. This study aimed at determining the influence of a beverage based on a soybean extract

and peach pulp on the formation of lipid plaque in the thoracic aorta of rabbits. Male New Zealand breed rabbits were used, submitted to normal (commercial feed) or hypercholesterolemic (110g commercial feed + 200mg cholesterol) diets, with or without the beverage (50mL), for 105 days. The planimetric determination of lipid plaques was carried out by longitudinally segmenting the aorta, thus exposing the internal part, fixing in a 15% formol solution containing 3% and staining of the total lipids with oil-red. The segments were photographed, digitalised and the images analysed using the Image-Pro Plus 4.1.0.0 programme (Cybernetics Media), the areas showing lipid plaques being calculated as a percentage of the total area of the aorta segment. The animals submitted to the normal diet showed no formation of lipid plaque. However for the animals in which hypercholesterelaemia was induced, those receiving the feed plus cholesterol showed, on average, 48.7% of the aortic segment corresponding to atherosclerotic injury, whereas for those receiving the feed plus cholesterol plus the soybean beverage, these plaques only corresponded to 5.5% of the total area of the aorta. It was concluded that the administration of the beverage based on soy extract plus peach pulp interfered favourably, reducing the evolution of atherosclerotic injuries in the aortas of rabbits fed on a hypercholesteremic diet for 105 days.

P139. Effect of ingesting a soybean beverage on the blood cholesterol level of rabbits

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The consumption of soy-based foods has been associated with the prevention of cardiovascular diseases. This association led to an FDA recommendation (1999) for the ingestion of 25g soy protein per day associated with a diet low in saturated fats and cholesterol. This parameter cannot be considered definitive, since numerous positive results have been obtained in the treatment of hypercholesterolaemia, the main factor involved in such infirmities, using smaller amounts of soy protein. This research aimed at verifying the influence of a beverage based on a soybean extract (2% soy protein) and peach pulp in the control of hypercholesterolaemia in rabbits. Twenty four male New Zealand breed rabbits were used, divided into 4 groups and submitted to different diets for 105 days: G1: commercial feed, G2: commercial feed + 0,2% cholesterol, G3: commercial feed + 50mL beverage, G4: commercial feed + 0,2% cholesterol + 50mL beverage. Total cholesterol was determined in the blood serum, separated by centrifugation, using the enzymatic-colorimetric method. Blood samples were collected at the start of the trial and thereafter every 15 days. The results showed that the total blood cholesterol levels increased with time in the groups of animals in which hypercholesterolaemia was induced (G2 and G4) and remained constant in those groups not ingesting cholesterol (G1 and G3). As from 60 days, smaller increases in blood cholesterol levels were shown in those animals submitted to the hypercholesterolemic diet associated with the beverage formulated with soy extract and peach pulp (G4), as compared to the animals receiving feed plus cholesterol (G2). In this case, administration of the beverage controlled the total cholesterol level at a rate of 58%. The results suggest that smaller percentages of soy protein, when consumed daily, can be effective in the control of hypercholesterolaemia.

P140. Soy-based functional beverages: synergy between soy oligosaccharides, vit. C, polyphenols and probiotics

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Soymilk from Enzyme Active Soy Flour (ESAF) was used to produce a range of beverages with acceptable sensory profile for Western consumers. The first generation of beverages used plain soymilk which showed no beany flavour and minimal residual trypsin inhibitors, while having high protein solubility, isoflavones and oligosaccharides content. Several flavour formulations were developed and subjected to chemical, physical and sensory evaluations. The most popular beverages were found to be chocolate and honey comb flavours. The second generation beverages were developed from probiotic-rich Soghurt (made from blends of soy-bovine milk) and polyphenol/Vit.C rich fruit juices. Effects of processing steps and storage conditions on the viability of probiotics and the level of functional ingredients were studied, and the consumer acceptance of such beverages was determined using CompuSence Techniques. The product showed minimum levels of residual trypsin inhibitors, and almost no beany flavour. Based on the sensory evaluations using the CompuSense techniques, the most popular beverages were the ones with orange juice and blackcurrant juice blends.

P141. The viability of lactic and probiotic cultures in spray-dried and frozen soghurt

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Full fat enzyme-active soy-flour (EASF) and low heat skim milk powder was used for preparation of soy-bovine milk. The milk blend was further fermented with a mixed culture of *Streptococcus thermophilus* and AB cultures (*Lactobacillus acidophilus LA-5* and *Bifidobacterium pseudolongum BB-12*) to produce Soghurt. To improve the shelf life of soghurt in a stable and readily usable form, it was turned in powder form in a Baby Niro spray drier. Soghurt was also used in the formulation of an ice cream-like frozen dessert with an overrun of about 48%. To qualify as a 'functional' ingredient or food, the lactic and probiotic cultures must be present at high viable numbers in the final product. However, probiotics being mostly anaerobic, the contact with air during spray drying or churning of the frozen dessert may be detrimental to their survival. The survival of *S. thermophilus* and the AB cultures was determined under various spray drying and/or churning/freezing conditions. The Microbiological tests were conducted to enumerate *L. acidophilus* LA-5 on MRS (37°C/5 days/ AnO_{2}) and *B. pseudolongum* BB-12 on NNL (37°C/3 days/AnO_{2}). Results of spray dried samples showed that the number of viable cells (CFU/g) of all the cultures decreased with an increase in the outlet air temperature of the spray drier. Suitable conditions for optimal survival were found to be Inlet air temperature of 175°C, outlet air temperature of 70°C, %Timer at 4.5 - 5, Operation Switch II and air pressure gauge set at 6. *L. acidophilus* was shown to be more heat resistant and not as oxygen sensitive as *B. pseudolongum*. Tests on frozen dessert samples showed that there was positive growth.

P142. Elaboration and development of "condensed milk of soy" and recipe of modifying bonbon without lactose for the consumption of bearers of intolerance to the lactose

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This paper is constituted in the elaboration and development of a similar product to the condensed milk traditional and a similar candy to the bonbon, without the use of milk and derived, with the use of other ingredients, with similar, and also nutritious biochemical properties for people's consumption with intolerance to the lactose. The Intolerance to the Lactose is the incapacity of taking advantage of the lactose, characteristic ingredient of the animal milk or derived (dairy products) that produces abdominal alterations and diarrhea, that it is more evident in the first following hours to its consumption. It grows in the mucous surface of the small intestine where there are cells that produce, they stock and they liberate a digestive enzyme (ferment) called lactase, responsible for the digestion of the lactose. When this is badly absorbed raisin to be fermented by the intestinal flora, producing gas and organic acids, what results in the called like this osmotic diarrhea, whith great intestinal loss of the organic liquid. There are people that born without the capacity to produce lactase and, while babies at least can be breastfeeded, therefore they appear implacable diarrhea. On the other hand, in any time of the life it can appear this production incapacity or a temporary inhibition, for instance, in the sequence of na alimentary toxinfection that brought damage to the intestinal mucous membrane. Equally, the difficulty can occur of chronic intestinal lesions as in the diseases of "Crohn" and "Whipple", disease celiac, giardiase, AIDS, malnutrition and also for the surgical retreats of long passages of the intestine (syndrome of the short intestine).For the elaboration of the products, were used soy extracts, aroma of condensed milk, powdered chocolate and exempt chocolate of milk. They were certain their characteristics physiochemical migrobiologic and sensorial basic, being evaluated the composition and the nutritional value of the obtained products. It was gotten to produce nutritious products(14,32% protein) of low cost, of palate pleasant, similar texture, of easy digestion and of excellent nutritional value, isent of lactose.

P143. Elaboration and development of bread enriched whith isoflavone, used as an auxiliary treatment of women during the period of menopause

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This essay is base don the development and elaboration of traditional bread and another bread enriched with isoflavone which was obtained by adding soy milk and kinako flour to the traditional bread's recipe, with the purpose of using it as an auxiliary treatment of women during the period of menopause. The great majority of menopausal symptoms occur due to the lack of estrogen.Soy contains a substance called isoflavone which has a chemical structure very similar to human's estrogen. For this reason it is also called phytoestrogen.

Isoflavones have a softer action so when absorbed by the organism they act like weak estrogens and function like regulators because they are able to supply the lack of estrogen, preventing problems related to that lack and they can also reduce the excess of that hormone, competing with it for the receptors in the cells. Therefore they inhibit the growth of cells and proliferation of tumors induced by human estrogen.In order to obtain the soy's benefits it should be consumed from 20 to 35 g daily (30-50mg of isoflavone = needed quantity to obtain the benefits of this substance). Isoflavones are distributed in the entire soy grain, but the biggest concentration is in its germ. The physicochemistry, microbiologic and sensorial characteristics of the obtained bread were determined evaluating its composition, nutritional value and quantity of isoflavone. It was obtained distinguished nutritional food with pleasant taste according to standards of acceptance of the product. Although the bread production has been in small scale, it becomes possible to affirm the viability technique for the bread elaboration enriched with isoflavona with a good quality and significant amount of isoflavonas, being that the recommended of consumption and ' supplied daily amount in 2 slices of the product, and whose cost of production for unit of bread(1,050kg) with isoflavona was of USS 1,17, a little more than bread without isoflavona, whose cost was of USS 0,88 for unit.

P144. Preparation of a soy protein shake, enriched with vitamins and mineral salts for individuals who underwent Bariatric surgery

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Approximately 35% of the Brazilian population is composed of obese individuals, of whom 2 million are classified as "morbid obese". Morbid obesity is defined as being the excess of corporeal weight in such high degree that it may lead to the appearance of illnesses or conditions which impair the good health and the life of its carriers. The main causes of obesity include: bad eating habits, such as eating the wrong foods, eating hurriedly and excesses in general, lack of physical exercise, genetic predisposition and psychological factors. Many diseases like *mellitus* diabetes, arterial hypertension, dislipidemia, coronary diseases, cerebral vascular accidents, apnoea during sleep and other respiratory dysfunctions, various orthopaedic problems and cholecistopathy are most of the times related to obesity. Many obese individuals undergo Bariatric surgery, which is a procedure carried out in the digestive system, with the aim of promoting both the reduction of one's weight and the improvement in the quality of life. Nutritional follow-up has paramount importance in the post-operation process, through the selection of the foods which contain the adequate nutrients and which fulfil the needs of the patient who underwent Bariatric surgery. The aim of this work was the preparation of a powdered lacteous beverage, like a milkshake, rich in proteins, vitamins and mineral salts, for individuals who underwent Bariatric surgery. For the formulation of both shakes, strawberry and chocolate flavoured, skimmed powdered milk, isolate soy protein, wheat gluten, dehydrated albumin, soy oil, flavouring (strawberry), powder cocoa, carrageen thickening, edulcorant, colorants, vitamins and mineral salts were used. These ingredients were balanced in such a way that they would cater for 40%VD in relation to the proteins and 30% VD of Ca, Mg, Zn, vitamins C, D, E. A profile of characteristics and hedonistic scale, structured at 9 points and 26 partly-trained provers were carried out in the sensory analysis of these products. The formulations showed good acceptability, with approximately 90% for the strawberry shake and 79% for the chocolate one. According to the Brazilian legislation in force, the products prepared can be said "to have high protein content, vitamins and mineral salts, no addition of sugar and no cholesterol".

P145. Quantification of Kunitz soybean trypsin inhibitor (KSTI) in Brazilian soybean cultivars developed by Embrapa Soja

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For the last fifty years the protease inhibitors, which are also found in potatoes, eggs, and many cereals were considered antinutrients that interferes with the digestion of dietary protein. They were the responsible for the poor growth of animals fed with raw or unprocessed soybeans. However in the end of the 80's, the protease inhibitors turned to be considered as anticancer agents. Since these early studies many scientists have investigated protease inhibitors and found that, in laboratory experiments, they inhibited cancers of breast, skin, bladder, colon, lung, pancreas, mouth and esophagus. Protease inhibitors prevent the activation of the specific genes that cause cancer and also protect against the damaging effects of radiation and free radicals, which can attack DNA. Much of the protease inhibitor in soybeans is destroyed when the beans are heated to produce commercial soyfoods. Therefore, although much of the protease inhibitor is destroyed in the soybean foods we eat, there may be enough to help lower cancer risk. In this study Kunitz

soybean trypsin inhibitor (KSTI) was quantified using the methodology of KAKADE et al. (1973) modified by HAMERSTRAND et al. (1981) in thirteen Brazilian soybean cultivars (BRS 155, BRS 156, BRS 183, BRS 184, BRS 185, BRS 212, BRS 213, BRS 214, BRS 215, BRS 216, BRS 230, BRS 231, BRS 233) developed by the breeding program of Embrapa Soja. The KSTI amount found in the defatted flour obtained from the raw beans ranged from 10.65 mg/g (BRS 155) to 27.23 mg/g (BRS 213).

P146. Breeding of soybean with reduced trypsin inhibitor activity for cultivation in Central Europe

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The main interest in Central European soybean cultivation is in the production of a high quality vegetable protein, whereas soybean oil is of minor importance due to the availability of vegetable oils from other oilseed crop species such as oilseed rape, sunflower or linseed. Moreover, livestock farmers often are searching for an on-farm protein source for feeding. However, the utilization of raw soybean is prohibited by the presence of protease inhibitors as well as a number of other antinutritional factors. Experimental soybean populations of maturity groups 0 to 000 have therefore been developed targeting at a reduction of trypsin inhibitor activity by utilizing germplasm carrying a null-allele at the Kunitz trypsin inhibitor locus. Cv. 'Kunitz' (MG III) was used as the donor of the Kunitz null-allele, and breeding lines pre-selected for early maturity and absence of the Kunitz trypsin inhibitor were evaluated for seed quality characters in five macro-environments in Austria. Trypsin inhibitor activity (TIA) of conventional standard cultivars was in the range of 85 to 140 mg trypsin inhibited by one gram of defatted soybean meal, whereas TIA of genotypes lacking the Kunitz trypsin inhibitor was in the range of 30 to 105 mg/g. Macro-environments and genotypes had a large influence on TIA, while genotype by environment interaction was of low importance. In most of the single experiments analyzed, TIA was positively correlated to oil content and time to maturity, whereas correlation between TIA and seed protein content was not significant or negative. Within the pool of breeding lines carrying the Kunitz null-allele, significant differences in TIA were found between different crosses as well as between different F_2-derived families within the same cross. This finding points to possible effects of genetic segregation within the Bowman-Birk group of inhibitors and to general genetic background effects. The results from the present set of experiments suggest that reduction of TIA in early maturity soybean genotypes is possible by treating trypsin inhibitor activity as a quantitative character and by applying appropriate selection.

P147. Concentration of lectins in soybean seeds

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There is an increased interest in the potential health benefits of bioactive proteins from soybeans. Lectins are glycoproteins present in soybean which selectively bind carbohydrates and are used in medicine in a variety of novel applications. The objective of this research was to determine the lectin concentration and physicochemical characteristics of 144 selected and diverse soybean accessions from the USDA Soybean Germplasm Collection grown under different environmental conditions. ELISA and gel electrophoresis were used to determine lectin concentration in defatted samples. Lectin concentration ranged from 1.1 to 14.5 mg/g of extracted protein. Since samples were grown in diverse environments, it was not possible to separate the environmental from the genetic effects. However, greater than 100% differences were observed among accessions of similar maturity grown under the same environment indicating that major genetic differences do exist. The mean of 23 major ancestral lines of U.S. cultivars was not different from the mean of 16 modern cultivars selected to represent the current diversity of the crop. The highest concentration of lectin was found in the exotic accessions. The lectin concentration was not related to maturity group except that many of the highest concentrations were observed in maturity group IX and X, grown in a subtropical environment. These results show that diversity for lectin concentration does exist within commercial soybean cultivars and that even greater diversity exists within the *Glycine max* species. Thus, it is feasible that the levels of this important bioactive protein can be genetically manipulated.

P148. Antinutrients, protein digestibility and iron bio-availability of soybean grains as influenced by germination

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Soybeans are rich in proteins (40%) and good source of carbohydrates, vitamins and minerals too. In spite

of good nutritional profile, soybeans possess several nutritional and processing problems including the presence of antinutrients, prolonged cooking time and poor digestibility. Due to the presence of several antinutritional factors like saponins, trypsin inhibitors and phytates, they possess low digestibility. Soybeans are processed in a number of ways before consumption which may have effect on their nutritional quality and digestibility of nutrients. Keeping it in view, the newly released high yielding varieties of soybeans by the Department of Genetics and Plant Breeding, GBPUA&T, Pantnagar were processed in the conventional manner and analyzed for their antinutrients, digestibility of protein and iron bio-availability. After germination of grains, products namely sprouted soybean *salad* and sprouted soybean *chaat* were formulated which being rich in protein, carbohydrates, fibre, vitamin c and low in fat and antinutrients can be best suitable for people suffering from obesity, CHD and other degenerative diseases. Study revealed that germination substantially increased ascorbic acid content i.e. up to 28.00 mg/ 100gm. along with decrease in trypsin inhibitor activity (TIA) i.e. up to 15.75 TUI/mg in geminated grains. Phytic acid content decreased up to 24.00 ± 0.80 mg/100 gm as against 39.90 ±0.19 in raw grains. The IVPD and in-vitro iron bioavailability of geminated grains ranged from 65.50±0.24 % to 74.05±0.40% and 3.85±0.14% to 6.90±0.19% as against 47.30±0.11 and 3.62±0.15 in raw grains. Product formulated (i) sprouted soybean *salad* and (ii) sprouted soybean *chaat* for in a category between "like very much" and "like moderately" respectively on 9 point hedonic scale. Results on nutritional quality of sprouted soybean *chaat* showed protein content ranging form 28.0 to 29.0% and crude fibre 4.95±0.24 to 2.75±0.24%. The protein content for sprouted soybean *salad* was found to be from 30.00±0.80 to 33.52±0.50% and crude fibre from 2.95±0.12 to 5.10±0.17%. From the study, it might be concluded that germination significantly improves the nutritional quality of soybean as very much clear by the reduction in the content of antinutrients, increase in IVPD and in-vitro iron bioavailability. Sprouted soybean *salad* and *chaat* have therapeutic importance so these should be popularized through hospitals, health centers and diet clinics.

P149. Incorporation of drumstick leaf powder in soy fortified traditional snack: effect on nutritional quality

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Despite considerable improvement in food security at national level, under nutrition and micronutrient deficiencies among vulnerable groups continue to be widespread in India. Moringa Olifera (drumstick) leaves grow wild and remains generally unconsumed by humans in spite of being a high source of Beta carotene, iron, calcium and phosphorus. In view of the above facts, the present study was planned to incorporate defatted soy flour (DSF-50-55% protein) and drumstick leaf powder (DLP) in traditional snack *Sev* for value addition. *Sev* were prepared using Bengal gram flour: DSF: DLP in the ratio of 80:20:5. These DSF and DLP incorporated *Sev* showed an increase in protein and fat content by 49.77% and 7.37% respectively, as compared to control. The DSF and DLP incorporated snack had protein and fat content of 26.51±0.41 and 35.65±0.31 as compared to control 17.70±0.18 and 33.20±0.93 g/100g respectively. There was a decrease in carbohydrate content by 55.88%. The energy content of control snack was 455.92 kcal whereas it increased to 465.65 kcal/100gm on incorporation of DSF and DLP. The incorporated snack had calcium content of 126.20 mg/100g thus showing an increase of 94.15% compared to control (100% Bengal gram flour). Control snack had phosphorus content of 330±0.62 mg/100g whereas on incorporation it increased to 397.30±0.51 mg/100g showing an increase by 20.40%. Iron content of DSF and DLP incorporated snack was 16.49±0.10 mg/100g as against 8.50±0.10 mg/100g in control. In-vitro protein digestibility (IVPD) of incorporated snack was estimated to be 63.39% as compared to control (51%), whereas Beta carotene in control snack was 43.00± 0.81 µg/100g that in incorporated snack. It can be concluded that in order to reduce the incidences of malnutrition and micronutrient deficiency diseases these DSF and DLP incorporated products can be used in supplementary feeding programmes for underprivileged and malnourished population.

P150. Development of nutri-soy-cookies

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Soybean has been considered as the "Health food of the east" for a long time, whereas its use for human consumption is limited to certain pockets because of certain reasons. Substantial scientific evidences suggest that incorporating soy foods into our dietaries holds the potential to reduce the risk of several chronic degenerative diseases. Promotion of defatted soy flour (DSF-by product of oil industry, rich source of protein) and okara (soy milk residue, waste product of soy milk industry, rich in fiber and minerals) utilization is the promising answer to the problem of chronic degenerative diseases and malnutrition among the population of lower socio-economic class and vulnerable section of society. So the present study was undertaken

to develop nutri-soy-cookies by incorporating DSF and okara. The product was further evaluated for sensory and nutritional quality. Results of over all acceptability revealed that cookies II (50%DSF+40%RWF+10%okara) and cookies III (40%DSF+50%RWF+10%okara) showed non-significant difference in comparison to cookies I (100%RWF-control). The proximate analysis results showed that the crude protein content of cookies II (22.59g/100g) and cookies III (21.44g/100g) increase to 360% and 337% respectively in comparison to control (4.91g/100g). But the fat content of cookies II (14.77g/100g) and III (15.24g/100g) was decreased in comparison to control (17.94g/100g). Similar trend was obtained for the carbohydrate content. The total ash content of cookies II (2.83g/100g) and III (2.21g/100g) was increased in comparison to control (0.67g/100g). The crude fiber content showed similar trend i.e.,0.12g/100g,1.32g/100g,and1.37g/100g in cookies I, II and III respectively. Thus it can be concluded that 40-50% DSF and 10%okara substitution for cookies increases its nutritional quality without affecting its acceptability. These nutri-cookies will be helpful in eradicating different chronic diseases and malnutrition from the world.

P151. Production of anti-nutritional factors free full-fat soy flour

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In spite of the fact that the food grain production in India is reaching the figure of 200 MT the majority of population in the country, particularly children suffer from protein calorie malnutrition. This problem has created a need for exploring new sources of protein for direct consumption. In this reference the soybean due to its high nutritive value has considerable potential to feed the people better and could do much to reduce nutritional deficiencies in India. The nutritive value of soybean appears to have no rival in supplying good quality protein (40%), fat (18-20%), mineral salts like calcium,sodium, manganese, phosphorous etc. Since soybean contains less carbohydrate and more protein, it forms one of the best foods for diabetic patients. Soybeans are alkaline in nature. Use of soybean in diet reduces acidity in blood. Among all the constituents we need in our food protein is the costliest one which is abundantly available in soy bean.Full fat soy flour (FFSF) which is comparatively easy and inexpensive to process is one of the most promising forms in which soy protein and soy oil can be used in human4"diet. Full fat soy flour is rich in high quality protein; it is an excellent source of iron, calcium and Vitamin B. Full fat soy flour is rich in lysine an essential amino acid needed for growth whereas the wheat flour is generally deficient in lysine. However, for use as a raw material to human feed full fat soy flour need to be heat treated to deactivate tT1e enzyme called Lipoxygenase (to avoid development of rancidity during storage) and to destroy some anti nutritional factors that are inhibitors of trypsin and chymotrysin. When they are present we can not digest proteins properly.The processing technology involves, cleaning and dehulling of whole soy beans and conditioning of dehulled soy bean with water followed by tempering of conditioned soy bean at room temperature for 24 hours. It was now subjected to heat treatment for 20-3"0 min at 110oC and for 20-30 min at 105oC and than allowed to cool to room temperature to yield soy dal. This dal was now subjected to grinding to yield full fat soy flour. It can be stored safely alone or in combination with wheat flour. The storage stability of the product was high at lower temperatures and lower relative humidity levels. Chapattis, breads and biscuits made of different blends of wheat-soy flour were liked by the test panel/ consumers, indicating that full fat soy flour can be successfully used in combination with wheat flour for making chapattis, breads, biscuits and other confectionaries.

P152. Night flower (*Oenothera indecora*) control before soybean crop

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Night flower (*O. indecora*) is a species of the *Onagraceae* family. It is an annual weed of spring-summer cycle, usually present in non perturbed areas. During the last years the relative abundance of this weed increased in fallow before soybean crop in Argentina. It may be due to its adaptation to no tillage system and its glyphosate tolerance. The objective of this experience was to determine the efficacy of several rates of glyphosate, alone and in mixture with an adjuvant, in a treatment before soybean crop in a no tillage system. The rates of glyphosate evaluated were 360, 720, 1440 and 2160 g.a.e. ha^{-1}. Two checks without herbicide treatment were included. The adjuvant addition allowed to get an 11% more control that without it. Probit analysis estimation showed a positive response to dose increment and to adjuvant use. The major herbicide activity improved with the adjuvant addition would be related to a limitation in the absorption process of glyphosate alone.

P153. Weed control in narrow row spacing soybean

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The experiment was carried out at Embrapa Soybean, Londrina, Paraná, Brazil in order to evaluate weed control methods, integrating the cultural control, through reduced row spacings, and herbicide doses in soybean crop (cultivar BRS 156). The experiment was arranged in a split-plot design of a randomized complete block, with four replicates. Row spacings (20, 40 and 60 cm) were as the plots. In the subplots, it were applied four management types: 1-recommended dose of the formulated mixture of fluazifop-p-butyl more fomesafen (250 plus 250 g a.i./ha); 2- half of the recommended dose of the formulated mixture of fluazifop-p-butyl more fomesafen (150 plus 150 g a.i./ha); 3- weed-free check; and 4- weedy check). Percentage of weed control at 8, 17, 25 days after herbicide application (DAHA) and soybean yield were evaluated. Row spacings 20 and 40 cm combined with half of the recommended dose provided efficient weed control at 17 and 25 DAHA. Except of the weedy check, all the other treatments provided similar soybean yield. The use of reduced row spacings associeted with low herbicide doses is a good strategy for controlling weeds, reducing for the half the recommended dose of the formulated mixture of fluazifop-p-butyl more fomesafen.

P154. Biology and management of *Cardiospermum halicacabum*

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Biology studies and management of the balloonvine (*Cardiospermum halicacabum*) were carried out at Embrapa Soybean, Londrina, Paraná, Brazil. Four experiments were conducted under field and greenhouse conditions. The first was conducted to evaluate growth, development and nutrient demands of the balloonvine plants. The second experiment was conducted under field conditions. Balloonvine seeds were sowed at several depths in order to evaluate the capacity of plant emergency. The two other experiments were carried out under greenhouse conditions to evalaute the herbicide effectiveness in controlling this species. The highest dry matter accumulation was, in decreasing order, in the stem, leaf and root. Balloonvine presented the following decreasing sequence of nutrient recruitment: N, K, Ca, Mg, S and P. The emergence of balloonvine seedlings occurred from several depths of sowing, including seeds on the soil surface up to 12 cm. The treatments 2,4-D (1005 g a.e./ha), paraquat (400 g a.i./ha), glufosinate-ammonium (300 g a.i./ha), lactofen (144 g a.i./ha), carfentrazone-ethyl (12 g a.i./ha), sulfentrazone (600 g a.i./ha) and glyphosate (960 g a.i./ha) were efficient in controlling balloonvine in the period up to four leaves.

P155. Population dynamics and competition of *Cardiospermum halicacabum* with soybeans in two management systems

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Balloonvine (*Cardiospermum halicacabum*) is of recent introduction in Parana State, and is an economically important weed in summer crop in Southern region of Brazil. In order to determine the time and rate of

emergence, survival and competition of balloonvine with soybeans (cv. Embrapa 62), grown under two management systems, one experiment was carried out at Londrina, PR during three seasons (1997/98 to 1999/00). Five population densities of ballonvine (zero, 60, 120, 240 and 480 seeds/m²) were established by sowing seeds in till and no-till managements for soybeans. A split-plot in a randomized complete block design, with four replications, was used. An annual seedbank decrease rate of 61.6% and 56.4% was observed for till and no-till, respectively, related to survival time estimates of six and seven years. Annual rates of emergence, in the absence of re-infestations, were higher in no-till (42.6%, 32.0% and 5.0%) than in till (29.9%, 10.9% and 0.7%), in those three seasons. Average losses of soybeans were estimated in about 8.1% in the presence of 10 plants/m² of balloonvine over 3,549 kg/ha of soybeans. Balloonvine presents significant infestation and competition hability in the soybean crop. The weed, as a plant, is eliminated by downy mildio (*Peronospora farinosa*) attach.

P156. Evaluation of the response profile over time of known seedbank population of *Cardiospermum halicacabum*, under two soil managements

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Samplings were carried out through six different occasions from 1997 to 2000, corresponding to 5,11,17,23,29 and 35 months after random sowing of the density of 480 seeds/m² of *Cardiospermum halicacabum* in experimental units with soybean under no-tillage and tillage systems. Significant effect of evaluation time on the reduction of the mean response of *C. halicacabum* population was observed, within each system and jointly. These treatments were represented by second degree polynomials equations and no significant difference was observed between management systems for population densities means levels of *C. halicacabum*.

P157. Impact of no tillage management on soybean weed communities in the Rolling Pampa

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During the last years no tillage was widely adopted in the Rolling Pampa, Argentina. The number of years with continuous no tillage interacted with the crops included in the rotation and their sowing date, generating particular environments that may change the agroecosystem components. In order to formulate suitable management techniques for soybean weeds, it is necessary to identify the weed communities related to specific practices. The objective of this work was to identify the impact of no-tillage management (specially the number of years cultivated with no-tillage) on weed communities in terms of specific and functional structure (morphotype and life cycle), and diversity. During the summer of 2003, weed surveys were done in spring-sown single soybean crops and in summer-sown wheat/soybean double crop selected randomly among a group of contrasting situations: less than five years with continuous no-tillage and more than five years with continuous no-tillage. In each field weed species were registered, weed abundance was estimated, and management information was collected. Data was analysed using uni and multivariate analysis techniques. Species constancy, alpha and gamma diversity, Shannon's diversity index and evenness were calculated. Four communities and eight floristic groups were identified. Community I was present in fields with many years with agriculture and no-tillage, and was characterised by the floristic group composed by *Oxalis chrysantha* (Kunth) Prog., *Sida rhombifolia* L. and *Veronica persica* Poir. Community II was present in fields with spring-sown soybean and few years with no-tillage. Community III was associated with the summer-sown soybean, few years with agriculture and many years with no-tillage, and was characterised by the absence of the floristic group composed by *Trifolium repens* L., *Stellaria media* (L.) Vill., *Zea mays* L.. Community IV was not related with any specific management factor among those who were considered in this study, and was characterized by the presence of *Amaranthus quitensis* H.B.K. and *Eleusine indica* (L.) Gaertn. Alpha, gamma and Shannon diversity were similar between communities, except in community III where they were lower because of the absence of the mentioned group and perennial dicotyledonous species. Equitativity was also lower in Community III.

P158. Assessment of the weed *Euphorbia heterophylla* L. resistant to ALS-inhibiting herbicides in southern Brazil

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Herbicide resistant *Euphorbia heterophylla* L. has been increasing in Southern Brazil. This work was designed to evaluate the geographic distribution of *E. heterophylla* in farms located in two states in Southern Brazil, to analyze the species genetic background, and to obtain

data to determine the major contributing management causes for the selection of weed resistance. *E. heterophylla* seeds were sampled in 148 sites located in Paraná and Rio Grande do Sul states, during 2001 and 2002. On each site, farmers informed management procedures adopted the previous years concerning weed control, tillage system, crop rotation, and harvesting operation. Seeds were planted in pots and kept on greenhouse. A susceptible biotype was planted as a control. When the plants were at 4-leaf stage, 200 g/ha of imazethapyr were sprayed. Visual injury and plant mass was assessed 4 weeks after treatment. Genetic analysis was performed using standard RAPD protocols. Plants from all 148 sampled areas, from 62 counties in both states, confirmed resistance to ALS inhibitors. This survey demonstrated ALS resistant *E. heterophylla* biotypes are widely distributed in Southern Brazil. RAPD analysis of 45 populations from both states indicates limited genetic similarity among biotypes suggesting no resistance dispersion in the region, and also indicating resistance to have been individually selected in each farm. Analysis of questionnaire data suggests that dissemination of seeds from resistant plants is unlikely to explain the widespread distribution of resistance. The majority of the samples were collected in farms on the no-till cropping system. ALS-inhibiting herbicides were the major wild poinsettia control method for at least 10 years in most sampled areas. During the 2 years before seed sampling there was a trend of increased use of PROTOX inhibitors and/or herbicide mixtures for adequate wild poinsettia control. The frequent use of ALS-inhibiting herbicides is the probable cause of widespread distribution of herbicide resistance in the region.

P159. Integrated management reduces the weed impact in soybean

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The weeds cause great looses in the crops yield and the herbicides consist in the main tool for its control. However, the appearance of herbicide-resistant weeds and the growing concerns about the environmental and economic impact of pest control has valorized the techniques related to integrated management. In that sense, two experiments were carried-out at Cruz Alta, RS, Brazil, to evaluate the effect of straw over the soil and the spacing of soybean rows in the weed interference on grain yield. Two field experiments were installed in the summer 2002-2003 growing season, both arranged in a split-plot design with four replications. Straw levels of black oat (*Avena strigosa*) 0, 3, 6 and 9 Mg ha^{-1} was the main plot and the spacing between soybean rows (20, 30 and 40 cm) was the subplot. In the first experiment the weeds were chemically controlled, while in the second no weed control was made. The evaluations consisted of weed dry mass at soybean flowering time and soybean grain yield. The predominant weeds in area were alexandergrass (*Brachiaria plantaginea*), morningglory (*Ipomoea* sp.), redroot pigweed (*Amaranthus* sp.) and hairy beggarticks (*Bidens pilosa*). The soybean production in the area without weed competition was 3071 kg ha^{-1}, and the infested area yielded 1285 kg ha^{-1}. When the soybean was cultivated competing with weeds, the smallest spacing in rows increased its competitiveness and decreased the losses in 55%, passing from 933 kg ha^{-1} (40 cm) to 1678 kg ha^{-1} (20 cm). The presence of black oat straw on the soil (6,0 t ha^{-1}) decreased the weed dry mass in more than 83%, when compared to the nude soil, and that had reflexes in soybean yield, that presented 782, 1208, 1678 and 1470 kg ha^{-1} for straw levels of 0, 3, 6 and 9 t ha^{-1}, respectively. When the weeds were controlled with herbicides, don't was perceived significant effect of the row spacing on yield, however the straw over the soil was beneficial to the culture. In that condition, the soybean produced 2769, 3062, 3189 and 3314 kg ha^{-1}, for straw levels of 0, 3, 6 and 9 t ha^{-1}, respectively. It is presumed that the productivity has decreased, accompanying the straw levels, because two main reasons: the plots without straw lost part of soil humidity, and in these plots the chemical control was not as efficient as in the plots with 6 or 9 t ha^{-1} of residues over the soil surface. In summary, the results indicate to be possible to reduce the weed impact in soybean yield with techniques of integrated management, such as the maintenance of residues in the soil surface and the reduction of the soybean row spacing.

P160. Standardization of chlorimuron-ethyl for selectivity and phytotoxicity to control weeds in soybean (*Glycine max*) and its residual effects on succeeding wheat (*Triticum aestivum*) crop

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Soybean is an important oilseed crop of India as well as Rajasthan State and grown during rainy season, which is very conducive for intense weed infestation exerts greater stress and losses (25-85%) than other pests if not controlled timely. Chemical weed control is in infancy mostly by pre-emergence or pre-plant incorporations having limitations in their ways of use and can be overcome by post-emergence herbicides but informations are scare in India. An experiment was carried out to evaluate bio-efficacy of the new herbicide – chlorimuron-ethyl in soybean and residual effects on succeeding wheat crop at Agricultural Research Station,

Kota during 1999 to 2001 situated between 25°13' latitude N and 75°25' longitude E and an altitude of 258 MSL, having average rainfall 850mm, maximum temperature 30.6°C and minimum temperature 18.7°C. The experimental soil belonged to clay-loam (vertisols) having pH 7.96, EC 0.42 dS/m, available N, P_2O_5 and K_2O, 335, 28 and 305 kgha^{-1}, respectively. Fourteen treatments, comprising two levels of chlorimuron – ethyl i.e. 6.25 and 9.37 g a.i.ha^{-1} with five application time as post-emergence viz., 5, 10, 15, 20 and 25 days after sowing compared with alachlor 2.0 kg a.i.ha^{-1} as pre-emergence, farmer's practice, two hand weedings and weedy check, were laid out in randomized block design. The experimental field was infested by broad leaf weeds especially *Celosia argentea*, *Digera arvensis*, *Commelina benghalensis* etc. (60%) and narrow leaf weeds – *Echinochloa colonum*, *E. Crusgalli*, *Cyperus rotundus*. The lowest weed density and their dry weight were found under two hand weedings followed by chlorimuron – ethyl treatments. Chlorimuron – ethyl 9.37g a.i.ha^{-1} at 10 and 15 days after sowing was found more effective on most of broad leaved weeds as evidenced from the higher weed control efficiency and was significantly superior to lower dose 6.25 g and had recorded higher pooled yield (1754 & 1764 kgha^{-1}) compared to farmer's practice (1230 kgha^{-1}) and weedy check (955 kgha^{-1}). The test herbicide did not show adverse effect on soybean crop and yield. However, yellowing of some younger leaves occurred in 2000 due to dry conditions applied at 25 days after sowing but recovered within 5-10 days as sufficient moisture available to crop plants. Residual studies showed that either dose of chlorimuron-ethyl did not have adverse residual effects on the succeeding wheat crop and yield. The herbicide chlorimuon – ethyl (9.37 gha^{-1}) as post emergence can be safely used for selective weed control especially broad leaf weeds in soybean – wheat cropping sequence.

P161. Soybean inoculation effects with *Bradyrhizobium japonicum* in vertisol soils of East Center of Entre Rios, Argentine

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The nitrogen fixation is one of the determining factors for obtain high yields in soybean crop in Argentina, when there aren't others limitations. Strains, inoculants and methods of inoculation can have great influence on the amount of N_2 fixed. The area of study is characterized by the presence of vertisol soils with high clay and low P content. In the case of fields newly used to cultivated soybean, chlorotic symptoms have been found and plant without nodules, specially in late date sowing when there is less humidity in the soil. Taking in account these limitations, one experiment was carried out in 2002/3 on non cultivated vertisol soil since 20 years. A randomized block design with five replications was employed and soybean cv. A 6040 was used. Peat sterile inoculant was prepared *ad hoc* and inoculation was adjusted a one million rhizobia/ seed. The results were analyzed through variance method and LSD test (P:0,05) was used in order to know the mean differences. The treatments were as follows 1) without inoculation 2) without inoculation and fertilized with 800 kg N-urea ha-1, 3), 4), 5), 6) and 7) inoculated with IMYZA strain collection of *Bradyrhizobium japonicum* E109, E210, E321, E328 and E340 respectively. The soil was fertilized with P at sowing. No differences were observed among treatments inoculated from the point view of total nodule number and nodule dry weight at vegetative state neither nor reproductive state. At soybean reproductive R5 state the strain E109 was significantly higher in primary root nodule number and % of nodulated plant with 3 or more nodules. The maximum yield of soybean was obtained with E109 seed inoculation with a 38% more than control plants without inoculation. The increased yield was 873 kg/ha. No differences were observed among E109, E210, E340 and the control fertilized with N. The native/naturalized strains E321 and E328 not improve high yields in that conditions. E109 it's actually a strain recommend for production of inoculants in Argentine.

P162. Use of *Azospirillum Az* 39 INTA and commercial mixed inoculant in cultivation of fertilized soya

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The extensive use of land accompanied by a bad handling practice produces a decrease in the physical-chemical and biological properties of the soil. The conventional cultivation techniques increase the speed of degradation of the vegetable residues and produce an increase in the speed of mineralization of the organic matter of the soil. Treatment 1: without inoculation. Treatment 2: 6 mL kg seed^{-1} of inoculant containing 1x10^9 UFC of *Azospirillum Az* 39 INTA in liquid support. Treatment 3: 8 g kg seed^{-1} of commercial Mixed inoculant containing 1x10^9 UFC of Rizobios and *Endogone sp* 8 colony units x g; Treatment 4 co-inoculation: treatment T2 + T3. *Number of nodules:* although there were not statistically significant differences in the number of nodules in to the primary

root, there were favourable tendencies in the treatments 2 and 3; not being so for the number of nodules in secondary root since these tendencies reached statistically significant differences. *Radical, air and dry weight:* only treatment 2 showed statistically favourable differences for dry weight air part as well as for dry weight radical part. *Harvests:* statistically favourable differences were not reflected in none of the treatments and analysis carried out, being treatment 4 with co-inoculation the one that showed a favourable tendency in the number of chauchas with one grain. Inoculation with *Azospirillum Az* 39 INTA showed favourable values in the vegetative development. The co-inoculation didn't mark substantial improvements.

P163. Inoculation and co-inoculation with *Bradyrhizobium japonicum* and *Azotobacter* spp. in fertilized soya (*Glycine max* L.) trial on field

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In a conceptual landmark of sustainable agriculture, the ideotype of leguminous is that that obtains the maximum quantity of N from the atmosphere before it obtains it from the floor, preserving the conservation of the edafic N. Since it is leguminous, the soya can be associated simbiotically to bacterias of the *Bradyrhizobium* type and form nodules able to fix nitrogen with varied efficiency. 5 treatments were carried out. They were: Treatment 1: witness not inoculated; Treatment 2: 1 g kg seed^{-1} of inoculant containing 1x10^{9} UFC of *Bradyrhizobium japonicum* in peat support; Treatment 3: 6 mL kg seed^{-1} of inoculant containing 1x10^{2} UFC of *Azotobacter sp* in liquid support; Treatment 4: treatment 2+3 y Treatment 5: treatment 3 + 8 g kg seed^{-1} of inoculant containing 1x10^{2} UFC of Rizobios, *Endogone spp* 8 colony units x g of mixed inoculant. *Numbers of nodules:* the witnesses presented good nodulation for all the carried out samples. This is due to the naturalized flora. But the contribution of new *Bradyrhizobium japonicum* shows greater nodulation. Statistical differences were not reflected in the numbers of nodules in the primary root throughout the 50 days; however, tendencies were evidenced different from the secondary root in which these tendencies reached values with statistically significant differences. Treatment 3 is the one most favoured and the one that had an application of a free fixer as the Azotobacter spp is. *Radical, air and dry weight:* the plant was favoured in the air development with statistically favourable differences, in which the treatment 3 was the greatest, not being so for the radical development in which favourable differences were not reflected. *Harvest:* it was clearly shown that the co-inoculated treatments were the ones of greatest yield reflecting statistically favourable differences. Although there were no statistical differences for the number of beans with one grain, there were tendencies. These tendencies reached values that reflected the statistically favourable differences in the number of chauchas with two and three grains. At harvest time, the treatments 4 and 5 that were co-inoculated ones were the ones of greatest yield with statistically significant differences. Inoculation with free fixers notably increased the vegetative development of the plant reaching values as were reflected in the statistical analyses, being the co-inoculated treatments the ones with greatest yield at harvest time.

P164. Co-inoculation with *Bradyrhizobium japonicum* and *Azospirillum* Az 39 INTA in the cultivation of fertilized soya (*Glycine max* L.)

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The extensive production is related to the availability of nutrients in enough quantity for the cultivation. The need of agricultural products to enhance production to the maximum, to improve the quality of the product, present the inoculation (biofertilizer) as an useful tool that can complement the productive system. Four fringes of 250 m long were carried out. The treatments were: TREATMENT 1: witness. TREATMENT 2: 1 g kg seed^{-1} of inoculant containing 1x10^{9} UFC of *Bradyrhizobium japonicum* in peat support. TREATMENT 3: 6 mL kg seed^{-1} of inoculant containing 1x10^{9} UFC of *Azospirillum Az* 39 INTA in liquid support. TREATMENT 4 CO-INOCULATION: treatment 2+3. *Number of nodules:* although there were not statistical differences in the primary root, there were tendencies in the treatment with *Azospirillum Az* 39 INTA, which were the same in the secondary root, not reaching values that show the statistically favourable differences. *Dry weigh, air and radical part:* all treatments were superior to the witness for air part reaching statistical differences; not being so for dry weight of root because there were not statistically favourable differences and the tendencies were minimum except in treatment 2. *Harvest:* none of the treatments showed statistically significant differences. However, in the total weight, the witness showed the greatest yield reflecting statistically significant differences. Inoculation with *Azospirillum Az* 39 INTA and co-inoculation with *Bradyrhizobium japonicum* and *Azospirillum Az* 39 INTA showed, under these conditions, favourable advantages for the

number of nodules and for the vegetative development, not being so at harvest time, in which case the witness was the one of most yield.

P165. Vancomycin as a selective agent in agarized media for evaluating bacterial inoculants after seed treatment

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Agar plate counts remain as the most frequently used method for evaluating the number of living rhizobia in legume inoculants, as nodulation-based methods need a much longer incubation time. However, seeds are not sterile, and direct bacterial counts from inoculant treated seeds are not is a difficult task, even after the use of different fungistatic agents in the formulations, as contaminating bacteria ussually overgrow slower growing rhizobia. For these reasons, we attempted the use of vancomycin, a selective antibiotic controlling several gram positive microorganisms, as a supplent to classic YEM agar, first discarding any inhibitory effects on different rhizobial species and strains frequently used in the formulation of comercial inoculants. Not a single strain out of 4 *Sinorhizobium meliloti,* 2 *Rhizobium leguminosarum* biovar viceae, *Rhizobium leguminosarum* biovar trifolii, one *Mesorhizobium huakii,* 2 *Rhizobium loti,* one *Bradyrhizobium spp,* and 4 *Bradyrhizobium japonicum* was inhibited when 1 mg/l vancomycin was incorporated in the media. Without the use of this agent, contaminants/rhizobial colonies ratio (after recovery from inoculated non-sterile commercial seeds) was always higher than 1, while with it, always lower than 0.1. In the first case, contaminant colony size, very mucous colonies, and rhizobial inhibition by the contaminats precluded any serious enumeration. In the second case, even if some gram negative contaminants were still detected, bacterial enumeration was always possible, facilitating the evaluation of on-seed bacterial stability after different seed treatments were used. We have not used (nor suggest) this modified medium for the direct evaluation of sterile inoculants, as it may obscure the presence of relevant contaminants.

P166. Slaughterhouse organic fertilizer on soybean nodulation and production

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Several organic residues are produced in slaughtering and processing cattle products. If no proper destination is provided for this organic material, it may represent a serious environmental problem. On the other hand, if well processed, these residues represent a rich source of nutrients with good potential for agricultural use. The objective of the present work was to evaluate the effects of a slaughterhouse organic fertilizer on soybean nodulation and production. The organic fertilizer is composed of different residues produced in the usual activities of a slaughterhouse, enriched with rock powder, saw powder and charcoal. It's elementary composition is: 11,7 g kg^{-1} of N; 13,6 g kg^{-1} of P_2O_5 (citric acid); 1,2 g kg^{-1} of K_2O; 48,3 g kg^{-1} of Ca; 5,9 g kg^{-1} of Mg; 2,8 g kg^{-1} of S; 47,7 g kg^{-1} of Fe; 2,2 g kg^{-1} of Mn; 117,5 mg kg^{-1} of Cu; 122,5 mg kg^{-1} of Zn; 190,0 mg kg^{-1} of B; 4,5 g kg^{-1} of Na; 7,50 mg kg^{-1} of Co; 40,2% moisture content (65°C); 383 g kg^{-1} of organic matter; bulk density of 0,53 g cm^{-3}; C:N ratio of 18,2; pH 8,6; 12,3 g kg^{-1} of Al; 2,3 g kg^{-1} of Cl. The studied soil was a sandy Argissolo Vermelho Amarelo, poor in nutrients: pH 5,30; 12,0 g kg^{-1} of organic matter; 1,11 $cmol_c$ kg^{-1} of Ca^{2+}; 0,57 $cmol_c$ kg^{-1} of Mg^{2+}; 0,21 $cmol_c$ kg^{-1} of K^+; 0,24 $cmol_c$ kg^{-1} of Al^{3+}; 4,09 $cmol_c$ kg^{-1} of $H^+ + Al^{3+}$; 13,1 mg kg^{-1}. Soybean (Cv. BRS 181) was sowed on November and 5 treatments were tested: T0 – No fertilizer; T1 – 1000 kg ha^{-1} of organic fertilizer; T2 – 2000 kg ha^{-1} of organic fertilizer; T3 – 4000 kg ha^{-1}; T4 – 240 kg ha^{-1} of mineral fertilizer, 0-25-25. When the plants were at full blooming, soil blocks with dimensions of 25 x 25 x 60 cm were collected for analysis of nodulation. The different treatments did not affect significantly the nodulation of soybean. It was observed, though, a trend of increasing nodulation (weight of nodules/weight of dry matter of aboveground plant material) with increasing organic fertilizer levels of 43, 72 and 43%, respectively to 1000, 2000 and 4000 Kg ha^{-1}. Inversely, mineral fertilizer induced a trend of reducing 41% of the nodulation. Soybean productivity was not significantly different among the treatments. Productivity was of 3964, 4198, 4151, 4322 and 4022 kg ha^{-1}, respectively to T0, T1, T2, T3 and T4. It is concluded that the organic fertilizer, although providing a significant amount of nitrogen to the soil, did not influenced negatively the soybean nodulation. The absence of organic and mineral fertilizer effect on soybean productivity was probably related to favorable climatic conditions during the experiment. The observed trends, though, signalizes for a possible positive effect of the organic fertilizer on productivity, which should be confirmed in further research.

P167. Biological nitrogen fixation efficiency by strains of *Bradyrhizobium* in soybean, in Mato Grosso do Sul State, Brazil

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This study was carried out to evaluate the efficiency of the *Bradyrhizobium* strains as recommended by research, in soybean crop under disk plowing and no-tillage systems. These experiments were carried out in the 2000/2001, 2001/2002 and 2002/2003 cropping seasons, in Dourados and Ponta Porã, Mato Grosso do Sul State. In the season of 2000/2001, the cropping system was conventional, while in the other seasons the experiments were cunduced in areas cultivated under no-tillage systems, after cropping of *Triticum aestivum* L. or *Avena strigosa*. In the season of 2000/2001, the treatments were: non-inoculated control; 200 kg ha^{-1} of nitrogen fertilizer, split twice and without inoculation; the commercial strains SEMIA 587, SEMIA 5019, SEMIA 5079 and SEMIA 5080, tested individually, and the combinations of the strains SEMIA 587 + SEMIA 5019 and SEMIA 5079 + SEMIA 5080. In the seasons 2001/2002 and 2002/2003, the treatments with 30 (at sowing) and 120 kg ha^{-1} (split four times) of nitrogen fertilizer were added. In the season of 2001/2002, under no-tillage system, the inoculation by SEMIA 5019 strain promote a increase around 22% highter of soybean grain yield in relation to non-inoculated control. In all experiments, the addition of 200 kg ha^{-1} of nitrogen fertilizer decreased nodules dry weight and did not increased soybean grain yield in relation to majority of the plants inoculated. Similarly, the addition of others treatments with nitrogen fertlizers did not increased soybean grain yield. The non-inoculated control did not differ significantly from the majority of the treatments with plants inoculated, for soybean grain yield evaluation, during the three cropping seasons. This lack of soybean response to inoculantion may be attributed to the established population of *Bradyrhizobium*, that showed a hight symbiotic efficiency.

P168. Early diagnosis of the sting bug damage in soybean by x-ray

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The soybean seed is sensitive to suffer alterations in its quality as a consequence of the different biotic and non-biotic factors that may be present during the crop production. One of the main factors that affect the seed quality is the incidence of different sting bugs species that can be present in the seed lot in any stage of the seed development. In insect control techniques it is necessary to make different control evaluations at different intervals of time with the aim to make the corresponding controls. If the realization of one or more controls is necessary to evaluate the need of the pesticide application, they do not serve to know the real damage produced to the seeds inside the pods. This damage can be accumulated in the seed and it is referred to the number of stings, intensity and localization of the different seed structures. The objective of this work was to evaluate the use of the X-Ray technology as an early diagnosis tool of the accumulated sting bug damage in the seed lot at any time of the crop production. There were examined samples of 100 pods randomized selected and 100 pods with visible symptoms of the sting bug attack in the upper four nodes of the plants in R5, R6 and R8. The pods were submitted to the X-Ray assay using the prototype named SEMAX and they were evaluated by digital radiographic images. These images were compared with colour digital images to analyze visually the sting damage produced by the sting bugs and the relationship that exists between both methods. In R5 and R6 the sting of the insect that produced necrosis of the tissues both in filled seeds and in pods, were visualized radiographically by a rapid and precise identification of the injured area. The tissues of the sting area showed lower density and it was observed dark areas in all of the cases, while tissues well hydrated showed a greater opacity with white coloration and good marked limits around the seed. The damages by fissure were clearly observed. Besides, in R6 the filling and empty areas of severely wrinkled seeds were easily distinguished. In R8 the same relationship between digital radiographic and colour images were confirmed. The radiographic images permitted to enlarge the visual diagnosis, obtaining a greater precision of the existent damage. The evaluation of the sting bug attack by digital radiographic images may be used as a complement of the traditional methods in a control program of soybean lots.

P169. Quality of soybean seed in Tucumán and influence areas, Argentina

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Within grain production scheme of Tucumán and areas of influence (South eastern Catamarca and Western Santiago del Estero) soybean crop is the most important, reaching 338.000 ha in the last campaign. EEAOC Seed Laboratory, controls the quality of samples sent by growers, nurseries and brokers of the region to determine their sowing aptitude. The objective of this paper is to estimate the germinative quality of soybean seed, in four campaigns from 1999-00 at 2002-03. Quality of 2507 seed samples cured with fungicide was determined, accordingly to ISTA Norms. Data of normal seedling % (able to germinate) were arranged in three groups: "best quality" (same or above 85%); "intermediate quality" (between 84% and 71%); "not too bad to bad quality" (bellow or similar to 70%). The behavior of maturation groups VIII, VII, VI, V and IV, was determined by frequency % of samples of each group for each agricultural campaign. In this work, reference is made only to best quality group. As to environmental conditions, the first three campaigns were rainier and more humid than normal during the pre-harvest period. On the contrary, last campaign was drier. Data analysis indicates that varieties from maturation group VIII, exhibited the best behavior, with an average of 82,7% of samples pertaining to "best quality group" with scarce variations along the studied years (80% to 85%). This would result from escape by cycle conditions (conditions of later maturity) and from variety characteristics. Group VII varieties were stable during three campaigns, with an average of 72% of samples in "best quality group" and a strong fall (44%) in the 2000-01 campaign, in which a variety sensitive to environmental conditions occurring during pre-harvest, prevailed. The varieties from group VI showed less best quality averages during the three humid campaigns (41% to 60%), while higher averages (76%) were detected during the driest campaign. This would indicate a strong interaction between the varieties of this group and environmental conditions prior to crop. Varieties from group V can be assimilated in its general behavior to group VI. Group IV, which had a scarce number of samples, was evaluated during the last three seasons, with an average of 70% samples in "best quality group" and scarce variation along the studied years (67% to 73%). Another factor of significant importance, although not measurable, that affected quality was the delay of harvest in the humid campaigns.

P170. Sanitary quality of commercial seed lots of soybean

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With the objective of evaluate the sanity of soybean seeds commercialized in the Northwest area of São Paulo State, an experiment was installed at the Laboratory of Seed Pathology in the Department of Fitossanidade at UNESP, Jaboticabal, in experimental design entirely randomized with 19 treatments and four repetitions, being each parcel represented by five plates with ten seeds each. The soybean cultivates used were: BRS 133, BRS 183, BRS 184, BRS MG Garantia, BRS MG Liderança, BRS MG 68 Vencedora, CD 201, CD 207, CD 208, CD 211, Embrapa 48, Engopa 313, Engopa 315, MG/BR 46 Conquista, M-SOY 6101, M-SOY 7901, M-SOY 8001, M-SOY 8400 and M-SOY 9001. Which cultivate was appraised by the blotter test, being the seeds incubated in plates of Petri, above three leaves of filter paper soaked in water and later maintained for 7 days in camera with alternation of light (12/12) and temperature of 20 ± 2°C. The evaluation was accomplished with stereoscopic microscope. The results were analyzed through the test F and the averages compared by the test of Tukey ($P < 0,05$). It was verified the presence of *Aspergillus* sp. and *Penicillium* sp. more frequently in cultivate BRS 184 (68%), differing significantly of the others. The cultivates EMGOPA 313, M-SOY 7901, M-SOY 8400, CD 211, M-SOY 9001, EMBRAPA 48, BRS-MG 68 Vencedora, BRS-MG Liderança, M-SOY 6101, M-SOY 8001, BRS 133 and CD 208 presented the smallest frequencies of these storage fungi. In CD 201 and BRS 133 cultivates it was observed the largest frequencies of *Phomopsis* sp. (10% and 6%, respectively), differing significantly of the other ones. Besides those fungi, it was observed the presence of *Fusarium* sp., *Alternaria* sp., *Phoma* sp., *Curvularia* sp. and *Epicoccum* sp., however in low frequency, not having differences among the evaluated cultivates. Considering the total of all the found fungi, the cultivate BRS 184 showed the largest frequency (71,5%).

P171. Physiological quality of soybean seeds grown on savannas of Roraima, ameliorated with sources of phosphorus, and side dressed with nitrogen and sulfur

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This work aimed to study the effects of soil application of phosphorus sources and of Nitrogen and Sulfur side dressing in a medium textured yellow latosol from the savannas of Roraima, over soybean (BRS Tracajá and BRS Sambaíba) seed quality, during the rainy season. The experiment took place at Embrapa Roraima, and began in May, 2002. As corrective fertilization 100 kg.ha^{-1} of P_2O_5 were used (sources as Super phosphate, Triple phosphate, partially acidulated phosphate and reactive natural phosphate); a fifth stripe consisted on the application in the row of 120kg.ha^{-1} of P_2O_5. As side dressing fertilization 20 kg.ha^{-1} of N, 45kg.ha^{-1} of S and 20+45kg.ha^{-1} of N+S were applicated. The different treatments were distributed among randomized horizontal and vertical stripes on the field. The different P sources were attributed to the stripes (75x4,0m) in a direction and the N, N+S and S doses to stripes (25x20m) perpendicular to the former. The fertilization concerning to planting operation consisted on the application within the planting row of 80 kg.ha^{-1} of P_2O_5 (SS) and of 120 kg.ha^{-1} of K_2O (KCl, ½ during planting operation and ½ in side dressing 35 days after planting). The seeds were treated with fungicides, inoculated and sowed. The seed physiological quality (germination, vigor) was assessed at harvest. The methodology utilized was according to Brazilian seed analysis rules. Concerning to BRS Sambaiba the best seed quality was obtained with SS P source, while for Tracajá was obtained with ST P source. Sulfur applied as side dressing resulted in best seed quality for both cultivars and all P sources. The BRS Sambaiba presented the best seed quality.

P172. Seed quality of soybean produced on savanna of Roraima with application of micronutrients, during planting year of 2002

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The influence of levels of base saturation [$V_{(\%)}$] and of (copper, boron, zinc and manganese) on soybean (cv BRS Tracajá) seed quality was assessed on savanna ecosystem (Yellow Latossol with medium texture), during planting year of 2002, three years after previous corrective fertilization with macronutrients and micronutrients (except for those under study), incorporated through harrow disc. The basic fertilization consisted of 90 kg.ha^{-1} of P2O5 and 120 kg.ha^{-1} (60 + 60) of K2O. The experimental design was a completely randomized blocks, with four replicates in a factorial scheme with four levels of base saturation (30-45-60-75%) and five doses of: copper (0,0-1,5-3,0-6,0-12,0kg.ha^{-1}); boron (0,0-0,8-1,6-3,2-6,4kg.ha^{-1}); zinc (0,0-2,0-4,0-8,0-16,0kg.ha^{-1}) and manganese (0,0-7,0-14,0-28,0-56,0kg.ha^{-1}). The analysis of data on soybean seed quality obtained at harvest took place under quadratic response surface method, with SAS System. Both vigor and germination were affected exclusively by base saturation, linearly and quadratic for B, Cu e Zn. Maximum germination levels (85-95%) and vigor (80-90%) were obtained at $V_{(\%)}$ level of 45%, satisfying the minimum level considering seed quality purposes (80%), superior in order of 14 to 28% and from 33 to 44%, when compared to minimum level of base saturation ($V_{(\%)}$ = 30%). As concerning to manganese, both vigor as germination were affected by base saturation and of Mn, linearly and quadratic. Maximum germination (95%) and vigor (90%) were obtained under $V_{(\%)}$ levels of 45-60% and 30-40kg.ha^{-1} of manganese, superior in order of 47% and 71%, when compared to minimum level ($V_{(\%)}$ = 30%) of base saturation and absence of manganese.

P173. Anatomical changes of testa and physiological potential of soybean seeds, cv. Monsoy 8400, subjected to storage

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During the aging of the seeds, the reduction of the physiologic potential is consequence of the deterioration process that can lead to alterations in the anatomy of the testa, which tend to interfere in the process of imbibition, and consequently, in the physiologic potential of the seed. The present work had as objective to evaluate anatomically the testa of seeds of soybean, cultivar Monsoy 8400, through the use of the scanning electron microscopy, after the storage, as well as the physiologic potential. The treatments consisted of the storage of the seeds in two different conditions: cold ambient and laboratory conditions, and three evaluation instances zero, three and six months, respectively, after, of storage. At these occasions, the following determinations were made: water content, seed germination, and vigor evaluated by the tests: seedlings length, dry matter, accelerated aging, cold, electric conductivity and seedlings field emergence. In each treatment, cross sections from the testa of 10 seeds were observed. The cross section was performed at the median region of seed, surrounding the hilum region.

Layers from palisade, hypodermic, and parenchyma cells were observed. The storage of the seeds for six months, under cold ambient and under laboratory, conditions can influence a larger collapse of the hypodermic layer of the testa. The collapse of the hypodermic layer, in function of the time and of the conditions in that the seeds are stored, may have influenced the increase of the electrical conductivity.

P174. Anatomy of the testa and physiological potential of soybean seeds, cv. Monsoy 8411

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The process of deterioration can provoke changes in the testa anatomy, which tend to interfere with the physiological potential. The present work had the purpose of checking a possible relationship between the testa anatomy of soybean seeds, cv. Monsoy 8411, and the physiological potential after seed storage, by using scanning electron microscopy. Treatments consisted of different periods of storage (zero, three and six months) in cold store and in laboratory conditions environmentally not controlled. Water content, germination, vigor (length and dry matter of seedlings, accelerated aging, cold, electric conductivity and emergence of seedlings) and testa anatomy were evaluated. In each treatment, cross sections from the testa of 10 seeds were observed. The cross section was performed at the median region of seed, surrounding the hilum region. Layers from palisade, hypodermic, and parenchyma cells were observed. The randomized blocks design was employed and treatments were arranged in subdivided parts, storage conditions being considered as parts and storage period as subparts. Aging favored the higher permeability of seed testa, what can be identified by the higher values of conductivity. When coat is damaged or removed, the amount of damage by imbibition increases and as a result there is higher loss of solutes. The problem is aggravated in case of weakened membranes on account of aging (Powell, 1986, Journal of Seed Technology 10:2:81-100). Seed testa, stored in cold store presented the thickness of palisade, hypodermic, and the three combined layers significantly higher than the testa of seeds stored in laboratory. It was assumed that conditions of the cold store delayed the collapse of cells making up the layers. In storing soybean seeds at 10°C found that, possibly, that condition of storage stabilized the membrane integrity, since no change was found in results of electric conductivity during the experiment, what can be resulting from the restoration or reorganization of membranes during the storage at low temperature (Vieira et al., 2001, Seed Science and Technology 29:3:599-608). Aging can have weakened cell membranes from testa layers, thus contributing to the thickness reduction of the mentioned layers. At three months hypoderm cells of testa from seeds conserved in laboratory exhibited a look more prone to come into collapse than those of the testa from seeds stored in cold store. Testa from seeds stored for six months in laboratory showed a more pronounced collapse of hypoderm cells relative to testa from seeds stored in cold store. All layers presented a significant decrease in thickness at six-month storage, and this decrease was more pronounced on hypoderm.

P175. Seed health analysis of soybean seeds from plants dead by root rot

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The occurrence of wilt and death of plants in soybean crops has been frequently observed, causing losses in some areas. The early symptoms observed are leaf spots which evolved to the leaves' yellowish color and interveinal necrotic areas, wilting and death. Research results have shown that those symptoms are associated with the fungi *Fusarium solani*, *Macrophomina phaseolina*, *Corynespora cassicola*, *Rhizoctonia solani* etc and also with nematodes. With the objective of evaluating the seed health quality and the possible relation with the causal agents of the plants' death, seeds from 50 dead plants were randomly collected in three different spot patches, and the same amount were collected from healthy plants at the same area. The seeds were incubated in gerbox, 12h day light / 12h dark for seven days at 22°C. In the three seed samples taken from the dead plants (DP) and from the healthy plants (HP) the fungi observed more frequently were: *Fusarium* sp. (29,8% DP, 12,7%), *Phomopsis* sp. (13,7% DP, 7,4% HP), *Cercospora kikuchii* (3,8% DP, 7,5% HP), *Colletotrichum truncatum* (0,2% DP, 0% HP), *Phoma* sp. (0,9% DP, 0,7% HP), *Cladosporium* sp. (24,2% DP, 35,1 HP), *Penicillium* sp. (4,9% DP, 36,2% HP), *Alternaria* sp. (34,2% DP, 2,2% HP) e *Aspergillus* sp. (0,2% DP, 1,8% HP). The seeds germination levels varied from 44,2% in DP to 89,4% in HP.

P176. Study on effects of seed germination with different sterilization methods in tissue culture of soybean

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To establish the most optimal methods of sterilization on soybean, variety Hefeng No.35 were taken as ma-

terial to compare effects of seed germination with different disinfectants which is saturate bleaching powder solution, 0.1% aqueous mercuric chloride and 70% alcohol solution and different treating time at 28°C or 4°C in tissue culture. The results showed that the effect of saturate bleaching powder solution is better than that of 0.1% aqueous mercuric chloride; the long-time treatment in lower temperature can keep higher germination rate and lower contamination rate comparing with the normal treatment; 70% ethanol is more harmful to the germination of seeds comparing with other disinfectants; the most optimal methods of sterilization is one-two hour's treatment with saturate bleaching powder solution in 4°C after 30 seconds' pretreatment with 70% ethanol or two hour's treatment with 0.1% aqueous mercuric chloride in 4°C.

P177. Post-harvest physiological behavior and sanitary requirements of soybean seed/grain

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Availability of quality seed, having high levels of germination, vigour and health standards, is a major constraint for soybean cultivation in the tropics. Sanitation and phyto-sanitation standards are also to be met for international trade. The quality of soybean seed/ grain is influenced by several abiotic and biotic factor viz. extreme fluctuations in temperature and moisture during seed maturation, weathering due to pre-harvest rains, pre-and post-harvest incidence of pests and pathogens to the grains and conditions at seed drying, processing, storage and transit. Both physiological and pathological factors contribute significantly in the deterioration of seed quality. The genotypic differences with respect to physical and chemical characteristics of the seed influence the storability behavior of soybean varieties. Protein and lipids, the major constituents of soybean seed, play important roles in moisture absorption/ desorption patterns and lipid peroxidation mechanism, which have a direct effect on seed longevity. In addition, micro/macro damages on the seed coat surfaces result in grater incidence of pathogens and pests causing faster deterioration of seed. Physiological and seed health parameters governing soybean seed quality will be discussed towards attaining desired longevity and phyto-sanitation in soybean seed/ grain.

P178. Research on the relationship between texture and microstructure of vegetable soybean

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This experiment was carried out to study the relationship between rigidity and microstructure of soybean seeds as well as the difference between vegetable and grain-type soybeans in seeds rigidity and microstructure. Seven vegetable-type and seven grain-type soybean cultivars were planted on the farm field of Shanghai Jiaotong University. Plump intact pods that have two or three seeds in R6 growth stage were sampled. After fresh pods cooked in boiling water for 0min, 2min, 4min, 6min, 8min and 10min respectively, their rigidity were measured using GY-1 sclerometer. Seeds that have close sizes were made cryosections of seed cotyledons and seed skins. Microscope and micromeasuring ruler were used to observe and measure cell densities and plies of different parts of the seed. Cell densities of the seed skin palisade tissue and infundibular tissue of vegetable-type soybean cultivars are higher than those of grain-type ones. Grain-type soybean has higher cell density in cotyledon than that of vegetable-soybean. Seed rigidity correlates negatively with the cell density of seed cotyledon and correlates positively with the cell density of the seed skin palisade tissue among different cultivars. Vegetable-type soybean changes soft after a short period of cooking (2min) and it keeps in this rigidity for a long time (4-8min), whereas grain-type soybean becomes soft after a longer period of cooking (4min) then keeps that rigidity and it is softer than vegetable-type soybean. Furthermore, cell density and the dynamic change of seed rigidity could be used as the indexes of distinguishing vegetable and grain-type soybeans.

P179. Development of screening assays to identify resistance to Phomopsis seed decay in soybean

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Phomopsis seed decay (PSD) caused primarily by *Phomopsis longicolla* contributes to poor seed quality in early-planted soybeans in the southern United States. Current control recommendations lack consistency and entail added production costs to growers. Resistance could provide more effective and dependable control with no added cost. Literature reports indicate that resistance to PSD occurs in several plant introductions and cultivars. Resistances in PI 417479 and PI 80837 have been studied in some detail, and a PSD resistant breeding line MO/PSD-0259 has been developed from PI 417479. Current screening procedures to identify genotypes with resistance to PSD rely on bioassay of field grown seed, which is time consuming and

problematic. Several reports have emphasized a need for greenhouse screening procedures to identify resistant genotypes. The objectives of this research were to determine if the recovery of *P. longicolla* from first trifoliate leaf disks and from seed of known resistant and susceptible genotypes grown and inoculated in the greenhouse correlated with seed infection from the field. Extensive experiments to optimize conditions for identifying PSD-resistant genotypes using the PSD-susceptible 'Pioneer 9482' and the PSD-resistant MO/PSD-0259 resulted in two different procedures. Seedlings at V2 were inoculated with 15,000 conidia/ml of *P. longicolla* and given 39 hours of dew. Eight, 10-mm diameter leaf disks from first trifoliate leaves were harvested after 30-52 hours in the greenhouse and bioassayed on PDA. For greenhouse seed assays, R6 pods were inoculated with 100,000 conidia/ml and given 72 hours of dew. Seeds were harvested at R8 and bioassayed. Field studies done at two locations for two years, and both greenhouse procedures were use to compare several genotypes with varying levels of PSD resistance. *P. longicolla* incidences from seed of the PSD-susceptible 'Pioneer 9482' and 'Asgrow A 4922' grown in the field were significantly greater than from the PSD-resistant genotypes PI80837 and MO/PSD-0259 (P=0.05). These differences were positively correlated with *P. longicolla* recoveries from trifoliate leaf disks, 0.813 (P = 0.014) and greenhouse seed assays, 0.796 (P = 0.018). Recovery of *P. longicolla* from trifoliate leaf disks was weakly correlated with recoveries from greenhouse seed, 0.657 (P = 0.077). These results indicated that both greenhouse procedures were as accurate in resolving highly resistant and susceptible genotypes as current field screening. Further work is being done to address the resolution of the leaf disk assay as a tool for genetic studies and line selection.

P180. Environmental damage on soybean seeds [*Glycine max* (L) Merr]

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Since 1996, an intensification of the environmental damage on soybean seeds and the appearance of new manifestations, which highly differ from the traditional pattern, have been observed in Argentina. The main objective of this study was to describe this new manifestation and the intensity of the environmental damage on soybean seeds. Seeds from Pioneer 9492 RR cultivar, produced in 2001, in Oliveros, Argentina, were harvested and threshed manually. Seeds were subjected to the Tetrazolium Test, using 16 replicates of 50 seeds each. Seed samples were placed in wet towel paper rolls at room temperature during 18 hours. Later, seeds were incubated in a 2, 3, 5 Triphenyltetrazolium Chloride solution at a concentration of 0.075% during 3 hours at 38 °C (100.4 °F). Seeds were evaluated individually and cotyledons were observed internally and externally. The following data was recorded: Presence, type, location and depth of the traditional environmental damage (T), and the new manifestation, which was called non-traditional (NT). The latter was characterized by areas of damaged and/or dead tissue, which were randomly distributed over the cotyledons. In some cases, areas of damaged tissue inside the cotyledon, but without external manifestations, were observed. Unlike T (traditional damage), NT (non-traditional damage) neither appeared at the periphery nor did it show the symmetry and homology, both characteristic features of the traditional damage. The description of the NT would allow these new manifestations to be incorporated to the T pattern in the Tetrazolium Test.

P181. Efficiency of foliar fungicides for the control of soybean seed pathogens in Tucumán, Argentina

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The late season fungal disease complex is now recognized as a major constrain to soybean production in Tucumán and other provinces in northwestern Argentina. The use of healthy seed is regarded as an important practice to include in management programs for these diseases since all the pathogens included in this complex are seedborne. The objective of this research was to evaluate the efficiency of foliar fungicides in the control of pathogens present in soybean seed. Tests were conducted during the 2001/02 and 2002/03 growing seasons in San Agustín, Tucumán, in fields of cultivar A 6401 RG previously cropped to soybean. Treatments included two fungicides (carbendazim and azoxystrobin) and four fungicide mixtures (difenoconazole + propiconazole, epoxiconazole + carbendazim, pyraclostrobin + carbendazim, and trifloxistrobin + cyproconazole), applied at different growth stages, R3 or R5.4. The experimental design used in both tests was a randomized complete block design with 4 replications. Plots consisted of four 6-m rows, spaced 0.5 m apart.

One hundred seeds per plot of the mechanically harvested sample were assayed for seedborne fungi in the laboratory. Predominant fungi were *Fusarium* spp., *Cercospora kikuchii,* and *Alternaria* spp. *Fusarium* spp. was controlled with 50% efficiency when carbendazim was applied at either of the 2 stages. Treatments that included triazoles had an efficiency greater than 50% when applied at R5, and the main control was achieved with the mixture of epoxiconazole + carbendazim. Among the strobilurins, trifloxistrobin showed the highest control with more than 50% control in R3 applications. *C. kikuchii* was controlled with 35% efficiency when carbendazim was applied at either of the 2 stages. Triazoles showed an efficiency of 58.3% in 2001/02 and 56.2% in 2002/03, when applied at R3. When applications were done at R5.4, the control was 41.5% in 2001/02 and 62.5% in 2002/03. Strobilurins had 44.4% efficiency in 2001/02 and 54.2% in 2002/03 when applied at R3, and 54.2% when treatments were applied at R5.4. The highest levels of control of seedborne *C. kikuchii*, were obtained with azoxystrobin and pyraclostrobin + carbendazim. The most efficient treatments for *Alternaria* spp. control were those that included strobilurins. These treatments showed an efficiency of 68.4% and 67.5% for R3 and R5 applications, respectively. Triazoles showed 45.1% and 70.4% control when applied at R3 and R5, respectively. Carbendazim had the lowest levels of *Alternaria* spp. control (35%).

P182. Efficacy of some new seed dressing combination products against seed and seedling diseases of soybean (*Glycine max* (L.) Merrill)

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Soybean [*Glycine max* (L.) Merrill] has become an important oleiferous cash crop of India, occupying approximately 6.0 million hectare area. With phenomenal increase in the hectarage and continuous monoculture in the same fields, soybean has become prone to a number of pathogens. Seed and seed borne pathogens pose a potential threat at early crop stages and at times drastically reduce the emergence, plant stand and ultimately the yield. A vast spectrum of pathogens has been found to be associated with the seed and seedling mortality of soybean. The conventional fungicidal seed dressers being used singly are not that effective against such diverse categories of pathogens. Hence, combinations of various fungicides especially the formulated combi products were evaluated for 3 years during rainy season of 2000 to 2002, along with their components applied singly. Combination of thiram 20 % + carboxin 20 % (Vitavax 200 FF) applied @ 0.2 % was most effective in improving the emergence (68.31 %), reducing the seedling mortality (19.66 %) and fetching higher yields (1195 kg ha^{-1}) as against 49.22 %, 41.24% and 881 kg ha^{-1} recorded under untreated control. Remaining on par with it, thiram + carbendazim (2:1) @ 0.3 %, captan + carbendazim (2:1) @ o.3 % and thiram 37 % + carboxin 37 % (Vitavax 200 WP), were next in order of efficacy, all being significantly superior over control. These seed dressers exhibited a great potential in protecting the soybean from seed and seedling diseases and improving the plant stand and yields.

P183. Compatibility of biostimulant with fungicides in seeds treatment

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The use of biostimulant can enhance root growth and water and nutrients uptake, since the beginning of plant development. The goal of this experiment was evaluating the effectiveness of some fungicides associated to STIMULATE® (0,09 g/L of kinetin + 0,05 g/L of gibberellic acid + 0,05 g/L of indolbutyric acid) on seed treatment on the control of fungus diseases of soybeans and the effect of this association on seed germination and seedlings vigor. Treatments consisted of the biostimulant, at the dosage 3 mL/kg of seeds, associated to the fungicides fludioxonil + metalaxyl, carbendazim + thiram, carbendazim + tolyfluanid and carboxim + thiram at the recommended dosages. Soybean seeds without products (control) presented 30,5 % of *Fusarium semitectum*, 15,5 % of *Phomopsis* spp., 2,0 % of *Colletotrichum dematium* and 7,5 % of *Penicillium* spp. All fungicides were efficient, reducing the incidence of the fungus, independent of the association with biostimulant. Carbendazim + thiram, carbendazim + tolyfluanid and carboxim-thiram eradicated all fungi, independent of the association with bioestimulant. Evaluation of germination on paper and emergence in greenhouse and field treatment were conducted, but neither treatment showed negative effect of the biostimulant on the performance of the fungicides. In the field experiment it was observed that plants derived from seeds treated with fungicides presented greater vigor in relation to plants without seed treatment. In this experiment was concluded that the biostimulant did not affect the efficiency of the fungicides, when used in association on seed treatment. Seed germination and seedlings vigor were not affected by the fungicides or their association with the biostimulant. Thus, seed treatment with fungicides and the biostimulant can be carried out in a single operation, bringing economic advantage to the farmer.

P184. Relatioships among *Cercospora kikuchii* and soybean seed germination

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The purple seed stain in soybean (*Glycine max* L.) caused by *Cercospora kikuchii* (Matsumoto & Tomosayu) Gardner affects seed quality. Nevertheless *C. kikuchii* role in soybean seed health is very poorly understood. Studies on germination and field emergency in relation to discolored seeds are very contradictory. Several reports conclude that germination is reduced until 30% in laboratory test. Others said that seed discoloration is a cosmetic seed quality problem, primarily affecting marketability. Another think that *C. kikuchii* may produce weak seedlings. Surface discoloration over nearly 50%, could delay germination. Four samples of soybean seeds were harvested and analyzed to determine infection level and germination percentage using blotter test. Furthermore, seeds with varying degrees of pink to purple seed coat discoloration (100, 75, 50, 25 and 0%) were studied. Seeds with 40.7, 26.1, 23.3 and 3.5% of purple seeds stained registered 42, 78, 62 and 95% germination percentage, respectively. There was an inverse correlation between purple stained seeds and percentage of germination (r^2 = -0.80). At lower infection level there was more higher germination than in purple stained seeds. There was significant negative correlation between discoloration rate and germination in three samples. Diseased seeds originated necrothic cotylendons and hypocotile and *C. kikuchii* was reisolated from these lesions.

P185. *In vitro* and *in vivo* fungicides efficacy for controlling soybean seed pathogens

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The "in vitro" and "in vivo" efectiveness of fungicides for controlling soybean seed pathogens was evaluated on Kayabi and Pintado cultivars in 2003 year. Experiments were carried out at SEEDS, located in Passo Fundo, RS, Brazil. Seeds naturally infected were treated inside a PET bottle. Fungicides and doses of active ingredient + 0.25 % of water/100 kg of seeds were: carbendazim + thiram (30 g + 70 g); carboxin + thiram (50 g + 50 g); thiabendazole + thiram (17 g + 70 g); tolylfluanid (50 g); thiophanate-methyl (50 g); difenoconazole (5 g) and metalaxyl + fludioxonil (1 g + 2,5 g). One check was used for each cultivar. In the *"in vitro"* essay, two hundred seeds (4 replication of 50) per treatment were plated inside a gerbox with PDA (potato-dextrose-agar) media and incubated in a growth chamber (25 °C ± 5 °C and 12 h x 12 h of photoperiod). Ten days later, seeds were observed by the use of digital microscope (Scalar USB microscope M2) and fungi recorded. In the *"in vivo"* essay, seeds were sowed on a plastic box (40 cm x 30 cm x 8 cm) with a mixture of substrate: two parts of field soil from a area with soybean over the previous 5 years, plus one part of washed river sand. Four hundred seeds (4 replications of 100) were hand planted at 4 cm deepness. Twelve days after planting (DAP), seedling number (SN) and seedling height (SH) were evaluated. Seedlings were washed and desinfested with a sodium hipochloride (1:1) for one minute. From each seedling 0,5 cm segment of hypocotile was cut, and placed inside a gerbox with PDA+S (potato-dextrose-agar + streptomycin sulfate) in order to determine the fungi transmission. The fungi incidence (%) at check treatments for Kaiabi and Pintado cultivars were: *Cercospora kikuchii* (CK), 14,0 and 11,0; *Colletotrichum truncatum* (CT), 1,0 and 0,0; *Fusarium solani* (FS), 31,0 and 38,0; *Fusarium graminearum* (FG), 6,0 and 4,0; *Phomopsis sojae* (PS), 21,0 and 21,0; *Pennicillium* spp. (PEN), 6,0 and 3,0 and *Rhizopus* spp. (RZ), 3,0 and 2,0, respectivelly. All fungicide "in vitro" evaluated reduced fungi incidence. *Fusarium* complex (FS+FG) were best controled with carbendazim + thiram, thiabendazole + thiram and thiophanate-methyl in both cultivars. Carboxin + thiran and tolylfluanid showed a control of ≥ 84,0 %. PS was erradicated with carboxin + thiram, carbendazim + thiram, thiabendazole + thiram and thiophanate-methyl. The "in vivo" essay showed statistic differences ($P \geq 0,05$) for SN and SH parameters. Carboxin + thiram, difenoconazole and tolylfluanid showed the highest SN values differing from check and other fungicide treatments. The fungi transmission at the check treatment for Kaiabi cultivar was 4,0 %, 4,33 % and 1,0 % for CK, FS and CT, respectively. In Carbendazim + thiram and thiabendazole + thiram treatments, transmission was 1,0 % for CT and PS, while in difenoconazole treatment 1,0 % of CK and FS was observed. In the Pintado cultivar, CK and FS incidences of 2,5 % and 1,5 % were observed in seedlings from check treatment while only 1,0 % of FS was observed in difenoconazole treatment. The results showed differences on "in vitro" and "in vivo" fungitoxic activiy. It is hypothesized that they are probabilly due to seed cover, type and infection level, environmental factors (T °C and RH) and competition by fungi flora in the soil. Fungi transmission, seedling number and velocity of emergence are important factors to be considered in chemical control of seeds with fungicides.

P186. The efficacy of soybean seed treatment with Vitavax in the laboratory and field evaluation of seed vigor

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Soybean seed treatment fungicides could improve stand establishment if the conditions at planting are not favorable for rapid germination and emergence, what favors early-season soybean diseases. Seed ageing is also an important cause of low vigor and bad performance, especially in adverse seedbed conditions. Therefore, in this investigation, soybean seed vigor was tested by three laboratory tests (germination energy, standard germination test and cold test) and in a field trial, as well. The seed of selected Croatian soybean cultivars (five cultivars from maturity groups 0 to I) was stored in a warehouse for 6, 18 and 30 months prior to testing. In general, laboratory evaluation of seed vigor showed that seed age was the most important limiting factor ($P>0.01$) and highly significant positive influence of treatment with Vitavax on seed vigor. In a field trial, the planting was done on early and optimal planting date, considering the climatic conditions in eastern Croatia. The influences of seed age, Vitavax treatment and cultivar on the field emergence at V1 stage were significant ($P>0.01$) in both planting dates. However, these factors were more important in unfavorable conditions at early planting. The influence of seed treatment with Vitavax was the strongest in 18 months old seed group. The cultivar differences significantly rose with seed age and were more expressed in treated seed. Seed deterioration by ageing was more expressed in untreated seed. The connection among laboratory tests and field emergence was similar in treated and untreated seed, as well. At early planting, the strongest correlation was established between the field emergence and cold test ($r = 0.949^{**}$, $P>0.01$) and in optimal planting date was between the field emergence and standard germination test ($r = 0.943^{**}$, $P>0.01$). This investigation confirmed that seed treatment with Vitavax could be useful measure for improvement of soybean seed performance at early stand establishment, especially by carried over seed and in adverse conditions at planting.

P187. Growth and yield of soybean with seeds inoculated and treated with fungicide and micronutrients

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This research had as purposes to evaluate the effect of fungicides, associated or not to the use of Co and Mo micronutrients on soybean seeds treatment, in terms of the toxicity of these substances to N_2 fixing bacteria and on nodules development. It also aimed to evaluate the effect of these treatments on the growth and yield of soybean. Two independent experiments had been carried: complete randomized (in pots) and other in randomized blocks (in field) design, both with three replicates and with the following 16 treatments: 1) total control (seeds without inoculation, fungicide and micronutrients); 2) inoculated seeds; 3) seeds treated with micronutrients (Co and Mo); 4) seeds inoculated and treated with micronutrients (Co and Mo); 5) seeds treated with the fungicide difenoconazole; 6) seeds treated with the fungicide tolylfluanid; 7) seeds treated with the fungicide thiran + carboxin; 8) seeds treated with the fungicide thiran + thiabendazole; 9) seeds inoculated and treated with the fungicide difenoconazole; 10) seeds inoculated and treated with the fungicide tolylfluanid; 11) seeds inoculated and treated with the fungicide thiran + carboxin; 12) seeds inoculated and treated with the fungicide thiran + thiabendazole; 13) seeds inoculated and treated with the fungicide difenoconazole + micronutrient (Co and Mo); 14) seeds inoculated and treated with the fungicide tolylfluanid + micronutrient (Co and Mo); 15) seeds inoculated and treated with the fungicide thiran + carboxin + micronutrient (Co and Mo) and 16) seeds inoculated and treated with the fungicide thiran + thiabendazole + micronutrient (Co and Mo). The following characteristics had been evaluated: initial and final stands, number of pods per plant; number of seeds per plant, number of nodules, dry mass of nodules, dry mass of roots and above-ground biomass, mass of 1000 seeds and yield. It was concluded that the treatment of the seeds with fungicide favors the establishment of plants in the field. There are interferences differentiated between the treatments with and without fungicide and with and without the micronutrients cobalt and molybdenum, on the nodule and production components and on the agricultural soybean productivity.

P188. Effect of fungicides on Rhizoctonia Foliar Blight and soybean seed health

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The occurrence of the Rhizoctonia Foliar Blight (RFB) of soybeans, caused by *Rhizoctonia solani* AG1-IA, raises the yield reductions in tropical regions. The

fungicides based on strobilurines and triazoles best controlled the disease under greenhouse conditions. The objective of this work was to evaluate the effect of several fungicides groups on the control of RFB, in Maranhão field conditions, as well as its impact on seed health. The fungicides were applied using a backpack sprayer pressurized with CO_2, when the plants showed 10% of infected leaf area that occurred at R3 stage. Disease severity was evaluated using a scale of notes (0 to 11), when the plants reached the R5.5 stage. Grain weight and seeds health were evaluated in the laboratory. The treatments using Pyraclostrobin + Epoxiconazole (3.0), Azoxystrobin + Difenoconazole (3.5) and Azoxystrobin (3.75) presented best control of the RFB, as compared to the check treatment (7.25). The plants treated with Pyraclostrobin + Epoxiconazole, also showed the highest yield, with an increase of 38.4% related to the untreated plots. All treatments with strobilurines and triazoles, only or mixed, were higher than benzimidazoles. Seed health test showed incidence of *Aspergillus flavus*, *Aspergillus* sp., *Fusarium* sp., *Cercospora sojinae*, *Cercospora kikuchii*, *Phomopsis* sp., *Colletotrichum* sp., *Rhizopus* sp., *Penicillium* sp. and bacteria on all treatments, without differences among them and the occurrence of storage fungi predominated upon seed pathogens.

P189. A diagrammatic scale to assess late season leaf soybean diseases under natural occurrence of *Septoria glycines* Hemmi and *Cercospora kikuchii* (Matsu. & Tomoyasu) Gardner

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The occurrence of late season leaf diseases caused by the fungus *Septoria glycines* and *Cercospora kikuchii* is easily identified in field. The lack of a standardized visual method may lead to inaccurate estimates of their severity, inducing inexact conclusions. With the purposes: to elaborate and validate a diagrammatic scale to assess late season leaf soybean diseases; to verify the relation between severity of these diseases and yield and to evaluate the effect of these diseases on healthy leaf area duration and healthy leaf area absorption, were installed field experiments at Fazenda Areão (ESALQ/USP), in Piracicaba - SP. The soybean cultivar MG/BR - 46 (Conquista), susceptible to both diseases was sown in a complete randomized blocks design in factorial 2 x 3 (two fungicides: benomyl and tebuconazole and three application stages: R_4, $R_{5.3}$ e R_6) and three extra treatments (control without application, fortnightly application of benomyl and fortnightly application of tebuconazole), at three replications. To quantify the severity of these diseases it was elaborated a diagrammatic scale, from leaves collected in the field presenting different levels of severity. The area of each leaf and its correspondent severity were determined, and following the "Stimulus Law by Weber-Fechner" a scale was elaborated with the severity levels: 2.4, 15.2, 25.9, 40.5 and 66.6%. The validation was carried out by nine appraisers, without previous practice in assessing late season leaf diseases, who estimate the severity on 30 leaflets of soybean with disease symptoms. The evaluation precision varied according to the appraiser ($0.84 < R^2 < 0.65$), as well as the accuracy ($0.00 < a < 3.40$; $0.90 < b < 1.29$), do not occurring systematic mistakes in the super or underestimation of the disease among the appraisers. Based on the obtained results in three consecutive crop seasons (1999/2000, 2000/2001 e 2001/2002), it was possible to conclude that: a) the developed diagrammatic scale is appropriate to quantify the late season leaf diseases severity of soybean; b) the late season leaf diseases, when in severity below 10%, do not affect the number of pod and seeds per plant but cause reduction of yield; c) the healthy leaf area absorption is the variable which most express the relation between the severity of this diseases and the soybean yield.

P190. Quantification proposal of diseases of the soybean through diagramatical scales

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The leaf diseases of the soybean severe losses in the income of grains, however, do not exist, until the present moment, study epidemiologist with emphasis in diagramatical scale of these diseases. The present work had as objective to develop a method of quantification of *Septoria glycines*, *Microsphaera diffusa*, *Peronospora manshurica* and *Phakopsora pachyrhizi* aiming at a standardization, in the field, the evaluation of severity of these diseases. The scales had been developed according to recommendations of Campbell & Madden (1990), where the levels maximum of diseases of the scale must coincide with the maximum amount of diseases found in field, leading in consideration the law of Weber- Fechner, where the visual acuidade is proportional to the neperiano logarithms of the stimulaton intensity. The scales had been developed with the aid of the Quant program, of the Federal University of Viçosa, presented levels of 0, 25, 50, 75, 100% of lesion leaf area. The results had

indicated that the integrated handling of diseases of the soybean will have to earn with the adoption of the scales, beyond the use of the same ones inside of a program of genetic improvement of soybean.

P191. Effect of late season diseases on healthy leaf area index and healthy leaf area duration of different soybean genotypes in Tucumán, Argentina

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The effect of late season diseases (LSD) on different soybean genotypes with 4 different planting dates (PD) was assessed by an integrated variable, healthy leaf area duration (HAD), and two discrete variables, LSD severity and healthy leaf area index (HLAI), in relation to yield. Field tests were conducted in San Agustin, Tucumán, Argentina. Twelve genotypes (Maturity groups VI to XI) were evaluated in the 2000/01 growing season and 15 genotypes were evaluated in the 2001/02 season, with four planting dates (PD) in each season. The first two PD were also compared with fungicide treated plots. The experimental design was a randomized complete block with 3 replications. Plots consisted of four, 6-m rows, spaced 0.5 m apart. Brown spot (*Septoria glycines*), leaf blight (*Cercospora kikuchii*), bacterial blight (*Pseudomonas savastanoi* pv. *glycinea*), downy mildew (*Peronospora manshurica*) and frogeye leaf spot (*Cercospora sojina*) were the main LSD during the first season, while brown spot, bacterial blight, downy mildew and target spot (*Corynespora cassiicola*) predominated during the following season. Growing season, PD, and maturity group affected HLAI progress curves; in addition, interactions among growing season, PD and genotype were observed for HAD. The HLAI values for 2000/01 were higher than those for 2001/02. The HLAI progress curves in late plantings were flatter than in early plantings. For fungicide treated plots, long maturity group genotypes showed higher HLAI values (highest values were 4.9 for FAM 940 in 2000/01 and 4.4 for IB 8212/22 in 2001/02) than short maturity group (4.6 for A 6445 RG and 2.0 for A 6401 RG for 2000/01 and 2001/02, respectively). Reduction of soybean growth was determined using HAD reduction percentages. In 2000/01, growth reduction percentages varied between 17 and 36 for the first PD and between 10 and 36 % for the second PD. In 2001/02, reduction rates varied between 17 and 49 % and from 17 to 51 % for the first and second PD, respectively. Associated with these reductions in HLAI and HAD, yield decreased between 4 and 38 %. These results show that the late season disease complex significantly affected the HLAI and HAD parameters, which was reflected in important yield reductions. Thus, appropriate management strategies should be adopted to diminish the impact on soybean of this disease complex.

P192. Frequency and chemical control of causal pathogens of soybean late season diseases in the Pampeana Region

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Damages caused by late season diseases of soybean (*Glycine max*) have increased lately in Pampeana Region, mainly due to wide spread of no tillage combined to soybean monoculture. In order to evaluate yield reduction caused by the complex, efficiency of foliar applications of fungicides, and frequency of pathogens involved, twelve trials were conducted from 2001 to 2003 growing seasons in no-tilled monoculture commercial crops in south Santa Fe and southeast Cordoba provinces. Triazoles, benzimidazols and strobirulins fungicides, pure or mixed, were applied once in reproductive soybean stages R3 and R5. Treatments were arranged in a complete random block design. Variables measured were: foliar incidence and severity and yield (kg/ha). Frequency of pathogens determined by incubation of leaves, stems and pods, showed that *Cercospora kikuchii, Septoria glycines, Colletotrichum truncatum* and *Phomopsis sojae* were most prevalent. Fructifications of *Glomerella* spp, *Phomopsis* and *S. glycines* often developed on foliar tissues and pods apparently healthy, indicating that these diseases had long incubation and latency period. Results evaluated by multifactorial ANOVA and Tukey test for means comparison, with 5% of significance level, indicated that fungicide applications were effective against the diseases involved. Severity was reduced up to 50%. However there was no significant difference between timing of application, R3 or R5 for the two years considered. Treatments increased soybean yield about 300 kg/ha. It is concluded that under current environment and crop management conditions of Pampeana Region, one application of foliar fungicides in reproductive stages R3 or R5 is an efficient tool to reduce damages caused by late season diseases of soybean. More research is necessary to know the epidemiology, prediction and management of late season diseases of soybean.

P193. Control of late stage soybean diseases in Entre Ríos, Argentine

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The increment of seeded area and soybean monoculture are the main causes of the gradual increase of soybean diseases in Central-East Entre Ríos. Late stage diseases are very frequent affecting grain yield and seed quality. These diseases increase their intensity during crop reproductives stages when plant senescence makes less active natural resistance mechanisms. This situation coupled with rainy and humid climatic conditions foster the manifestations of this disease complex. During 2002/2003 a trial was carried out in Central-East Entre Ríos with the following objectives: identify pathogens involved, determine damages caused and evaluate the efficiency of last generation fungicides like triazoles, estrobirulines and their mixes in foliar applications at R3 and R5 stages. Fungicides combinations used were: Azoxistrobine, Propiconazole + Difenoconazole, Pyraclostrobine + Carbendazim, Trifloxistrobine + Cyproconazole, and Carbendazim. Foliar disease incidence, stem, leaf and seed pod disease severity (divided in upper, middle and lower plant sectors), grain yield and seed weight were measured as response variables. Statistical analyses included ANOVA, means comparisons (Newman-Keuls Test) and orthogonal contrasts between control vs treated and applications at R3 vs R5 were performed. Different spatial location was observed among pathogens. *Septoria* was more incident in the lower part, *Pseudomonas syringae*, *Xanthomonas campestris* and mildew in the middle, and *Cercospora kikuchii* in leaves of the upper sector. At R7 stage pod and stem spots produced by *C. kikuchii* and *Colletotrichum truncatum* were observed, similarly to what was found by Formento (2001) in West Entre Ríos. Values of foliar incidence at R5 and R6.5 were not affected by fungicide treatments, however treated plots showed less severity than controls. Stem disease severity evaluations showed differences between treatments and control ($p<0.01$) and among fungicides. Similar effect was found on seed pod spots incidence ($p<0.05$). Grain yield showed significant differences between Pyraclostrobin + Carbendazim R3 treatment and control ($p<0,05$) with a 15% yield increment (4194 vs 3650 kg/ha). Treated plots averaged an increment of 200 kg/ha over control ($p<0.07$). R3 applications increased 170 kg/ha in average over R5 applications ($p<0.01$), similar response to the one found by Arevalo (2001) in Entre Ríos. No clear effect was found on seed weight, however tretated plots averaged greater seed weight than control ($p<0.07$) that can partially explain seed yield differences. Despite the low severity values observed in this experience, the reduction of foliar, stem and seed pod disease severity of R3 fungicide treated plots produced grain yield increases that varies between 7-15%.

P194. An overview of chemical control of late season diseases of soybean in Tucumán Argentina

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Soybean diseases in Tucumán and other provinces of northwestern Argentina (NWA) have increased in importance since the early 1990s. The late season disease complex, a combination of various diseases that affect foliage, stems, pods, and seeds during the mid to late reproductive growth stages, has been shown to cause significant yield losses, especially under conditions that favor the development of these diseases. The most common late season diseases in NWA are brown spot (*Septoria glycines*), leaf blight (*Cercospora kikuchii*), downy mildew (*Peronospora manshurica*), frogeye leaf spot (*Cercospora sojina*), target spot (*Corynespora cassiicola*), pod and stem blight (*Diaporthe phaseolorum* var. *sojae*), Phomopsis seed decay (*Phomopsis* spp.), and anthracnose (*Colletotrichum* spp.). Application of foliar fungicides is considered the most effective way of managing these diseases under the current cropping conditions in NWA (soybean monoculture and no-till systems). Extensive field evaluations of foliar fungicides have been carried out in Tucumán since the 1998/99 growing season. This report summarizes yield data from 18 experiments conducted in the past 3 seasons (2000/01, 2001/02, and 2002/03), in which different fungicides, rates, and application moments were compared. Experiments were conducted at the EEAOC Monte Redondo Substation in San Agustín, Tucumán, in fields previously cropped to soybean. Treatments were arranged in randomized complete blocks with four replications per test. Plots consisted of four, 6-m rows, spaced 0.5 m apart. Disease and yield data were obtained from the center two rows. Fungicides were applied with a CO_2 backpack sprayer. A total of 227 treatments were evaluated. The fungicides carbendazim, benomyl, thiophanate-methyl, epoxiconazole + carbendazim, fenbuconazole, miclobutanil, tebuconazole, difenoconazole + propiconazole, azoxystrobin, trifloxystrobin + cyproconazole, and pyraclostrobin were compared at different rates and application moments. Out of a total of 227 fungicide treatments, only 68 (30 %) showed significant yield differences with respect to the

untreated control. Of those 68 cases, 21 (31%) were benzimidazoles, 17 (25%) triazoles, and 30 (44%) strobilurins. Throughout the 18 experiments, in only 42 cases a paired comparison between R3 and R5 applications was possible. Fifty-five of those treatments were not significantly different from the untreated controls, while 13 and 16 treatments differed significantly from the untreated control when applied at R3 or R5, respectively. In 11 of those 42 cases, there were significant yield differences between application stages, 7 in favor of the R3 and 4 in favor of the R5 application. In the 68 cases that differed significantly from the untreated control, a mean yield increase of 483 kg/ha was obtained as a response to the fungicide application.

P195. Damage related with late season and powdery mildew diseases on soybean cultivars

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Experiments have been carried out in order to evaluate the impact of late season diseases and powdery mildew on different soybean cultivars. Experiments have been located at Cruz Alta, Itáara, Julio de Castilhos, Não-Me-Toque and Santa Rosa. Different active ingredients were sprayed according to several experimental combinations. Evaluation of disease damage was evaluated In 1999/2000 season on 16 cultivars; in 2000/2001 season on 12 cultivars; in 2001/2002 on 10 cultivars and in 2002/2003 on 24 cultivars. Fungicides were sprayed at all reprodutive stages (R_1, R_2, R_3, R_4, R_5). All cultivars showed a significant damage due to diseases dispite the severity level observed. It has not been observed a correspondence between cultivar's reaction to the diseases and the damage caused by them. In 1999/2000 season the variation on the powdery mildew damage was rated among 0,13% and 24,51% and for late season diseases the damage varied among 3,97% and 44,26%. In the 2000/2001 season the variation on the damage was among 15,37% and 27,25% for late season diseases. In the 2001/2002 and 2002/2003 the combined effect of powdery mildew and late season diseases varied among 6 to 20% of damage. The true impact due to the soybean foliar diseases must be considered based on the interaction between patossistem (soybean x pathogen) and the factor related to the operational control system utilized. Chemical control of soybean foliar diseases is an important production component and should be considered as a factor of preventive disease control. The more preventive chemical control was applied (since flowering beggining) higher response was observed mainly on those cultivars with low level of tolerance.

P196. Pyraclostrobin + epoxiconazole to control foliar diseases on Fepagro RS 10 soybean cultivar

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Experiments have been carried out in order to evaluate the impact of late season diseases, powdery mildew and rust on Fepagro RS 10 cultivar. Experiments were located at Itáara/RS. Efficiency of Pyraclostrobin + Epoxiconazole, Azoxystrobin and Pyraclostrobin + Propiconazole were compared based on efficiency control of late season diseases, percentage of green leaf area, percentage of defoliation and yield. Fungicides were sprayed at R_4 soybean development stage. Total control treatment included sprayings at all reprodutive stages (R_1, R_2, R_3, R_4, R_5). Efficiency of Pyraclostrobin + Epoxiconazole on late season and rust control was 83.71% and 94.61%. The effect of Pyraclostrobin + Epoxiconazole on the green leaf area and defoliation was 101.27% and 77.07%. The consistent performance of Pyraclostrobin + Epoxiconazole on late season and rust diseases control can be demonstrated by comparasion to the total control on all evaluated parameters. Differences due to Pyraclostrobin + Epoxiconazole were closer to the total control than the other treatments. It is important to consider that Fepagro RS 10 is susceptible to most foliar diseases which suggest the efficiency of Pyraclostrobin + Epoxiconazole on control them. Also, ability of Pyraclostrobin + Epoxiconazole to increase green leaf area and reduce defoliation correspond to its effect on yield. Considering the late cicle of Fepagro RS 10 and the R_4 as spraying timing suggests how important is the preventive control to allow a superior yield response.

P197. Assesment of the fungicides effectiveness in the control of late season diseases of soybean

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The experiment was carried out at the Gralha Azul Experimental Farm/ PUCPR. The objective of this work was to evaluate the efficiency of different active ingredients in the control of late season diseases of the soybean. The statistical design was randomized block design to the consisting of eight treatments with four repetitions, the data were submitted the analysis with test of comparison of averages of Tukey to 5%. the useful area for each portion is of 6,72 m². The

treatments were: carbendazin (0,250 g i.a.ha^{-1}), trifloxistrobina + propiconazol (93,75 + 93,75 g i.a.ha^{-1}), tebuconazole (0,150 g i.a.ha^{-1}), pyraclostrobin (75 g i.a.ha^{-1}), fluquinconazol (62,5 g i.a.ha^{-1}), epoxyconazole + pyraclostrobin (137,25 + 183 g i.a.ha^{-1}), fluquinconazole + carbendazim (0,250 + 62,5 g i.a.ha^{-1}). The treatments were sproyed at growth stage R4 and evaluated at R7.1 through scale of grades being 0 the absence and 5, above 70% of the leaf area affected. The fungicides flunquinconazole + carbendazin, pyraclostrobin, fluquinconazole and the epoxiconazole + pyraclostrobin differed in relation to the other treatments. There were no difference in the productivity and the mass of a thousand seeds. For the powdery mildew control the fluquinconazole presented ausence of symptom of the disease.

P198. Preliminary report of Asian soybean rust reaction on soybean accessions planted in Brazil, China, Paraguay and Thailand with seedling reactions from greenhouse screens in the United States

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Asian soybean rust, *Phakopsora pachyrhizi,* has been an important pathogen of soybean in Asia with yield losses of 40 to 80% commonly reported. The pathogen has moved into Africa, where it was reported in Uganda in 1996, then Zimbabwe (1998) and South Africa (2001). The pathogen was first found South America in Paraguay then Brazil during the 2001growing season. A set of 174 soybean accessions was evaluated against local soybean rust populations in field or greenhouse studies in Brazil, China, Paraguay, and Thailand. The materials were also evaluated in the USDA BSL-3 containment greenhouse in Ft. Detrick MD against a mixed collection of *P. pachyrhizi* from Brazil, Paraguay, Thailand and Zimbabwe. Among the set were soybeans that had previously been reported to have resistance to either *P. pachyrhizi* or *P. meibomia*, including the sources of the four identified resistance genes. The pathogen is known to have a complex and diverse virulence pattern with many phenotypes seen within a field collection. This was observed as mixed resistant (RB) and susceptible reactions on several lines within each location. Disease severity and reaction phenotypes on individual lines differed by location. These differences were due to local environmental conditions, which reduced rust severity as well as differences in the virulence of the rust population at each location. No lines were found to be resistant at all locations.

P199. Timing of fungicidal sprays for the control of foliar diseases on soybeans

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Field experiments were conducted at FAMV/UPF, in 2002/03 soybean season, to study the timing of fungicidal sprays for better disease control and higher grain yields on soybeans. Two medium crop cycle cultivars, BR 16 and BRS 154, were sprayed with the fungicides difenoconazole + propiconazole (37.5 + 37.5 mL/ha) or difenoconazole (37.5 mL/ha) + azoxystrobin (50 mL/ha) at the following plant growth stages: R2 (full flowering), R3 (end flowering), R4 (beginning grain formation), R5.1 (grain size at 10%), or R2 + R5.1. The control of powdery mildew and late season diseases, as well as the leaf area index and the grain yield, decreased linearly as the spray was delayed from R2 to R5.1. Two applications at R2 + R5.1 did not differ from a single treatment at R2. The overall performance of the fungicides was similar, although difenoconazole + propiconazole provided better initial control of powdery mildew while difenoconazole + azoxystrobin determined a less amount of late season diseases. Soybean rust was reported at the R6 growth stage, only on non-sprayed plants. The results allow to conclude that, in the Median Planes of Rio Grande do Sul, efficient control of powdery mildew, rust, and late season diseases can be achieved with a single spray of fungicide, from full (R2) to end (R3) flowering.

P200. Performance of fungicides on the control of soybean foliar diseases

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In the 2002/03 soybean season, field experiments were carried out at Passo Fundo to evaluate the control of foliar diseases with fungicides. Plants of the BR 16 cultivar were sprayed once with tetraconazole (30, 40, and 50 mL/ha), methyl thiofan (300, 375, and 450 mL/ha), and carbendazin (250 mL) at the R4 growth stage. The spray volume was 200 L/ha, delivered by flat jet nozzles (DG 11002). Powdery mildew and the late season diseases reached severities of 47.1% and 20.2% respectively. The various fungicides controlled powdery mildew by 47.9% to 82.9% and late season diseases by 49% to 72.3%.

The soybean grain yield was 7.4% to 23.3% higher on sprayed plots. Among the tested fungicides, a better performance was achieved with tetraconazole, at 40 and 50 mL/ha. The benzimidazol fungicides (methyl thiofan and carbendazin) resulted in similar disease control and grain yield. Soybean rust showed up at the R6 plant growth stage, only on non-sprayed plants. The fungicides caused no side effects to the plants.

P201. Efficiency of fungicides in the control of soybean rust (*Phakopsora phachyrhizi*), at Cambé, PR

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An experiment was carried out to evaluate fungicides efficiency in the control of soybean rust, in the 2002/03 crop season, at Cambé, PR. Soybean cultivar BRS 133 was used, under RBC with four replications and plot size of 10 m². The fungicides were sprayed with a back pack CO_2 growth stage R5.3. Rust severity readings (% leaf area infected - lai) were below 1%. The fungicides and dosages (g i.a./ha) tested were: tebuconazole Bayer (100) and Milênia (62.5 and 100); pyraclostrobin + epoxiconazole (66.5+25); oxycarboxin (750); tebuconazole + oxycarboxin (60+750 and 100+375); tetraconazole (50); trifloxystrobin + propiconazole (50+50); fluquinconazole + mineral oil (62.5+187.5); difenoconazole (50); azoxystrobin + mineral oil (50 + 0.5%) and difenoconazole + propiconazole (37.5 + 37.5 and 25+25). Rust severity readings was taken on all treatments, considering the two central rows, when control plots had an average of 71.25% lai; additional reading on % lai was taken on the 3rd. and 4th. trifoliolate leaves with 37.5% lai. The fungicides tested had significant effect upon the control of soybean rust. Control efficiency varied from 23% (oxycarboxin) to 71% (pyraclostrobin + epoxiconazole) on the overall plot assessment per treatment and 87% on the trifoliolate leaves. The fungicides significantly delayed date of harvest in relation to the check. The fungicide control of the rust soybean promoted gains of 0.36% (oxycarboxin) to 7.4% (pyraclostrobin + epoxiconazole) in TSW, compared to the control (147.86 g). Yields of fungicide treated plots increased from 2.05% to 13.25% when compared to control (2798.74 kg/ha); pyraclostrobin + epoxiconazole, had significantly higher yield (3169.53 kg/ha) as compared to check although it did not differ from the other fungicides. The chemicals tested showed no phytotoxicity to the soybean plants.

P202. Fungicides efficiency on the control of soybean rust (*Phakopsora phachyrhizi*) and soybean late season diseases (LSD), at Jaborandi, BA

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In order to evaluate the efficiency of fungicides on the control of soybean rust and soybean late season diseases (lsd), an experiment was carried out in the 2002/03 crop season at Jaborandi, BA. The soybean cultivar BRS Sambaíba was used. Fifteen treatments were compared under RCB experimental design, with four replications and plot size of 10.8 m². The fungicides and dosages (g i.a./ha) tested were: tebuconazole Bayer (100) and Milênia (62.5 and 100); pyraclostrobin + epoxiconazole (66.5+25); oxycarboxin (750); tebuconazole + oxycarboxin (60+750 and 100+375); trifloxystrobin + propiconazole (50+50); tetraconazole (50); fluquinconazole + mineral oil (62.5+187.5); difenoconazole (50); azoxystrobin + mineral oil (50+0.5%) and difenoconazole + propiconazole (37.5+37.5 and 25+25). The fungicides were sprayed using a CO_2 backpack sprayer at growth stage R5.3, with 30% rust severity (% leaf area infected - %lai). All fungicides showed significant control of the rust disease and late season diseases. Control efficiency on soybean rust varied from 63.83% (tebuconazole and tebuconazole + oxycarboxin) to 10,64% (oxycarboxin). On the soybean late season diseases, the best treatments were pyraclostrobin + epoxiconazole and azoxystrobin + mineral oil. The fungicides delayed defoliation (D = 20% to 73%) and harvest maturity (HM) by 0.4 to 11.8 days and increased thousand seed weight (TSW) from 0.8% to 20.2%, as compared to control (lai = 94%, D = 78%, HM = 130.2 days and TSW = 127.84 g). The fungicides that promoted the best yield increases were tebuconazole + oxycarboxin / 100 + 375 g i.a./ha (41.2%), pyraclostrobin + epoxiconazole (38.9%) and tebuconazole Bayer (36.8%) as compared to control (2139.66 kg/ha). None of the fungicides showed phytotoxicity to the soybean plants.

P203. Effect of foliar fungicide spraying in soybean, Cv. BRS 154 on control of powdery mildew, Asian leaf rust, and yield

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During the growing season of 2002/2003, the effectiveness of fungicides in the control of powdery

mildew (*Microsphaera diffusa*) and asian soybean rust (*Phakopsora pachyrhizi*) and the effect on yield and test weight were evaluated in the soybean cultivar BRS 154. The experiment was carried out at SEEDS Experimental Area located in Carazinho, RS, Brazil. The experimental area has been under conservation tillage over the last 15 years. Fertilizers and agronomic practices were done according to official recommendations. Experimental plots measured 2.50 x 5.0 (5 lines spaced 50 cm). The seed rate used was 14 seeds per meter. The seeds were previously treated (vitavax + thiram, 250 ml per 100 kg of seeds). The fungicides used and their commercial doses per hectare were: epoxiconazol + pyraclostrobin (500 ml); pyraclostrobin (300 ml); metconazol (300 ml, 400 ml e 500 ml); epoxiconazol (200 ml); azoxystrobin (200 ml) and difenoconazol (200 ml). A nontreated plot was used for comparison. The fungicides were sprayed when soybean plants reached development stage R3. At such stage, powdery mindew severity was 4,5 % and traces of soybean rust were observed on the leaves. Fungicides were apllied by means of a boom sprayer eqquiped with ten $D_2$13 spaced 20 cm appart. A volume of 200 liters of wather ha^{-1} was used. The plots were mechanically harvested, and grain moisture content was set to 13 percent. The data were subjected to analysis of variance. Yields lower than normal were probably due to the exceptionally late planting. Plots sprayed with fungicides were estatistically equal in yields varying from 1,277 kg ha^{-1} (epoxiconazol) to 944 kg ha^{-1} (metconazol, 400 ml). Metconazol (400 ml) did not differ statistically from the control plot (601 kg ha^{-1}). The yield increase in the plots treated with fungicides in relation to the control plots varied from 112.5 % to 56.9 % (21,3 and 9,5 soybean bags), respectively. In the variable one thousand grains, pyraclostrobin (300 ml), epoxiconazol + pyraclostrobin (500 ml), metconazol (300 ml), difenoconazol (200 ml) and metconazole (400 ml) with average value of 188.4 g were statistically similar. Epoxiconazol, azoxystrobin, difenoconazol, and metconazol (400 ml) with average value of 183.1 g did not differ from control plots (178.5 g). In the nontreated plots, maximum powdery mildew and soybean rust severity reached 28,75 % and 61,25 %, respectively. In the treatment plots, the powdery mildew and rust severity varied from 4.0 % (metconazol 400 ml) to 12.7 % (azoxystrobin) and 5,2 % (epoxiconazole + pyraclostrobin 500 ml) to 22,5 % (epoxiconazol), respectively. The relative efficiency of the fungicides varied from 86 % (metconazole 400 ml) to 56 % (azoxystrobin) for powdery mildew control. For the asian soybean rust, except the tretments with epoxicolazol and azoxystrobin with 63 % and 66 % of control, respectively, the other triazol tested showed control level ≥ 80 %. All fungicides tested suppressed diseases progress, however, a single application was insufficient to erradicate the powdery mildew and asian soybean rust in the field.

P204. One or two applications of tetraconazole equally reduced the Asian rust of soybean in Águas Frias, GO, Brazil

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The Asian rust (*Phakopsora pachyrhizi*) of soybean (*Glycine max*) was reported recently in Central Brazil and its occurrence has increased since then. This rust is one of the most important soybean diseases. The goal of this study was to evaluate the effect of fungicides and the number of fungicide applications on rust severity (% of affected leaf area), and on soybean (cv. 'Embrapa 313') defoliation (%) and productivity (kg/ha). One experiment was conducted in 'Águas Frias', GO, Brazil, from 10/12/2002 (Planting) to 20/5/2003 (Harvesting). The pulverizations (200l/ha) of the fungicides were made in 21/3 and 28/3/2003(soybean growth stage R 5.1-5.2) using a CO_2 costal sprayer with a 2m wide spraying bar with four nozzles. The test was designed in a completely randomized block with 14 treatments and four replications. The products applied in the experiment were: check (no fungicide), tetraconazole 100g/l (30, 40, 50, and 60g a.i./ha), and tebuconazole 200g/l (80g a.i./ha), each of these treatments with one or two pulverizations. All fungicide treatments significantly ($P < 0.05$) reduced rust severity and defoliation compared to check. Rust severity decreased significantly from 75% (check) to 31.3-47.5% (treatments). Defoliation decreased from 97.5% (check) to 40-63.8% (treatments). Productivity was higher in most of the treatments with fungicides in experiment (2302-2482 kg/ha) compared to check (1920-1954 kg/ha). There was not any significant ($P < 0.05$) difference between one or two fungicide applications. Tetraconazole ('Domark 100CE') was as efficient as tebuconazole in reducing rust severity and soybean productivity loss.

P205. Identification of QTL associated with resistance to soybean cyst nematode (*Heterodera glycines* Ichinohe) in an inter-specific soybean population

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Yield losses due to soybean cyst nematode (SCN) in the top 10 soybean-producing countries are greater than those caused by any other disease. Primary control relies

on SCN resistant cultivars, but reliance on few germplasm sources may result in resistance breakdown. To prevent this, soybean researchers are constantly trying to identify and utilize new SCN resistant genes. In this research, we investigated the use of *Glycine soja* Sieb. and Zucc., soybean's wild ancestor, as a source of new SCN resistance genes. Simple sequence repeat (SSR) markers will be used within a *G. max* x *G. soja* population to identify novel SCN resistant genes or alleles and place them on a soybean linkage map. A total of 191 $F_{2:5}$ recombinant inbred lines (RIL) from the biparental cross NK S08-80 x PI464925B (*G. soja*) were planted in the greenhouse using a RCBD (three replicates over time). Pre-germinated seedlings were inoculated with SCN eggs from a previously phenotyped Race 3 population and planted in silt-loam filled conetainers. Thirty-five days after inoculation, cysts were collected from individual roots and counted, and then the dry root weight was determined. For two replicates, a female index (FI = cyst count of RIL / cyst count of Lee 74) revealed one RIL that was completely resistant against Race 3 SCN (FI < 10% = resistant). A third replicate is underway and other races will be tested in the near future. The distribution pattern of the cyst count from RILs suggests quantitative inheritance for the trait. Leaf tissue was collected from each RIL and DNA was extracted and screened with 449 SSR markers. Approximately 135 polymorphic markers are currently being screened to develop a linkage map of the RIL population. Linkage maps will be used to determine molecular markers that are associated with QTL for SCN resistance. Identification of markers associated with SCN resistant novel genes or alleles within *G. soja* would provide an alternative germplasm source for cultivar development facilitated by marker-assisted selection.

P206. Influence of crop sequences on the population of "soybean cyst nematod", *Heterodera glycines*, in the south of Santa Fe, Argentina

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In Argentina the Soybean Cyst Nematode (SCN) *Heterodera glycines* Ichinohe was detected in 1997 in the provinces of Córdoba and Santa Fe. In 1998 it was found in the provinces of Buenos Aires, Tucumán, Salta and Chaco. In the southern-center of Santa Fe the percentage of infested plots was 82%, causing losses of between 30 and 60%. In 1998 two Centres for the Integrated Management of SCN were created in fields infested with race 3, located in Totoras and Armstrong, Santa Fe. The objective was to assess the incidence of different crop sequences on the population of cysts of SCN. Two levels of initial infestation were considered: high in Totoras (90 viable cysts/100g soil) and low in Armstrong (5 viable cysts/100g soil) thus covering the range of infestation determined in the assessment carried out in 1998. In each place ten crop sequences were assessed: 1) Corn (C) -C-C (three consecutive years of corn); 2) C-C-Susceptible soybean (Ss); 3) C-Ss-Wheat (W)/Resistant Soybean (Rs); 4) C-Rs-W/Ss; 5) W/Ss-C-Ss; 6) W/Rs-W/Ss-C; 7) Rs-C-Ss, 8) Rs-W/Rs-C; 9) Rs-Rs-Rs; 10) Ss-Ss-Ss. The trials were conducted during three campaigns, from 1998 until 2002. The Ss and Rs varieties in Armstrong were A. 6445 RG and A. 5435 RG respectively and A. 5409 RG and NK Campeona 64 respectively in Totoras. Plots with 10m width and 80m length were used. The plots were arranged in randomized complete blocks with three replications. The SCN soil samples were taken at three times of year: August, November and May, determining the total number of cysts and their viability every 100g of soil. The trials showed that a) with high population densities of SCN (higher than 10 viable cysts/100g of soil), just one year of C or Rs is not enough to reduce the population of SCN to levels below the damage threshold. b) With low population densities, a switch to a non-host crop or Rs with Ss or W/Ss, enables the reduction of the population of cysts to levels which do not affect the soybean yield. c) The inclusion of a single year of Ss in the rotation is enough to increase the population of the nematode to levels which cause yield losses. d) Double-crop W/Ss would be the most effective way to place the susceptible materials in the rotations to avoid the appearance of new races and the growth of the population e) Single-crop corn production enabled the lowest infestation levels, however, it was not possible to eliminate the pest. Regardless of the sequences, in both places, there was a progressive reduction of the population as the result of the existence of natural regulation factors.

P207. Effect of pretreatment time on survival of the second stage juveniles of soybean cyst nematode *Heterodera glycines*

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The procedures for different two-step pretreatment before preservation in liquid nitrogen 4 days were studied in detail for the second stage juveniles(J2) of soybean cyst nematode *Heterodera glycines* , including pretreatment 1)with 10% ethanediol for 1h at room temperature and 40% ethanediol for 0, 30,45,60,75,90 min on ice ,2)21h at room temperature and 40% ethanediol for 0, 30,45,60,75,90 min on ice, 3)pretreatment with 10% ethanediol for 0,30,60,120,180,240,360min at first step and 40% ethanediol 45min at second step and 4) pretreatment

with 10% ethanediol for 0,30,60,120,180,240,360min at first step and 40% ethanediol 90min at second step in order to find optimum protection of J2. Survival rates of 21h at first step and 0~90min at second step ranged of from 51%~80%.An average survival of 78% and 80% were obtained with a pretreatment consisting of a 21h at first step and 30and 75min at second step. Survival rates of 1h at first step and 0~90min at second step ranged of from 51.1%~71.9%. A significantly lower a average survival of 7.4%~41.7% were obtained at a 0,30,60,120,180,240,360min at first step and 90min at second step. Survival rates of 45min at second step and 0,30,60,120,180,240,360 min at first step ranged of from 11.7%~80% and. However, there was more fluctuation in survival with the treatments. An significantly higher average survival of 83.1% and 80.4% were obtained at periods of 45min at second step and a 180 and 360 min at first step.

P208. Nematodes associated with soybean in Tucumán, Argentina

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Soybean is one of the most economically important crops in Tucumán, Argentina and is grown on 243.390 hectares in the province. Nematodes are among the pests associated with the crop. The presence of soybean cyst nematode (*Heterodera glycines*) in the region was confirmed in 1998. Root-knot nematodes, *Meloidogyne* spp., have also been reported in the region. The incidence and predominance of other plant-parasitic nematodes are little known. In order to document new infestations of *Heterodera glycines* and *Meloidogyne* spp. and the presence of other nematodes, a nematological survey was conducted during the 2002/2003 growing season. Soybean fields were sampled using direct soil sampling, which consisted of taking 10 subsamples from each hectare and combining those to make a compound sample. Selection criteria for the sampling were the presence of lighter sandy soils and the occurrence of poor crop growth, or chlorotic or withered plants. In the laboratory, 81 soil samples were processed utilizing the flotation and the flotation-centrifugation techniques. *H. glycines* was found in 19% of the soil samples, with population levels between 0.5 and 25 cysts per 100 cm^3 of soil. The root-knot-nematode, *Meloidogyne* sp. was detected in 62% of soil samples with population levels between 0.25 and 254 second-stage juveniles per 100 cm^3 of soil. The remaining nematodes identified from the soil samples were: *Helicotylenchus, Pratylenchus, Tylenchus, Tylenchorhynchus, Trichodorus, Macroposthonia, Xiphinema* and *Scutellonema.*

P209. Reaction of soybean cultivars to root-knot nematode *Meloidogyne javanica*

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Root-knot nematodes, *M. javanica* and *M. incognita*, have been reported in several soybean areas of Argentina. These nematodes can cause stunting of soybean plants and economic losses when fields are heavily infested. The use of nematode-resistant cultivars can reduce yield losses due to these nematodes. The objective of the research was to determine the reaction of commercial soybean cultivars to *M. javanica*. An experiment was conducted during the 2002/03 growing season in La Cocha, Tucumán, in a field naturally infested with *M. javanica*. Thirty-eight cultivars were evaluated using a randomized complete block design with three replications. Each plot consisted of four rows 5 m long and 0.5 m apart. When plants had reached the R5 stage of development, five plants of the two central rows in each plot were rated for galling on a 0-10 scale (0= no galls; 10= maximum galls) (Bridge & Page, 1980). All soybean cultivars were galled, but they differed in root-gall indices. A 5409 RG, Nueva Mercedes 70 RR, and Mágica 7.3 RR had the lowest root gall indices (2.4 to 2.7). Based on their high gall indices (6 to 7) the cultivars RA 605, A 7636 RG, RA 505 and DM 5800 RR were considered the most susceptible of this group to *M. javanica*. The remaining cultivars showed intermediate levels of gall indices (3.1 to 5.9).

P210. Association of isoflavonoids with the incompatible response of soybean roots to *Meloidogyne incognita*

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Accumulation of the isoflavonoids has been associated with incompatible response of soybean roots to infection by the root-knot nematode. The soybean isoflavonoids have been proposed to have many effects on host-patogen interaction. The antibiotic accumulated in soybean tissues in response to the patogen attack is the glyceollin which is derived from the isoflavonoid precursor daidzein. Accumulation of isoflavonoids genistin, daidzin and the aglycones genistein and

daidzein in roots of soybean following inoculation with race 3 of *Meloidogyne incognita* was determined in whole-root system by high performance liquid chromatography (HPLC). The roots were harvested from controls and nematode-inoculated seedlings 24 hours, 72 hours and 240 hours after the inoculation. The roots were extracted with ethanol and the extracts were subjected to HPLC. There was no significant defected difference between susceptible cultivar Picket 71 either resistant cultivar FT-Cometa 24 hours after inoculation. Daidzein and genistein were detected 72 hours and 240 hours after the inoculation at the resistant cultivar FT-Cometa. For the susceptible cultivar Picket 71 there was no significative difference for isoflavnoid accumulation between the control or inoculated seedlings. The resistant cultivar FT-Cometa showed maximum concentration of daidzein with range variation from 0.181 to 1.025 mg/100g roots 240 hours after inoculation.

P211. Soybean cultivar reaction to the root-knot nematode in Córdoba-Argentine

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Root-Knot nematode (*Meloidogyne* spp.) (RK) affects soybean in Argentine, specially in Tucuman, Salta and Córdoba states. The main area of distribution of the RK in Córdoba, is located in the mid-west and south-west of the state. The fast adoption, since 1997/98, of the first 5 soybean cultivars, tolerant to gliphosate and highly susceptibles to the RK, determine an increase of the incidence of the RK in Córdoba. Genetic resistance is the most simple method of control, so it is important to know the reaction of the available cultivars to the RK. The present work evaluated the reaction of cultivar of maturity group (MG) II to VIII to the RK, under natural condition of infection. During 2002/2003, 105 cultivars of MG II to VIII (2 of MG II, 23 of MG III, 33 of MG IV, 20 of MG V, 12 of MG VI and 15 of MG VII and VIII), were evaluated in 2 locations of the mid-west of Córdoba, Hernando and Villa Ascasubi. The experimental design of trials is based on blocks at random with 6 replications, and hill plots planted to 50 cm. At R5 the gall index (Bridge y Page 1980), was determined. The gall index has a direct correlation with eggs per plant and an inverse relation with yield, so it is an effective method of evaluation. The Nematode Laboratory of INTA Balcarce identified the species of RK for both location. The extraction of the nematodes from the root and the determination of the number of females per gram of root was done using the metodology of Coolen & D'Herde (1972). The species of Meloidogyne were determined by the morphology of females perineal pattern and males morphology of the cephalic region (Eisenback & Triantaphyllou, 1991). In both location was identified *Meloidogyne javanica* in the 100% of the samples. The average gall index (AGI) for all cultivars was 5,7 for Hernando and 4,2 for Villa Ascasubi. The AGI for each MG in each location were: MG II y III 4.05, MG IV 4.6, MG V 5.15, MG VI 5.6 y MG VII y VIII 5.15. The lowest and highest AGI for Hernando were: MG II 5.0 and 5.5, MG III 2.5 and 7.5, MG IV 3.2 and 7.5, MG V 3.0 and 7.0, MG VI 4.7 and 7.3, MG VII and VIII 3.8 and 7.0; and for Villa Ascasubi were: MG II 3.3 and 4.0, MG III 1.2 and 5.0, MG IV 1.5 and 6.5, MG V 2.0 and 7.2, MG VI 2.5 and 6.2, MG VII and VIII 1.8 and 7.0. Cultivars with low AGI for both locations were, MG III: A3302RG, DM3100RR, Pioneer93B34RR and RAR 307; MG IV: Pioneer94B73RR and Pioneer9492RR; MG V: Nueva María55RR; MG VI: Nueva Andrea66RR and MG VII and VIII: Mágica73RR and Nueva Mercedes70RR.

P212. An update on genetic mapping for resistance to soybean cyst nematode

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Inheritance of resistance to soybean cyst nematode *Heterodera glycines* is complex and involves three to four major genes plus minor genes. Molecular (DNA) markers are successfully used for tagging soybean cyst nematode resistance genes (Quantitative Trait Loci or QTLs) in soybean. These markers are valuable in marker assisted selection of progenies for resistance. Significant markers have been developed to map the primary resistance QTLs rhg_1, rhg_2, rhg_3 and Rhg_4 in Peking and Rhg_5 in PI 88788. Mapping studies indicate that designated genes Rhg_4, rhg_1, rhg_2 and Rhg_5 found in Peking or PI 88788 for soybean cyst nematode resistance are located on linkage groups A_2, G, M and J, respectively. Nearly all of the cultivars in the US trace to these two sources of resistance and carry major resistance genes on linkage groups A_2, G and/or J. It also appears that there are several minor genes on linkage group G, either clustered together or have one major QTL controlling resistance to several nematode populations. Ideally, a few markers could be used to select nearly all resistant types in breeding populations. Routinely used makers in public programs include Satt 309, Satt-162 and Satt 632 for selecting resistant breeding lines in Peking and/or PI 88788 types of resistance. Additional soybean cyst nematode resistance genes have been mapped and have different linkage groups than sources of resistance used in today's cultivars however; more data is needed for gene designations. PI lines 438489B and 89772 from *Glycine*

max and PI 468916 from *Glycine soja* are resistant to several nematode populations and carry novel genes for resistance. Introgression of some of these novel genes in soybean would provide alternate genes for resistance to soybean cyst nematode instead of the traditionally used rhg_1, Rhg_4 and Rhg_5 genes. Other promising strains are being mapped from the more than 100 known sources of resistance. Further enhancement of resistance could be accomplished by pyramiding genes via marker assisted breeding from a variety of resistance sources that might lead to the development of soybean cultivars with more durable resistance to the range of genetically variable field populations of soybean cyst nematode.

P213. Genetics of resistance in soybeans to race 4+ of soybean cyst nematode, *Heterodera glycines*

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The work had as objectives to study the inheritance of resistance to race 4+ of soybean cyst nematode (SCN) and to identify markers, of microsatelites and loco *i* (the seed coat color), associated to the loci of resistance. Race 4+ refers to population of SCN, identified for the first time in Brazil, and wich differs from traditional race 4 for its ability to infect Hartwig cultivar, but not its ancestral PI 437654. The experiments were carried out at Embrapa Soybean, in Londrina, PR, Brazil. The inheritance of resistance of genotypes E97-2502-1 and E97-2502-5 (types PI 437654), crossed with the susceptible parent E96-776 (type 'Hartwig'), was studied using 120 $F_{2:3}$ families, 120 F_2 individuals and 20 F_1 individuals and each of parental. Generations of each crossing were evaluated at greenhouse, during October, November and December of 2000. Seedlings of each generation and of the diferencials of race were transplanted (one by pot) in clay pots and inoculated with 4000 nematode eggs. In both crossings, the inoculations resulted in high numbers of females in the susceptible genotypes, confirming the presence of race 4+. There was no effect of the reciprocal. The estimates of heritability were of medium to high magnitude. Transgressive segregation and partial dominance to resistance were observed. For the crossing E96-776 x E97-2502-1 were detected additive, dominant and epistatics of additive x additive type effects, with at least two genes controlling the resistance. In the crossing E96-776 x E97-2502-5, only one gene was enough to explain the observed segregation. An additive-dominant model adjusted well to the data. The studies for identification of microsatelites markers were realized in the first semester of 2003, using leave DNAs extracted from parentals, F_1s and of 122 F_2 plants of crossing E96-776 x E97-2502-1. The *Satt 177* and *Satt 341*, located in the A2 group, next to loco *i*, were the only associated with resistance. The three marks codominants were enclosed in one same group of linkage. The loco *i* was located between the two microsatelites, at 28.2 cM of *Satt 177* and at 18.4 cM of *Satt 341*. The analysis on the three markers indicated the presence of a resistance QTL situated 4 cM of loco *i*, 24 cM of *Satt 177* and 14.4 cM of *Satt 341*. The identified genomic region matches with that one of the A2 group, where the Rhg_4 gene for resistance to some races of SCN is located. The three markers are significantly associated with the resistance. Although additivity and dominance in the direction of the resistance for the three markers were detected, additive effects always predominated. Variations in females number, explained with loco *i*, *Satt 341* and *Satt 177*, were of 64.1%, 55.1% and 30.7%, respectively. Considering only the resistant plants, selection efficiencies were, respectively, of 100.0%, 67.8% and 62.5%.

P214. Inheritance of soybean resistance to *Heterodera glycines* (race 3)

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The soybean cyst nematode (SCN) (*Heterodera glycines*) is one of the main problems of soybean culture. It is presumable that, in Brazil, this pathogen is present in an area superior to 2.0 million ha, causing economic losses about US$200 millions. The use of resistant cultivars and plant rotation is the most efficient and economic way of control the nematode. The present work aimed the evaluation and selection for *Heterodera glycines*, race 3, of 88 $F_{2:3}$ soybean lines derived from the crossing between the Brazilian soybean cultivars BRSMG Segurança (susceptible) and BRSMG Liderança (resistant). The experiment was performed under greenhouse conditions, in a completely randomized block design, with 10 replications. The number of females and cysts in the root and soil, respectively, was determined 30 days after inoculation. The female index [FI (%) = number of female and cysts on a given individual/average number of female and cysts on BRSMG Segurança) X 100] was used to evaluate the SCN response of each individual plant. After ANOVA, using a GLM procedure of the SAS software, it was observed significant differences ($P<0.01$) between the

parents and between the $F_{2:3}$ families. The FI average observed in the $F_{2:3}$ lines was higher in relation to the parent average, and were closer to the susceptible parent than the resistant one. These data suggest that, in the resistance of *Heterodera glycines* derived from BRSMG Liderança, there was no dominance effect. A cutoff equal to 10% was adopted to separate the groups in resistant families (FI<10%) and susceptible ones (FI³10%). The FI values adjusted to the genotypic ratios of 3:1 (P=0.33) and 13:3 (P=0.68). Thus, it was accepted the hypothesis of 13:3 distribution, indicating the presence of two genes (A and B) with independent distribution, each one with two alleles. The B allele is dominant and responsible for the characteristic of resistance. The A allele is dominant for the characteristic of susceptibility and have epistatic effect on B, inhibiting its expression. Therefore, the resistant genotypes would be "aaB_". Excluding the epistatic genic action between the two loci, the presence of two genes, one with dominant and another with recessive effect, agrees to the results of the molecular analysis, based on SSR markers, also carried out for this population.

P215. Identification of putative genes related to nematode resistance in soybean ZDD2315

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Soybean cyst nematode (SCN) can penetrate soybean roots to induce soybean gene expression and results in the formation of specialized feeding cells in the roots' vascular system. Studies have found that ZDD2315, a local germplasm of soybean in Shanxi province, is strong resistance to SCN race 4. However, the mechanism of such resistance has not been elucidated. In one study, genes responsive to nematode invasion were identified by means of mRNA differential display (DDRT-PCR), including 19 up-regulated putative genes and 17 down-regulated putative genes in SCN-infected ZDD315 root. Six of them were recovered as plasmid clones and named as A32 clone, B12 clone, B71 clone, C11 clone, CP12 clone, and CP32 clone respectively. A, B and C represent five days, ten days and fifteen days after inoculation. Their differential expression manner was confirmed in reverse dot-blotting assay, suggesting they may participate in the defendant mechanism of ZDD2315 toward SCN. Notably, sequence analysis indicated that A32 clone had strong similarity to cDNA coding for MYB, an effecter of *Arabidopsis* late elongated hypocityl protein, which has also been implicated in *pseudomonas* resistance in tomato. Another study was based on the NBS conserved sequences of known resistance genes. A pair of gene specific primer and four pairs of degenerate primers were designed for amplifying soybean resistance gene analogs (RGAs). Nine RGAs from genomic DNA and two from cDNA were obtained and sequenced. Four motifs of NBS conserved regions, P-loop (GGVGKTT), kinase-2(VLDD), kinase-3(GSRII) and membrane spanning region (GLPL), were found in all RGAs sequences. The amino acid sequences deduced from the RGAs showed 25%-42% homology with some of resistance genes such as *L6, RPM1, SRPS2 and N* genes. Moreover, these RGAs have high similarity compared with the published resistance like genes (RLGs).

P216. Resistance of soybean lines to *Heterodera glycines* race 3 isolate

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Soybean cyst nematode was first observed in Brazil in 1992 and since then has been resulting in extensive economic losses for farmers. The most effective way of controlling the infestation of this disease is the cultivation of resistant varieties. The objective of this study was to evaluate resistance to cyst nematode (*Heterodera glycines*) race 3, inoculated under greenhouse conditions.The bioassays were performed at Syngenta Seeds facilities in Uberlândia, MG. Seeds were grown in plastic containers filled with sterilized soil and sand in the proportion 2:1. They were placed in pots (6L) with damp sand in order to keep the soil temperature controlled. The bioassay was conducted using randomized blocks with six replications. Four F_6 populations were evaluated: CD-201 x Foster IAC (43 families); S83-30 x Conquista (38 families) S57-11 x La Suprema (60 families) and S65-50 x Parecis (44 families). Roots of the each 10-day-old seedling were inoculated with 2200 eggs. Forty days after inoculation white females and cysts from individual plants of each family were counted, and data were converted to female index (FI), which has been used to evaluate cyst nematode (Golden *et.,al* 1970). The female index was calculated based on the susceptible parental score. All individuals from each population were categorized as being resistant if the IF value was less than 10% of the susceptible parental FI, and as being susceptible if the IF value was equal to or greater than 10%. Populations CD-201 x Foster IAC, S57-11 x La Suprema and S65-50 x Parecis showed respectively 01, 23 and 06 resistant families. ANOVA results showed that there was significant phenotypic variability among F6

families (p>0,001). Populations CD-201 x Foster IAC, S83-30 x Conquista, S57-11 x La Suprema and S65-50 x Parecis showed heritability values of 46, 30, 65 and 79 per cent, respectively. Population S83-30 x Conquista presented no resistant family, which suggests that selection pressure for cyst nematode resistance needs to be applied earlier in the breeding program. These results also indicated that S57-11 x La Suprema was the best combination for selecting resistant lines, and that the degree of success with phenotypic selection for cyst nematode resistance is very dependent on parental choice and the source of resistance.

P217. Screening of several soybean inbred lines for cyst nematode (*Heterodera glycines* Ichinoe) in Goiás State, Brazil

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Soybean cyst nematode (*Heterodera glycines* Ichinoe) is one of the main problem causing yield losses in Brazil. In this study 195 soybean inbred lines were screened against *H. glycines* race 14. The germoplasm was originated from a soybean breeding program in Goiás State, Brazil, in a partnership among EMBRAPA, AGENCIARURAL and CENTRO TECNOLOGICO PARA PESQUISA AGROPECUÁRIA-CTPA. The differentials, 'Peking', 'Pickett', 'PI 88788', 'PI 90763', 'PI 437654' and the susceptible varieties 'Lee 74' and 'EMGOPA 314' were planted together in the same set in order to verify the race identification. Besides the differentials, the resistant varieties 'BRSGO Chapadões' and 'Hartwig' were also planted. For each treatment (total of 205) a set of 8 replications was pre-germinated in paper towel for 48 hours and the seedlings were transplanted into a 200 cc soil pot containing an average of 78 cysts per 100 cc of soil. Thirty five days after transplanting, all the white and the yellow females on the roots were counted and the results classified as resistant or susceptible according to the race scheme described by Riggs and Schimitt (1988). The race test confirmed the *H. glycines* to be race 14. Most of inbred lines tested were susceptible and only 6 inbred lines were resistant as follow: GOBR99-626036, GOBR99-689021, GOBR99-634012, GOBR99-689037, GOBR99-155033 and BRAS99-14068. The resistant varieties used as checker were 'Hartwig' and 'BRSGO Chapadões', which confirmed their resistance to race 14. The resistant inbred lines will be screened for agronomical traits in field trials for at least two years, before they are recommended as new soybean cyst nematode resistant varieties for the market.

P218. Evaluation of soybean breeding lines in an area infested with the soybean cyst nematode (*Heterodera glycines*)

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The soybean cyst nematode (SCN), *Heterodera glycines*, is one of the main limiting factors to obtain higher yields in soybeans in Brazil. To control SCN, as well as other diseases, genetic resistance from soybean germoplasm has been used. The objective of this research work was to evaluate the reaction to SCN of promising soybean breeding lines developed by Embrapa Wheat, at Passo Fundo/RS. In the season 2002/2003, an experiment was carried out in Assis – SP, in naturally infested area with race 3 of SCN. Were tested 168 breeding lines from resistant parentals to SCN, using the complete randomized blocks design, with three replications. Two cultivars, with fifteen replications, were used as checks: BRSMT Pintado (resistant) and Lee 68 (susceptible). The plots were 1 m long, with 0.50 m between rows. In the R8 stadium (physiologic maturation), an evaluation of the root system was made to check the presence of females of SCN, using a descriptive scale ranging from 0 (absence of females) to 5 (high incidence of females) and the root coloration, ranging from 0 (very clear coloration, without evidence of nematode attack) to 5 (dark coloration, with evidence of nematode attack). Five plants for row were pulled up, with a shovel aid, to evaluate the presence of females of SNC in the roots, based on the scale already mentioned. Plant height and agronomic value were also measured through notes varying from 1 (very adapted) to 9 (without adaptation). The values for presence of SCN females varied from 0.0 to 5.0, with average of 2.4, showing the variability among the tested genotypes. The values for presence of SCN females in Lee 68 and BRSMT Pintado cultivars were 2.3 and 0.1, respectively. Over the total of 168 breeding lines evaluated, 47 (27%) received infestation grades up to 1.7, not differing from BRSMT Pintado (Scott and Knott at probability 5%), showing low multiplication of SCN in these lines, which can also be observed by the low root darkening. In general, the height of plants and the agronomic value presented lower values, due to mainly climatic and soil conditions. Among the breeding lines with lower nematode multiplication and better agronomic behavior, PF 98 1429-36565 was recommended for commercial cultivation, by Embrapa

Wheat, in the a States of Rio Grande do Sul, Paraná and São Paulo, with the name of "BRS Invernada".

P219. Environment x genotype interaction in soybean progenies resultant of the crosses with resistance source to the cyst nematode

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Soybean is one of the most important oleaginous and also one of the main agricultural products for the national economy. Brazil is the second national producer with an annual crop ranging around 45,6 million grains (2002/03). Among the favorable factor leading to soybean productivity increase is the important knowledge of the genetic mechanisms involved in its control. This work aimed to evaluate the effect of the interactions occurred during four years of consecutive growth, as well as the selection of superior progenies. The experiments were conducted during the agricultural years of 1999/00, 2000/01, 2001/02, and 2002/03, using seven segregant progenies derived from crosses in which one of the parental shows a source of resistance to cyst nematode (race 3). The progenies used were JAB99-10, JAB99-16, JAB99-17, JAB99-40, JAB99-43 and JAB99-44, having as checks Liderança, Cristalina and Renascença. The used experimental design for the first three years was augemented blocks and for the last year randomized blocks with two replications. Six plants from the useful area of each experimental parcel were observed as to number of days for flowering (NDF), number of pods (NP), total plant weight (TW), weight of a hundred seeds (WHS), number of days for maturation (NDM), plant height at maturation (PHM), first pod insertion height (FPIH), lodging (L), agronomic value (AV) and number of nodes (NN). A conjunct variance analysis was conducted in which the characters NP, TW, WHS, PHM and NN differed up to 1% of significance, whereas NDF differed 5% throughout the years indicating that the environmental factors did not repeat from year to the next. Among the control differences up to 1% of significance were found for the NDF, TW, WHS, NDM, PHM, FPIH, AV and NN characters, and for lodging 5%, however for NP the controls did not differ amongst each other. On the other side, significant differences were found among progenies of 1% for NDF, WHS, NDM, PHM, L and NN, and insignificant differences for the other characters. Among the studies generations, differences were not found except for NDM (5%). Significant 1% differences were detected in the contrast control x progenies for all characters, except for AV and NN (ns). The interaction (control x progenies) x years showed 1% significance only for PHM. The control did not present a differential behavior throughout the years for any of the studied characters. The variation coefficients presented low to intermediate values, showing good experimental accuracy for all characters. The progeny JAB99-17 is considered prominent, having differed from the best control 5% in the Tukey Test for NP and TW, besides being precocious, having PHM and FPIH adequate for mechanical harvesting, best AV average and low lodging average.

P220. Genetics of resistance in soybeans to race 3 of *Heterodera glycines* and *Meloidogyne javanica*

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The genetics of resistance to soybean cyst nematode (SCN) and root-knot (*M. javanica*) was studied in 100 individuals of the parentals, 60 families F_3 and 120 families F_4 of BRS 133 (susceptible) x Gordon (resistant) crossing. The experiments were carried out in the 2002/03 season, in fields infested at Assis-SP (SCN) and Londrina-PR (root-knot). The experimental design was entirely randomized and each plot was represented by an individual plant spaced 0,2 m x 0,45 m. The evaluation of the nematode reaction was donne at stadiums R4 and R6. In agreement with the presence of cysts or galls in the root system, each plant was graded fron zero (abscence of galls or cysts) to five. For both nematode species, significant differences were verified between the two parentals the studied characteres. The grades given for galls or cysts in the generations F_3 and F_4 were similar and placed next to the average value between the parentals. The mean components revealed only the presence of additive effects. Addictive-dominant model was perfectly adjusted to data. In both studies, genotype by environment interaction was detected. Results suggest the possibility of gains with selection for the resistance to the two nematode species.

P221. Status of yellow mosaic virus resistance in soybean [*Glycine max* (L.) Merrill] in India

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The relative low productivity in India is mainly ascribed to a short growing period available in the Indian sub-tropical conditions and the narrow genetic base of

soybean cultivars resulting in susceptibility to biotic and abiotic stresses. Yellow mosaic virus (YMV) continues to affect the soybean in the endemic areas of the country. Development of YMV resistant, high yielding soybean is the major approach to overcome this problem. So far, resistance has been observed in wild species viz. *G. formosana, G. tabacina, G. tomentella,* and *G. wightii.* Among various varieties, lines and germplasm, PK 515, PK 586, 'PK 416', Himso 1548, SL 104, SL 160, 'PK 564', PI 171443 (UPSM 534), EC 107014, EC 107003, EC 100777, 'PK 1046', DS-93Br (OT) 2, PK1060, PK1061, PK1069, PK1042, PK 1189, PK 1180, SL 443, SL 444, 'PK 416', 'PK 564', 'PK 1024', 'PK 1029', 'PK 1042', 'SL 298', Himso 1588, MACS 730, MACS 740, PK 1188, PK 1189, SL 284, SL 328, SL 443, SL 459, SL 517 were rated as resistant. The resistance is reported to be governed by two recessive gene pairs in PI 171443 (UPSM 534) and by a single dominant gene in *G. soja* (Syn *G. formosana*). Resistant lines to YMV are being also developed at NRC for soybean, Indore, employing artificial hybridization. Progenies (F1, F2, F3) and their parents were screened at YMV hot spots viz. Jabalpur, Ludhiana and Delhi. The genotypes were scored as: free of infection, score 0 (SL 603 and SL 295); highly resistant, score 1 [(F3: PS 1024 x Ankur), NRC 20, SL 525 and SL 328]; resistant, score 3 [(PK 472 x PK 416), PK 416, UPSM 534, SL 428 and (F4: Ankur x PS 1024)]; moderately resistant, score 5 (PK 564, SL 459 and SL 517); susceptible, score 7 (G. soja derived lines, list is more); and highly susceptible, score 9 (Ahilya 4, Samrat, JS 80-21, JS 335 and many segregating lines). The perusal of table reveal that the lines derived from crosses PS 1024 x Ankur, PK 416 x Samrat were YMV resistant; however, lines derived from PS 1029 x JS 80-21, JS 335 x PS 1024, Ankur x PK 416 and Ahilya 4 x PS 1024 were susceptible. Among parents Ankur, PS 1024, PS 1029 and PK 416 were found moderately resistant while Ahilya 4, JS 80-21, JS 335, and a popular unreleased variety *Samrat* were susceptible to YMV. Yellow mosaic virus resistant lines having high yield potential may be directly exploited after agronomic testing under different national trials and these stocks may be better source for further utilization in breeding high yielding soybean than those lines which are either susceptible to YMV or have unacceptable plant type.

P222. Studies on strains of soybean mosaic virus in Western Japan and genetic analysis of resistance to SMV-A2 strain

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Soybean mosaic disease, caused by the soybean mosaic virus (SMV) is one of the most widespread soybean diseases in Japan. It is important target to develop SMV resistant varieties. But there is rare date about strains of SMV in western Japan. So at first, we surveyed about strains of SMV spread to major soybean variety in this region. We isolated some SMV strains from the mottled seeds and inoculated these SMV strains to some soybean varieties that are used for differentiating SMV strains in Japan. The results show that there are two types of SMV strains, one is A2 strain and another is D strain in Japanese classification. But SMV-A2 had been thought to rare strain in Japan, there are few date about A2 strain and resistance to A2 strain. So we cloned and sequenced the CP genes of the two SMV isolates that belongs to the A2 and D strains. And the sequence of those isolates is compared with other strains. Next we inoculated the two isolates to soybean varieties. The result show that soybean cultivars that has resistance gene from Harosoy (resistant to A,C,D) are resistant to A2 strains and Japanese soybean cultivars thought to resistant to SMV-A and B strain can be separated to two group by reaction to inoculation of those isolates. The one group appears mosaic symptom by inoculation of each strain. And the other group appears mosaic symptom and top necrosis by inoculation of A2 and D isolate respectively. And many of soybean cultivars cultivated in western Japan are susceptible to A2 strain. Next, to know the inheritance of resistance to A2 strain and develop resistant soybean cultivars to A2 strain, we crossed susceptible cultivar (Sachiyutaka) and resistant cultivars (Tamahomare, Harosoy). We inoculated SMV-A2 strain to F1 and F2 progenies of those crosses and observed symptoms two weeks later. The symptom of F1 progenies is top necrosis and that of F2 progenies is symptomless, top necrosis and mosaic symptom. The ratio of these symptoms shows that resistance to SMV-A2 strain is controlled by single dominant gene.

P223. M-SOY 8248 RR: a new cultivar for Cerrados

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The soybean (*Glycine max* L. Merrill) cultivar M-Soy 8248 Roundup Ready was developed and tested under the designation of M99-54448 RR. After preliminary tests, this cultivar was evaluated for yield and adaptation in the state of Mato Grosso during the 2001/02 and 2002/03 crop seasons. The M-Soy 8248 RR has maturity group 8.2 with an average of 112 days from emergence to maturity in its region of adaptation. M-SOY 8248 RR has purple flower, tawny pubescence, black hilum, determinate growth habit and an average

of 74cm in height in its region of adaptation. M-SOY 8248 RR has resistance to frogeye leaf spot (*Cercospora sojina*), stem canker (*Diaporthe phaseolurum* f.sp. *meridionalis)* e bacterial pustule (*Xanthomonas axonopodis* pv. *glycines)*, moderate resistance to powdery mildew (*Microsphaera diffusa)* and bacterial blight (*Pseudomonas savastanoi* pv. *glycinea*). M-SOY 8248 RR is tolerant to the glyphosate herbicide, allows early plantings in the Northern of Mato Grosso, followed by corn plantings (safrinha). The average of 15 testing environments, the M-Soy 8248 RR had mean yield of 3689 Kg/ha and was 3,1% superior to Goiânia, 8,3% superior to M-SOY8329 and 9,3% superior to Conquista used as experimental controls. The M-Soy 8248 Roundup Ready should be cultivated in medium to high fertility soils, planted in October/November and with plant density between 330.000- 370.000. Variety protection and registration for M-SOY 8248 RR has been filed in Serviço Nacional de Proteção de Cultivares (SNPC) in the Ministério da Agricultura.

P224. M-SOY 8585 RR: a new cultivar for Cerrados

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The soybean (*Glycine max* L. Merrill) cultivar M-Soy 8585 Roundup Ready was developed and tested under the designation of M99-56630 RR. After preliminary tests, this cultivar was evaluated for yield and adaptation in the states of Mato Grosso do Sul, Minas Gerais, Goiás, Mato Grosso, Rondônia and Bahia during the 2000/01, 2001/02 and 2002/03 crop seasons. The M-Soy 8585 RR has maturity group 8.5 with an average of 124 days from emergence to maturity in its region of adaptation. M-SOY 8585 RR has white flower, gray pubescence, buff hilum, determinate growth habit and an average of 80cm in height in its region of adaptation. M-SOY 8585 RR has resistance to frogeye leaf spot (*Cercospora sojina*), stem canker (*Diaporthe phaseolurum* f.sp. *meridionalis)* e bacterial pustule (*Xanthomonas axonopodis* pv. *glycines)*, moderate resistance to powdery mildew (*Microsphaera diffusa)* and bacterial blight (*Pseudomonas savastanoi* pv. *glycinea*). M-SOY 8585 RR is tolerant to the glyphosate herbicide, has high yield potential, broad adaptation to different environments and good lodging tolerance. The average of 46 testing environments, the M-Soy 8585 RR had mean yield of 3401 Kg/ha and was 1,6% inferior to M-Soy 8411, 3,7% superior to Conquista and 1,5% superior to EMG-315, used as experimental controls. The M-Soy 8585 RR should be cultivated in medium to high fertility soils, planted in October/November and with plant density between 300.000- 350.000. Variety protection and registration for M-SOY 8000 RR has been filled in the Serviço Nacional de Proteção de Cultivares (SNPC) in the Ministério da Agricultura.

P225. M-SOY 8787 RR: a new cultivar for Cerrados

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The soybean (*Glycine max* L. Merrill) cultivar M-Soy 8787 Roundup Ready was developed and tested under the designation of M99-56374 RR. After preliminary tests, this cultivar was evaluated for yield and adaptation in the state of Mato Grosso do Sul, Minas Gerais, Goiás, Mato Grosso, Rondônia, Bahia, Maranhão and Piauí during the 2001/02 and 2002/03 crop seasons. The M-Soy 8787 RR has maturity group 8.7 with an average of 127 days from emergence to maturity in its region of adaptation. M-SOY 8787 RR has purple flower, gray pubescence, imperfect black hilum, determinate growth habit and an average of 84cm in height in its region of adaptation. M-SOY 8787 RR has resistance to frogeye leaf spot (*Cercospora sojina*), stem canker (*Diaporthe phaseolurum* f.sp. *meridionalis)* e bacterial pustule (*Xanthomonas axonopodis* pv. *glycines)*, moderate resistance to powdery mildew (*Microsphaera diffusa)* and bacterial blight (*Pseudomonas savastanoi* pv. *glycinea*). M-SOY 8787 Roundup Ready is tolerant to glyphosate herbicide, has high yield potential and broad adaptation to different environments. The average of 26 testing environments, the M-Soy 8787 RR had mean yield of 3591 Kg/ha and was 2,5% inferior to M-Soy 8866, 1,0% superior to DM-309 used as experimental controls. The M-Soy 8787 RR should be cultivated in medium to high fertility soils, planted in November and with plant density between 300.000- 350.000. Variety protection and registration for M-SOY 8787 RR has been filled in the Serviço Nacional de Proteção de Cultivares (SNPC) in the Ministério da Agricultura.

P226. New transgenic soybean cultivar: Munasqa RR

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The use of glyphosate-resistant varieties in northwestern Argentina (NWA) has experienced a remarkable increment in recent years. Currently, over

95% of the soybean area in this region is occupied by these transgenic varieties. Main reasons for the rapid adoption of this technology were reduction in production costs, improved weed management, and high yield potential of many of these materials. Considering this new scenario, the Estación Experimental Agroindustrial Obispo Colombres (EEAOC) developed Munasqa RR, a new soybean cultivar resistant to glyphosate, which adds another option to the current offer of long cycle materials for NWA. In addition to resistance to the main diseases of the region, Munasqa RR has shown great adaptation, stability, and high yield potential throughout NWA. Munasqa RR was obtained from a cross between the varieties A 6401 RG and FAM 841 performed during the 1996/97 season at the Monte Redondo Substation, located in San Agustín, Department Cruz Alta, Tucumán. This new variety has a determinate stem and is classified as Maturity Group VIII, with 52 and 125 days from planting to flowering and physiological maturity, respectively. It has white flowers, grey pubescence, very good plant structure, and resistance to lodging and shattering. Seeds are spherical, yellow, with clear brown hila. Mean weight of 1000 seeds is 141.8 g, and the reaction for the peroxidase test is negative. Seed quality tends to be good to very good, with average 21.35% oil and 39.52% protein. In addition to high and stable yields, Munasqa RR has shown good plasticity, allowing a wide range of planting dates, from 15 November to 15 January, with the optimum during the second and third decades of December. After two consecutive years of Yield Comparative Trials at San Agustín, La Cruz, and La Cocha, Munasqa RR averaged 3909 kg/ha, while the control cultivars Coker 6738, A 6401 RG, and A 7986 were 11%, 10%, and 5%, respectively, lower than the new cultivar.

P227. Performance and description of BRSGO Amaralina soybean cultivar in Goias and Distrito Federal

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BRSGO Amaralina soybean cultivar was developed by a modified pedigree selection from the cross VERNAL X HARTWIG. It was extensively evaluated under the experimental designation BR 95-409-01 and is recommended for planting in the states of Goias and Distrito Federal. Amaralina has determinate growth habit and is a late maturity cultivar, reaching maturity approximately 143 days after emergence. It has white flower, tawny pubescence, yellow intermediate seeds with black hila and 100-seed weight of 17 grams. Amaralina has good resistance to both lodging and shattering. It is also resistant to frogeye leaf spot (*Cercospora sojina*), stem canker (*Diaphorte phaseolorum*) and powdery mildew (*Microspora diffusa* Cke. & Pk.). In performance trials over 2000/2001 and 2001/2002 across 16 locations in Goias and Distrito Federal , seed yield of Amaralina averaged 3212 kg/ha, 14%, 6%, 6% and 3% greater than the check cultivars 'Uirapuru', 'M-SOY 8800', 'DM 339' and 'BRSGO Jataí', respectively. Amaralina is best adapted for planting in November at plant populations of 350,000 plants/ha. Amaralina is a high yielding and a very stable cultivar.

P228. BRS Petala soybean cultivar

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BRS Petala soybean cultivar was developed by a modified pedigree selection from the cross Bragg X [Braxton*2 X (BR 27*4 X Cristalina)]. It was extensively evaluated under the experimental designation BR95-1985. It is recommended for planting in the states of Goias, Bahia, Minas Gerais, Mato Grosso, Tocantins and Distrito Federal. Petala has determinate growth habit and reaches maturity approximately 139 days after emergence. It has purple flower, tawny pubescence, seeds with black hila and 100-seed weight of 17 grams. Petala has good resistance to both lodging and shattering. Average plant height is 85 cm and is adapted for planting in different regions and planting dates. Petala is resistant to frogeye leaf spot (*Cercospora sojina*), bacterial pustule (*Pseudomonas syringae* pv. *glycinea*) and moderately resistant to SDS (*Fusarium solani* f.sp. *Glycines)* and stem canker (*Diaphorte phaseolorum*). It has also good resistance to root-knot nematode *Meloydogine javanica* and moderate resistance to root-knot nematode *Meloydogine incognita*. In performance trials across 27 locations at cerrado region, over 2 years Petala had higher seed yield than the checks Uirapuru, 'FT 104' 'DM 339', 'M-SOY 8800' and 'Garça Branca'. The average seed yield of Petala was 3381 kg/ha in Tocantins, 3069 kg/ha in Minas Gerais, 3447 kg/ha and Mato Grosso and has a yield potential of 4085 kg/ha. It exibits a high stability of seed yield and is best adapted when

planted in November at plant populations of 250,000 to 300,000 plants/ha in Minas Gerais, 300,000 to 350,000 plants/ha in Goias and Distrito Federal and 300,000 plants/ha in Tocantins and Mato Grosso. Petala is a high yielding, root-knot nematode resistant soybean cultivar available for soybean farmers.

P229. Soybean cultivar BRS Cambona, indicated for Brazilian regions located in the south of parallel 20° S

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Soybean cultivar BRS Cambona was selected from the cross PF 912 x Embrapa 19, carried out at Embrapa – National Wheat Research Center in 1993/94. F_1 population was advanced in the greenhouse during the winter of 1994. Segregating generations, F_2 to F_5, were conducted using the bulk population method under field conditions in no-till system. Individual plant selection was carried out in F_5, in 1997/98. Line PF 99 1081 was formed in the following growing season and evaluated under this designation. Soybean cultivar BRS Cambona life-cycle is semi-late, with an average cycle of 149 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has determinate growth habit, white flowers, and brown pubescence. The grain has bright yellow tegument and black hilum. Average 100 grains weight is 15.8 g. Average oil and protein contents are 19.9% and 40.8%, respectively. It is resistant to lodging and shattering. BRS Cambona is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), frogeye leaf spot (*Cercospora sojina*), and powdery mildew (*Microsphaera diffusa*). It is susceptible to soybean mosaic virus and to the root-knot nematodes. It shows positive peroxidase reaction. In 2001/02 and 2002/03, average grain yield of BRS Cambona was, in 14 environments of Rio Grande do Sul, 6.8% higher than the one of cultivar Fepagro RS-10; in five environments of Santa Catarina, grain yield was 6.2% higher than the one of cultivar M-Soy 7501; in 12 environments of Paraná, grain yield was 9.4% higher than the one of cultivar M-Soy 7501; in five environments of São Paulo, 15.0% higher than the average yield of cultivars BRS 134 and BRSMG Conquista; and, in three environments of southern Mato Grosso do Sul, grain yield was 15.7% higher than the one of cultivar FT-2000.

P230. Soybean cultivar BRS Candiero, indicated for Brazilian regions located in the south of parallel 20° S

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Soybean cultivar BRS Candiero was selected from the cross BRS 66 x Hartwig, carried out at Embrapa – National Wheat Research Center in 1992/93. F_1 population was advanced in the greenhouse during the winter of 1993. Segregating generations, F_2 to F_5, were conducted using the bulk population method under field conditions in no-till system. Individual plant selection was carried out in F_5, in 1996/97. Line PF 98 1399 was formed in the following growing season and evaluated under this designation. Soybean cultivar BRS Candiero life-cycle is semi-late, with an average cycle of 148 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has determinate growth habit, white flowers, and brown pubescence. The grain has dull yellow tegument and black hilum. Average 100 grains weight is 16.1 g. Average oil and protein contents are 20.6% and 39.9%, respectively. It is resistant to lodging and shattering. BRS Candiero is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), and frogeye leaf spot (*Cercospora sojina*). It is moderately resistant to powdery mildew (*Microsphaera diffusa*) and susceptible to soybean mosaic virus and to the root-knot nematodes. It shows negative peroxidase reaction. From 2000/01 to 2002/03, average grain yield of BRS Candiero was, in 21 environments of Rio Grande do Sul, 2.3% higher than the one of cultivar Fepagro RS-10; in eight environments of Santa Catarina, grain yield was 3.7% higher than the one of cultivar M-Soy 7501; in 14 environments of Paraná, grain yield was 5.7% higher than the one of cultivar M-Soy 7501. In the years 2001/02 and 2002/03, in five environments of São Paulo, it was 1.6% higher than the average yield of cultivars BRS 134 and BRSMG Conquista; and, in four environments of southern Mato Grosso do Sul, grain yield was 4.9% higher than the one of cultivar FT-2000.

P231. Soybean cultivar BRS Guapa, indicated for Brazilian regions located in the south of parallel 20° S

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Soybean cultivar BRS Guapa was selected from the cross BRS 66 x Hartwig, carried out at Embrapa – National Wheat Research Center in 1993/94. F_1

population was advanced in the greenhouse during the winter of 1994. Segregating generations, F_2 to F_5, were conducted using the bulk population method under field conditions in no-till system. Individual plant selection was carried out in F_5, in 1997/98. Line PF 99 1324 was formed in the following growing season and evaluated under this designation. Soybean cultivar BRS Guapa life-cycle is semi-late, with an average cycle of 149 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has determinate growth habit, white flowers, and brown pubescence. The grain has dull yellow tegument and brown hilum. Average 100 grains weight is 15.4 g. Average oil and protein contents are 21.2% and 38.8%, respectively. It is resistant to lodging and shattering. BRS Guapa is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), frogeye leaf spot (*Cercospora sojina*), powdery mildew (*Microsphaera diffusa*), and soybean mosaic virus. It is susceptible to the root-knot nematodes. It shows negative peroxidase reaction. In 2001/02 and 2002/03, average grain yield of BRS Guapa was, in 14 environments of Rio Grande do Sul, 4.7% higher than the one of cultivar Fepagro RS-10; in seven environments of Santa Catarina, grain yield was 8.1% higher than the one of cultivar M-Soy 7501; in 12 environments of Paraná, grain yield was 6.4% higher than the one of cultivar M-Soy 7501; in five environments of São Paulo, grain yield was 4.1% higher than the average yield of cultivars BRS 134 and BRSMG Conquista; and, in three environments of southern Mato Grosso do Sul, grain yield was 20.6% higher than the one of cultivar FT-2000.

P232. Terminal inflorescence morphology of fasciated soybean is controlled by photoperiod

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Fasciated soybean is a spontaneous mutant in soybean. It is still unknown if the expression of fasciation character is controlled by photoperiod. In the present study, both short-day (SD, 12h) and long-day (LD, 16h) treatments were conducted to investigate the photoperiod effects on developmental rate and morphology of fasciated and normal round-shaped soybean genotypes, by using the materials of 4 fasciated genotypes and 1 wild type. The result showed that photoperiod not only influenced flowering and maturity dates, but also altered the morphology of terminal inflorescences of soybeans. In LD treatment, the reproductive development of all genotypes was inhibited, the dates for flowering and maturity were delayed, and all genotypes failed to mature before mid-October in Beijing. The rachis length of terminal inflorescences in all genotypes was prolonged, and branch inflorescence rachises were produced in some fasciated genotypes, but no fascination characters were found in any genotype in LD treatment although the fasciated soybeans bore fasciated stems and inflorescences in their original sites of Northeast China or Midwest in the US. In SD treatment, the developmental rate was increased, and typical racemes were found in all genotypes. However, no fasciation characters were found in SD. The results of this study indicated that the fasciation characters of fasciated soybeans could be altered by photoperiod and other environmental factors.

P233. Study on the physiology of photosynthesis and its' relationship with yield of soybean

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Photosynthetic physiological properties of soybean and its' relationship with yields were evaluated in the present study. 12 varieties of soybean were grown in different years. The results indicated that the soybean yield increases 20 kg / hectare each year, raising 56%, and plant photosynthetic rate raised 57.04%. The photosynthetic rate showed a significantly positive correlation with yields at the period of pod bearing($r = 0.9221$, $P<0.01$). We studied the changing of photosynthetic rate, leaf specific weight, leaf area for photosynthesis, leaf area index, photosynthetic potential, chlorophyll content and RuBP activity among different varieties, as well as their relationship with yield. Some of the factors displayed a significant correlation with yield. The similar results were obtained with the same varieties under 5 kinds of output levels. In addition, the activities of four C_4 enzymes in 10 varieties were measured. The activities of four C_4 enzymes varied greatly among varieties, especially for the activity of PPDK that couldn't tested in mature leaf or new leaf in some varieties following the growth of plant, but tested in pod skin weakly. A low activity of malic enzyme was observed in fresh and tender leaves, but increased in mature leaves and seed coat. A positive correlation existed between the PEPCase activity and yield ($r=0.68$, $P<0.01$), whereas, a negative correlation existed between the malic enzyme activity and yield. No correlation was found between yield with other two C_4 enzymes.

P234. Morphological characteristics and biomass production of soybean varieties

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Soybean is a short day plant. Short days speed the beginning of reproductive development. The change from vegetative to flowering stage in soybeans is the result of changes in the length of darkness in a 24 hour period. Flowering time is often related to plant size and crop yield. Adapted varieties to a zone and sowed at optimun date find appropriate photoperiods that allow the plants to produce sufficient vegetative material in order to optimize the use of radiation and to produce a large number of nodes where the reproductive structures are set. At the beginning dry matter accumulation is slow, and becomes highest when flowering begins during pod-setting and at the beginning of seed filling. A highest duration of emergence-flowering period produces a highest number of nodes and consecuently a highest biomass production at the beginning of seed-filling. The objective of this work was to assess for soybean Group II (A2900) , III (DM 3100 and A3900) , IV (A4910) and V (DM 50048) varieties the following characteristics per plant: heigh (H), branches (NR), nodes (Nu), pods (NV), seed per pod (Gv), Vegetative aerial biomass (Bav) and Reproductive aerial biomass (pod and seed biomass: Bvyg and seed biomass: Bg). The field experiment has been performed at the Experimental Field of the Universidad Nacional de Luján (34°36' S; 59°7' W) during 2002/2003 growing season under a Randomized Complete Block design, the data were subjected to analysis of variance and the differences between the means were established by Tukey Test. The highest cycle length varieties (Group IV and V) overcome the Group II and III varieties and showed statistically significant differences (96.38 cm. against 67.14 cm. respectively). The same tendency was observed related to number of nodes (Nu) 20.29 for the Group IV and V and 16.31 for the Group II and III varieties. A4910 presented the highest number of pods per plant (82.33), while the other varieties presented on average 51.1. A low number of seeds per pod (1.29) were recorded for all the varieties. Vegetative aerial biomass production was positively related to cycle length, Group IV and V presented on average 20.71 gr per plant and Group II and III varieties presented on average 12.76 gr per plant. A2900 variety showed the highest Reproductive aerial biomass (Bg), and A4910 variety the lowest. A4910 variety showed highest Bav and Bvyg and A2900 the lowest. Related to Bg the tendency was the opposite, showing the shortest cycle length varieties a highest partitioning through reproductive structures.

P235. The "Convênio Cerrados" - The Savannah Agreement - Partnership, Technology and Quality

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The "Convênio Cerrados" – The Savannah Agreement – results from the partnership of institutions such as "Embrapa", "AGENCIARURAL" and the " Centro Tecnológico para Pesquisas Agropecuárias" (CTPA). The main purpose of partnership is to develop better soybeans varieties in order to be grown and commercialized by the CTPA seed producers, which are responsible for funding the research work. The extent of this partnership is given by its own name, thus including all the savannah region, specially the states of Goias, Mato Grosso, Minas Gerais, Bahia, Tocantins, Distrito Federal, etc. The varieties developed in this partnership may also to able benefit adjacent states such as Mato Grosso do Sul, Rondonia, Piaui, Para and other states; not only due to the number of varieties already developed, but also by means of high stability and great adaptation of varieties. In spite of fact that main genotypes are tested in up to 50 savannah locations before being as a commercial variety, the research activities are performed in at least four main location which are: "Embrapa Cerrados" – in Distrito Federal, "AGENCIARURAL" and "CTPA" – in Goiania and "Embrapa Soja" – in Londrina. The main research field, among the creation of conventional and transgenics varieties are: productivity, stability, dry spells tolerance, insects and diseasesresistence or tolerance – specially the cist nematode and the soybean rust. The use of biotechnology studies have highly increased, specially for the cost reduction, quality and quantity increase of the products as a result of development of new and specific techniques of crop management, varieties improvement and the production of high quality seeds.

P236. Soybean breeding at the Novi Sad Institute

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The Institute of Field and Vegetable Crops in Novi Sad, just as our country in general, does not have long tradition of soybean growing. Soybean acreage varies significantly due to weather conditions. Soybean yields are quite variable also, but average yields in recent years were above 2.2 t/ha, which greatly encouraged growers to expand their soybean acreages. Thus far, 66 varieties of different maturity groups developed at the Institute have been released in our country, four in Hungary and two in each Russia, Italy, Romania and Bulgaria. They are characterized by a high yield potential and they are well adapted to the local agroecological conditions.

P237. Real-time PCR analysis of selected genes expressed in leaf tissue during soil drying

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Most plant physiological processes respond similarly to soil drying. Essentially, no response is evident until 60-70% of the available soil water has been lost. Critical physiological processes such as transpiration, photosynthesis, and leaf expansion have been shown to respond in this manner over a wide range of species. However, few studies have followed individual gene expression as the soil dries over a range of available soil water contents. In this experiment we grew two soybean genotypes ('Williams 82' and 'Maple Arrow') in a controlled environment growth chamber and imposed a slow soil-drying regime. As the soil dried, transpiration was measured in relation to well-watered control plants. As transpiration changed from 100% of control to 0% over the length of the experiment, leaves from individual plants were harvested approximately every 10% drop in transpiration. At the end of the experiment, daily transpiration was related to the available soil water content measured as the fraction of transpirable soil water (FTSW). RNA was extracted from the harvested leaves. The expression of selected genes over the course of the dry down was analyzed using Real-Time PCR. Transcripts of two genes, actin and DREB1 were shown to be stable across the full range of soil water contents. These genes were used to normalize the response of other genes. Differences in expression in response to soil water content (FTSW) were clearly evident among the genes evaluated.

P238. Genetic analysis of traits related to stink bugs resistance in soybean

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Generally, the selection of soybean genotypes resistant to insects is made in an indirect manner, based on traits correlated to plant tolerance to insect injury. Information on the genetic controls behind the expression of these traits is relatively scarce. The goal of this study was to investigate the genetic mechanisms of the following traits, both associated with the resistance to stink bugs injuries: grain filling period (GFP) and foliar retention (FR). The analyzed materials were originated from a crossing between soybean cultivars FT-Estrela (susceptible) and IAC-100 (resistant), including its F_2 and F_4 generations and $F_{2:3}$, $F_{2:3}$...BC_{11} $F_{2:3}BC_{21}$ progenies. Three experiments, using randomized complete blocks design, with three replications, were conducted in the field experimental area of the EA/UFG, in Goiânia-GO, Brazil. Each experiment had 36 treatments: six reference treatments (common to all three experiments) plus 30 varying treatments (not the same in three experiments). The common treatments were represented by four cultivars, including the two genitors, and the F_2 and F_4 generations. The varying treatments were represented by $F_{2:3}$, $F_{2:3}$...BC_{11} $F_{2:3}BC_{21}$ progenies. The GFP was calculated from the difference between R7 and R5 reproductive stages. The FR was evaluated in R8 stage, measured by a scale from 1 to 5, followed by a transformation using $(x+0.5)^{-1/2}$. The genetic analysis of means and variances was carried out using weighted least mean squared procedure (Mather & Jinks, 1984, SBG, 242p.). From the adjusted models, it was verified that the expression of the trait GFP is predominantly governed by additive genetic effects [d], followed by some dominant effects [h]. For the FR trait, it was observed additive, dominant and epistatics effects (additive x dominant [j] and dominant x dominant [l]). From the analysis of variance, it was verified that additive genetic effects [D] was predominant in the traits studied.

P239. Development of soybean inbred lines combining grain yielding potential and stinkbugs resistance

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One of the main problems for soybean in the expansion areas of Central Brazil as in the traditional crop areas of the South region, is the incidence of high insect populations, causing significant losses directly on grain yield and indirectly on grain and seed quality. Chemical control has been extensively used to avoid greater losses. The use of tolerant varieties in combination with a program of pest management is the best solution to attempt the comprehensive exigencies of economic and environmental sustainability. Our purpose was to evaluate the potential of soybean inbred lines selected in the breeding program for insect resistance developed at Embrapa Soybean. Experiments including resistant lines and commercial varieties (including the resistant standard variety IAC-100) were installed in two localities of Londrina, PR, in 2000/01 and 2001/02 crop seasons. Different pest management strategies were applied on each locality, one with standard insect control and other without control, permitting the attack of natural insect populations. The grain yielding was determined and samples of seeds derived from each plot were classified as good, medium and bad depending on the visible grain aspects. The different grain classes were weighted separately to determine their relative proportions for each genotype. Total grain yield, commercial grain yield (medium plus good grains) and good grain yield were calculated for each genotype. Resistant genotypes showed lower loss for good grain yield in relation to susceptible varieties, mainly under high insect population condition. No significant differences were observed among resistant lines and varieties for total and commercial grain yield. The inbred lines BRQ94-1311, BRQ95-2193, BRQ95-1159 and BRQ95-1873 were selected, considering their resistance level and yield potential observed along the experiments. Resistant and adapted lines can contribute with the breeding process, taking part of a new cycle of cross and selection.

P240. Resistance to the soybean aphid in soybean germplasm and other legumes

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Resistance to the soybean aphid (*Aphis glycines* Matsumara), a new pest of soybean [*Glycine max* (L.) Merr.] in North America, was found in accessions in the USDA Soybean Germplasm Collection, *G. soja*, and other cultivated legumes. About 30 resistant and putative resistant soybean accessions have been identified in over 3000 accessions tested using a greenhouse screening method. Dense pubescence did not provide protection against the soybean aphid. Expression of resistance in four resistant soybean genotypes was characterized in detail in choice and non-choice tests. Few if any aphids were found on Dowling, Jackson, PI 200538, and PI 71506 plants in choice tests compared to susceptible cultivars that had several hundred on them 7 days after exposure to aphids. Aphid populations did not develop from either first instar nymphs or viviparous aptera placed on Dowling, Jackson, and PI 200538 in non-choice tests, indicating that they had strong antibiosis type resistance. There was significantly lower fecundity and longevity, and increased mortality of *A. glycines* on those cultivars compared to susceptible genotypes. Population development on PI 71506 was not significantly different from development on susceptible cultivars, indicating that antixenosis was more important in that cultivar. Resistance was expressed at all plant stages. Dowling provided season long protection against aphids equal to the use of the systemic insecticide imidacloprid in a field test. In host range choice-test studies, aphid colonization occurred on species in the genus *Glycine* Wild. Colonization was limited or aphids were transient on *Phaseolus* L., *Trifolium* L., and *Medicago* L. *spp.* No colonization occurred on accessions of *Lablab purpureus* (L.) Sweet, *Lens culinaris* Medik, *Pisum sativum* L., *Vicia* L. spp., and *Vigna* Savi spp. Those species appeared to be non-hosts of *A. glycines*. There were significant differences in aphid colonization among *M. truncatula* accessions with populations ranging from 7 to 97 aphids per plant. Six *G. soja* Sieb. & Zucc. accessions had resistance to *A. glycines* equal to that found in *G. max* accessions. Antibiosis was found to play a large role in the expression of resistance in three of the resistant *G. soja* accessions that were evaluated in a non-choice test. Results indicated that *G. max* and *G. soja* were the preferred secondary hosts of *A. glycines*; however, its secondary host range may include other leguminous species. Therefore *A. glycines* did not appear to have a highly restricted monophagous secondary host range. Work has begun to determine the inheritance of resistance, genetic relationships of resistance sources, identify molecular markers linked to resistance genes, and develop resistant soybean germplasm.

P241. Dose related effect of gamma-irradiation and ethyl-methane sulfonate on some quantitative characters in soybean

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Induced mutations play important role in crop improvement, where variability cannot be created by conventional breeding methods. Physical and chemical mutagens used for inducing variations often impart adverse effects on plant growth due to their effect on chromosomes. Measurement of this effect in M_1 generation of ten serves as an indicator of proper mutagen treatment. In the present studies, seeds of soybean cultivar 'MACS 450' were exposed to 10, 15, 20 and 25 Kr ¡-rays followed by treatment with ethyl-methane-sulfonate (EMS) at 0.05, 0.1 and 0.15% in combinations as also individual treatment. Nineteen treatments along with untreated seeds as control were planted in Randomized Block Design with four replications. Each treatment consisted of two rows of 5m length. Hundred seeds were dibbled at 5cm distance. Data were recorded on five random plants per row on eight quantitative characters. Analysis of variance of the data indicated significant effect of mutagen treatments on all the characters. All the nineteen treatments recorded reduction effect on these characters. Percentage reduction over control in different treatments ranged from 6.51 to 21.44% for germination, 0.09 to 20.99% for survival, -5.44 to 26.07% for plant height, 1.11 to 47.76% for pods/plant, -6.71 to 56.63% for seed weight/plant and 1.48 to 65.54% for plot yield. Maximum reduction was observed in 25 Kr dose combined with EMS 0.01% treatment. The effect was less at lower doses. The results indicated that the doses used for mutagen treatment were optimum showing possibility of getting variants in further generations.

P242. National Soybean Pathogen Collection Center (NSPCC) in the U.S.

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The National Soybean Pathogen Collection Center (NSPCC) was established in August 2002 and is located in the National Soybean Research Center (NSRC) at the University of Illinois (http//:www.nspcc.cropsci.uiuc.edu). The University of Illinois also is the site of USDA Soybean Germplasm Collection, which complements the NSPCC by having specific germplasm to characterize the isolates. In addition to the University of Illinois location, there are eight other laboratories maintaining soybean pathogen cultures at the U.S. and Canada. The goals of NSPCC are to: (i) assemble collections of living soybean pathogens representing the range of diversity, (ii) characterize, evaluate, maintain, and distribute the collections, and (iii) serve as a liaison among public and private researchers for information and training on germplasm screening, and to enhance the understanding of pathogen diversity. NSPCC maintains representative duplicates of individual state collections as well as maintains and seeks collections of its own. At the present time, the NSPCC has representative cultures of *Fusarium solani* f. sp. *glycines* (cause of sudden death syndrome), *Heterodera glycines* (soybean cyst nematode), *Meloidogyne* spp. (root-knot nematode), and *Phytophthora sojae* (cause of Phytophthora stem and root rot). Also, the NSPCC has in reserve minor collections of a number of other soybean pathogens. Diseases are the result of the genetic interaction of the host and the pathogen over time. Considerable federal, state, and private resources have been used to assemble diverse soybean germplasm and to utilize this germplasm for genetic improvements including disease resistance. Therefore, a centralized collection supported by a long-term strategy to address diversity and preservation of soybean pathogens will benefit soybean researchers and producers. An extensive, genetically diverse collection of soybean pathogens is essential for identifying novel genes for resistance in soybean, improving disease resistance, and understanding pathogen genomics. Strengthening these areas is imperative in order to protect the long-term productivity of soybean in the United States.

P243. Advances of study on utilization of wild soybean (*Glycine soja*) in soybean breeding in China

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Wild soybean (G.soja) resources are distributed widely in China, and the genotypes are variational and abundant. Up to now, 6172 wild soybean varieties have been collected and conserved in the National Gene bank of China in the Chinese Academy of Agricultural Sciences which is located in Beijing. Since 1980, the major characters of agronomy and biochemistry of wild soybean are being evaluated by Chinese researchers. They have affirmed that there are improvable values in wild soybean. There are hereditary potentials in wild soybean, which can be used to improve soybean cultivars. Some wild soybean germplasms with favorable characteristics were screened. Among the

maximum data of the traits, the highest protein content is over 55%, the 11s/7s value is 4.4, linoleic acid content is 61.24%, sulfur-containing amino acid is over 3g/16gN, Over 3000 pods per plant and 17 pods per nod, high resistance to soybean aphid, high resistance to salt. These germplasms with good chemical quality, more pods, resistance to diseases and pests, resistance to salt will provide good genes for soybean breeding of China. The potentials and improvable value of wild soybean has been affirmed in soybean breeding. Some wild soybean germplasms were used in breeding programs and achievements have been obtained. In 20 years, researchers have been studying on utilization of wild soybean in high yield breeding in China. They obtained some lines with higher yield and abundant heritable variation from wild soybean. Yang Guangyu etc developed a new high yield variety "Jiyu No. 66". It was registered in Jilin province in 2002. Wang Jinling, Yang Guangyu, Fu Lianshun, Yao Zhenchun and Li Fushan etc developed new soybean lines from wild soybean with yield 10% higher than that of CK varieties. Yang Guangyu etc obtained some materials from wild soybean with erect type plant, about 10 g per 100 seeds weight, over 300 pods per plant, shorter distance between node and node, more pods in each node, over 25 nods in main stem. There are great heritable potentials in these materials. From the crosses with wild soybean, Academy of Agricultural Sciences of Jilin province, Northeast Agricultural University, Heilongjiang Academy of Agricultural Sciences have developed new soybean varieties with small seed size. The products have been exported to Japan and Korea. A lot of research results on utilization of wild soybean showed that the good traits of wild soybean are heritable, for example higher protein content, more pods, more seeds, more nodes, resistance to disease and pests etc. The not good traits of wild soybean may be conquered, for example the sprawl habit, splintery pods, small seed size, dark seed coat color etc. It was effective of utilizing wild soybean to broaden genetic base of soybean breeding and improve soybean cultivars. It was created out of some new materials with higher protein content, higher yield from wild soybean. These materials had broad genetic base and abundant variation. If they are used in soybean breeding, they will enhance the genetic variation and will change the predicament of the narrow genetic background and will bring vigour and improvement to soybean breeding.

P244. Soybean breeding in Northern China

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Northern China has more than ten provinces, municipalities, autonomous regions, including Hebei, Henan, Shandong, Shangxi, Beijing, Tianjin, Part of Inter Mongolia and Shaanxi, northern part of Anhui and Jiangshu Provinces. This Region is second largest region after Northeast region ,it occupied about 3 million hectare of soybean planted area, total soybean production of this region is about 4.2 million ton annually. But not enough in this region. Soybean procession capacity in this region is about 10 million ton, therefore annually import more than 10 million ton soybean. Oil content of soybean cultivars in this region is lower than foreign soybean cultivars. This region needs high-yielding soybean cultivars, cultivars with high protein and with broad adaptability. During 1991-2003 we are doing soybean breeding in this region and we developed 10 soybean cultivars, from these cultivars five was released by National Committee for Release of new Crop cultivars of PRC, five was release by Provincial committee. During the past 1991-1993 years we made 610 combinations, annually made about 50 combinations. The objective of our breeding program is high yielding, quality, resistance to cyst nematode and broad adaptability. We use pedigree method. F_1 we eliminate false hybrids according dominance law;F_2 we mostly select progenies according maturity and plant height;F_3–F_5 we paid much attention to yield, including pod number, seed number and weight of seeds and to resistance to diseases and insects;F_5-F_7 we select lines and then test yield of these lines in different locations. The best lines attend national and provincial regional and production tests 2-3 years and best lines will approved by National and Provincial committee for release of new cultivars. Breeding for high yielding: we select high-yielding cultivars for hybridization and test these progenies in soils with high fertility and irrigation. The plant high of these lines is about 50-80cm ,mostly semidwarf types. These lines resistant to lodging and has determinate or subdeterminated pod bear habit, because this kind of soybean has top dominance. By this means we successfully select high yielding cultivar Zhonghuang 13 (Zhongzuo 975) with high protein content(45.8% in Anhui Province) and broad adaptability, this cultivar released by four provinces and National committee for release new cultivars PRC. Breeding for high oil content and for high protein content: we made special combinations for high oil content and high protein content. Usually we analyse oil content from F_3 and we test a lot of samples more than 1200 progenies and lines and we get two lines ,which oil content is more than 23,50.The Zhonghuang20 (Zhongzuo 983) was released in three provinces. We developed new cultivar with high protein content Zhonghuang 22,it protein content –47.76%,it released by National and Tianjin committee for release new cultivars. Breeding for resistance to cyst nematode: soybean cyst nematode causes serious damage to soybean production. In 1991, we start breeding study on resistance to cyst nematode . We found, near Beijing area dominant race of cyst nematode was race 4. We made a lot of cross, more than 50 combinations. The best combination is Dan 8×PI 437654 with big

segregation in resistance to cyst nematode, plant height ,pod habit, maturity, and we got a lot of soybean new lines highly resistant to cyst nematode through pedigree method of selection, enlarge the number of plants of good combination, alternate Breeding in North and on South, identification at early generation. Now we released Zhonghuang 26(Zhongzuo RN02) with high resistance to cyst nematode, two soybean cultivars Zhonghuang 12 and Zhonghuang 13 with moderate resistance to cyst nematode in Beijing, Anhui and Tianjin area, and we got a lot of lines, highly resistant to cyst nematode under testing. Breeding for broad adaptability: we cross cultivars and germplasm from different latitudes and we succeeded to developed good cultivar with broad adaptability-Zhonghuang 13(Zhongzuo 975), we used Yudou 8 as a female parent (from Henan Academy of Agricultural Sciences,Latitude of this region is 34),and we used Zhongzuo 90052-76 as a male parent(from Crop Institute,Chinese Academy of Agricultural Sciences latitude of this region is 40).This cultivar released by Anhui,Shaanxi ,Beijing,Tianjin and National Committee for release of new crop cultivars during 2001-2002years.By the end 2003, it will released in Sichuan(Latitude-30) and Liaoning Provinces (Latitude-42).It means,this cultivar can occupied 12 latitudes in production areas. Breeding soybean for different cropping system: during the past 13 years we developed 10 cultivars ,suitable to different cropping system.Five from them released by National Committee for release new crop cultivars. We select Zhonghuang 23 with early maturity, suitable to Southern part of Inner Mongolia and we select cultivar with late maturity-Zhonghuang 19(Zhongzuo 9612), it can planted in southern part of Anhui and Henan Provinces. Some cultivars can planted in Northern part of region as spring sowing ,and in the same time it can grows in southern part as summer sowing as the second crop after winter wheat.

P245. Water relations of soybean as affected by phosphorus supply

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Soybean yield is affected by water variables, especially insuficient soil moisture in the subhumid and semiarid region of Central Argentina. In order to evaluate the role of phosphorus (P) nutrition on drought tolerance, soybean was subjected to water stress at two phosphorus levels. Leaf water potential, stomatal conductance, leaf area, shoot and root dry weight were recorded. Soybean was sown in the field at Hilario Ascasubi (39° 23' S, 62° 37' W) and Santa Rosa (36° 37'S, 64° 17' W), and in the greenhouse. Soils were Ustipsament (H. Ascasubi) and Entic Haplustolls (Santa Rosa), with sandy loam texture. Experimental plots were arranged in a randomized block design with six replications. Leaf area was more affected than root and shoot dry weight by low-P and dry soil conditions. All growth traits were lower when soybean plants were grown in low-P and water stress. When the supply of P increased the growth of all plant parts were higher than in low-P. Increased P supply to soybean plants growing in a low-P and dry soil, improved water conditions of the plants and increased plant recovery on rewatering. High-P improved the water use efficiency of the plants by decreasing the rate of transpiration per unit leaf area in dry soil. Plants in low-P has more transpiration due to a lower control of the loss of water. Under dry soil conditions, leaf water potential and stomatal conductance decreased. At high-P level increase the capability of soybean plants to tolerate drought through an increase of total leaf area and the penetration of root in deeper soil layers.

P246. Methodology proposition hydric balances the Thornthwaite-Barbieri-Ranzani in an Excel® environmental for soybean crop for at Departament Independencia, Chaco

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The object was to relate edaphic hydric balance at soil profile, according to Ranzani using Barbieri solution, and Thornthwaite and Blaney and Criddle. The more recent tendency to operate the hydric balance are the inclusion of climate-plant-soil spaces. Previous work achieved the Thornthwaite and Blaney and Criddle hydric balances association, through use of crop Kc at it on the other hand incorporation of CAD (Water availabity capacity) at root depth as Barbieri. This could be random success to soil physic aspects and plot history. Work was done on soil sample from soil series clasified as Flecha Ustocrept udic (INTA), was valorized Water capacity (CC), permanent withering point (PMP) and apparent density (da); and midth of each horizon at two stages of soybean crop: full leafy and ¾ bloom. Integrating the hydric balances to weigh available water into profile, in function of plant demand to relate in to environmental contributions. This methodology allow interesting strategies for evaluation of water accumulation related with crop needs and the enveronmental contributions, as imput and exit in an Excel® environmental balance.

P247. Environmental hydric and edaphic balances at soil series in a soybean crop at Department Independencia, Chaco

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This work tried to relate environmental hydric balance with edaphic balance through water accumulation into soil and environmental crop requirements. Soil samples were taken at two stages of soybean crop: full leafy and ¾ bloom. Experiment was carried at Independencia Department, Chaco (Argentina). Samples were taken from Flecha Serie Soil (Ustocrept Udic, Inceptisoil). Evapotranspiration was measured with Blaney and Criddle Method adjusted to determined consultive use. Water availability was valorized as water sheet using Ranzani formulas. The results showed that crop had an hydric deficit according to climatic balance of 247,61 mm ha-1 from December to March. Values obtained through Ranzani showed that water was available in each horizon with 1071, 08 mm ha-1. Water was accessible for crop growth. Some soil impediment would be present to avoid water utilization.

P248. Hydric stress induced by mannitol in soybean seeds with different sizes. II. 'IAC-22'

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The first event in the sequence of germination is the imbibition. Water uptake limitation could affect the germination velocity decreasing that or stopping it. In water stress conditions seeds with different sizes may present different comportment. The objective of this work was to evaluate the effects of mannitol induced hydric stress in the germination of soybean 'IAC-22' classified by size in the 12, 13 and 14 mesh. Seeds were germinated in paper embedded in mannitol solutions with different concentrations (0; 44.58; 89.17; 133.75 gL^{-1} of distilled water) that produced the hydric potentials of 0, -0.6, -1.2 and -1.8MPa. Treatments were evaluated according the following parameters: germination, first germination counting, vigour classification, hypocotil and root length and shoot and root dry weight. The experiment was conducted as completely random design and treatments were in a factorial arrangement of 3x4 (seed size x mannitol concentration). Results showed that water potential of -0.514, -0.51 and -0.46MPa produced maximum germination for the seeds of 12, 13 and 14 respectively. Until the water potential of -1.04MPa the largest seeds produced the highest germination. In the lower water potentials tested there were an elevated germination of the smallest seeds. Germination was less affected than the evaluations of seedling development in the different levels of water deficit, and these parameters were decreasing with the increasing of water deficit.

P249. Response of early-planted soybean to early season flood

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Early soybean production system has gained popularity in Mississippi recently as a means of avoiding late season drought stress. However, flood is often a problem in early-planted soybeans, especially during seed germination and seedling emergence. Field experiment was conducted on Sharkey clay soil at Stoneville, MS to assess the effects of flooding and its duration on soybean seedling emergence, seed yield and yield components. Three Roundup Ready soybean cultivars from Maturity Groups III and IV: DK3964, AG4403, and DK4964 were planted on 2 April. Plots were flooded before seedling emergence (7 d after planting, DAP) or at V1 (unifoliate stage, 14 DAP). Floodwater remained on the plots for 0 (non-flooded control), 18 or 24 h for the treatment applied before seedling emergence, and for 0, 24 or 48 h for the treatment at V1 growth stage. Flood treatment before seedling emergence or at V1 growth stage reduced the populations of all the soybean cultivars but seed yield was not affected. On average, the yield of AG4403 was higher than those of DK3964 and DK4965 at both flood treatment periods. The 24 h flood duration before seedling emergence reduced plant height and seed weight, whereas flooding for 24 or 48 h at V1 stage decreased the number of pods produced. The data suggest that the soybean cultivars used in this study were tolerant of the flood stress applied and also indicate that yield losses resulting from flood may be attributed to the production of fewer pods.

P250. Different water stress levels during reproductive stages produce different reductions in soybean yield and its components

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Soybean yield is function of seed number and seed size. Modifications in soil water conditions during the reproductive stages could affect yield and its components in different ways, according to water stress timing and intensity. The objective of this study was to evaluate different levels of soil water affecting soybean yield and its components during different reproductive stages. Field experiments were conducted using an automatic mobile shelter in 2001-02 and 2002-03, at the EEA Oliveros, Argentina (32°33 ' S; 60°51 ' W). The treatments included imposed drought during four reproductive stages: R1-R4(T1), R4-R5.3(T2), R5.3-R6(T3) and R6-R7(T4), at two levels of available soil water content (ASWC) (50-40% and 40-30%), and a well-watered treatment (check), close to field capacity during the whole growth season. Soil moisture was measured with a Troxler depth moisture gauge down to 2 meter depth and water was supplied with a drop system. On mid-November Asgrow 5520 cultivar (MG V), was sown with 35 plants m^{-2} density and 0.52 m row spacing. In both experiments (2001-02 and 2002-03), all treatments at R1 presented photosynthetic active radiation interception (measured at midday) greater than 90%. The two levels of ASWC were obtained at both growth seasons. Two-year combined analyses showed that water stress significantly reduced yields in all treatments for 40-30% and 50-40% ASWC levels. In this last level, water stress yield reductions were 9, 16, 11 and 9% for T1, T2, T3 and T4, respectively. T2 yield was significantly lower than T1 and T3, and presented the lowest seed number. On the other hand, T2 presented the greatest seed size, but this was not enough to compensate yield reductions caused by lower seed number. At the 40-30% ASWC yield reductions were 23, 26, 17 and 21% for T1, T2, T3 and T4, respectively. Only T3 and T2 yields differed significantly. All drought treatments reduced seed number and T1 and T2 seed number were significantly lower thanT3 and T4. T4 obtained the lowest seed size and T2 the highest. The greater T2 seed size was not enough to allow this treatment to obtain a yield similar than T3 and T4. However, higher T1 seed size (respect to T3 and T4), was enough to obtain similar yields among these treatments. In conclusion, R4-R5.3 was the most sensitive period to drought. The 50-40% ASWC level affected mainly the seed number, and the 40-30% ASWC level reduced both seed number and seed size.

P251. Effects of genotype and weather factors on soybean seed yield at Oliveros, Argentina

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During the last years there was a change in the cultivar (CV) selection, choosing genotypes of earlier maturity groups (MG) III and IV instead of MG V and VI. It was argued that earlier CV have higher yield potential and/or their critical phenological stages develop under better environmental conditions to express seed yield. The aim of this study was to evaluate the effects of weather conditions during vegetative and reproductive stages upon seed yield and its components in different CV. Field experiments were carried out in rainfed conditions in EEA Oliveros INTA, Argentina (32° 33' S; 60° 51' W) in 2000/01; 2001/02 and 2002/03 growing seasons on a Maciel typic Aurgidoll soil, in a randomized complete block design with three replications. Sowing dates were 11/16/2000; 11/14/01 and 11/28/02. Phenology, daily mean temperature, rainfall, and incident solar radiation ($MJ.m^{-2}$) were recorded through the growing seasons. Seed yield, seed size and seed number by m^2 were determined at harvest. Analysis of variance indicated that the effects of MG, CV within MG, years, and CV by years interaction explained 5,2; 33,0; 42,3 and 10,2 % of the total variance, respectively. Thus, CV and weather conditions had an important effect on seed yield differences. This evidence highlighted the importance of selecting outstanding genotypes and the decision to select them should not be only based on MG performance. Principal Components Analysis allowed to distinguish MG according to weather conditions during the vegetative and reproductive stages. Principal Components (PC) 1 and 2 explain 47 and 28 % of the total variability, respectively. PC 1, indicated that MG III and IV had lower daily mean temperature and accumulated solar radiation during E-R1, higher daily mean solar radiation and accumulated solar radiation during R1-R5, and higher daily mean temperature and accumulated solar radiation during R5-R7 than the later MG. MG VII had the opposite values. CP 2 showed that 2001/02 growing season had lower rainfalls and higher daily mean solar radiation during E-R1 and lower daily mean solar radiation and higher rainfalls during R5-R7 than 2000/01. The third season was in the opposite position. In the last two years, MG III and IV had the highest seed yields because later CV had light stress in 2001/02 and water stress in 2002/03, during the seed-filling period. On the other hand, in 2000/01, with better weather conditions for all MG, no MG III or IV genotypes had an outstanding seed yield. Differences among MG

yields were due to the differences in yield components. These were function of the weather conditions that influenced in each phenological stage. The variability among CV within each MG was attributed to differences in genetic yield potential and the sensitivity of each yield component to the main weather factors occurring during the critical growth stages of its definition.

P252. Tolerance to drought in *Glycine max* (L.) Merril: ecophysiological aspects

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One of the main causes on the variation in soybean yields, has been the stress events, caused by climatic adversities such as drought. The aim of this work was to evaluate physiological and morpho-anatomical strategies of two soybean cultivars, Conquista (MGBR-46) and BR-16, tolerant and susceptible to drought, respectively, during two periods of water deficit: 30 and 45 days. The experiment was performed in greenhouse, in a completely randomized design (CRD), in PVC pots with sand, considering the treatments with gravimetric humidity of 15% (field capacity) and 5% (moderate stress). Measurements were made on leaf area, plant height, relative growth rate (RGR), photosynthesis and stomatal conductance. As results, it was observed that the photosynthesis was significantly reduced with 45 days of stress, and the tolerant cultivar presented smaller values of photosynthetic rate. Data on stomatal conductance showed that values weren't significantly different. It was also observed a small reduction in the leaf area between the cultivars in the period of 45 days of treatment. During water stress period, leaf abscission had occurred, which could have contributed to the reduction in leaf area, as well as the reduction in the photosynthetic rate. The relative growth rate, which express the plant growth as a function of dry mass accumulation versus time, presented a significant reduction in the 30 days treatment. Fifteen days after this period, which means 45 days of treatment, the plants of the drought susceptible cultivar in stressed condition, showed loss of dry mass. This result also showed that, during the 30 days treatment plants showed some stress which increased with time. Considering the dry mass of pods, it was observed a significant reduction in the cultivar BR-16 when compared to Conquista and, also, inside each cultivar in the different treatments. It shows that this reduction in total dry mass could be affecting the yield of these cultivars. The anatomical study, using permanent slides of leaf and root was done using the method of paraffin inclusion. Quantitative analysis were performed on palisade and spongy parenchyma and intercellular space. Next, it will be doing molecular studies to understand the soybean tolerance strategies to drought, for example how genes are differentially expressed during this period.

P253. Evaluation and characterization of drought tolerance among Brazilian soybean cultivars in the field

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Drought is one of the major constraints for soybean production in Brazil. Drought stress treatments with rain-out shelters were applied for one month period after the first flowering to evaluate drought tolerance of ten Brazilian soybean cultivars based on seed yield over two growing seasons in the field of Embrapa Soybean in Londrina, PR, Brazil. Drought stress reduced seed yield. Cultivar differences in drought tolerance on the basis of seed yield were found, and the yield ranking among cultivars was fairly stable across two years. Cultivars with higher drought tolerance had a characteristic to maintain their crop growth rate (CGR) higher during the drought stress period compared to other cultivars. They also maintained larger leaf area during the stress period. Reproductive development was retarded by the drought stress, however, the cultivars with higher tolerance tended to retard less. The information obtained in this research can be used for breeding drought-tolerant cultivars or selecting the diverse germplasm of soybean cultivars.

P254. Soybean response and residual effect of micronutrients in Cerrado soils

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With the increase of soybean yields in the last years, there is a greater concern for furnishing micronutrients for this crop. The quantity of micronutrients exported by the seeds increased because of the high yields of

the new soybean varieties. Besides, native cerrado soils, have in general, low availability of micronutrients, mainly, zinc, manganese and copper, which may lead to possible deficiencies of these nutrients in soybean. Thus, the objective of the present study was to evaluate the effect of the application of these micronutrients on soybean yield, under different soil acidity conditions.The research began in 1997, at two sites in the South of the State of Maranhão and included experiments for calibrating the recommendable doses and the critical levels of Zn, Mn, Cu and B. Each experiment was run in a factorial arrangement (6 X 6), including six doses of lime in order to obtain high levels of base saturation between 30 to 80 % and also six doses of each micronutrient. The experiments were run in a randomized block design with split plot and four replications. At both sites the soil was classified as a distrofic Red-yellow Latosol (LVAd), however, with different soil texture, sandy clay loam (27% of clay) and clay soil (55% of clay). In both soils, the initial soil content of Zn and Cu (Mehlich-1) and of B (Hot Water) were below the critical levels of these nutrients in the soil; 1.0 , 0.8 , and 0.5 mg/dm^3, respectively, while the initial content of Mn was higher than the critical level of 5.0 mg/dm^3. In general, there was no significant response to application of the micronutrients, Zn, Mn, and B in the five growing seasons 1997/98 to 2001/02 and even when the response was significant yield increases due the application of the micronutrients were small. However, a significant effect of Cu application was observed at both sites, indicating that this is the main limiting micronutrient in soils of this region. The increase of the level of base saturation had significant effect on soybean yields, with the highest increases in the clay soil. The small response to application of micronutrients in the present trials may be due to the addition of nutrients as contaminants in lime and in fertilizers, and by the capacity of the soybean roots to solubilize and to absorb these micronutrients.

P255. Availability of zinc, manganese and copper for soybean by different extraction solutions in Cerrado soils

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Micronutrient availability can be evaluated by correlation studies between the content obtained by different soil solution extractors and the quantity of these nutrients accumulated in plants. In this manner we evaluated the efficiency of three solution extractors (Mehlich-1, Mehlich-3 e DTPA-TEA) in estimating the availability of zinc, manganese and copper for soybean in cerrado soils. The data were collected in soil calibration field experiments for micronutrients run at two sites in the region of Balsas, MA. In both sites the soil was classified as Red-yellow latosol (LVAd), but with different textures, sandy clay loam (27% of clay) and clay soil (55% of clay). Each experiment (Zn, Mn and Cu) was run for five years in a factorial arrangement (6 X 6), where six doses of lime were applied to reach base saturation between 30 to 80 %, and six doses of each micronutrient. The experimental design was in randomized blocks with four repetitions. To evaluate the efficiency of the micronutrient extraction solutions, the soil content of Zn, Mn, and Cu, were correlated with the contents of these micronutrients in soybean shoots. For zinc, DTPA-TEA was the solution extraction with the best correlation coefficient (r = 0.76) in the sandy clay loam, while in the clay soil the three solutions had similar correlation coefficients. For Mn, in both soils, DTPA-TEA was the extraction solution which best estimated the availability of Mn for soybean, when there were changes in soil pH. The other two methods, Mehlich-1 and Mehlich-3, had lower correlation coefficients. However, when the correlations were calculated inside each saturation level, the coefficients were similar, indicating that both methods might be used for estimating the availability of micronutrients when the range of base saturation or the pH of the soil is known. In the case of Cu, all the soil solution extractors evaluated were equally efficient in predicting the availability of this micronutrient to soybean, although Mehlich-1 and DTPA-TEA were slightly better than Mehlich-3. For all three micronutrients, correlation coefficients were higher in the sandy clay loam than in the clay soil. Indicating the higher readiness of the three extractors. DTPA-TEA appeared to be the most efficient method in predicting the availability of Zn, Mn and Cu for soybean in distinct soil pH conditions, although, the others methods were also efficient when the range of soil pH and of base saturation of the soil were known.

P256. Soybean response to sulfur application, in a Cerrado soil of Piauí, Brazil

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Of the essential macronutrients to crops, sulfur (S) is the element less studied, which results in the lack of information for the establishment of critical levels in soils, or even response curves of crops to this nutrient. In fact, soybean cultivation occupies extensive areas in Brazil and the addition of fertilizers requires rational recommendations. The objetive of this paper was to study S response. In Bom Jesus, State of Piauí, from Cerrado vegetation, an experiment was carried out on dystrofic oxisol (latossolo vermelho-amarelo distrófico) soil with five levels of S (zero; 20; 40; 80

and 120 kg ha^{-1} of S) and three sources of S: Simple Superphosphate (SFS); Elementary Sulfur and Gypsum. In the thrid year of cultivation, great response of S application to soybean, was observed resulting in yields of 3701 kg ha^{-1} with 120 kg ha^{-1} of S applied as SFS, 3409 kg ha^{-1} with 100 kg ha^{-1} of S as elementary sulfur and 3430 kg ha^{-1} with 69 kg ha^{-1} of S as Gypsum. Using mean values, there was a response to soybean production up to 91 kg ha^{-1} of S, with maximum yield of 3419 kg ha^{-1}.

P257. Planting date and yield of soybean genotypes differing in maturity group and growth habit

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The relationship between planting date and soybean (*Glycine max* L.) yield depends on maturity groups (MG), growth habits (GH) and phototermal sensitivity (PTS) of soybean genotypes. In this study several genotypes, differing in MG, GH, and PTS were planted at different planting date during seven growing season (1996/97 through 2002/3) at the west of Entre Ríos Province, Argentina (31° 30´ S, 60° 3´ W, altitude 110 m). MGII to MGIX genotypes of determinate and indeterminate habit were sown form September to February. For each planting date and growing season, minimal relative yield (i.e., the ratio between the highest and lowest yield) was used to compare yield variations at different planting date. For each growing season, maximum relative yield (i.e., yield as a proportion of the highest yield) was used to compare genotypes within planting date. The minimal relative yield was minimum when genotypes were planted in September (30%) and February (20%), and showed an optimum when planted in November (70%). Maximum relative yield showed a wide variation in early planting date (September and October), the greatest yield in optimum planting date (November and December), and a decline in late planting date (January and February). Nevertheless, early planting showed the greatest yield in two out seven growing season. Results indicate that choosing soybean genotypes became critical in early and late planting dates and suggest that, when temperature and rainfall are favourable, soybean yields in early planting date are comparable to those attained in optimum planting date.

P258. Planting soybean at late date

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Information about cultural practices for soybean at late planting dates are necessary because sowing can be delayed by double cropping or weather conditions. The objective was to study the effects of row spacing and plant population density at late planting date on yield and its components. A 3-year study was done at Nueva Roma (38° 29' 33" S, 62° 38'48"W). Soybeans of maturity group I, II, III and IV were planted at a late date, January 15, and at an optimum date, November 20. Row spacing were 0,70 and 0,35 m and plant densities were 250,000 and 500,000 plants ha^{-1}. Furrow irrigation was applied as necessary. The experimental design was a randomized complete block in a split-split plot arrangement. Plants sown at a late date had fewer nodes and less leaf area. Leaf area index was markedly reduced by the planting delayed. The vegetative period was shorter and there were not much difference in the extent of the reproductive period and in the seed filling period at both dates. Yield reduction of late planted soybean were due to a decrease on the number of seeds per unit area. There were only a slight difference on seed size in both dates. Higher plant density did not compensate the detrimental effect of late planting. An increased density reduce the number of branches and branch nodes. There was a positive response to narrow rows in both dates.

P259. Late planting date soybean yield: maturity group, row spacing and plant density effects

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Delayed planting date in double-cropping system (Wheat-Soybean), shift critical periods to restrictive environment, limiting potential yield in Entre Rios Province (Argentina). Early maturing cultivars anticipate reproductive periods to less adverse environment and can diminish yield decline of delayed planting date. The objective of this research was study the effects of narrowing row spacing an increasing plant density in early and later maturing soybean cultivars in late planting date. Two maturing group (MG) were evaluated, Don Mario 4800 RR (MG IV, indeterminate), and A 6401 RG and A 6445 RG (MG VI, determinate). Row spacing was 70; 52.5; 35 and 17.5 cm and plant densities ranging from 200.000 to 500.000 plants ha-1.Narrow row and high density treatment in MG IV out yielded MG VI in 2000 and 2001, (2661 vs. 2419 kg ha-1, and 2742 vs. 2239 kg ha-1 respectively), and show higher response to narrowing row spacing and increasing plant density. Narrowing row spacing increased more intercepted photosinthetically active solar radiation (iPAR) during R1-R5 in MG IV than in MG VI. RUE was higher in MG IV (1.47 MJ m-2) than

in MG VI (1.23 MJ m-2) and decreased with narrowing row. Seed crop yield was associated to early coverage, iPAR, and accumulated biomass to R1 and R5 growth stages but not with crop growth rate during this period. This research suggest that early maturing soybean may be an option to improve soybean yield in late planting date, outyielding later maturing cultivars for our region, if agronomic practices us row spacing and plant density are manipulate to increase early crop growth, and iPAR.

P260. Effect of the planting dates on soybean cultivars, in the three last agricultural harvests

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The present work had as objective to evaluate the behavior of soybean cultivars, how much to the agronomical caracters, in Uberlândia-MG, in last the three agricultural harvests, with three planting dates. The delineation randomized complete block design with three replications, composition for a factorial of 5x3x3, corresponding to the five to cultivate (DM 247, DM 309, Vitória, DM 339 and DM 118), three agricultural harvests (2000/01, 2001/02 and 2002/03) and three planting dates (13/11, 28/11 and 17/12), respectively. After the accomplishment of the analysis of the variance, test of averages and simple correlation of Pearson, concludes that to cultivar DM 309 it revealed more productive, independent of the date and year of culture. The sowing carried through at the third date (17/12) provided reduction in the values of the studied quantitative caracters (Number of days for budding and maturation, height of the plant in the budding and maturation, height of insertion of the first string bean and productivity). In all the planting dates, the best incomes had been gotten in harvest 2001/02. Still, how much bigger the number of days for budding, height of the plant in the budding and insertion of the first string bean, greater was the productivity.

P261. Evaluation of soybean genotypes at two planting dates and four plant population

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This work had as objective to evaluate seven genotypes of soybean, at two planting dates (03/12/02 and 20/12/02) and four plant population, how much to the agronomical caracteristics: number of days for maturation (NDM), height of insertion of the first string bean (AIPV), budding and maturation (APM), gramas/parcela and income of grains (RG). The assay was installed using randomized complete block design with three replications, testing itself the genotypes: UFU 13, UFU 15, UFU 16, UFU 17, UFU 18, Liderança and Emgopa 316. The materials Liderança, UFU 18 and UFU 13 had presented more productive independent of the times and populations of plants studied in this experiment. The sowing carried through at the second time (20/12/02) provided reduction in the values of some studied quantitative caracters (number of days for maturation, income of grains and productivity). For the majority of the studied genotypes, the population of 21 plants linear meter provided to greaters incomes. Still, the biggest productivity had been gotten when the genotypes presented greaters: height of the plant in the budding, the maturation and insertion of the first string bean, number of days for maturation.

P262. State of the art of soybean plant population at Cooperativa Agrária Mista de Entre Rios Ltda.

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The most suitable population for the soybean culture to express its highest soybean productive potential varies according to the cultivar, planting season, plant population and geographycal location. For this reason, soybean is widely recommended, a condition which many producers consider to justify the elevated planting speed. Seeders are usually regulated to seed at the highest density, disregarding the uniformity of the plantation distribution, thus losing in terms of quality. Concerned with quality in the process of soybean planting for the Cooperativa Agrária associates, Fundação Agrária de Pesquisa Agropecuária – FAPA has been developing studies to evaluate soybean cultivars planted in different populations, as well as to verify the quality in the crop implantation. To this end, for the 2002/2003 crops, they held an experiment evaluating cultivars CD 206, BRS 154, RS 183, MSOY 5942 and CD/FAPA 142573 in populations of 100, 200, 300 and 400 thousand plants.ha^{-1}. In the same agricultural year, they diagnosed the planting processes in the associates productive units to verify if productivity was as recommended and the pattern of plantation distribution. To this end, a sample with 40 equidistant points at every 20 meters was taken, counting the plants in one linear meter a row to each

point. In order to evaluate how homogeneous the plant distribution was, the Variation Coefficient was used. Concerning the development of cultivars in the various populations, it was observed that the grain production was crescent to cultivars CD206 and MSOY5942 up to a population of 400 thousand plants hec^{-1}. The other cultivars displayed an increase in productivity up to a population of 300 thousand plants ha^{-1}. Cultivars BRS 154 and CD/FAPA 142573 presented greater bedding in 300 thousand plants ha^{-1}. After analysis of planting processes applied at the associates' farms, it was verified that the average population was of 300 thousand plants.ha^{-1} and 18% of all seeds were lost. Such a population is within FAPA's recommendation. With respect of the evenness in the distribution of planting processes, the variation coefficient remained between 10 and 30%, being a fact that the smaller this rate, the better the quality of the crop implantation.

P263. Effect of time of sowing on the productivity of soybean genotypes

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A field experiment was conducted during rainy season of 2001 on a loamy sand soil at the Punjab Agricultural University, Ludhiana (30° 56'N, 75° 52'E, altitude 247m), India to study the effect of time of sowing on the productivity of genotypes of soybean. The experiment having four replications was conducted in a split plot design by keeping four dates of sowing (24 May, 8, 24 June and 8 July) in the main plots and three genotypes (SL 295, SL 459 and PK 416) in the sub- plots. Before sowing a uniform fertilizer dose of 30 kg N and 60 kg P_2O_5 ha^{-1} was applied. The sowing was done in rows 45 cm apart using 75 kg seed rate ha^{-1}. The results showed that the differences in grain yield due to sowing dates were statistically significant. The highest grain yield of 1419 kg ha^{-1}, averaged over genotypes, was obtained from the crop sown on 8 June, which was, however, closely followed by 24 May (1414 kg ha^{-1}) and 24 June (1363 kg ha^{-1}) sowing . The crop sown on 8 July produced the lowest grain yield (723 kg ha^{-1}), which was significantly lower than that obtained with other three dates of sowing. Genotypes also exhibited significant differences in grain yield. Genotypes SL 459 was the highest yielder (1670 kg ha^{-1}), which was significantly better than PK 416 (1026 kg ha^{-1}) and SL 295 (993 kg ha^{-1}). The interaction effects of sowing dates and genotypes were non-significant.

P264. The influence of sowing dates on the physiological and sanitary quality of soybean seeds

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Considering the difficulties of producing high quality soybean [*Glycine max* (L.) Merrill] seeds during the traditional cropping period in some areas of the State of Paraná, Brazil, a research project was carried out with the objective of evaluating the influence of sowing dates on the physiological and sanitary quality of seeds, during the 1998/99 and 1999/00 cropping seasons, in Maringá, PR, Brazil. The experiment consisted of five cultivar competition assays, arranged in a completely randomized block design, with each assay sown at different dates (10/15, 10/30, 11/15, 11/30 and 12/15) for each cropping season. The evaluated cultivars were BRS 132 (early), BRS 133 (semi-early), BR 16 (semi-early), BRS 134 (intermediate) and FT-Estrela (late). Seeds obtained at the sowing dates were evaluated in laboratory by germination, accelerated aging, and health tests. Sowing in November resulted in seeds in seeds with superior physiological and health quality. Cultivar BRS 133 showed the greatest stability in seed production with better quality for the different sowing dates. Cultivars BRS 134 and BRS 133, which were sown during the period from 10/15 to 11/30, produced seeds that had higher percentages of normal seedlings in the germination and accelerated aging tests. Advancing or delaying sowing dates had adverse effects on the soybean seed production with regard to their sanitary quality.

P265. Evaluation of sowing systems in soybean in the tropic of Mexico

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One of the main problems that affect the yield of the soybean in the Mexican Tropic (14°-23° LN), is the plant distribution inadequate for surface unit, it limit the better use of light, floor, nutrients and available humidity and affects the yield of the crop yield up to 30%. To optimize the use of these factors, the INIFAP carried out during the period of 1999 - 2000, in the Field Experimental South of Tamaulipas (22° 34 ' 10 ' ' Lat. N. and 98° 09 ' 20 ' ' Long. W, 60 msnm.),

trials of sowing system in order to evaluate the effect of this factor on the soybean yield using two varieties (Huasteca 100 and Huasteca 200), three distances among furrows (75, 60 and 40 cm) and three populations densities (250, 300 and 350 thousand plants for hectare). The trials settled down two under rainfed conditions and one under irrigation. Under rainfed conditions, it highlighted the Huasteca 200 variety, the sowing system in furrows to 60 cm and population's of 300 thousand pl/ha density with yields of 2,498.9 kg/ha when being sowed July 31 1999 and 1,218.3 when being sowed August 30 the 2000. Under watering conditions, in sowing of January 17 the 2000, the best treatment was Huasteca 100 in furrows to 60 cm and 350 thousand pl/ha, with a yield of 3,253.2 kg/ha. In conclusion, the reduction of the furrows distance increment the yield with the Huasteca 200 variety in sowing "late" of August 30; and in watering with the use of the variety Huasteca 100.

P266. Performance of soybean and wheat crops in a Haplorthox under different soil tillage systems for 22 years, in Brazil

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The objective of this study was to evaluate the performance of soybean and wheat in a Haplorthox (Latossolo Vermelho distroférrico) under different soil tillage systems for 22 years, in Londrina, Paraná State , Brazil. The experiment started in 1981. The following treatment were disposed in a randomized block design with four replications: no-tillage; conventional tillage (disc plow + light-disc harrow); plow with field cultivator (field cultivator + plain harrow); and heavy-disc harrow (heavy-disc harrow + plain harrow). The results show that the single crop rotation soybean/wheat does not offer sustainability to no-tillage system, mainly, into the first five years of cropping. In this period, the performance of no-tillage was similar or lower than the conventional system in this soil previously cultivated with heavy-disc plow for long time. After six years, no-tillage improved gradually the soil performance and crop yield was increased. Soybean and wheat yields were lower in the first years, but gradually soybean yield showed significant gains while wheat yield remained the same. This fact shows that the single rotation soybean/wheat was not profitable for wheat under no-tillage system.

P267. Soil management systems and crop rotation for soybean in a Haplorthox soil in Brazil

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The objective of this study was to evaluate different soil management systems, with emphasis in the no-tillage system and its interaction with crop rotation and chemical and physical soil features, as well as on yield of corn, soybean and wheat. The trial was installed in a Haplorthox (Latossolo Vermelho distroférico) in Londrina, Paraná State, Brazil. The experimental layout was a factorial in a randomized block design with four replications. The treatments were as follow: 1) cultivation (field cultivation), 2) no-tillage for three years, 3) continuous no-tillage, 4) disc plow, 5) mouldboard plow, 6) heavy-disc harrow, and 7) plowing yearly. In the treatments 1 and 2, the field cultivator was used for winter crop and it was sown without plain harrow. The rotation systems were: 1) single soybean/wheat rotation and 2) corn/lupin - oat/soybean - wheat(2)/soybean(2). Besides improving soybean yield, the multiple crop rotation reduced the soil resistance and bulk density. After system stabilization, no-tillage provided higher yield to soybean, regardless to the rotation crop system used. Corn performance was less affected by soil management than rotation crop. Corn plants always yielded more when sowed after lupins than fodder radish. Wheat grown in the single crop rotation with soybean yielded less in the no-tillage system. In the other hand, the use of multiple crop rotation improved the performance of wheat.

P268. Effect of soil resistance to penetration and least limiting water range in soybean yield in Haplustox

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Soil compaction of anthropic origin is caused by mechanical forces related especially to the traffic of heavy machinery and equipment on very moist soils, which can hinder the penetration and ramification of roots in soil leading to significant reduction in the yield and result in increases in production costs. The objective of this study was to determine the resistance to penetration (*PR*), the least limiting water range (*LLWR*),

and the critical bulk density ($D_{b\text{-}crit}$) for soybean production in a medium-textured kaolinitic oxisol (Haplustox). This study was conducted at the Universidade Estadual Paulista – Faculdade de Ciências Agrárias e Veterinárias experimental farm in Jaboticabal, SP, Brazil. The Haplustox had 271 g kg^{-1} of clay, 42 g kg^{-1} of silt and 687 g kg^{-1} of sand, in 0.20 m depth, and it was tillaged at 0.30 m depth, followed by a harrowing to level the soil. The treatments represented the compaction of the soil by passing a 11 Mg tractor over the site 0, 1, 2, 4, and 6 times, with 4 replications, in a randomized experimental design. Soybean (*Glycine max* cv. Embrapa 48) was sowed in December 10, 2002, at a 0.05 m depth, in rows 0.45 m apart, and plants were thinned to 20 plants/m 10 days post-sowed and the cultivation was conducted according to standard recommendations. Plant height, number of pods, aerial dry matter, weight of 100 seeds, and the yield in 3.6 m^2 plots were recorded. After the sowing, soil samples were collected from 0.02-0.05, 0.07-0.10 and 0.15-0.18 m depths to determine the *PR*, *LLWR*, $D_{b\text{-}crit}$ and bulk density (D_b), as well as the soil-water retention curve, from which an average was used. Soybean yield started reduction at the *PR* of 0.85 MPa and D_b of 1.48 Mg m^{-3}. Thus, through quadratic regressions fitted to *PR* and D_b data, a decrease in soybean yield was found at 5.18 and 2.28%, respectively, for the critical values of *PR* (2.0 MPa) and D_b (1.55 Mg m^{-3}). For these data to be used as critical values and be adopted as measurements to loosen the soil, an economic analysis of the cost-benefit must be conducted. The *LLWR* was limited in highest part by water content at field capacity (0.01 MPa tension) and in lowest part by water content at PR_{crit}, achieved the $D_{b\text{-}crit}$ to root development at 1.48 Mg m^{-3}. Soil traffic of an 11 Mg tractor in water content at tension of field capacity (0.01 MPa), compacted the soil and decreased soybean yield in 45.6% when passed six time in same place.

P269. Performance of soybean (*Glycine max* (L.) Merrill) on different soil management systems, crop rotation and covering crops cultivated in no season crop

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With the constant increase of world population it can reach 8,3 billion inhabitants in 2025, it leads the need of elevating the production of food. In this way, an enormous range of researches aiming to provide satisfactory response in the exploration of the soil must be done seeking the increase in the agricultural yield. In this context, the present study was developed with the objective of evaluating in a typical soil of savannah area and cultivated in a conventional system for several years, the effect in the fourth agricultural year of soil management systems, crop rotation or monoculture and covering crops of the soil (no season), in the agronomic characteristics of soybean crop. The study was conducted at Experimental Station of UNESP – Ilha Solteira Campus, located in Selvíria county - MS, Brazil, having as geographical coordinates 51° 22' W and 20°22'S and 335 m of altitude. The treatments used in the experiment were: two soil management systems (no tillage and conventional), crop rotation (corn-soybean) or monoculture (soybean-soybean) and the covering cultures (guandú (*Cajanus cajan* (L.) Mill sp.), capim pé-de-galinha (*Eleusine coracana* L.), crotalária (*Crotalaria juncea* L.) and milheto (*Pennisetum americanun*)) and a fallow area. The covering crops were sowed in the beginning of September and the soybean on cultural residues of these crops or in the fallow area in 11/12/02. The conventional soil system was accomplished through plough + leveling disc and in the system no tillage the area was dessecated with glyphosate. In the sowing the inoculation and treatment of seeds were done in agreement with the recommendations for the culture. The fertilization at sowing consisted of 250 kg ha^{-1} of 08-28-16 and the used variety was BRS 133. Through the obtained results it was verified that the *Crotalaria* and the *Pennisetum* are the two covering crops recommended for cultivation in the area in spring, with the purpose of straw production, preceding the summer crops; *Crotalaria* was the covering culture that provided larger grain yield (3582 kg ha^{-1}) and the *Cajanus* the smallest (3009 kg ha^{-1}); in the fourth agricultural year there is not difference between area under rotation or soybean in monoculture, in any appraised characteristic; the no tillage system was better in relation to stand and plant height but inferior to conventional system to number of beans for plant and soybean yield.

P270. Sustainable production of soybean in soybean-wheat cropping sequence by integrated nutrient supply system on vertisols under humid irrigated agro-ecosystem

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Substantial amount of crop residues (350 MT) are produced in India annually. Due to monoculture of soybean and continuous rotation of soybean-wheat cropping sequence without Judicious nutrient management resulting stagnation in productivity and decline in soil fertility in Rajasthan State. An experiment was conducted at ARS, Kota situated between 25°13'

latitude N and 75°25' longitude E and an altitude of 258 MSL, having average rainfall 850mm, maximum temperature 30.6°C and minimum temperature 18.7°C, during 2000-2003, to evaluate the feasibility of integration of nutrient supply system for sustaining the soybean yield and system productivity as a whole. The experiment was laid out in split plot design with three replications comprising main treatments viz;, T_1 : crop residue @ 5 t/ha; T_2 : FYM @ 5 t/ha; T_3 : T_1 + T_2 + Zn @ 5 kg/ha; T_4 : No residue and subplot treatments fertilizer levels viz.; F_1 : 100% recommended dose of fertilizer (RDF); F_2 : 50% RDF; F_3 : control (No Fertilizer). These treatments were applied only in kharif soybean and their residual effects tested in succeeding wheat crop. The soil was clay-loam (vertisol) having pH 7.96, EC 0.42 dS/m, available N, P_2O_5 and K_2O, 352, 28 and 305 kgha^{-1}, respectively. The results indicated that conjunctive use of crop residues at 5 t/ha and organics (FYM 5 t/ha) amalgamated with micro-nutrient (Zn 5 kg/ha) have significantly enhanced soybean yield (2110 kgha^{-1}) which was 35.80 per cent higher than no residue (control). Among the fertilizer levels 100% RDF gave significantly higher yield potential. The residual beneficial effect of the integrated nutrient supply system also persisted in the succeeding wheat crop wherein maximum grain was obtained being 23.80 per cent higher over no residue control. It can be concluded that integrated nutrient supply system as crop residue 5 t/ha, FYM 5 t/ha and Zn 5 kg/ha with RDF are feasible and effective for sustaining soybean system productivity and improving soil fertility due to nutrients integration, enhanced availability and their recycling in soybean-wheat cropping system as a whole under heavy textured humid irrigated soil micro farming situations.

P271. Importance of crop rotation (soybean) on sugarcane production

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Sugarcane yield depends on crop management used during the sugarcane crop renewal (reform). The use of alternative crops as soybean and other legumes in rotation with cane can bring important benefits to yield and sustainability to the cane production. In that sense an experiment was installed in 1997 in the Jalles Machado sugar-mill (Goianésia-GO) in a clay yellow red Latosol with the objective of evaluating the contribution of the soybean crop rotation to the sugarcane yield. The treatments used were cane cultivated after cane, cane cultivated after 1 year soybean crop (year crop 1998/1999), cane cultivated after 2 years soybean crop (year crop 1997/1998 and 1998/1999). The sugarcane (stalk) and soybean yield (grains) were located in 2500m² plots with 4 replications and in a randomized block design. The sugarcane yield increased 3.2 and 6.1 t ha^{-1} in the first and second cut respectively, where sugarcane was cultivated after 1 year soybean crop rotation compared to where did not have crop rotation. Where 2 successive soybean crops were cultivated, sugarcane yield was 13.9 and 7.4 t ha^{-1} higher respectively in the first and second cut, compared to the cane after cane treatment or without crop rotation. The grain production (soybean) was also higher where 2 successive soybean crops were established. The difference between 1 and 2 years soybean crop was of 6.8 soybean 60 kg bags (grains with 14% of humidity). Considering the total sugarcane produced across first and second harvest, it was possible to obtain an average of 6.0 and 13.9% increase on sugarcane production, respectively for treatments 1 and 2 years soybean crop in comparison to the check plot, i.e., without crop rotation (cane after cane).

P272. Sorghum-soybean intercropping. XII. Selection of soybean cultivars and hybrids of sorghum forage in intercropping condition in the between rows seeking the better forage yields in two cutting systems

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With the objective of selecling in intercropping condition soybean cultivars and sorghum hybrids with better forage yields, two trial were conduced, in 1996/1997 and 1997/1998, at the Agricultural Department of the Federal Universidade of Lavras, in Lavras (Mg). The experimental design was a randomized block in a factorial scheme 2x2x2+2 with three replication, consisting of two cutting systems (a single cutting, close to the soil, of both crops at R_5 stage of the soybean, and a two cutting system: the first done 60 days after emergence, at 30 cm from the soil surface and the second after the plants regrowth, close to the soil, at the same time of the cutting of the first system); two soybean cultivars (CAC-1 and Doko RC) and two hybrids of forage sorghum (AG 2002 and BR 601) and two aditional treatments corresponding to the sorghum alone (cutting in the stage of farinaceous grains). The use of two cuttings systems provided the best yields of the total green mass and total crude protein. The total dry matter provided a great yield in systems of one cutting. The association of hybrid of sorghum BR

601 and soybean cultivars CAC-1 and Doko RC in the systems of two cuttings provided significant increments in total green mass and intercropping. For the total yield crude protein the better increments were provided for the associations BR 601 and Ag 2002 with CAC-1 and Doko RC in the systems of two cuttings, and CAC-1 with AG 2002 and BR 601 in the system of one cutting.

P273. The effect of grass and soybean cultivation on soil nitrogen under the agropastral system (pasture - soybean rotation system) in Brazilian savannas (Cerrado)

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Soil samples were collected in the end of dry season in 1993, 1997, 2001 and soil carbon (C), nitrogen (N), inorganic-N, mineralized-N estimated by incubation method, the origin of soil C using natural abundance technique were analyzed under different cropping systems since 1993. A degraded pasture (DP) of *Brachiaria decumbens* planted in 1973, and a natural vegetation of Cerrados (CER) were utilized as control plots, And three cropping systems were examined: continuous pasture plot renovated in 1993 (CP), continuous soybean plot (CC), and rotation plot (pasture for 4 years and followed by 4 years of soybeans as a summer crop) (P4C4). Total soil C in CP, CC, and P4C4 plots decreased, but not largely in CER and DP. Total N content in all treatment was not changed largely at 8 years after the start of experiment. Total soil C and N contents in CER (2.1 - 2.7 %C and 0.15 - 0.20 %N, respectively) were highest in all treatments. NH_4-N content in soil decreased during 8 years experiment and its reduction is not so different in all treatments. NO_3-N content in soil increased after 8 years in all treatments. Especially, its increment in CC and P4C4 was quite larger than that in the other treatment plot. Mineralized-N in CC and P4C4 decreased, but that in DP, CER, and CP was not changed largely after 8 years. Total soil C in DP after 23 years cultivation contained 71% of the original C from pasture and 29 % of original C from native forest of CER. In CC, after 8 years, soybean-originated C accounted for 27 % of total C, while 39% was derived from the previous pasture period from 1978 to 93, and 34 % of total C derived from native forest of CER. In P4C4, 48 % of total-C was originated from pasture, 21 % of total-C derived from soybean, and 30 % derived from native forest of CER. These results suggested that soybean cultivation would stimulate oxidation of pasture-C and caused the reduction of mineralized-N after 8 years in CP and P4C4 plots. As far as soil fertility, it was indicated that soybean cultivation would accelerate degradation of soil organic N.

P274. Soybean productivity in pastured areas with different feeding heights during winter in a Cattle Farming Integration System

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Cattle Farming integration systems in that the same feeding areas are used during the winter period and sowed with soybean at summer period are expanding in the State of Paraná. However, still there are concerns about the possible effects of different feeding intensities in the productivity of the soybean. An experiment has been led seeking to evaluate different pasture heights offered for feeding (7, 14, 21 and 28 cm) in black oat species (Avena sativa) + annual azevém (Lolium multiflorum). The feeding in the winter was continuous with variable load and adjustment of the number of animals in agreement with the forage readiness (AP) seeking maintanence of pré-defined heights. Feeding areas (AP) and non-feeding areas (ASP) were separated from each other in each experiment and the the areas of animal concentrationwere mapped (AC) being located most of the time close to hods of water and salt. AC it was estimated as being 0,64% of the total area where it was observed agregation of the superficial layer of the soil and high difficulty for soybean estabilishment. The variety V-MAX it was used. Seeds were treated and inoculated but the area used it was not fertilized since it had been fertilized in the winter period and that animals export very few nutrients when feeding themselves. Significant stand differences were not observed in the different areas. The soybean productivity was of 42,77 scs/ha in the pasture concentrated areas, 66,58 scs/ha in the areas non pastured and 68,95 scs/ha in the pastured areas. Significant differences in productivity were not observed due to different heights of pasture (7, 14, 21 and 28 cm), which were respectively of 68,42; 70,74; 68,32 and 68,34 scs / ha. However a significant difference it was observed among AP, ASP and AC for soil covering on soybean due to the different feeding heights offered in the winter.

Contributed Papers

ISPUC

C062. Effect of integrated micronutrients management on seed yield and nutritional quality of soybean (*Glycine max* L. Merrill) grown in North Indian Plain

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A field experiment was conducted during *Kharif* 2001 and 2002 on Mollisol of the Crop Research Centre, Pantnagar. Ten treatments: control with recommended fertilizer (25.0 kg N + 60.0 kg P_2O_5 + 40.0 kg K_2O per ha), Zinc at 5.0 kg/ha, Zinc at 10.0 kg/ha, seed treatment with 4.0 g Na-molybdate/kg seed, Boron at 0.5 kg/ha, Boron at 1.0 kg/ha, Farm Yard Manure (FYM) at 10.0 t/ha, Zinc at 5.0 kg + FYM at 10.0 t/ha, Zinc at 10.0 kg/ha + FYM at 10.0 t/ha, Seed treatment with 4.0 g Na-molybdate/ kg seed + FYM at 10.0 t/ha, Boron at 0.5 kg + FYM at 10.0 t/ha and Boron at 1.0 kg + FYM at 10.0 t/ha were tested in randomized block design with 3 replications on determinate soybean cv. PK-1042. Seed was uniformly inoculated with peat based *Bradyrhizobium japonicum* culture at 1g/kg seed. Effect of these treatments on seed yield, symbiotic N_2-fixation, protein and oil contents in grains and fatty acid composition of oil were studied. Pooled analyses of 2 years data have been reported. Integrated micronutrients management significantly increased the seed yield, N_2-fixation and nutritional qualities of grain. Highest grain yield (34.7 Q/ha) and symbiotic N_2-fixation (130 kg/ha) were recorded with the application of Zinc at 5.0kg + FYM at 10.0 t/ha resulting 11.9 % increase in seed yield and 58.5 % increase in symbiotic N_2-fixation. In general, integrated use of micronutrients and FYM improved the seed yield and N_2-fixation of soybean. Application of micronutrients alone as well as with FYM also increased protein and oil contents of grain. Highest protein (40.4s %) in grain was recorded with Zinc at 5.0 kg/ha + FYM at 10.0 t/ha but highest oil content in grain (19.4 %) was found with Zinc at 10.0 kg/ha + FYM at 10.0 t/ha. Composition of saturated and unsaturated fatty acids in Soya oil were also affected significantly by micronutrients applications. Application of Zinc at 5.0 kg/ha resulted in the highest Palmatic acid (12.95 %) and stearic acid (2.625 %) in Soya oil which were 9.4 and 39.4 % greater than control respectively resulting 12.1 % more total saturated fatty acids over control. This treatment also resulted in the highest oleic acid (20.65 %) and linoleic acid (57.12 %) but linolenic acid (7.068 %) was very close to lowest in control (6.13 %).

C063. Nutritional and immunological response in selected adult women on administration of SPC beverage

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A beverage mix was formulated using SPC. Susceptibility of the selected 50 women to allergic reactions was studied. Based on the subjects' exposure to soy, 43 were selected for short-term study (5 days) to know the clinical effect of SPC intake. The remaining 7 who had never tasted soy or tasted it only once in their lifetime, were selected for long-term study (3 months). Nutritional assessments through anthropometrics and bio-chemical tests of hematological parameters (hemoglobin, total serum protein, A: G ratio) were carried out initially and after 3 months. Assessment of immunological parameters (Immunoglobulin E, eosinophills, packed cell volume and erythrocyte sedimentation rate) was done at day 0, day 1 and day 15 and clinical examination after 3 months. Eleven had experienced episodes of allergic reactions prior to the study due to other reasons. Only 62 % of them had tasted soy products. In the short-term study 95.34 % of the selected volunteers reported 'nil' allergic response. The remaining reported flatulence and/or indigestion. Nutritional and immunological parameters assessed during the long-term supplementation study showed no difference of clinical significance between the initial and final levels. But one subject had abdominal discomfort and vomiting during the experimental period. But, no significant differences in immunological parameters were noticed. The remaining 6 sub-samples completed the study successfully without any abnormal clinical symptoms.

C064. Kinako - an easy way to consume soybeans

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"Kinako" is a finely ground flour made from soybeans and is, unlike many flours, very high in protein (having twice that of wheat flour) and low in carbohydrates. Kinako is flour from soybeans in its entirety, in easy-to-use, ready-to-eat form, which can be served in a variety of ways. The use of kinako and its derivatives for human consumption has become a necessity for maintaining the physiologic balance of our organism since it reduces the risk of early development of certain chronic degenerative diseases and is a functional food of easy utilization. Brought to public attention by researchers from Embrapa-Soja (Brazil), we have joined the effort to introduce kinako into the Brazilian diet. It is well known that the dietary benefits from soybeans are greater when it is consumed in its entirety rather than its isolated components. Some researchers believe that a synergy exists between the different bioactive components of soybeans, increasing its capacity of modulating metabolic responses. Having been involved with research groups in all phases of the soybean chain—genetic development, crop growing and industrial processing—we decided to make kinako available to the consumer's table. After innumerous tests with diverse varieties, we have chosen those that yield the highest protein content along with the best palatability after going through thermal processing. Palatability tests have been conducted with a universe of about 1,200 people, using pure kinako in different combinations—with milk, powdered chocolate, yogurt and fruits—resulting in a 90% rate of approval. In the production process, we sought to apply the available Western technical concepts along with the millennial experience of the oriental people in processing soybeans, in order to preserve all its nutraceutical properties. The isoflavone content of any given soybean variety changes with the growing location (latitude, temperature during maturation). To optimize the processing technology for functional soybeans, time and temperature are very important factors for activating the development of bioavailable isoflavone aglycones. Equipment has been adapted in order to produce a kinako acceptable to the Western palate, by reducing the anti-nutritional factors (trypsin and chymotrypsin inhibitor, the urease, the lipase and the lipoxygenase (peroxidation and "beany" flavor) through the control of time and temperature and by using top grade raw material—rigorously selected soybeans, grown in our own fields. Kinako has a better acceptance when combined with other foods. In order to meet this demand, we have developed new products such as cookies, snacks and cake mixes. The market is promising, with room for development, but much work is still needed in the area of palatability and consumer awareness, until the existing resistance to soybean consumption is overcome and the consumer incorporates the soybean in his daily diet, enjoying all its benefits.

C065. State of the art technologies for manufacturing soymilk

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Traditional technologies for manufacturing soymilk impart beany flavor, chalky mouth feel and flatulence problems. This has been a major hurdle in making the soy beverage popular in India. Two technologies, viz., airless cold grinding and soy flakes as a base produce soymilk with excellent flavor, velvety smooth mouth feel with no flatulence problems. These technologies differ mainly with the type of raw material used, viz., whole soybean and soy flakes respectively. The respective suppliers of machinery and raw material patent both the technologies. Cost of machinery is less in the later one whereas cost of raw material is less in the first one. The quantity of effluent generated is 20% lesser in soy flakes technology as also the power requirement. Soymilk yield is again 20% more in soy flakes technology. Techno-economic feasibility of both the technologies was studied for manufacturing 4000l/h of soymilk base. Both the technologies were found to be technically feasible and economically viable with pay back period of less than 5 years. In today's market scenario of soymilk, these technologies could be of great help for supplying good quality of soymilk and increasing the turnover of the manufacturers.

C066. Studies on extending shelf life of tofu using multi-layer film

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Low shelf life of tofu is a major constraint in distribution and marketing in India. Tofu remains wholesome for only 10-12h under tropical storage conditions and for 72h at 5°C (Grover *et al.* 1983). Studies were conducted to enhance the shelf life of tofu using different types of packaging material, viz., LDPE film, HDPE box and five-layer film with nylon as an oxygen barrier. Samples with LDPE film and multi-layer film were vacuum packed. Tofu samples were preserved at 30°C and 5°C. Total plate count, coliform count, protein and pH were measured at an interval of 12 h. It was observed that the protein content of tofu decreased more at 30°C than at 5°C for the same time period. However, tofu

stored at 30°C was not acceptable after one day with pH decreasing from 6.2 to 5.3 and total plate count increasing from 22400 to more than 100,000. Tofu samples vacuum packed in multi-layer film with oxygen barrier and stored at 5°C had a shelf life of 30 days, which was the maximum amongst all the treatments. The research would be helpful in establishing wider distribution network across the country with lesser cost of spoilage.

C067. Application of *tofu* (soybean-curd)-residue to development of new fermented pancake and to quality improvement of *tofu*

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Generation of *tofu* (soybean-curd) residue amounted to 800 million tons is one of the most important environmental-issues in *tofu* industry of Japan. Although it had been utilized as a food or animal feed in olden times, it has become a sort of waste now a day. Dosa is an Indian traditional-pancake made by lactic acid fermentation of rice and black gram. The particular texture and aroma of the baked product seem to be very much preferred by Japanese consumers as well as by Indian ones. In this context, we have tried to apply the process of dosa fermentation to effective use of *indica* type rice imported and *tofu* residue. In the first part of this study, it was investigated to substitute the black gram by *tofu* residue. And then identification of effective strain of lactic acid bacteria by a simple identification kit was made for proper fermentation of dosa dough and for the determination of antioxidant fraction from *tofu* residue dosa by 1,1-diphenyl-2-picrylhydrazyl spectrophotometric method. Some physical properties of original dosa and *tofu* residue dosa were measured for the comparison of the two and for searching optimal condition of *tofu* residue dosa processing. In the second, the effect of *tofu* residue application on texture change in *tofu* was investigated for industrial production of *tofu* having harder texture and longer shelf life. The experimental results showed that the screening and identifying of effective strains in fermentation of original dosa could contribute to proper fermentation of dosa dough including 10 to 20% of *tofu* residue, and addition of *tofu* residue could improve the functionality of dosa. The combination of coagulant and thicker soy milk by 20% than common soy milk could make harder textured *tofu* that would be acceptable by Chinese consumers, and it was found that it can also be produced by industrial method which is very popular in Japan.

C068. The fate of soy oligosaccharides and isoflavones in fermented soy-bovine milk products

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Entrepreneurial products where the beneficial factors of two or more ingredients can be combined to produce healthier functional foods are gaining more interest. One such partnership can be established between soymilk and cow's milk, to produce a range of beverages and fermented products with improved flavour profile and health attributes. Natural soybean is an ideal source of biogenic compounds such as oligosaccharides and isoflavones, and we propose to use natural soybeans in preference to soy protein isolates and concentrates, to maximize the health benefit. Furthermore, we are in favour of using full-fat enzyme-active soy flour (EASF) instead of whole soaked soybeans due to technical and biochemical considerations. In an attempt to optimize the preparation of soymilk in the manufacture of a fermented product (Soghurt), we Co-processed skim milk powder and EASF in aqueous solution (90°C/6 min). The beany flavour development was prevented and a reasonable reduction in trypsin inhibitors activity was achieved with minimum heat damage to proteins and isoflavones. HPLC determinations revealed that commercial soymilks/beverages had significantly lower isoflavones content compared to the experimental soymilk. Similarly, the soghurt made from Co-processed soy-bovine milk blend using ABT4 (*S. thermophilus, L. acidophilus LA-5 and B. pseudolongum BB-12)* was found to contain higher levels of isoflavones (aglycones) compared with commercially available soy-yoghurts. Soy-oligosaccharides were mostly used up by the probiotic bacteria as a readily available source of prebiotic, and only small quantities were left at the end of the soghurt shelf life.

C069. Effects of processing shear on protein bodies of soybeans

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Full-fat Enzyme-active soy flour (EASF) has been used in our previous works for the hydrothermal extraction

of soymilk (1:12, 85°C for 5min) with high yield and improved flavour profile. However, the tofu (0.27% $CaSO_4$ and 0.03% Glucono-d-lactone) made from this soymilk consistently failed to produce an acceptable tofu. Control tofu made with whole soaked soybeans (WSS) under the same conditions usually resulted in a better product. Initially, it was postulated that the protein bodies might have undergone shear-damage during the dry milling of soy flour, thus preventing the formation of 3-dimensional matrix needed for a good coagulum formation. Scanning Electron Microscopy (SEM & ESEM) studies were conducted on flour, soymilk and tofu samples to compare the protein structure and the effects of processing shear on protein bodies. Tofu samples were tested for curd homogeneity, firmness, elasticity and cohesiveness using TA XT2 Texture Analyser. There was a lack of conclusive evidence on shear damage to protein bodies caused by milling, however, the quality of tofu made from EASF milk could be improved to match that of WSS milk by extending the cooking time and temperature. It was also observed that the instantaneous inactivation of lipoxygenases during hydrothermal extraction, despite its positive role in preventing the formation of hexanals (beany flavour agents), may also prevent the formation of disulfide bridges, so important in the formation of tofu curd, thus undermining tofu quality.

C070. Actions taken by PSA Peugeot Citroën for biofuels: towards a global reduction in Greenhouse Gas emissions

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The Greenhouse effect - a natural process: anything can be dangerous if taken to excess. To take a simple example, plants and humans both need water to live. However, excessive amounts of water would disrupt and subsequently destroy the workings of living organism. The same can be said of the green house effect and the Earth. A natural process that is essential for maintaining life on earth, it becomes a serious threat if it spirals out of control. An imbalance in the carbon cycle: arbon dioxide is the main gas contributing to the greenhouse effect, but it is not the only one. CO2 is emitted by many different sources : by burning fossil fuels (oil and coat) of course, but also by the respiration systems of living beings, by forest fires and by decaying organic matter. It is absorbed by plants during photosynthesis and by the ocean, which turn it into sediment – forming carbonates. However, when the vegetation and oceans are no longer able to absorb the concentrations present in the atmosphere, the build-up favours global warming. Over a number of years, this process has given rise to an imbalance in the natural carbon cycle, since CO2 concentrations in the atmosphere have leaped by 15% in just 50 years. This increase is directly linked not only to the energy and transport sectors but also to other human activities such as deforestation. Finally, even if CO2 is not a toxic gas (it is produced as part of a natural process that involves all living being), it nevertheless constitutes a major environmental problem. This is because an imbalance has emerged between the quantity of CO2 produced and the quantity absorbed by the ecosystem. This imbalance could have serious consequences, the scientific community now recognise that global warming could occur if the greenhouse effect is left to develop uncontrolled. The consequences of global warming are many and varied : they are potentially serious for fauna, flora and for human society. Towards a global reduction in greenhouse gas emissions: the key factor in this recent imbalance is the consumption of energy produced by burning fossil fuels : oil, gas and coal. However, the increase in energy consumption in recent decades is closely linked to the development of trade and hence to the different forms of transport : the car is one of them. It plays a particularly important role in the eyes of public opinion, since it is continuously present in our daily lives. Cars are indispensable, they play an important social and economic role. In many cases, no viable alternative exists to the services provided by cars. They remain the mode of transport that best satisfies people's desire for individual mobility. PSA PEUGEOT CITROËN believes that it has a responsibility to provide a basis for the sustainable usage of cars – viewed by most people as indispensable – while pursuing efforts to bring about a global reduction in CO2 levels. A global approach that looks at all the factors in play is essential ; for this reason, PSA PEUGEOT CITROËN is active in several areas, and the first of these is (naturally) automotive technology. Topics such as upgraded combustion engines, lighter, more aerodynamic cars and new types of engine are at the heart of the Group's research programmes. In addition to these initiatives, the Group is active in related areas, such as the improvement of fuels and the development of new forms of energy for cars, notably biofuels. Biofuels : a major area of focus in the research studies conducted by PSA PEUGEOT CITROËN: PSA PEUGEOT CITROËN is a strong supporter of biofuels development. The Group is always ready to draw attention to the advantages of biofuels and to validate the different applications envisaged, whether for pure ethanol, its derivative ETBE, or vegetable oil esters. For example, the Group encourages broad adoption of "diester 30", a mix comprising 30% VOME (vegetable Oil Methyl Ester) for 70% of diesel fuel. This biofuels has an impact upstream on CO2 concentration in the atmosphere. Like any form of vegetation, the plants used to make diester "trap" carbon dioxide by photosynthesis. Overall, from the oilseed rape field to the exhaust pipe of a car running on diester 30, CO2 emissions are 18% lower than for the same vehicle running on conventional diesel fuel. Above all, however, in addition to its ability to cut CO2

emissions, diester 30 also has a significant environmental impact in that it cuts particulate emissions by 10% in indirect-injection diesel engines and 22% in HDI engines. These reductions apply to all cars on the road : diester 30 is immediately accessible to vehicles of any generation. The Group is also involved in actions in the field to promote biofuels, notably through the "club des villes Diester" (Diester cities club). The Group guarantees that Peugeot and Citroën vehicles running on diester will contain up to 30% of ester ; it also runs its own in-house fleet on diester 30. In Brazil, PSA PEUGEOT CITROËN has started an experiment with real cars with the partnership of the University of São Paulo.

C071. Correlation studies for various biochemical and physical attributes of soybean seeds grown over widely differing latitude

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Multi-locational field trial with seven Indian cultivars at four widely differing latitudes was conducted with the purpose to study the influence of growing environment on biochemical and physical attributes of soybean seed. Genotypic, locational and genotypic x locational interaction were found to be significant for protein, oil and unsaturated fatty acids *viz.* oleic acid, linoleic acid and linolenic acid ($p<.001$). Phytic acid, the heat stable antinutritional factor, showed significant locational and genotypic x locational effects ($p<0.01$). Among climatic factors, latitude showed positive correlation with oil ($p < .05$) and negative correlation with protein ($p<.01$) Rainfall during bean development showed positive correlation with oil ($p< 0.05$) and negative with protein content ($p<.05$). However, total rainfall during the cropping season in our studies showed stronger negative correlation with protein ($p<.001$). Maximum and minimum temperature prevailing during bean development showed negative correlation with linolenic acid. However, correlation of linolenic acid was stronger with maximum temperature ($p<.01$) than minimum temperature ($p<.05$). Both maximum and minimum temperatures also showed positive correlations with palmitic acid ($p<.05$). Average minimum temperature seemed to affect protein and oil also as it showed positive correlation with protein ($p<.01$) and negative correlation with oil ($p<.05$). Mean temperature during bean development showed significant positive correlation with protein and negative with oil and linolenic acid ($p<.05$). Seed size showed positive correlation with phytic acid ($p<.05$) and oleic acid ($p<.01$) and negative with linloleic ($p<.01$) and linolenic acid ($p<.05$). Over four growing locations, seed coat color showed no variation while light hilum color cultivars responded differentially. The effect of various climatic factors on biochemical characteristics of soybean seed and their interrelationship as observed in our studies suggest streamlining of breeding objectives for food uses *vis-a-vis* growing environment.

C072. Association of fatty acid composition of soybean with maturity period and seed size

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To improve soybean oil quality, soybeans with high oleic and low linolenic content are desirable. The information on the influence of maturity periods and seed size on fatty acid composition of soybean is scarce. Eighty soybean genotypes, comprising cultivars / advanced lines of Indian soybean, were grown and the maturity period and seed size were observed. The mature seeds of all the genotypes were evaluated for fatty acid composition to identify cultivars/ lines with comparatively low linolenic and high oleic acid. High variability existed for different fatty acids; with oleic, linoleic and linolenic acid ranging from 18.5-48.5, 30.0-55.5 and 4.6-9.0 respectively. Negative association of oleic with linoleic acid ($p<.001$) and linolenic acid ($p<.001$) were observed along with positive association between linoleic acid and linolenic acid ($p<.001$). Maturity period of the genetic material studied ranged from 80-112 days. Maturity period exhibited strong associations with individual fatty acids. It exhibited very strong negative correlation with oleic acid ($p<.001$). Positive associations were observed between maturity period and stearic, linoleic and linolenic acid. However, the association between maturity period and linoleic acid has been found to be more stronger ($p< .001$) than with linolenic ($p<.01$) and stearic acid ($p<.05$). Seed size, expressed in terms of 100 seed weight of the genetic material studied, varied between 7.0-13.2g. Significant correlations were observed between seed size and individual fatty acids. Seed size showed a positive association with oleic acid ($p<.001$) and negative association with linoleic, linolenic acid and stearic acid. The negative association of seed size with linoleic ($p<.001$) and linolenic acid ($p<.01$) was stronger than with stearic acid ($p<.05$). M/P (monounsaturated / polyunsaturated fatty acids) ratio, an indicator of oxidative stability, ranged between 0.31- 1.39 and exhibited very high negative correlation with maturity period ($p<.001$) and positive correlation with seed size ($p<.001$). The results observed suggest that maturity period and seed size may be considered in soybean breeding for developing high oleic and low linolenic lines.

C073. Characterization of a soybean (*Glycine max*) 7S globulin β-subunit deficient line

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β-conglycinin (7S globulin) is a major storage protein of soybean and contains α'-, α- and β-subunits. Although soybean 7S globulin subunits were well characterized, the information about β-subunit is still limited. β-subunit contains no sulfur-amino acid which is considered to be largely responsible for a nutritional deficiency of soybean. Accordingly, materials with β-subunit deficient or reduced are expected to be valuable materials in precise genetic study of soybean 7S globulin β-subunit gene(s). On SDS-PAGE analysis, a soybean line preserved in our laboratory showed a lack or an extremely low level of the b-subunit bands. We call this line "β-null". The b-null line grew and produced progeny without any physiological abnormality. The progeny seed showed the same genotype as the original "β-null" line. This showed that the genotype of the β-null is a really inherited trait. The banding pattern of PCR products (using primers specific for a part of β-subunit gene sequence) of β-null or β-reduced plants was identical to that of Enrei(standard). The result of PCR analysis indicated that the deficiency is not caused by a lack of, or structural defects in the β-subunit gene(s). By the results of comparison the nucleotid sequence of the β-subunit gene of Enrei, Moshidou, β-5_7 (β-null) and β-5_{33} (β-reduced), only one base pair difference was found. The base "A" in Enrei was altered to "C" in Mo-shi-dou Gong 503 (α·β low), β-5_7 (β-null) and β-5_{33} (β-reduced). The changed base results in the change of amino acid composition: *Phe* is replaced by *Leu*, suggesting that the null (or reduced) trait is likely to be associated with the alteration of a single base such that the encoded amino acid is altered. By using our new line(s), we can establish new qualified lines for breeding and a controlling system.

C074. Molecular analysis of soybean lines with favorable oil traits

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Major breeding efforts have been made to improve the quality of soybean oil by reducing its levels of the saturated fatty acid (palmitic) and the polyunsaturated fatty acid (linolenic). Several studies have shown that two major loci, designated *fap1* and fap_{nc}, lower the palmitic acid content of soybean. We have established that fap_{nc} represents a deletion in a gene encoding a 16:0-ACP thioesterase (FATB2). Allele specific primers have been generated from the complete nucleotide sequence information (wild type and mutant) of *FATB2*. These primers can be used as molecular markers for the purpose of selective identification of individual soybean plants possessing the fap_{nc} alleles. Because fap_{nc} represents a deletion mutant, plants homozygous for this locus are scored according to their failure to produce a band using primers specific for the wild type FATB2 gene. Therefore, the fap_{nc}-specific markers are not able to distinguish plants heterozygous for fap_{nc} in F1 (BC1) generations, but are very effective in identifying individuals that are homozygous for fap_{nc} in segregating F2 generations (and beyond). To test the efficacy of the fap_{nc} specific primers in screening large populations of segregating individuals, we have screened at least 100 individuals from a N97-3708-13 x Brim population. N97-3708-13 represents a low palmitic acid (*fap1 fap1*, fap_{nc} , fap_{nc}), low linolenic acid (*fan*) soybean line. The fatty acid composition of seeds from each individual plant have been determined using GC analysis and compared to the predicted *fap* genotype as determined by allele-specific PCR. The fap_{nc} markers generated from this study should provide an effective, facile means of introgressing this low palmitic acid trait into elite cultivars by enabling the selection of individuals possessing the trait at the young seedling stage, thus obviating the need to grow all plants in segregating populations to maturity and assaying the fatty acid composition of the seed.

C075. Protein banding variations in early mutations of soybean

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Isolation and evaluation of desirable induced mutations in crops has been an economically expensive practice due to random occurrence, low frequency, pleiotropic effects and time that is why mutation breeding has been considered at a very low profile in last few decades. However, in a crop like soybean with very limited genetic base it would be profitable proposition with a specific approach to induce variability to an added selection advantages for example early mutations, using rapid and reliable screening techniques. The present study deals with induction of early mutations with efficient and effective mutagenic dose (250 GY)of gamma rays in three agronomically promising soybean varieties (JS 335, JS 93-05 and NRC 37) at fixed screening scale (90 days or less maturity duration) a

large number of early mutations of higher frequency were recovered in M_2 generation (0-12%). Extra early mutations were very rare (0.03%) observed in only one variety JS 335. These early mutations were observed for variation in protein banding patterns for evaluation and confirmation at molecular level. Results obtained, have been discussed as a new approach for rapid isolation and characterization of induced mutations in soybean.

C076. Improved seed longevity under ambient storage in advanced generations of crosses among Indian soybean varieties

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The problem of poor seed longevity in soybean is very much pronounced under tropical climate. The stored seed deteriorates rapidly in high temperature and high humidity condition reducing its planting value. This is a major constraint in soybean production in the tropical countries like India. Varietal differences exist for seed longevity and often land race varieties have superior storability compared to high yielding varieties developed in temperate regions (Kuenman & Wein, 1981). Indian soybean varieties have been classified for their storability (Bhatia, 1996). A number of improved varieties and black seeded land race variety Kalitur have shown superior storability. Crosses were affected among varieties differing in seed longevity to incorporate the genes for good storability. Among parent, NRC 7 and JS 71-05 have large seeds and poor storability while JS 335, Kalitur, Punjab 1 had good storability. The generations were advanced by pedigree method and plants were selected based on agronomic superiority as well seed quality characters. The progenies of different crosses were evaluated for seed quality characters in F_4, F_5 and F_6 generations by visual rating, laboratory germination, and seedling length and vigor index after 8 months ambient storage and seed size. The field performance was evaluated in replicated trials along with controls. Significant differences were observed for seed quality characters and seed yield. The mean performance of progenies was better than NRC 7 and JHS 71-05, parents with poor seed quality and close to better parent. The germination and vigor index of NRC 7 and JS 71095 was 58 and 65% and 1136 and 1301 respectively. Thirteen progenies of crosses NRC x JS 335; Punjab 1 x NRC 7, JS 80-21 x JS 71-05 and Punjab 1 x JS 71-05 showed superior seed longevity by recording 86-94% germination and a vigour index of 2096-2716. Their yields, too, were at par with highest yielding controls. In soybean large seeds are more prone to mechanical damage and deterioration during storage. Karmakar et al., (1999) identified large seeded lines with good longevity. In this study line 13-1 of cross NRC 7 x JS 335 recorded 90% germination and 2716 vigor index despite a seed index of 15.0 gms. The visual quality of seed too was found to be better in this line. The study shows that improvement in seed longevity maintaining yield and seed size can be achieved through breeding.

C077. Soybean testing locations as predictors of cultivar yields in Argentina

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Determining testing locations that best represent the yield performance of cultivars across a region is important to improve efficiency in breeding programs. Soybean breeders can exercise higher selection intensities by using data from testing sites that identify cultivars that perform well over a broad area. Our objective was to identify these locations for the full season crop, for the heartland soybean region of the Argentine Pampas. Mean yields from MG III through VII cultivars, published by the Regional Soybean Testing coordinated by INTA, for twelve locations of Region II-4 for the 99/00 through 02/03 seasons, were used in linear regressions as independent variables. Dependent variables in the regressions were the average yields of the same cultivars across all other locations for each MG/Year combination. Additionally, the error term of ANOVAs calculated using cultivar means as treatments and locations as replications, of separate sets of three locations each, with the highest and lowest R^2 from regressions, respectively were used to estimate GxE interaction within each MG/Year combination. Regressions showed that within each MG/Year combination, cultivar yields at some locations were significantly associated with their overall performance for the region. However, the best locations were not always consistent across planting dates, MG and years. Lower GxE interactions were found across the better locations. As a consequence, highly significant cultivar differences and low CVs were usually detected, across the best locations within each MG/Year combination, and vice versa. The better locations with most consistent results for each MG/planting date combination were: Fontezuela for MG III in Nov., GM V Late and VI in Nov.; Marcos Juarez for MG III, V Late, VI and VII in Nov. and Dec.; Oliveros for MG IV in Nov., MG VI in Nov. and Jan. and MG VII in Nov. through Jan.; Pergamino for MG III, IV, VI and VII in Nov. and Dec.; Venado Tuerto for MG IV in Nov., MG V Early and V Late in Nov. and Dec., and MG VI in Dec.

C078. The effect of site-specific selection of soybean in the F_2

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Selecting in an environment that is representative of the target is the recognised method of developing varieties adapted to those specific biotic and abiotic conditions. Logistical and monetary constraints however prevent selection in all possible environments, which has led to the investigation of satellite breeding stations where breeding activities are reduced to the minimum. This study was designed to establish whether it would be possible to achieve site-specific adaptation through the selection of only a single generation (F_2) at that site. For comparisons, two pedigree selection strategies were followed. The Greytown selection strategy (GSS) entailed selection exclusively at the Greytown locality from F_2 through to F_5 generations. The Delmas selection strategy (DSS) involved the selection of the F_2 at the Delmas location, followed by the F_3 to F_5 generations at Greytown. Five populations, derived from parents adapted to both Greytown and Delmas, were selected utilising the two selection strategies. Each selection strategy contributed fifteen lines (three of the best F_6 lines derived from each population) towards replicated trials at Greytown and Delmas. The lines developed through DSS (F_2 selection in Delmas) performed best at the Delmas location, averaging 11.9% higher yield than GSS lines. In the Greytown trials, the GSS (selected exclusively in Greytown) lines yielded an average of 5.3% more than those developed using DSS. The smaller difference in yield experienced in the trials at Greytown was ascribed to genes for adaptation to that location being fixed in the DSS lines during the selection process in Greytown during the F_3 to F_5 generations. By extrapolating these results it could be concluded that roughly two thirds of the potential yield gain that could be achieved through site-specific selection, could be achieved by selecting the F_2 in that environment.

C079. Considerations in using increased pubescence density as a positive characteristic in soybean breeding

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Normal soybean leaf pubescence density is 150 trichomes per square cm. Dominant alleles at two genes (Pd1 and Pd2) both increase the density to 1500 trichomes per square cm. The two genes are additive producing 3000 trichomes per square cm. This increased pubescence density has some proven and hypothesized advantages but also some potential disadvantages. Increased pubescence density might provide a degree of drought tolerance. Extra-dense pubescence reduces SMV spread vectored by aphids such as *Rhopalosiphum maidis*. *Aphis glycines*, however, is a much smaller aphid. In that case the increased pubescence may protect the soybean aphid from predator insects. Soybean lines with increased pubescence have been previously noted to grow taller and lodge more than lines with normal pubescence. The 'Clark' isoline with extra-dense pubescence, used as the Pd1Pd2 donor in the breeding program, has leaves which are noticeably smaller and more rugose than the isolines with dense or normal pubescence. Several studies evaluated the potential disadvantages of soybean with extra-dense pubescence in order to decide whether to proceed with increased pubescence density as a positive characteristic for selection. Ten lines in each of four pubescence classes: normal, dense, extra-dense with non-rugose leaves and extra-dense with rugose leaves, from the second cycle of crossing Clark Pd1Pd2 to high yielding cultivars were compared. Lines with extra-dense pubescence had similar crop growth rates, node numbers and plant heights as lines with dense and normal pubescence. Lines with extra-dense pubescence were competitive in yield with lines with normal and dense pubescence. Extra-dense lines with rugose leaves were not at an agronomic disadvantage. The Clark pubescence density isoline series along with numerous advanced lines of varying pubescence densities were present in a field trial which became infested with the soybean aphid. The soybean aphid did not colonize plants with dense or extra-dense pubescence at a faster rate than plants with normal or reduced pubescence densities. I will continue to incorporate increased pubescence density in breeding populations.

C080. Standardization of selective medium for quantification of *Bradyrhizobium* spp. from soils under soybean cultivation

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Ecological studies require well-defined methods and tool for isolation the quantification of indigenous and applied inoculant strains. The potential usefulness of a selective medium for rhizobial population enumeration has long been recognized, but rhizobia differ widely in their physiological characteristics and it would undoubtedly be difficult to develop a com-

plete selective medium that would inhibit all undesirable microorganisms except rhizobial population. To quantify rhizobial abundance, three methods, such as plant -infection most probable number (MPN) assay, immunoflourescent technique and direct isolation on medium supplemented with antibiotic and metabolic inhibitors have been reported but each has certain limitations. The present investigation was undertaken to evaluate the growth performance of soybean rhizobia of exotic and indigenous origin on *Bradyrhizobium japonicum* selective medium (BJSM) supplemented with two different concentration of zinc (as $ZnCl_2$) and cobalt (as $COCl_2$) to determine maximum tolerable concentration (MTC) of these metals in an endeavor to modify BJSM for maximum recovery of soybean rhizobia from soils collected from soybean fields. The growth performances of 16 standard rhizobial strains originated from different countries (India, USA, Brazil, Japan and Korea) were evaluated on BJSM at different concentration of Zn and Co (35 and 40 µg/ml). It was observed that all the strains tend to grow well on arabinose-gluconate (AG) medium with differential growth performance. However, BJSM allowed growth of only *B. japonicum* and *B. elkanii*, slow grower, but did not allow *Sinorhizobium fredii* (USDA 205), a fast grower. Growth performance of all the strains on BJSM with 35µg/ml Zn and Co were found comparatively better than 40 µg/ml. Maximum growth performance were shown by some of *B. japonicum* strains such as USDA 110, SEMIA 5080, SB 119 and YCK 229 at 40 µg/ml, while all other *B. japonicum* strains from almost all the countries including Asia were performed better at 35µg/ml,. In general, growth of *B. japonicum* strains was better than *B. elkanii*. All strains were showing relatively faster growth on BJSM with 35 µg/ml compared to 40 µg/ml, however, all USDA strains performed equally well on both concentration. Ten isolates of rhizobia were isolated from nodules of 10 soybean cultivars and their growth performance was also evaluated on two different concentrations of Zn and Co (35 and 40 µg/ml). An isolate of cultivars VLS-2 origin showed higher growth compared to rest of the isolates. In general, growth performance of all the isolates was relatively less compared to exotic strains on AG and BJSM. Isolates from cultivar PK 427 and Punjab 1 showed optimum growth only at 35 µg/ml but failed to grow at 40 µg/ml. Twenty five soils from all over India and 14 soils with contrasting management histories under soybean based cropping systems were subjected to enumeration of rhizobia employing modified non-antibiotic BJSM and the results indicated that maximum population of rhizobia (1.15×10^5 cfu g^{-1} soils) in soils with high organic carbon and low pH. Furthermore, soil with high pH but managed with high organic carbon also favoured more rhizobial population. Approximately, 75-90 percent of isolates recovered from modified selective medium was found to nodule cultivars such as JS 335 and PK 416. The results suggest that all isolates and from Indian soils grow well on BJSM containing 35µg/ml Zn and Co each. Therefore, this modified selective medium could be used for selective isolation and quantification of bradyrhizobia form soils of India.

C081. Post emergence herbicidal effect on soil enzymes under soybean

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Application of herbicides is becoming a wide spread practice as weeds often pose a serious threat to sustainable soybean production. In recent years, post-emergence herbicides application has gained momentum due to narrow time gap between sowing period and on set of monsoon, which forbid the use of pre plant incorporation or pre-emergence herbicide application. Intensive use of herbicides without adequate knowledge on its effect on soil enzymes may have adverse impact on soil biochemical processes and cycling of nutrients and can be used as a tool to document the ecological effect of herbicide application to soil. Field experiments were conducted in rainy seasons of 1996 and 1997 at research farm. National Research Centre for Soybean, Indore on Sarol soil series to assess the effect of different post-emergence herbicides (20 days after sowing) applied at two levels viz., fenaxyprop-p-ethyl (50 and 70 g a.i/ha), propaquizafop (50 and 75 g ai/ha) and imazethapyr (75 and 100 g a.i/ha) with weedy check (Control). Soil enzymatic activities namely, dehydrogenase, urease, phosphatase and aryl sulphatase were monitored at 30 and 60 days after sowing (DAS) and at harvest. During both the years, application of fenaxyprop significantly inhibited dehydrogenase activity irrespective of the periods of sampling. After a transient inhibition (30 DAS), propaquizafop (50 g a.i/ha) and imazethapyr (75 g a.i/ha) did not significantly affect dehydrogenase activity at 60 DAS in 1996. However, in 1997, application of propaquizafop (50 g ai/ha) alone did not affect dehydrogenase activity significantly over control. At harvest, application of propaquizafop and imazethapyr either stimulated or did not significantly affect dehydrogenase activity over control during both the years. Stimulation or no significant change in urease activity was recorded with the application of post-emergence herbicides at the lowest level of their application irrespective of periods of sampling and years of study. Fenaxyprop (70 g ai/ha) and imazethapyr (100 g a.i /ha) did not cause appreciable variation in urease activity after initial suppression in

its activity (30 DAS), while propaquizafop stimulated urease activity during the entire crop growth period. During both the years, significant inhibition in alkaline phosphatase activity was observed due to herbicide application over control at 30 DAS. Fenaxyprop inhibited acid phosphatase activity irrespective of the periods of sampling and years of study. Stimulation or no significant change in acid phosphatase activity was noticed with application of propaquizafop and imazethapyr over control after initial phase of suppression. During both years, aryl sulphatase activity was significantly affected due to application of herbicides irrespective of periods of sampling. The study revealed that application of post emergence herbicide viz., imazethapyr and propaquizafop did not affect soil enzymatic activity and can be recommended for effective weed control in soybean.

C082. Effect of rate and application time of nitrogen with phosphorus on grain yield, nodulation and nutrient uptake by soybean (*Glycine max* L. Merrill) grown in Mollisols of Uttaranchal

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The experiment was conducted on Mollisols of the Crop Research Centre, Pantnagar during *Kharif* 2000 and 2001 on determinate soybean cv. PK 416 to evaluate the effect of nitrogen management at different stages with varying phosphorus levels on grain yield, number of nodules per plant, nodule dry weight and nitrogen and phosphorus uptake by soybean. The experiment was conducted in split-plot design with three replications. The main-plot treatments were 40 kg P_2O_5 ha^{-1}, 60 kg P_2O_5 ha^{-1}, 80 kg P_2O_5 ha^{-1} as basal and sub-plot treatments were 20 kg Nha^{-1} as basal, 20 kg Nha^{-1} as basal + 20 kg Nha^{-1} at 60 days after sowing (DAS), 20 kg Nha^{-1} as basal + 20 kg Nha^{-1} at 60 DAS + 20 kg Nha^{-1} at 75 DAS, 40 kg Nha^{-1} as basal + 40 kg Nha^{-1} at 60 DAS, 40 kg Nha^{-1} as basal + 40 kg Nha^{-1} at 60 DAS + 20 kg Nha^{-1} at 75 DAS. Pooled data for 2 years have been reported. The number of nodules per plant and nodule dry weight were significantly increased as compared to control with split application of nitrogen along with increasing dose of phosphorus. The highest number of nodules per plant (103.7) and nodules dry weight (765.2 g per plant) were recorded with 40 kg Nha^{-1} basal + 40 kg Nha^{-1} at 60 DAS along with 80 kg P_2O_5 during both the years. Grain yield (32.5 Q/ha), N-uptake and P-uptake were highest with 40 kg Nha^{-1} as basal + 40 kg Nha^{-1} at 60 DAS + 20 kg Nha^{-1} at 75 DAS along with 80 kg P_2O_5. Thus, nodulation, grain yield and N and P-uptake by soybean can be increased with the split application of nitrogen.

C083. Phosphorus, sulfur and calcium on soybean grain yield in the eastern area of Santa Fe

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In the eastern area of Santa Fe province the only nutrient used as fertilizer to produce soybean [*Glycine max* (L.) Merr.] is P. The low organic matter content and the low exchangeable Ca^{++} in the surface soil permit to support that S and Ca^{++} could also be necessary. The objective of the present work was to evaluate P, Ca^{++} and S fertilization and their interactions on soybean production. Field experiment was conducted at Videla in San Justo Department, Santa Fe, on San Justo serie (fine, illitic, thermic typic Argiudol) with organic matter, S-SO_4^-, Ca^{++} and pH of 2.6%, 2 mg kg^{-1}, 7.4 cmol kg^{-1} and 6.0, respectively. The rates of P were 0 and 20 kg ha^{-1}, S 0 and 24 kg ha^{-1} and Ca^{++} at four levels 0, 100, 200 and 300 kg ha^{-1}. P fertilizer was applied as triple calcium super phosphate (P= 20%), S as calcium sulfate (S= 18%) and Ca^{++} as a calcite (Ca^{++}= 37%). Fertilizers were banded and incorporated in the soil. The soybean cultivar planted was A 6401 by November 5th 2002 under no-till and with row spacing of 0.52m. The experimental design utilized was a sub-sub plot in a complete randomized block with four replications. The factor P was the main plot, the factor Ca^{++}, the subplot and the S factor the sub-subplot. The experimental unit was an area of four rows wide by 5 m long. Harvest was performed in the two central rows. Grain yield was analyzed through ANOVA at the level of 5% of probability. Orthogonal contrasts were used to evaluate Ca^{++}. The average grain yield of the trial was 4185 kg ha^{-1} and the variation coefficient, 12%. The analysis of variance showed significant differences between treatments ($P<0.05$). The simple effects of the factors P, Ca^{++} and S were also significant ($P<0.05$). Only the P*S interaction was important showing greater soybean increment with S24 compared to S0 at the level of P0 (1062 kg ha^{-1}) than at the level of P20 (113 kg ha^{-1}) through all levels of Ca^{++}. The simple effects of P and S fertilization were similar but lower than the combination of P*S. The treatment P20-S24 produced a grain increment of 1369 kg ha^{-1} compared with the control P0-S0. Ca^{++} doesn't interact significantly with the other factors, and the only difference founded was between Ca0 versus the rest of the rates. On the average the grain increment due to Ca^{++} through all the rates of P and S was 349 kg ha^{-1}. The results demonstrated, that beside the P, significant grain yield increments of soybean were found due to S and Ca^{++}. As a consequence, in the eastern area of Santa Fe, the optimum soybean productivity will require a fertilization using a combination of nutrients such as P, S and Ca^{++}.

C084. Approaches to raising soybean yields in Central India

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Most of the 5 to 6 million hectares grown annually in India occupy fields that, before soybean cultivation began, had not been used for intensive cropping during the monsoon season. While this provides soybean a comparative advantage due to the low opportunity cost, it also requires that variable costs be kept relatively low, given the uncertain rainfall and resulting uncertainty in yields. This can make it difficult to intensify production to raise yields, especially if intensification entails higher input costs and more risk of loss. On the other hand, producers will spend scarce resources on inputs if the expectation of return is high. The unpredictability of the start, intensity, consistency, and duration of monsoon rains is a primary determinant of yield potential. Water shortage is thus a major constraint to higher soybean yield in Central India, and ways to increase the retention of water and to increase access to water by the crop will increase yields, especially in the drier areas. The physical properties of the vertisols (cracking clays) often restrict root growth, and so tillage to increase soil exploration by roots should improve yield stability. Seeding rate and technology are generally adequate, though seeding rates are sometimes too high, especially when row spacing is less than 40 cm. Insect pests attack soybean vigorously in Central India, and they must be scouted and controlled. Foliar diseases usually are not a serious barrier to higher soybean yield. Lack of availability of good seed of higher-yielding cultivars is a definite barriers to higher yields, and improvement in the seed delivery system would do much to improve yields. Heavy dependence on hand weeding results in incomplete weed control in many fields, with attendant loss of yield. While there is clearly scope to increase soybean yields in Central India, doing so will require a concerted and sustained effort from both the private and public sectors.

C085. Soybean cultivation in the center-south of the province of Buenos Aires Argentina

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The production area of the center - south of the Province of Buenos Aires or mixed wheat area comprises the districts of Tres Arroyos, San Cayetano, Adolfo Gonzalez Chaves y Coronel Dorrego. Soybean cultivation was started in the zone in 1985 due to the need to diversify production. The area is situated at latitude 38° south and covers a surface of 1,682,711 hectares divided into four homogeneous agro-ecological areas according to soil and climatic features. With regard to climate, the zone presents a dry sub-humid water regime with an annual rainfall average of 826 mm. The potential water deficit is severe for the December-February period and is worsened by the soil low depths. The rainfalls recorded during the soybean filling period account for 77% of the yields obtained in the zone. In this period, there is a 31.5% probability of recording rainfalls of 100 to 150 mm. The annual average temperature is 14.7°C, and the hottest month (December) average is 23.0°C. The frost free period is 172 days, which limits the crop cycle significantly. Cultivars from the ripening groups II, III and IV are used in the zone. Given the limited frost free period, most of the surface is used for early crops. It is placed in the rotation to replace sunflower, and its predecessor can be wheat, corn or sunflower, i.e. any of the most frequently grown crops in the region. Wheat is the crop that follows soybean in the rotation. On average, as a result of various experimental works carried out, this wheat has shown an increase of 300 kg/hectare in yield as a result of the use of rapidly mineralizable nitrogen available from soybean stubble. With the introduction of direct sowing over the last years, late sowings on barley, oat, wheat or rapeseed are performed. With regard to sowing dates, the highest yields are obtained with late October to mid November sowings using the intermediate and long ripening groups. In research carried out over several years, it has been reported that from November 25th onwards there is a yield reduction of 28 kg/hectare per day of delay of the sowing date. Short cycle cultivars behavior is good when sown at the corresponding dates and in environments which allow them to reach full growth. In late sowings, the use of intermediate short cycle cultivars is recommended so that soybean grain filling occurs away from the first frosts, towards mid April. Low temperatures are a significant constraint on soybean in the mixed wheat area. As a result, cultivars show very low growth rates. There is a need for crops with greater vegetative vigor. Improvement programs should include the development of cultivars with more tolerance to cold and water deficits, and also with greater yield stability when facing dry Februarys. Special emphasis should be placed on research areas related to management such as rotations, proper choice of sowing dates and ripening groups, and nitrogenous fertilization. The introduction of soybean in late sowings requires that proper management of this practice, which is not yet fully developed in the zone, is established. The producer should have access to more information on management, and learn everything related to it, in order to introduce a crop new to the zone which will contribute to diversification. It will be possible to establish sustainable soybean cultivars in the area with the introduction of crops adapted to the zone constraints, with crop management within the most proper rotation, and using the required technology.

C086. Soybean cultivars evaluation network in Argentina

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The National Institute of Agricultural Technology (INTA) has been conducting the "Soybean cultivars evaluation network" (RECSO) in Argentina since 1980, in three cultivation regions (North, Pampeana Norte and Pampeana Sur) and 10 subregiones that cover all the country production areas. The specific objectives of the RECSO are: 1 - to characterize the phenologic, agronomic, plant health, yields and quality aspects of all available soybean cultivars in the seed market; 2 - to determine the interactions among the cultivars, production environments and the management; and 3 - to elaborate culture management recommendations for farmers and information for plant breeders. In early '80s RECSO evaluated 30 cultivars with an average of 30 trials, carried out in 16 INTA stations in 23 locations. Currently, INTA in a collaborative work with plant breeding companies, agronomy colleges, experimental stations and personnel from the private industry, evaluates 90 cultivars on an average of 60 locations, totalling 380 trials for maturity group (MG) II to IX along and across the country. The experimental design of trials is based on blocks at random with 3 repetitions of 4 rows 6 meters long plots. The cultivars are evaluated in different trials separated by MG and data concerning phenology, growth, sanitary and agronomic characteristics are recorded. Annually the information is analyzed particularly for each trial and totally for regions and cultivation subregiones, characterizing the cultivars for their morphology, phenologic and agronomic characters, sanitary response and yields. The stability is determined for each cultivar and its response to the environment, and for each MG the relationship between yields and days to maturity of the cultivars is also recorded. Besides, a computational program for calculation is also updated, allowing to determine the date of occurrence of the states R1, R5 and R8, as a function of cultivating and planting date for the central region of the country. The information obtained is relieved through technical reports, massive means of communication (newspapers, radio, television) and through technical meetings for plant breeders, agronomists and producers. INTA conduct an other network in 30 location along the country, including only the best cultivar of each MG in 5 to 7 planting dates; this network let to know the MG recomended for each place and the way to manage each MG.

C087. The Ultra-Short Season Production System (USSPS) for water-limited environments

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Mid to late summer drought is a major yield limitation of full season, maturity group (MG) V-VI, soybean in the mid-south of the US. Yield in the mid-south may be improved by matching crop development to periods of sufficient soil moisture. We have studied a production system called the ultra-short season production system (USSPS) that uses MG 00-I lines to avoid drought. Our objectives were to 1) determine yield potential and phenology of MG 00-I lines in the USSPS in the mid-south, 2) determine association of yield with other traits, 3) determine extent and pattern of genotype by environment interaction (GEI). From 2000-2003 we have tested hundreds of MG 00-I lines planted in late April at a density of 90-100 seeds per m^2 and irrigated as needed. This paper summarizes results of the studies. The MG 00-I lines matured in 65-100 days from emergence (Mid-July to early August). Most variation in maturity among the MG 00-I lines resulted from variation in seed-fill period, not time of flowering. The USSPS produced a growing season capable of avoiding late summer drought, or a crop that needed significantly less irrigation than full-season cultivars that mature in 135+ days. Well managed, full-season, irrigated soybean in the mid-south have an average yield of 3200 kg ha^{-1} while non-irrigated systems produce about 1900 kg ha^{-1}. The average yield of 43 USSPS trials exceeded 3000 kg ha^{-1} 43% of the time. The yield of the best line in a trial exceeded 3000 kg ha^{-1} 67% of the time. The average yield of the 43 trials exceeded 1900 kg ha^{-1} 72% of the time. The yield of the best line exceeded 1900 kg ha^{-1} in 91% of the trials. There was a strong trend for increased yield with increased height and with increased maturity. There was a greater variation among environment effects on yield in the USSPS than in irrigated full-season systems in the mid-south. However, the ratio of genetic to GEI variation for yield appears equal in both systems. Other aspects of GEI also appeared similar in the USSPS and conventional irrigated systems. Many of the USSPS trials were USDA uniform tests of MG 00-I lines that were also grown in northern sites. Generally, lines that yield well in the southern USSPS sites also yield well in the northern sites, and vice versa. The USSPS appears to have potential to avoid drought while producing a yield that is competitive with full-season systems. For environments where irrigation is possible, the USSPS requires considerably less water than conventional full-season irrigated systems. USSPS yield may be subject to more environment variation than in conventional systems,

however, selection of stable and adapted cultivars may reduce this problem. Selection for tall stature will be quite important to increasing yield. The potential of the USSPS to produce a competitive yield in 65-100 days may have significant implications as water supplies become more limited and expensive in the mid-south and many other regions of the world.

C088. Cross mechanism for seed drills, spraying and weeding machines to reduce losses in soybean

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Straight line sowing of crops is very crucial for row crops such as soybean . Inter row crop operations such as spraying or weed control operation, wherein, > 90% of farmers follow manual weeding and therefore sowing in straight rows is of utmost importance. Fields in which sowing is zig zag, loss of crop due to inter crop operations is significant. This condition can be checked partially by check chains. Check chains are of two types; one is internal check chains and another is external check chains. Both the above said chains fail to control total lateral movement of lower links of the tractors. On account of this lateral movement of the lower links of the seed drills, inter row weeding equipments and spraying equipments can not move in line with the prime mover even if it is moving in straight line. External check chains do not allow the lower links to be lifted at the headland at all. Even the internal check chains do not control total lateral movement thus it is also not suitable to control the lateral movement of seed drills and other inter row machines for inter culture and spraying operations. Cross mechanism devised by NRC for Soybean is very useful for checking or elimination of lateral movement of seed drills and other equipments. This mechanism is easy to fit and detach to and from lower links of tractor. Movement of few centimeters on either side could make the rows of crop sinusoidal. In the prevailing practices, huge loss of crop during weeding and application of sprays reduces final yields by 10-15% of the crop. Using this simple device, these losses could be brought down to 3-4%. Local artisans at meager price of Rs 80 ($2) could manufacture this simple device easily. It is always better to get this device manufactured for individual tractors for better alignment.

C089. Development and validation of furrow irrigated raised bed sowing machine for *in-situ* moisture management for increased soybean productivity in vertisols

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Erratic distribution of rainfall enticed with soil management strategies we adopt is an impediment for harnessing better soybean yields. To achieve increased and sustained soybean yields, proper rainwater management through appropriate soil management practices is need of the hour. To achieve this in rainfed vertisols, there is a need to provide resource poor farmers with a system, which will provide adequate and effective means of surface drainage, ensures adequate root zone moisture recharge for the crop, and reduce runoff and soil erosion during rainy season. Therefore to achieve this objective, NRC for soybean, Indore has developed a tractor drawn ridge and furrow maker coupled with sowing mechanism for soybean crop, wherein, the system consists of an array of alternating ridges and furrows. The ridges are about 20cm high and 75 cm apart. This tractor drawn equipment can form two full and two half ridges on which simultaneously six rows of soybean can be sown. For successful use of this equipment deep tillage followed by heavy planking before the onset of monsoon is crucial for the formation of effective ridges. Higher frame clearance was provided to avoid clogging of ridgers and frame. The machine is so developed wherein sowing is carried after complete formation of raised bed simultaneously. *In-situ* rainwater conservation can be carried out either through land configuration or adoption of suitable tillage practices or through mulching. To validate, the equipment field experiments were conducted during Kharif of 2002 and 2003 on Sarol series (montmorollinitic, iso hyperthermic, typic chromusterts) and compared with commonly followed practice (flat bed). The results of the study revealed that furrow irrigated raised bed sowing machine for *in-situ* rainwater management provided an 32% yield advantage over flat bed method and can be recommended for increased soybean productivity in vertisols.

C090. Efficiency improvement of seed drills with a seed covering device for increased germination of soybean in vertisols

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With increasing awareness on the impact of good quality seed on total production, the farmers have realized the

value of each seed put into the fields. Although, there are several reasons for poor plant population in the field (seed germination), the most crucial among them is seed not being placed under the soil cover. Several aids are in vogue for this purpose with their own limitations. Failure in seed placement at the desired depth could lead to loss of precious input of crop. Slight greater depth than normal does not allow the seed to germinate. Coverage of seed with the help of newly developed seed covering device fitted to the shank of the tyne of the seed drill helps to provide congenial environment to the seed for germination and emergence. This method of putting soil over the dropped seed allows moisture and oxygen to approach the seed under the covered soil. National Research center for Soybean has developed a device with special mechanism to cover the planted seed rows. This seed covering device eliminates the loss due to uncovered seeds to jump of whole covering blade on hitting bigger clods. The device is 16 cm wide and 25 cm high. Inverted V notch with base of 10cms pushes the soil over the seeds for proper coverage. Normal planting results in 7-13% uncovered seed, which normally do not aid to plant stand. The device permits total coverage of exposed seeds and optimum plant stand is made possible.

C091. Preserving soybean quality during storage

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Soybean quality deteriorates over time during storage. The rate of deterioration is dependent on soybean temperature, moisture content, mechanical damage, variety and other factors. Laboratory studies were carried out to quantify effects of moisture content, harvest method, variety, and splits percentage on deterioration rate during storage. Deterioration was tracked by measurement CO_2 emission and free fatty acid (FFA) formation. Soybeans hand harvested at high moisture deteriorated slowest, followed by low moisture combine harvest, low moisture hand harvest, and high moisture combine harvest. There were no significant differences in CO_2 production among three tested varieties, but FFA formation rates were significantly different. CO_2 production and FFA formation increased with increased splits percentage. Within the 0 to 10% splits range, splits had a greater effect on FFA formation than on CO_2 production.

C092. Periodic inspection of crop sprayers on soybean production farms

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Several countries have been working on periodic inspection on crop sprayers aiming the optimization of chemical application in agriculture. For example, there are voluntary (France, Spain, England), conditional (Italy, Austria) and compulsory systems (Belgium, Germany, Holland). In Brazil, the IPP Project - Periodic Inspection on Crop Sprayers (*Projeto IPP - Inspeção Periódica de Pulverizadores*) started in 1998. The objectives of the IPP Project are to evaluate sprayers in Brazil, to study the need of a periodic inspection system, to develop specific methods to the Brazilian conditions and to offer a system for the certification of sprayers. The project is funded by FAPESP - *Fundação de Amparo a Pesquisa do Estado de São Paulo*. The inspections are performed at farm level, considering several components and operational parameters on the sprayers. In order to establish a precise diagnosis, more than 20 items are checked. The aim of this paper was to study inspection results on soybean production farms in the States of Paraná and São Paulo, Brazil. Soybean is responsible for 38% of the total pesticide consumption in Brazil, accounting for more than U$ 900 millions per year on chemical sales. More than 100 soybean production farms were visited from 2000 to 2003, and 69 sprayers were passed through a complete inspection procedure. The results showed that all the sprayers presented failures. The most frequent was related to the pressure gauge (82.4% of the sprayers). Problems on the nozzles appeared in 76.8% of the machines. Another important problem was related to dose rate errors (73.9% of the equipment presented more than 5% of error); around 42% of the spraying systems were actually applying more chemicals than needed. For this group, the average error was 20.1%. Based on an average cost of U$ 100.00 per hectare on chemicals for the soybean crop season, these sprayers could be responsible for losses up to U$ 8.44 per hectare. These results indicate the need of better procedures of use and maintenance of the sprayers, justifying the periodic inspection system.

C093. Mechanization of soybean production and post-production operations in India - status and the future programmes

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Mechanized tillage and planting operations help in timely sowing of soybean, specially in rainfed farming system, giving a desired plant population of about 0.45 million/ha. Use of power weeders and plant protection equipment saves time, cost and protect the crop. mechanical harvesting of physiologically matured soybean is done when grain moisture is in the range of 14-18%, wb. This stage reaches after 85-105 days after sowing the crop. However, it depend upon crop

variety, soil type and weather conditions. Use of appropriate production and post-production equipment and machines would help to bring down the field and post-harvest losses from about 15% to 5% level resulting in about half-million tonnes of more soybean from the same crop area.

P275. Value adding and utilization of okara in processed foods

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Okara, the industrial residue of soymilk processing is underutilized in most countries as animal feed, fertilizer, landfills, or burnt as waste. Okara has high fibre (53-58%db) and protein (25-28%db) content, some oil (9-11%db) and carbohydrate (4-5%db), and traces of isoflavones. In view of its nutritional and functional significance, we attempted to use Okara in the formulation of a number of processed foods. This paper reports the fortification of wholemeal bread and pizza base with Okara at different levels. Fresh Okara was supplied by a local soymilk manufacturer. It was first dried in an atmospheric dehydrator at a maximum temperature of 50°C. The dried Okara grits (4-5% moisture) were milled into a fine powder (100 mesh). The Okara powder was then incorporated at various levels in the formulation of the above-mentioned products. Product optimization based on the physico-chemical and sensory attributes of the foods revealed that the maximum incorporation of Okara powder in wholemeal bread and pizza base was 10% and 16% respectively. Fortified wholemeal bread had increased protein and fat content with low level of trypsin inhibitors. Texture analysis and sensory evaluation showed acceptable product attributes with no detectable beany flavour in any of these products.

P276. Introduction of new soya processing technologies in Ukraine

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At present, the total yield of soybeans in Ukraine comprises about 200,000 tons per year. Of course, it is far less quantity than the amounts produced in the USA, Brazil, China, Argentina, or India. Nevertheless, the rate of soybean production and the usage of these products in Ukraine is rather promising, in particular, soy oil and soy-cake as well as various food products. The share of soybean processing technologies is not very large so far. This is conditioned by non-availability of adequate technological equipment at least for principal technological procedures such as, for instance, oil and soy-cake production or for extruded or texturized products. However, a number of scientific and production enterprises are now working at improvement of technological methods and relevant equipment for realization of such methods with an aim to implement microionization of soybean flow with quartz halogen lamps of "KGI 220-1,000" type. Treatment of soybeans in infrared rays results in higher beans friction, emission of inside heat, and pressure increase in beans, their swelling and cracking. In the process of microionization, all nutrients (e.g., proteins, hydrocarbons, and others) are subjected to the similar structural changes as those occurring in hydrothermal or barothermal treatment. A number of new techniques, among them low-temperature extrusion, soybean treating in pneumatic channel or fluidized bed, expanding, etc., are being successfully tested now and could be introduced into agricultural practice. Undoubtedly, cooperation of Ukraine with other countries would expedite the introduction of advanced soybean processing technologies and equipment into agricultural practice.

P277. Conceptual design of a supercritical fluid process to concentrate vitamin e present in the DDOS

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This work has as an objective the scientific development of a supercritical fluid process to concentrate vitamin E (tocopherols) present in the deodorizer distillate of the soybean oil (DDOS). Vitamins, sterols and other high value aggregated compounds are produced synthetically but nowadays it has been increasing the interest in the extraction of these components from natural raw materials. The vitamin E is a mixture of four isomers, α, β, γ and δ-tocopherol and are used as additives in cosmetic and food industries due to their antioxidant activities. They are concentrated in the DDOS from 10 to 13%. Another component is the squalene, an important hydrocarbon in the cholesterol

synthesis and is present in higher concentration in fish oils. The fatty acids are presented in the DDOS in 70-80% and the linoleic acid represents 40-50% of this fraction. The sterols, presented in lower quantities in the DDOS, are utilized in many different industrial sectors like cosmetic, pharmaceutical and food. Nowadays, they are most used because of their characteristic in absorving the cholesterol molecule. Because of that, the motivation of this work is to concentrate the tocopherols present in the DDOS, a by-product of the refining process of the soybean oil, concentrated in tocopherols, sterols, squalene and fatty acids. Several steps were done to design a supercritical process as the experimental extraction and simulation of the process using supercritical carbon dioxide at 40, 60 and 80°C and pressures from 90 to 350 bar, the separation behavior between the main components present in the raw material, tocopherol, stigmasterol, squalene and linoleic acid, the design of the industrial plant and the economic evaluation of the supercritical fluid process. The best results obtained to concentrate vitamin E were at 40°C and 150 bar. This operational condition gave positive tendencies in relation to the technical and economical viability of the industrial proposed process.

P278. Full fat soy flour enriched with genistein

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Isoflavones in soybean are found mostly in their conjugated forms of β-glycosides, malonyl-glycosides and acetyl-glycosides constituting an isomeric group of 12 compounds. Isoflavones aglycons, mostly genistein, have been described as the chemical component in soybeans responsible for the decreased risk of some chronic diseases in individuals. Isoflavones are also present in soy foods where aglycons appear in higher concentrations in fermented soy foods, due to action of microbial glycosidase. The aglycons are absorbed quickly when ingested while conjugated glycosides depend on hydrolysis by b-glycosidase produced by the intestinal micro flora. Considering that the availability of the enzyme is variable among individuals, the ingestion of soy foods with higher aglycons concentration increases bioavailability. This work had for objective the development of full fat soybean flour with an increased amount of genistein. Soybean BRM 94 52273 harvested in Londrina and Ponta Grossa, Paraná, Brazil was submitted to hydrothermal treatment at 50°C for 1, 4, 8, 12, 16, 20 and 24 hours or toasting at 150°C for 20 minutes and sieve classification into three flour fractions of different granulometry. Isoflavones isolation was with 70% ethanol with 1% acetic acid, quantification and identification in the soy flours and in the hydration water were accomplished by HPLC. In the soybean malonyl-glycosides were predominant, 81.6 and 75.1% of the total isoflavones in the grains from Londrina and Ponta Grossa, respectively. After the hydrothermal treatment the concentration of malonyl compounds decreased, while the aglycons content after 24 hours of treatment, increased 48.7 and 20.4 times in the grains from Londrina and Ponta Grossa, respectively. The total content of isoflavones decreased to 55.7 mg/100g and 73.8 mg/ 100 g in samples from Londrina and Ponta Grossa, with the increasing time of the hydrothermal treatment, due to isoflavones leaching into the hydration water, 44.6 and 45.3% of the total for grain from Londrina and Ponta Grossa, respectively. Toasting and sieve classification did not cause significant effects in the aglycons concentration, but resulted in decreasing concentration of malonyl glycoside. Average protein concentration in the flours increased to 47.2 % from 42.5 % in the grain while carbohydrates decreased to 17.8% from 22.5 % in the grain. Considering the cost in a possible industrial production of flour, the hydration at 50°C for 12 hours can be ideal for obtaining soy flour with biologic functionality and higher genistein concentration. One hundred grams of the obtained flours can supply 14.2 mg and 22.4 mg of genistein, which are equivalent to 56.8 % and 89.6 % of the recommended daily ingestion of 25 mg for total isoflavones.

P279. Characteristics of textured soy proteins produced from mechanically defatted soybeans

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Chemical parameters and functional properties of textured soy proteins produced by dry extrusion of mechanically defatted (via ExPress® technology) soybeans were investigated. Textured proteins with a brand name Tetex® were manufactured at the soy processing plant of JSC "Technomol Foods" nearby Moscow. Soy proteins Tetex® were characterized by more than 45% crude protein content and a higher fat level (6-8%) versus traditional textured soy proteins manufactured from solvent defatted meals. Water holding capacity (WHC) of Tetex® depended on a size of particles and was equal or higher than WHC of traditional textured soy proteins produced from solvent defatted raw material. WHC of Tetex® with of 4 different particle sizes in water and salt solutions was determined. Influence of individual processing stages on protein fraction pattern and lipid characteristics of

intermediate and final products was studied. During the industrial processing protein fraction pattern underwent a number of changes with a decrease of water-soluble protein content and a growth of alkali-soluble protein content. But even after the double extrusion treatment of soy proteins the total content of soluble proteins remained relatively high- 81.6% (versus 91.7% in raw soybeans). Fatty acid composition of lipid fraction of final products and raw soybeans was preserved the same. Slight increase of phospholipid and tocopherol levels in finished textured soy products was demonstrated. Biological value of soy proteins Tetex® was determined using a biological model with a test microorganism *Tetrahymena pyriformis*. It was 85% of biological value of casein. Deactivation of enzymes with hydrolytic and oxidizing activity occurred in extruders, presence of tocopherols and phospholipids preventing the oxidation of lipids, localization of oil particles in protein-carbohydrate matrix with active antioxidants (isoflavones) contributed to the good sensory characteristics and storage stability of finished textured soy proteins. Textured soy proteins Tetex® were used by meat processing and canning enterprises. They would have also good perspectives for usage by fish processing industry, in dry food mixes, in confectionery and bakery product formulations and in public nutrition. They could be used as a meat additive in traditional foods and as a meat replacer in vegetarian products. Food product designer should consider both protein and lipid content and characteristics in formulation of new foods.

P280. Sensory acceptance of a cereal bar based on soy protein supplemented with vitamins C and E

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The soybean can prevent numerous diseases. It is rich in protein and contains isoflavones and other substances which can act in the prevention of menopausal symptoms, breast and prostate cancer, osteoporosis and in the reduction of coronary diseases and cholesteremic malfunctions. Products containing anti-oxidants such as tocopherol, ascorbic acid and soy lecithin dissolve cholesterol deposits in the blood and prevent arteriosclerosis. The development of designer foods from the soybean, supplemented with vitamins, is important in this context, since such foods show considerable application in functional foods. The objective of this research was to develop a cereal bar with a high content of soy protein and rich in vitamins C and E, aimed at reducing the risks of cardiovascular and chronic degenerative diseases, and also to determine its degree of sensory acceptance, since the cereal bar has been gaining space on the market, being considered as a healthy and practical food. The final formulation of the functional cereal bar was obtained after a series of tests: texturized soy protein, wheat germ, flaked oats, dried banana, whole sugar, glucose, malt dextrin, soy lecithin, hydrogenated vegetable fat. The product was enriched with vitamins C (ascorbic acid) and E (50% α-tocopherol acetate). Three formulations were evaluated, the variable being the ascorbic acid content (sample A: 2.0g/100g; sample B: 1.1g/100g and sample C: 0.2g/100g). The samples were presented to the judges in a monadic way, using a nine point linear non-structured scale for the acceptance test and a nine point structured scale for the ideal test for acidity and sweetness. The panel consisted of 45 judges representing the target population. With respect to the attribute of flavour, sample B was the most accepted with a mean score of 6.42, differing significantly from the other samples at the 5% level of significance ($p \leq 0.05$). With respect to the attributes of appearance, texture and overall impression, sample B showed the highest mean score, although not significantly different ($p \leq 0.05$) from sample A. Sample C was significantly less accepted than the other 2 samples with respect to the attributes of appearance, colour and overall impression. In the ideal test, 53.3% considered the acidity of sample B to be ideal and 57.7% its sweetness. 66.6% of the judges considered the acidity of the sample with 2.0g/100g ascorbic acid (sample A) to be "slightly or moderately more acid than the ideal". Thus it can be concluded that the formulation with 1.1g/100g ascorbic acid obtained the greatest acceptance with respect to flavour and the intensities of acidity and sweetness.

P281. Drying of residue of soybean extracts in rotary dryer drum

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The drying is a technology, which has been highly utilized for a long time by the industries to prolong the shelf life of products. However, to this day, there are still a lot of problems related to this matter, mainly of the drying reasoning and the specific methods to the drying of biological material, especially of those used for men feeding. In this research the drying of the hydro soluble soy extract residues will be analyzed, using the rotary dryer. Following the nomenclature of the publications, this residue rich in proteins, fiber and vitamins, will be named Okara, The Okara is a thermo sensitive material and highly perishable while wet, so the drying methodology must be studies very carefully. The paper consists of three main sections: (i) elaboration of the raw matter and determination of some of physical

and chemical properties. (ii) Study of drying in a rotary dryer. (iii) Analyses of the factorial planning, having as and answer the effective diffusion.

P282. Feasibility of vegetable soybean production for human consumption in Brasília, DF, Brazil

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Brazil is worlwide recognized as one of the biggest and most important soybean producers, but vegetable soybean for human consumption is almost unknown by producers and consumers. Vegetable soybean is the ordinary soybean (*Glycine max*) with some peculiar traits and harvested at an earlier plant growth stage, when seeds are immature. Cultivars of vegetable soybean have larger seeds, with better taste and texture, and also require less time of cooking due to higher fitic acid content when compared to other soybeans cultivars. In some Asian countries, the vegetable soybean is consumed as a snack, by boiling the pods in salty water. For this purpose, soybean cultivars with larger green pod (lenght ≥ 5cm) and seeds (dry seeds weight ≥ 30g) are preferred. As there are limited cultivars in Brazil for the production of vegetable soybean, some of the ordinary soybean cultivars already released by Embrapa Soybeans, such as 'BR 36', 'BRS 155' and 'BRS-213', can be used. The cultivation system for the vegetable soybeans is the same adopted for the ordinary soybeans, but is different at harvest stage, 35-40 days after flowering. Vegetable soybean can be commercialized as pods attached to stems, green pods in plastic bags or shelled green grains previously boiled in water for 5 minutes and packed in Styrofoam trays covered with PVC films. In a field trial carried out in Brasilia, DF, Brazil with eight soybean cultivars and breeding lines (cvs. IAS 5, BRS 155, BRS 183; lines 'F83-8000', 'F83-8207', 'F83-7864', 'BRM95-50570' and 'BRM94-52273'), yield ranged from 15.5t ha^{-1} to 18.8t ha^{-1} of pods with 2 or more seeds (Mendonça et al., 2002, Hortic. Bras. 20 Supplement). Soybean breeding lines "BRM94-52273" and "BRM95-50570" had the best performance and can be recommended for the production of vegetable soybean. In another trial carried out in Montes Claros, Minas Gerais state, spacing of plants in the same row (5, 8, 10 and 12cm) did not affected yield of green pods. Breeding new soybean cultivars for human consumption altogether with the improvement of agricultural techniques and technology transfer are essential to expand the crop cultivated area and popularize the product. Vegetable soybean can be a new option for consumers interested in a healthier diet, help to feed poor people and can also become a new alternative for small farmers.

P283. Extrusion of soy-sorghum blends as nutritious snack

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The extruded product from soy – sorghum blend was prepared on Wenger X-5 extruder. The properties of the extrudates were studied at three different moisture levels (15, 20 and 25% wb) and at three levels of temperature (75, 85 and 95°C) with five levels of soy – sorghum blend (10, 15, 20, 25 and 30%). Average diameter of extrudate was found highest at 15% moisture content of feed, 20% soybean in blend followed by 15% soybean in blend at 15% moisture content and 75°C temperature. Specific Length of extrudate was found highest at 75°C temperature, 15% moisture content and 20% blend ratio followed by 15% moisture content and 25% blend ratio. Mass flow rate was found maximum at 20% moisture content and 25% blend ratio followed by 15% moisture content, 25% blend ratio at 90°C temperature. In the same way Sectional, Volumetric and Longitudinal expansion indexes were also calculated. SEI was found maximum at 20% blend ratio, 15% moisture content at 75°C temperature followed by 10% blend ratio, 15% moisture content and 85°C temperature. VEI was found highest at highest at higher barrel temperature i.e. 95°C. The LEI increased with different blending ratio, moisture content and barrel temperature i.e. 95°C. The LEI increased with different blending ratio, moisture content and barrel temperature. With this, it may be concluded that the best quality extrudates were obtained at 75°C barrel temperature, 15% moisture content of feed and 20% blending ratio or 15% moisture content of feed, 10% blending ratio and 85°C barrel temperature.

P284. Stability of EPR signal intensity of some varieties of gamma-irradiated Brazilian soybean

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Soybean production and utilization as food is increasing during the last decades. Soybean has a unique chemical composition. The protein and oil contents are high in quantity and quality. Soybean seeds contain also important phytochemicals that have been shown in recent years to offer important health benefits. They are natural source of flavonoids - biologically active components which are thought to possess antioxidant

effects in vivo and in vitro systems. Alongside traditional methods of processing and preserving food, the technology of food irradiation is gaining more and more attention around the world. This study was undertaken to investigate the stability of free radicals generated by radiation processing on three different soybean cultivars. Scavenging and antioxidant activities of soybean can be involved on the response of the free-radicals generated by radiation. Electron paramagnetic resonance, EPR, is considered the most important technique to detect free-radicals on food. The soybean cultivars investigated (BRS 184, 216 and 216) were obtained from National Soybean Research Center (Embrapa-Soya), Londrina, Brazil, and gamma-irradiated in a Gammacell 220 (AECL) device with doses of 0, 2.0, 5.0, 10.0 and 15.0kGy at a dose rate of 4.7kGy/h. Both irradiation and the EPR measurements were performed at room temperature. The EPR signal intensity correlated well with the ionizing radiation dose. EPR spectra were recorded 16h, 11days and 40 days after irradiation. The results showed that the EPR signal intensities remained almost constant up to 40 days after irradiation for all the varieties assayed. It means that the free-radicals responsible for the EPR signal present stability over the period investigated. Further experiments are required in order to identify the species responsible for the EPR peaks and the proper antioxidant capability of these soybean cultivars against the radiation-induced oxidative shock.

P285. Extruded snack from soy - maize blends

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Due to high level of good quality protein and oil content soybeans have great potential for use as human food, they are specially rich in lysine an essential amino acid that in deficient in most cereal based diets. Extrusion of soy – maize blend was done in Wenger X – 5 extruder. The moisture content was 15, 20 and 25% wb. Temperature levels of 80, 90 and 100°C was taken for each set of moisture content at five levels of soy-maize blends 10,15, 20, 25 and 30%. The experiments were conducted to study the effect of processing parameters i.e. barrel temperature, feed, moisture content and blend ratio on the quality of snack made out of soy maize blends and to develop prediction model for extrusion performance under various condition. It was found that average diameter of extrudates was highest at 15% moisture content of feed and 10% soybean in blend followed by 15% soybean blend at 100°C followed by 90°C and 80°C. Sectional expansion index was found highest at 100°C temperature followed by 90°C and 80°C against percentage of soybean in blend at all moisture levels. The trend was same as that of average diameter because sectional expansion index is directly proportional to square of diameter of extrudate. The mass flow rate was found maximum at 25% moisture level followed by 20% and 15% moisture content at 80°C temperature followed by 90°C and 100°C.The specific length of extrudate was found highest at 80°C temperature, 15% moisture content and 10% blend ratio followed by 20% moisture content and 15% blend ratio at all the temperatures. With this, it may be concluded that the best quality extrudates were obtained at 80°C barrel temperature, 15 to 20% moisture content of feed rate and 10 to 15% blend ratio.

P286. Preparation and characterization of modified soy proteins by Maillard reaction

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Soy Protein Isolate (SPI) was modified with glucose (G-) through the amino-carbonyl reaction (Maillard Reaction). Functional properties of the modified proteins were investigated. Amounts of glucose covalently bound to soy protein isolate were determined by measuring the glucose content of the conjugate. To estimate intermolecular covalent cross-linking, SPI-G was analyzed by SDS-Polyacrylamide Gel Electrophoresis. Conjugates were clearly observed near or at the top of the separating gel. This indicated that soy protein isolate was conjugated with glucose and crosslinks may be formed between protein molecules. Glu-SPI conjugate was highly soluble at wide pHs while untreated SPI was hardly soluble at pH4-6. Emulsifying activity and emulsion stability of Glu-SPI conjugate were much higher than those of native SPI. The enhancement of the functional properties of the proteins is positively related to the extent of glycosylation. Soy protein isolate salted out at high ionic strength (2M NaCl) while SPI-G conjugate was not influenced by it. Comparing with some commercial emulsifiers, the SPI-G conjugate showed as good or better emulsifying properties in high salt concentration and in acidic pH. Because of the safety due to the naturally occurring reaction, this SPI-G conjugate can be used as a promising emulsifier.

P287. Enzimatic treatment of defatted soy meal

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The defatted soy meal is an important raw material for the formulation of food products containing ca

47% protein, low contents of fat and fibbers. It is also used to obtain soy protein concentrate and isolate or soy texturized. These products are thoroughly used in the food industry due to their functional and nutritional properties, making them a very versatile alimentary ingredient and of low cost. The leguminous crops, mainly soybean, present a high isoflavone content, being the aglycones part which one presents larger biological activity than the glucosides forms. The aglycones are formed from b - glucosides by the action of b - glucosidase (E.C.3.2.1.21), which is a group of enzymes presents in the soy that are able to do the hydrolysis of the bond b-1.4 of the isoflavones. The b - glucosidase presents maximum activity at 50°C in pH 6.0 and its extraction has been described for leguminous crops and tubers, however the extracts present difference in the temperature of maximum activity and of inactivation in function of their origin and composition. The aim of this work is to promote the enzymatic treatment of the defatted soy meal, using enzymatic extracts of leguminous crops and tubers, regarding to increase the availability of isoflavones aglycones. The samples of defatted soy meal (FDS) came from the port of Rio Grande – RS (Brazil). The chemical characterization was accomplished using methodology of AOAC. The defatted soy meal was finely grounded in a knives mills and the fraction of 100 mesh was used. The extracts with activity b - glucosidase was accomplished using procedure by Alice Fujita, et al. 2001. The enzymatic activity was determined according Matsuura et al. 1989, using the p-NPG as synthetic substrate. The inactivity enzymatic of the extracts was determined experimentally. The enzymatic treatment of FDS was accomplished in batch, following a statistical planning, with 3 factors (temperature, time, solid: liquid relation) in several levels, using a jacket reactor, the treated samples after being inactivated were freeze-dried to be later extracted and the aglycones analyzed by HPLC.

P288. Study on enzyme hydrolyzing concentrated phospholipid with phospholipase A_2

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The concentrated soybean phospholipid was selected as substrate and the phospholipase A_2 as the hydrolysis tool enzyme. The enzyme-modified phospholipid was studied by the means of quiescence reaction. In the optimum condition is enzyme dosage: 0.14%(w/w), $CaCl_2$: 0.03%(w/w), 7hr of hydrolysis, temperature 70°C. In this condition the amount of free fatty acid (FFA) is over 24.32ml, the transformation efficiency of can be up to 36.36%. The amount of the free fatty acid (FFA) produced has the significance with lysophospholipid ($P<0.01$),the equation of regression is : $Y=0.152X+13.677$.

P289. To lower the bitterness of soybean oligo-peptide with promatex and flavourzyme

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Soybean oligo—peptide have various physiological functions and is a good source of protein. But the bitter taste of soybean oligo—peptide limits its application in the food. This article makes use of single enzyme Promatex and the bi-enzyme Promatex—Flavourzyme respectively to process oligo—peptide by hydrolysis of soybean isolate protean , and discusses the influence of hydrolysis method on soybean oligo—peptide's bitter taste under the condition of the same DH. The result enunciates that adopting the bi-enzyme Promatex—Flavourzyme to produce the soybean oligo—peptide , the bitter taste is lowered consumedly and processing period is obviously shortened.

P290. Modelisation of flux decline during ultrafiltration of an okara hydrolysate

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A process of extraction of dietary fibres from okara at the laboratory scale has been developed. This process involves proteolysis of okara protein followed by defattening thanks to solvent or lipolysis. In order to improve the process, the opportunity of separation with ultrafiltration has been investigated. The main step of the process were: dissolution of crude or defatted okara in phosphate buffer pH 7.5, addition of protease (Alcalase), incubation (60°C, 30 min), and inhibition of the reaction by decreasing the temperature to 0°C. Ultrafiltration has been then carried out on organic membranes (50 or 10 KD) for fibre concentration. The effect of the pH (4.5, 6.0 or 7.5) on the ultrafiltration process has been investigated. An experimental design has been carried out to deter-

mine the influence of the parameters of the process by anova (membrane cut off, occurrence of lipids in the product, and pH of ultrafiltration) on the composition of the final product (protein, lipid, ash, fibre, and water holding capacity). The composition of the final retentate was significantly affected by the cut-off of the membrane, and the pH of the ultrafiltration process. The final content of fibre ranged from 46 to 62 % (P/P) in the final product, and the water holding capacity (WHC) ranged from 7.5 to 12.3 g of water fixed by gram of final product. This latter parameter was correlated to the amount of fibre in the samples. Regarding UF, the best results were obtained on XM50 membrane (cut-off of 50 KD). For a better understanding of fouling phenomena, the flux decline with whole or defatted okara at different pH has been then modelised. Four models have been used: standard blocking, complete and intermediate blocking and cake layer blocking. For defatted okara, all the models fitted significantly experimental curves. This could be explained by some similarity of basic hypothesis underlying the different models. The influence of the pH was not significant between pH 4.5 and 6, but was significant at pH 7.5. This result could be due to the influence of the pH on residual protein and peptides conformation and interaction which can change fouling phenomena. For crude okara, three of the models (*i.e.* standard blocking, complete and intermediate blocking) fitted significantly data at pH 4.5 and 6 but were inappropriate at pH 7.5. The cake layer model exhibited a different behaviour since it was possible to fit significantly the data with a two phases curve : the first one showing a slow decrease of the flux, and the second showing a drastic decrease of the flux due to fouling. The model parameter (slope of the curve) was modified by the pH, regarding the first phase, whereas it was fully comparable at any pH for the second phase of fouling. The difference of fouling between crude and defatted okara, and the lack of pH influence on fouling with crude okara, suggested a major contribution of lipids to fouling.

P291. Emerging soybean processing technologies for Afro-Asian countries

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Soybean contains about 40 percent protein, rich in essential amino acid, lysine and 20 percent oil containing good amount of omega-6 and omega-3 fatty acids, which are known to lower the bad cholesterol level and reducing the risk for CVD. Besides, it also contains vitamins and minerals specially vitamin B-complex and mineral, iron. The minor constituents such as isoflavones, trypsin inhibitors and saponins have become the topics of attention in the present time because the recent studies reveal the health benefits (role in the prevention of chronic diseases such as cancer. osteoporosis, CVD, diabeties and menopausal problems) associated with these constituents. Soybeans can be processed into varieties of food products such as oil, defatted soy flour, soy milk, soy candy, soy nuts (fried as well as roasted), soy paneer, fermented soy products, soy fortified bakery products, soybean blended dairy products, extruded snacks and texturized products. However, with so many health benefits, the soy products could not take off in the Indian market and this has happened probably due to the positioning of unmatched soy based food products to Indian taste in the market. Indians do not like characteristics beany flavour in the products. Therefore to make soy products acceptable, the technologies should be able to tailor food products free from beany flavour and anti-nutritional factors such as flatulence factors, phytic acid and trypsin inhibitors. The technologies developed by the department of Food Science and Technology of G.B. Pant University of Agriculture and Technology, Pantnagar offer the products free from beany flavour and fit into Indian Taste. Some of these technologies in brief are presented in this paper.

P292. Eared dove damage in soybean seedlings in southeastern Brazil

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After prior outbreaks in Argentina, Uruguay and Colombia (affecting several crops, especially sorghum), in the 70's and 80's Eared Doves (Zenaida auriculata) became particulary bothersome to soybean farmers in the western portion of the states of São Paulo and Paraná, Brazil. Farmers complained that doves were causing severe crop losses, most especially in emerging soybean seedlings, but no quantitative assessments were attempted. In the farmers' perception one cotyledon taken from a healthy seedling represented the loss of a whole plant at harvest time, implying a loss of about 30 grains, so that there was heavy investment in scaring Doves away from the fields. Bird-damage problems are characterized by several facts, prominent among which are a) damage is very irregular in both time and space and b) in most cases quantitative damage assessments are not available. This complicates attempts to develop effective, integrated management strategies. Adequate bird damage assessment has been limited by several technical difficulties, including a) insufficient information on bird behavior in connection with damage patten (eg factors determining spatial distribution of damage in a plot), b) compensatory responses by plants to damage, and c) lack of reliable, standardized assessment methodologies. Research development in damage assesment is therefore a clear priority for the area of crop management, especially relevant for soybean crop protection decisions in the study area. Here we report the results of a detailed analysis of dove damage to two soybean plots in an area at risk for dove damage in Eastern São Paulo State (50° 36'W, 22° 52'S). Our specific objectives were to (1) measure the intensity and spatial distribution of damage, (2) evaluate the implications these measurements on management practices. In a total of 127 sampling units (each 2 m^2, distributed in a square lattice 25 m on the side) we measured a) number of plants emerged and number of plants attacked and b) number of plants harvested and weight of soybean harvested. Dove damage was mostly confined to the edges of the field. Regression analysis of the data indicated an overall loss of 18.77 kg/ha per plant attacked per meter of furrow (95% confidence interval 0.0494 – 37.04 kg/ha). Considering that 2800 kg/ha were harvested, and average stand was 18 plants/m, this means that a reduction of 5.6% in the number of seedlings lead to a loss of only 0.67% in the weight of soybeans harvested, an order of magnitude less than intuitively expected. Because of the remarkable compensating capacity of soybeans, rather than trying to scare the birds away from the whole field (not a cost effective practice), we would recommend concentrating on the edges, and trying to keep overall damage below a threshold.

P293. Evidence for stinkbug resistance in soybean lines

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Stink bugs are approaching key pest status in the southern soybean growing region of the U.S., and as such are among the most injurious pests. The objective of this research was a rigorous evaluation of several soybean lines for resistance to stink bugs. The sources of resistance of the lines evaluated can be traced back to plant introductions 229358 and 227687. The following lines were included in the evaluation: D86-11836, D86-11839, D86-11861 (all carrying resistance from PI227687), and D96-1537, D96-1547, D96-1571, D96-3179, D96-3180 [from the cross of D86-11861 and Lyon (carrying resistance from PI229358)]. D96-3168 is a selected line from the cross of D86-11839 and Lyon. D82-6212 derives its resistance solely from PI227687. Two resistant standards were included (IAC 100 and GATIR 81-296). The cultivar 'Davis' was used as the susceptible standard. Screening was carried out in the field (2001) and in the laboratory (2002). Field results showed that the backcross of the advanced lines carrying resistance from PI229358 (D86- 11836, 11839, 11861) to a cultivar carrying resistance from PI227687 ('Lyon') was effective in producing progeny with higher resistance than the parental lines. The most resistant lines evaluated here were comparable to the resistant standard, IAC 100. Population growth parameters of *Nezara viridula* cohorts feeding on resistant and susceptible lines and cultivars were evaluated in the laboratory. Population growth was lowest for *N. virdula* cohorts reared on D96-1537, IAC 100, GATIR 81-296, D96-3179, and D86-11839 compared to growth of *N. viridula* cohorts reared on the susceptible standard 'Davis'. Survival was not substantially different among resistant soybean lines, but was substantially lower than survival on the susceptible standard, 'Davis'. Considering both agronomic and resistance traits, the highest ranking

lines were D96-1537 and D96-3179. This work has demonstrated clear resistance to stink bug populations in the laboratory, but it has not been clearly demonstrated that this resistance will stand up to the considerable stink bug pressure in the mid South.

P294. Time of response and quantification of isoflavone in soybean genotypes after damage by *Piezodorus guildinii*

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The induction of response to herbivory by production *de novo* or by augmentation of constitutive chemical compounds has been reported in various plants. Previous experiments carried out at the Embrapa Soybean Phytochemistry Laboratory, Londrina, PR, Brazil showed an increase in isoflavone content (induction) in some soybean genotypes after being damaged by *Nezara viridula*, as well as its negative effect on the insect feeding preference. Experiments were performed to evaluate the response time and the production of the isoflavones daidzin and genistin by several resistant genotypes (PI 229358, PI 171451, PI 274454, 'BRSMG 68', 'IAC 100'), as compared to a susceptible genotype ('Embrapa 4'). In the greenhouse, four *P. guildinii* (starved for 24h) were placed in cages (made from two Petri dishes bottoms) containing two soybean pods settled in a live plant of each tested genotype; insect-free cages were maintained as a control. After 18h of confining, the insects were removed from the cages and the pods were excised at 3, 7 and 15 days after herbivory (DAH) for seed extract preparation. An aliquot of the extract of each genotype was analyzed by HPLC to estimate the concentration of daidzin and genistin comparing with those obtained from pure compounds (standards). In general, the constitutive concentration of genistin (non-injured) was higher than daidzin in most of the tested genotypes. The maximum concentration of genistin in non-injured seeds was observed at 15 DAH, indicating an increase in this isoflavone concentration at the later stages of plant development. The injured and non-injured seeds of most genotypes produced the same amount of daidzin with exception of PI 171451 and 'BRSMG 68' at 3 and 7 DAH, respectively. At 15 DAH the concentration of genistin in the non-injured seeds was higher than in the injured seeds, with the exception of the genotype PI 274454. On the other hands, a gradual increase of daidzin concentration was observed over the time, mainly in injured seeds. At 3 DAH, the concentration of daidzin raised from 0.005, in non-injured to 0.169 mg/mL in injured seeds. However the most evident response was observed in the genotype 'BRSMG 68', at 7 and 15 DAH; daidzin concentration in injured seeds increased about three times (from 0,066 to 0,217 mg/mL and 0.087 to 0.229), compared with non-injured seeds. The results indicated that isoflavone concentration depends on the time, stage of plant development, genotype and may be induced by insect damage.

P295. Early cycle soybean lineages for the analysis of genotypes that confer greater productivity and offer tolerance to the chinch bug

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The international market lives a great moment with the increase of the price of the soybean. The growing demand propitiates a limitless increase of production and the consumption makes it possible the exploration of this product. This essay was conducted on Campo Alegre farm, located in the city of Araguari,Minas Gerais, Brazil, and installed on November 15, 2002 with 24 lineages and 4 witnesses (Conquista, UFV-19, MSOY- 8800 and MSOY- 8411). Each plot consisted of 4 lines (5 m long) with a spacing of 0.45 m between lines. A randomized block design with 4 repetitions was used, considering a useful plot of 0.45 m x 2 m x 4.0 m, making a total of 3.6 sq. m. Seeds were treated with Fungicide, Cobalt + Molybdenum and *Bradyryzobium japonicum*. The following characteristics were evaluated: height of budding, maturation and insertion of first string bean, diseases, productivity and resistance to attacks by chinch bugs. UFU-98122 lineage was considered the most productive; the lineage that suffered the least damage due to attacks by chinch bugs was UFU98121, according to the test of Tukey at 5 % of significance. Both lineages showed better performances than the witnesses, and can, thus, be considered superior to them.

P296. Delayed cycle soybean lineages for analysis of genotypes that confer greater productivity and offer resistance to the chinch bug

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To cultivate them of soybean bean present in the market today, pass for long periods of tests until thus arriving

at the platform desired for the inprovement, has invested more and more in tests with some lineages. This essay was carried out with 24 lineages and 4 witnesses (Garantia, DM 339, Emg.313 and Suprema). on Campo Alegre farm, located in the city of Araguari, Minas Gerais, Brazil and it was installed on November 15, 2002. The experiment was performed in a randomized block design with 4 repetitions, with plots consisting of 4 lines (5 meters long) and 0.45 m, considering a useful plot of 3.6 sq. m. Seeds were treated with fungicide, Cobalt + Molybdenum and *Bradyryzobium japonicum*.. Height of budding, maturation and insertion of first string bean, date of budding and maturation, productivity (kg/ha^{-1}) and effects of attacks by chinch bugs were evaluated. UFU-98520 lineage was considered the most productive and the one that suffered the least damage due to attacks by chinch bugs, according to the Tukey test at 5 % of significance, having shown a better performance than the witnesses.

P297. Genetic variability and gene flow among *Nezara viridula* (L.) (Heteroptera: Pentatomidae) populations

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The Southern Green Stinkbug (SGSB), *Nezara viridula,* is a cosmopolitan pest very important economically in several crops (soybean, peas, cucumber, lettuce, tobacco, etc) due to polyphagous behavior and potential to cause damage. Their populations are widely distributed in areas where soybean is cultivated. Studies on SGSB migration have been neglected and little is known about gene flow among stinkbug populations. We studied the intraspecific variation of geographically distinct SGSB populations to assess the variability of geographical populations from Brazil and to determine gene flow among them. Samples of SGSB were obtained from Planaltina (DF), Platina (SP), Sertanópolis, Warta (Londrina), Cambé, Curitiba, Palmital (PR), Chapecó (SC), Passo Fundo and from Cruz Alta (RS), Brazil. Specimens were collected from soybean fields and DNA extracted individually based on CTAB protocol. DNA samples were subjected to PCR-RAPD analysis and the genetic similarity matrix based on RAPD allele frequencies was obtained using Nei's (1972) genetic distance, in the NTSYS-pc software. The maximum level of similarity obtained occurred between individuals from Warta and from Sertanópolis. The SGSB population from Cruz Alta and Passo Fundo were entirely different from the remaining populations. There were no genotypic similarities (RAPD profile) similarities among individuals from different geographically regions. The highest similarity among individuals were observed inside Curitiba population and the highest dissimilarity was found in Cruz Alta stinkbugs. Adults collected from Planaltina clustered in 2 groups, one of them (females) was linked to Platina populations, and the other (males) to Palmital population (males and females). Interestingly, despite the short distance between Cambé and Warta (ca. 20 km), both populations clustered in different groups and the estimated gene flow index (Nm) among them was equal to 2.02, indicating that migration is restricted, even among the closest populations. The estimated overall index of gene flow was (Nm) equal to 1.41. Therefore, the possibilities to develop resistance to insecticides in local populations is higher than species showing a higher Nm, but by other hand, possibilities of resistance development is lower at metapopulation level.

P298. Susceptibility of soybean to the attack of the stink bugs *Euschistus heros* and *Piezodorus guildinii* prior to pod development

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The occurrence of high populations of the soybean stink bugs (*Euschistus heros* and *Piezodorus guildinii*) prior to pod set, has been a matter of constant concern and questioning by soybean farmers and technical assistance. To evaluate the damages caused by these stink bug population, present in the soybean fields, during the months of November/December, greenhouse and field experiments were carried out using infested soybean plants at vegetative-flowering growth stages. The damage caused by this early population was compared to those occurring during the critical period for stink bugs attack, the pod development stage. Soybean plants at vegetative and flowering growth stages, even under severe bugs infestation (8/plant) showed no significant on yield reductions. Seed quality, evaluated by the tetrazolium test, was also similar among population levels and between bug species. When the infestation with the brown stink bug occurred at vegetative (V6), and flowering (R1) stages, the yield was similar to those observed in the bug-free plants (control). Differently, at the stage R4, the productivity was lower than the control when the infestation was two to four bugs/plant. Only at the stage R4, the number of seedless pods at the upper half of the plant increased as the number of bugs/plant increased, varying from 1.7 in the control treatment to 9.1 for plants with four bugs. In a 15 days-infestation field experiment, yield and seed quality of soybean plants infested with up to four *E. heros* or *P. guildinii* adults per meter, at the end of the vegetative-flowering stage, were not affected when compared to bug-free plants. Otherwise, average yield decreased with the increase of population levels of both bug species, when infestations occurred at the pod filling stage (R5-R6). Data from seed quality analysis showed an increase in

the number of bug-punctured and unviable seeds. This damage increased proportionally with the increase in the level of infestation tested although the damage caused by *P. guildinii* was twice the damage caused by the brown stink bug. These results confirm literature data and indicate that control measures applied on early development soybean stages, prior to pod set, are not justifiable for these species and the population levels studied.

P299. Relationship between stink bug damage and soybean seed-borne diseases in Santa Fe, Argentina

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Stink bugs and diseases present at the end of the soybean crop cycle constitute the major biotic factors affecting the production of grains and seeds. In Argentina, there has been no research into the relationship between these two biotic factors or their interaction with row width. The objective was to assess the relationship among the natural infestation of different stink bug populations, seed damage and seed borne diseases on a short-cycle soybean variety. ADM 4800 RR (MG IV) variety was sown at 26 and 70 cm row width. Four control threshold (CT): 0, 1.4, 2.8 stink bugs.m^{-2}, and an uncontrolled check were assessed. A split-plot field design with an experimental unit (7.5 m x 24 m) was used. Samplings of stink bugs were made each 5-7 days using the vertical beat sheet. When the stink bug populations surpassed the established CT they were chemically controlled. The assessment of seed damage was made using samples manually harvested from 30 plants/plot, and the seeds were visually classified into 2 categories: medium damage (seeds with sunken deformed area) and severe damage (flat or severely atrophied seeds). Stink bug seed damage was further verified by topographical tetrazolium test. Pathogenic analysis was made on superficially disinfected seeds, incubated on potato glucose agar 2% medium, during seven days at 25 ± 2 °C, alternating 12 h periods light/dark. Isolated pathogens were identified based on their colonies, fruiting bodies and spore morphology. The incidence (%) of each pathogen was also determined. The prevailing species of stink bugs were *Nezara viridula* and *Piezodorus guildini*. All the CT affected the percentage of seeds with stink bug damage, while no differences related to row width were observed. The most frequent pathogens were: i) Bacteria: *Pseudomonas* spp. and *Bacillus subtilis*; and ii) Fungi: *Phomopsis sojae* and *P. longicolla*; *Fusarium graminearum, F. equiseti,* and *F. semitectum*; *Alternaria alternata* and *A.* spp.; and *Cercospora kikuchii*. The row width did not affect significantly the incidence of any of the diseases evaluated. The CT significantly affected the incidence of bacteria, *Fusarium* spp. and *C. kikucchi*. Bacteria and *Fusarium* spp. showed lower incidence at CT 0 and differed significantly at CT 2.8 and 1.4 stink bugs/m^{-2}, respectively. Conversely, *C. kikucchi* showed higher incidence en CT 0, probably due to their distinct competitive capacity for substrate in the absence of other pathogen. Fungal pathogens incidence was significantly related to the seed category of damage, but bacteria did not. *Phomopsis* spp. and *Alternaria* spp. were largely associated to seeds with severe damage, while the *Fusarium* spp. and *Cercospora* spp. were related to seeds with medium damage. The incidence of (*Fusarium* spp. + bacteria) was 2.2 times higher in the treatments with stink bugs.

P300. Incidence of stink bugs on the quality of soybean seeds in indeterminate early maturing variety sown in different row widths

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The complex of stink bugs which affects soybean crops constitute important pests in the production of seeds. In Argentina, data about the incidence of stink bugs on seed production in indeterminate early maturing varieties or their interaction with row width are relatively scarce. The objective was to assess the incidence of the natural infestation of different stink bug populations on the quality of the seeds of an indeterminate soybean variety: ADM 4800 RR (MG IV), sown with different row widths (RW). Three row widths were assessed: 26, 52 and 70 cm between rows and 4 Control Thresholds (CT): 0, 1.4, 2.8 stink bugs.m^{-2} and an uncontrolled check. A split- plot field design was used with a 7.5 m x 24 m experimental unit. Samplings of the stink bug population were made every 5-7 days using the vertical beat sheet method. When the stink bug populations surpassed the established CT they were chemically controlled. The assessment of injury to seed was made using two samples of different origin: a) plants: At physiological maturity 30 plants/plot were harvested and the injury to seed was determined in three canopy strata: upper, medium and lower, classifying the seeds visually into 3 categories according to the stink bug damage: no damage, medium damage and severe damage. The stink bug damage for each category of this material was determined by means of the topographical tetrazolium test. and b) seeds: The seed lot was combine harvested from plots and the seeds were randomly selected with a manual divider in order to obtain the working samples for the germination test, protein and oil content and damage seed. During the population peak (R6), the prevailing species were *Nezara viridula* and *Piezodorus*

guildini, a higher level of infestation was observed in the narrower row width. The visual analysis of the seeds from the sample of plants at physiological maturity showed that the most severe injury occurred in the upper third part of the plants and no significant differences were observed in the three categories of seeds with reference to row width. All the CT significantly affected the percentage of seeds with stink bug damage: 10.4, 38.8, 35.7 and 62.8 % for levels 0, 1.4, 2.8 stink bugs.m^{-2} and the uncotrolled check respectively. In the sample obtained through combine harvest, it was observed that although the germination test was not affected by the interaction RW x CT, it was affected by CT. The germination test of the 0 and 1.4 CT was significantly higher than in the rest of the treatments. There was a slight increase of the protein content and a slight decrease of the fat content as the CT increased. Damage seed increased from 0.8 to 6.2 % in the 0 CT and uncontrolled check respectively.

P301. Incidence of stink bugs in indeterminate early maturing varieties (MG III and IV) sown in different row widths

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No-till sowing, the use of genetically modified indeterminate early maturing varieties and the narrowing of row width have substantially modified the production system of soybean in Argentina. The Economic Threshold Levels for the complex of Phytophagous hemiptera have not been established for this new production background. The objective was to assess the incidence of 3 levels of stink bug natural infestation in indeterminate early maturing varieties with different row widths. Two varieties were assessed: ADM 3901 RR (MGIII) and ADM 4800 RR (MG IV); with three different row widths (RW): 26, 52 and 70 cm and three Control Threshold (CT): 0, 1.4 and 2.8 stink bugs.m^{-2}. A split-plit plot field design was used with a 7.5m x 24 m experimental unit. Samplings of stink bug population were made every 5-7 days using the vertical beat sheet method. When the stink bug populations surpassed the CT, the plots were treated with endosulfan 350 g/ha of a.i. At soybean maturity the injury to seed was assessed in three canopy strata: upper, medium and lower, classifying the seeds visually into 3 categories: no damage, medium damage (seeds with sunken deformed area) and severe damage (flat or severely atrophied seeds). 41 and 39 % of the stink bug population belonged to the *Nezara viridula* and *Piezodorus guildini* species respectively. The yield with a row width of 26 cm was significantly higher with reference to the other row widths and the interaction between row width and CT was not significant. The yield showed negative association with the CT (y = -125.34 x + 4092.7; r = 0.88) and decreased with populations bigger than 1.4 stink bugs.m^{-2}, in both CT and all the row widths. Seed weight increased when the CT went up to 1.4 stink bugs.m^{-2}, compensating for the fall in the number of seeds, then it went down considerably. A loss of 0.82 and 4.26 kg.ha^{-1}.day^{-1} was registered for the 1.4 and 2.8 CT respectively. The analysis of injury to seed did not detect any differences among the three categories of seeds with reference to the row width. Significant differences were found with reference to the CT in the three categories of seeds analyzed. All the levels of infestation affected the percentage of seeds with no damage. In all treatments the upper third part of the plants was the most damaged. The reduction of the Economic Threshold Levels, which is recommended by the IPM programs nowadays: from 2.8 stink bugs.m^{-2} to 1.4 stink bugs.m^{-2}, increased the gross margin/ha^{-1}. The following Economic Threshold Levels is proposed: 1.4 stink bugs.m^{-2} for varieties MG III and IV, for sowings with a row width of 26, 52 and 70 cm.

P302. Study on the efficacy of the insecticide acephate for the control of the bug *Euschistus heros* in a soybean crop grown under a no-tillage system in a savannah soil

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Besides the defoliator insects such as worms and some chrysomelids, the sucking species represented by the bugs also present a potential to cause economic losses to the soybean growers, and so imposing the need for curative control. This experiment, conducted in a commercial area at the Glória farm located at Uberlândia County, during March and April 2003, was installed over an R7 stage soybean crop, sowed with cultivar Engopa 313 under a no-tillage planting system. It was evaluated the efficacy of three doses of the insecticide acephate (225.0, 300.0 and 375.0 a.i./ha) for the control of the bug *Euschistus heros* as compared with the check insecticide treatments methamidophos (300.0 g a.i./ha) and endosulfan (437.5 g a.i./ha), all of them applied with a back-packed manual sprayer at a flow rate of 300l/ha. The experiment was installed as a randomized complete-block design with six treatments and four replications and 162.0m^2 experimental plots, in which a pre-evaluation was performed by means of four samplings per plot with the beat panel. The five definitive evaluations were done on the second, fourth, seventh and tenth days after the application of the products and their respective doses, by counting separately the adult and large nymph categories (from third through fifth instar). The means were compared according to Tukey's (5%) test and efficacy was calculated using Abott's formula (1925). It was verified

a good performance of the three doses tested of the insectide acephate on the control of the different categories of this pest up to the 15th day after the application, with no problems of phytotoxicity.

P303. Insecticides to control stink bug *Piezodorus guildinii* (Westwood, 1837) on soybean crop

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Small stink bug has large distribuition, found at all regions that products soybean in Brazil and around countries. It was evaluated in Bandeirantes-PR, insecticides to control small stink bug in soybean crop, cultivar Embrapa 48, at spacing of 0,45 m between rows with 18 plants per meter. Experimental design was randomized blocks with 6 treatments, 4 replications and plot with 135 m^2. The pulverization was done once when the crop was at stagium R_6, with following treatments in a.i./ha: acephate (Orthene 750 BR) 225, 300 and 375 g; endosulfan (Thiodan CE) 437,5 g; clothianidin (Zellus) 86 g and control (with no spraying). For applications it was used a CO_2 sprayer, with X_4 nozzle, pression of 65 lb/pol^2, and volume of 200 L/ha. Evaluations were done by pre-counting, and at 02, 04, 07, 10 and 15 days after application, with 4 randomized samples per plot using "cloth-method", counting alived adults of small stink bug falled on cloth. It was concluded that: a) The insecticides endosulfan (Thiodan CE) 437,5 g at 04 and 07 days; acephate (Orthene 750 BR) 300 and 375 g and clothianidin (Zellus) 86 g of a.i./ha at 02, 04, 07, 10 and 15 days after application showed more than 81% of efficiency in control adults of small stink bug on soybean crop; b) The insecticides and doses had not caused toxicity on the plants.

P304. Insecticides to control brown stink bug *Euschistus heros* (Fabr. 1794) on soybean crop

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Brown stink bug has most importance at regions with medium temperature more elevated and it is more frequent at North and West of Paraná, and at states placed on less latitude. It was evaluated in Nova América da Colina-PR, insecticides to control brown stink bug in soybean crop, cultivar CD 206, at spacing of 0,5 m between rows with 16 plants per meter. Experimental design was randomized blocks with 6 treatments, 4 replications and plot with 150 m^2. The pulverization was done once when the crop was at stagium R_6, with following treatments in a.i./ha: acephate (Orthene 750 BR) 225, 300 and 375 g; endosulfan (Thiodan CE) 437,5 g; clothianidin (Zellus) 86 g and control (with no spraying). For applications it was used a CO_2 sprayer, with X_4 nozzle, pression of 60 lb/pol^2, and volume of 200 L/ha. Evaluations were done by pre-counting, and at 02, 04, 07, 10 and 15 days after application, with 4 randomized samples per plot using "cloth-method", counting alived adults and nymphs of brown stink bug falled on cloth. It was concluded that: a) The insecticides acephate (Orthene 750 BR) 300 g and 375 g, endosulfan (Thiodan CE) 437,5 g and clothianidin (Zellus) 86 g showed more than 81% of efficiency in control adults; acephate (Orthene 750 BR) 225; 300 and 375 g, endosulfan (Thiodan CE) 437,5 g and clothianidin (Zellus) 86 g a.i./has showed more than 82% of efficiency to control nymphs of brown stink bug on soybean crop at 02, 04, 07 and 10 days after application; b) The insecticides and doses had not caused toxicity on the plants.

P305. Impact of insecticides used in the control of the soybean caterpillar (*Anticarsia gemmatalis*) about the different species of insects present in the cultivation areas captured with sweep-net collection

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With the objective of evaluating insecticides of different chemical groups recommended for the control of the soybean's caterpillar, to verify its effects on the species of present insects, an experiment was installed in commercial plantation of soybean in the direct system of plantation, Pelotas, RS, in the agricultural crop 2001/02. The portions were constituted by 20 arrays of plants of 15 meters in length. The structure was of aleatory blocks with 4 repetitions, according to Technical Recommendations of the Culture. It was used 80% of the doses of the recommended insecticides (lufenuron 6,0 g.a.i.ha^{-1}, spinosad 17,28 g.a.i.ha^{-1}, endosulfan 140,0 g.a.i.ha^{-1}, *Bacillus thuringiensis* 14,6 g.a.i.ha^{-1}, permethrin 10,0 g.a.i..ha^{-1}, clorpyrifós 96,0 g.a.i.ha^{-1}, methoxyfenozide 17,28 g.a.i.ha^{-1}). The applications were accomplished with manual spryer propelled by CO2 equipped with conical jet beaks, gauged for 150 l.ha^{-1}. The population rising of the species of present insects was accomplished with sweep-net collection, being made 15 hauls by portion. It was made a pre-evaluation and evaluations in four and eight days after

the application. The collected material was carried for laboratory for identification. The eight families of larger frequency (Crysopidae, Cercopidae, Ichneumonidae, Halictidae, Noctuidae, Agromyzidae, Drosophilidae and Sarcophagidae), were contained in a graph of flotation of the populations to verify differences between the treatments and the flotation population. The results were analyzed through the analysis of the variance and, the averages compared by the test of Duncan at the level of 5% of probability. The results indicate larger reduction of the species of the families Ichneumonidae and Halictidae registered in portions treated respectively with the clorpyrifós and spinosad, on the other hand, they were less affected by the insecticide endosulfan and methoxyfenozide, respectively. Observing the graph of flotation of the population was verified that there was a great reduction in the population of insects in the witness to the eight days after the application, which probably happened due to the effect of the application of the insecticides in the adjacent portion, because the insects captured by this method are flyers. The insecticide clorpyrifós promoted a great reduction of the population to the 8 days after the treatment.

P306. Impact of the insecticide methoxyfenozide applied in commercial plantation of soybean on the survival of *Anticarsia gemmatalis* Hübner 1818, (Lepidoptera: Noctuidae)

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The cultivation of the soybean is one of the main activities of agricultural exploration of Brazil, and the caterpillar *Anticarsia gemmatalis* is considered the main foliage-feeding pest. It was developed a research in 2003 in the laboratory of Biology of Insects of the Department of Fitossanidade of the College of Agronomy " Eliseu Maciel ", of the Federal University of Pelotas (UFPel), under temperature conditions (25 ± 1oC), relative humidity 85 ± 5% and phase with light of 14 hours with the objective to evaluate the effect of insecticide Intrepid 240 CE on populations of remaining caterpillar, being used 70% of the dose recommended in the soybean (methoxyfenozide 15,12 g.a.i..ha^{-1}). The treatment was applied in a portion of 800 m2 in commercial plantation. The evaluations were made in 10 aleatory points inside the portion, and the infections level corresponded to 30 caterpillar for ground-cloth in the pre-application. The application was accomplished with manual spryer propelled by CO2, equipped with conical jet beaks, gauged for 150 l.ha^{-1}. Three days after the application new evaluation was proceeded to verify the efficiency of the products, of this time, 100 remaining caterpillar of fifth and sixth instars larval were collected, which they were transported to the laboratory, being transferred for artificial diet, in tubes of rehearsal of 2,5 x 8,5 cm, where they were maintained until the metamorphosis. The pupae were heavy and identificaded the sex 24 hours after the metamorphosis. The variables observed were larval viability, pupal and pupae weight. The deformities of the larvae, prepupae, pupae and adult were classified in agreement with Rodriguez (1985). The evaluations in relation to the longevity were accomplished in 10 couples (a couple by cage), fed with honey solution and beer at 10 and 25%, respectively. Daily the adults' mortality were observed. Those that only survived until the fourth day were considered as premature death and disrespected for evaluation of the longevity. The results were analyzed through the analysis of the variance and the averages compared by the test of Duncan with 5% of mistake probability. It was verified that the insecticide promoted 59% of control of the caterpillar in 3 days after the application, it promoted defects like retention of the larval morphologic characters in 26% of the prepupae, reduction in the adults' longevity for 10 days compared with the witness that lived on the average 23 days The insecticide methoxyfenozide provokes deleterious effects, what provided reduction of 58% of the initial population, comparing with 21% of the witness. The effects don't limit the mortality during the larval phase, but they showed in the subsequent phases, what indicates to be a promising insecticide in the integrated control of the plague.

P307. A biocontrol-based IPM for soybeans in Mexico

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Anticarsia gemmatalis is the main soybean insect pest in México. Secondary insect pests include *Pseudoplusia includens*, *Trichoplusia ni*, and *Nezara viridula*. The nuclear polyhedrosis virus of *A. gemmatalis* (AgNVP) was first introduced to Mexico from Brazil in 1999, causing up to 100% mortality of *A. gemmatalis* larvae in the field, and favoring conservation of up to 20 different natural enemies, which maintain secondary insect pest at non-economic population levels. A biocontrol-based IPM has been developed for soybeans in southern Tamaulipas, Mexico and is currently being used in 3,500 ha. Main components of this system are: 1) Systematic sampling of insect pests and thier natural enemies; 2) Decision-making based on damage economic thresholds; 3) Usage of AgNPV as the main control strategy; 4) Strenghten biocontrol by using augmentative

releases of *Trichogramma* sp. and *Chrysoperla carnea*; and 5) Usage of selective insecticides as the last control strategy. Results obtained with this IPM system during the last four years have been by far much favorable than those obtained with the insecticide-based traditional method for controlling soybean insect pests in this area. Advantages of the biocontrol-based IPM system include: a) Maintaing all insect pests at population levels under economic threshold; b) Conservation and increase of natural enemies; c) Reduction of control costs up to 50%; d) Total elimination of insecticide usage; e) Reduction of risks by secondary insect pests; and f) Higher yields, quality, and profits.

P308. Anatomical changes of testa from soybean seeds, cv. Monsoy 8411, subjected to accelerated aging

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When seeds are subjected to conditions of high temperature and humidity, they deteriorate more quickly reducing their germination. The seed testa plays a fundamental role in conservation of physiological potential of seeds. In a cross section of the soybean seed testa four layers can be distinguished from its surface: cuticle, epidermis (palisade cells, macrosclereids), hypoderm (hourglass cells, osteosclereids) and parenchyma cells (parenchyma zone) (Swanson et al, 1985, Food Microstructure 4:115-124). Anatomical changes of the testa, resulting from aging, can be one of the factors contributing to a reduction of physiological potential. Seeds from cv. Monsoy 8411 were subjected to five periods of accelerated aging (0, 24, 48, 72, and 96 hours) at 42°C and approximately 100% of air relative humidity. At the end of aging periods, water content of seeds and germination were evaluated. Subsequently, following drying in stove with air circulation, the palisade, hourglass, and parenchyma cells were observed regardless of its location on the testa, that is to say, if they were near the hilum or not. For each aging period ten seeds were observed through scanning electron microscopy. From each seed a cross section was obtained. For each of layers from each seed seen through electron microscope five measurements were done. The completely randomized design was used both to germination and to layer thickness. The increase of aging periods caused decrease in germination. At 48, 72, and 96-hour aging, there was reduction of the thickness of testa cell layers. The anatomical change of osteosclereids from aged seeds can be related to a reduction of the physiological potential, since the cell collapse can be regarded as physical damage on the testa. Possibly, the capacity of seeds to repair physical and/or biological damages in the early stage of imbibition process interferes with the germination potential of seeds. In the early stage of imbibition process the seed capacity to reorganize its membranes, as well as to restore certain physical and/or biological damages, can influence in a remarkable way the quantity of leached substances (Hampton and Tekrony, 1995, Handbook of vigour test methods 22-34).

P309. Influence of accelerated aging on testa anatomy of soybean (cv. Monsoy 8400) seeds

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The speed of seed deterioration is determined primarily by the interaction among genotype, seed water content and temperature. Considering that the reduction of storage potential is the second physiological manifestation of seed deterioration, after the decrease of a speed germination, the accelerated aging test may be considered as one of the most sensitive to evaluate seed vigor among those the available tests. During the accelerated aging the seeds undergo degenerative changes that influence their physiological potential (germination and vigor). Among these changes, anatomical modifications on the cell layers of the seed coat can be present. This research work was carried out in order to verify possible relationship between the seed coat anatomy of soybean, cultivar Monsoy 8400 and the germination after seed aging (0, 24, 48, 72 and 96 hours) at 42°C. After aging, seed water content and standard germination were determined. Following the aging the seeds were dried and transverse sections of 10 seed coats of each treatment were electronically micrographed, using a scanning electron microscopy (JEOL, model JFM 5410). The transverse section was obtained in the medium region of the seed around the hilum. The palisade (macrosclereids), hypodermic and parenchymatic cell layers were observed. The results were analyzed as a completely randomized design for both germination and thickness layer data. The germination percentage decreased as the aging period increased. After 48, 72, and 96 hours of aging, the cell layers of seed coat showed thickness reduction. This thickness reduction of cell layers suggested the occurrence of cell collapse which may be related to seed germinative potential decrease. After 72 and 96 hours of seed aging, the hypodermic cells showed appearance of collapse being more evident primarily after 96 hours. It seems (Hampton & TeKrony, 1995, Handbook of vigour test methods, 22-34) that during the beginning of the imbibition process of the seeds, the capacity of reorganizing their cell membrane structures, repairing certain physical and/or biological damages, may influence significantly the quantity of leaches, providing an increase in the electrical

conductivity of the seeds. It is also possible that the seed ability to repair physical and/or biological damages during the initial imbibition process may interfere in the seeds germinative potential.

P310. Environmental conditions and testa structure in two soybean genotypes

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Seed quality of soybean is altered by the environmental conditions during the physiological maturity-harvest period. The objective of this work was to examine the effect of delaying harvest on testa tissue in soybean cultivars becoming from our breeding program (FCA). Two cultivars (Oro FCA and Cobriza FCA) were compared with two cultivars known by their tolerance to mechanical damage (Doko and Savana) in term of testa tissue deterioration. Oro FCA and Cobriza FCA showed an average of germination (mean of three years) of 88 and 82% and a vigor (measured at 60 days after R8) of 78 and 58%, respectively. Layers of seed testa were cut with a microtome, fixed with parafine, colored with safranine, and put on glycerin jelly. Length of Malphighian cells, and length and width of osteosclereids were measured on fifty seeds per cultivar. Length of Malphighian cells was variable and ranged from 41.08im (Oro FCA) to 27.32 im (Savana). Oro FCA and Doko, cultivars with the greatest length in this experiment, have been reported with high percentage of lignine in our previous experience. There were not differences among cultivars in respect to length and width of osteosclereids. Results indicate that length of Malphighian cells could be associated with tolerance to environment deterioration.

P311. The use of the tetrazolium test for estimating the potential of seedling emergence in the field of soybean seed lots

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The tetrazolium test (TTZ) provides a number of seed quality parameters, such as vigor (TZ-Vig), viability (TZ-Viab), and indexes of mechanical damage, field weathering, and stinkbug damage. The soybean seed-producing sector has demanded research studies that relate the results obtained by this test with the potential seedling emergence in the field (SEF). This type of information will greatly contribute for increasing the precision of soybean seed plantability. Additionally it will improve seed quality evaluation just before they are commercialized. The objective of this study was to verify the possibility of using the data of viability and vigor provided by the TTZ for predicting the potential of soybean SEF. Regression analyses were obtained with the results of vigor and viability provided by the TTZ with the ones of SEF during the period of six years, from 1997 to 2002. A total of 1,117 seed samples of different cultivars were evaluated in the study. In each of the study year the TTZ was performed in October, and in November (normal planting period for soybeans in Brazil) the evaluations o SEF were performed. All seed samples were treated with fungicide before planting. The evaluations of SEF were done on the experimental field of Embrapa Soybean, in Londrina, Brazil. The regression analyses provided adjusted equations between the results of SEF and TZ-Vig and TZ-Viab. The regression analyses were individually evaluated for each study year and in conjunction for the six-year period. Comparing the individual equations obtained each year, it was observed that the ones relating SEF and TZ-Vig were similar to each other. However this trend was not observed for the data relating SEF and TZ-Viab. This fact means that the TZ-Vig data is more reliable than those from TZ-Viab for estimating of SEF. The conjunction analysis for the six-year period provided regression equations between SEF and TZ-Vig and also TZ-Viab. Due to the fact that the individual equations for each year were more coherent and repeatable for TZ-Vig than for TZ-Viab, it was concluded that SEF is more precisely estimated using TZ-Vig information as reference. The obtained equation for the six-year period involving SEF and TZ-Vig (SEF = 0,6165TZ-Vig + 35,716; r^2 = 0,73 ***) was applied to all TZ-Vig of 100 seed samples evaluated in 2002. The values of SEF estimated by this equation were correlated with the actual recorded data of SEF, resulting in a coefficient of regression of 0.79, which was highly significant ($P \leq 0.001$). This equation was considered reliable for estimating SEF of soybean seed samples in soils of Londrina, with soil temperature and moisture levels near to ideal conditions.

P312. The use of the accelerated aging test for estimating the potential of seedling emergence in the field of soybean seed lots

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The accelerated aging test (AAT) is used for estimating a vigor index of seed lots and also for estimating their

storage potential. For soybean seeds an exposure period of 72 h at a constant temperature of 41°C and 100% RH is recommended by ISTA. However very few studies which relate the results of AAT with soybean seedling emergence in the field (SEF) are available in the literature. Preliminary results obtained by Embrapa Soybean indicated that the AAT could be used for estimating SEF, if the test is applied to soybean seeds just before planting time, and the stress period is reduced to 24 h. The objective of this study was to verify the possibility of using the data of vigor provided by the AAT (41°C/100%RH/24h) for predicting the potential of soybean SEF. Regression analyses were obtained with the results of vigor provided by the AAT with the ones of SEF during the period of five years, from 1998 to 2002. A total of 879 seed samples of different cultivars were evaluated in the study. In each of the study year the AAT with an exposure period of 24 h was performed in October, and in November (normal planting period for soybeans in Brazil) the evaluations o SEF were performed. All seed samples were treated with fungicide before planting. The evaluations of SEF were done on the experimental field of Embrapa Soybean, in Londrina, Brazil. The regression analyses provided adjusted equations between the results of SEF and AAT. The regression analyses were individually evaluated for each study year and in conjunction for the five-year period. Comparing the individual equations obtained each year, it was observed that they were similar to each other. The conjunction analysis for the five-year period provided a regression equation between SEF and AAT (SEF = 0,6316AAT + 28,922; r^2 = 0,83 ***), which was also similar to the individual equations obtained each year. This equation was applied to all AAT results of 100 seed samples evaluated in 2002. The values of SEF estimated by this equation were correlated with the actual recorded data of SEF, resulting in a coefficient of regression of 0.80, which was highly significant ($P \leq 0.001$). This equation was considered reliable for estimating SEF of soybean seed samples in soils of Londrina, with soil temperature and moisture levels near to ideal conditions.

P313. Evaluation of the alternative methodology for the tetrazolium test in soybean seeds

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Abstract: The study of fast methods in programs of quality control is basic upon the evaluation of the potential of a batch of seeds. Among these, the tetrazolium test has been considered as a promising tool, which have a high degree of reliability, especially for determining seed quality in the stages of harvest, drying, procesing and storage of seeds. The normal methodology establishes a period of 16h/25°C for preconditioning before staining the seeds. However, this period can be considered long and often can delay the generation of the required information. This study had the objective of validating the use of a reduced period for preconditioning soybean seeds for the TZ-test. Forty soybean genotypes were used. Two preconditioning periods (4h and 6h) at 41°C were tested and compared to the period of 16h at 25°C. The following parameters were determined: seed moisture content, TZ-vigor, TZ-viability, mechanical damage, weathering and sting-bug damages. The preconditioning period of 6h/41°C resulted in adequate staining of the seeds, allowing excellent interpretation of the results. This staining pattern was equivalent to the traditionally recommended period of 16h/25°C and had a better precision than the treatment of 4h/41°C. The 6h/41°C preconditioning treatment increased seed moisture content to 27% or more, which is considered adequate for a good staining pattern. It was concluded that seed preconditioning for 6h/41°C can be successfully applied to soybean seeds for the assessing of seed quality by the tetrazolium test.

P314. Methods of application and levels of molybdenum, nitrogen fertilization and period of sowing of soybean cultivated in system no tillage: physiological seed quality

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The molybdenum is one of the most important micronutrients of the plants, so it deals great amount of essential reactions to vegetable metabolism. The current work aimed to evaluate culture soybean, cropped at system no tillage, in two period of sowing (November and February) with or without nitrogen fertilization (0 or 200 kg/ha), to the efficiency of applying of different molybdenum levels (25, 50 or 100 g/ha) in different ways (seed or leaves to 30 days of emergency). Two evidenced treatments compound by absence of molybdenum and presence or absence of nitrogen fertilization, also were evaluated. The work was developed at the Experimental Station of UNESP – Ilha Solteira Campus, located in Selvíria county - MS, Brazil, presenting as geographical coordinates, 20°22´S and 51°22´W and approximately 335m of altitude. The used variety was the Conquest (MGBR 46), being carried out before sowing, the treatment and inoculation seeds according to advice to tillage. When used at the

seed Mo was applied together to fungicide. The spacing used was 0,45m and the tillage of covering predecessor to soybean was the millet. The evaluations were carried out at seeds obtained were: germination, first score germination, acellerated aging and electrical bulk condutivity. Through results obtained verified that both sowing epoch molybdenum, independent of an level used and way of applying, did not change the physiologic quality of seeds and the mineral N adding at implantation of tillage took the seed production with worst physiologic quality, when they were evaluated by tests of acellerated aging and electrical bulk condutivity.

P315. Correlations of tests for physiologic quality of soybean seeds with emergency under field conditions

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The experiments were carried out in order to study the evaluating methods for the physiologic quality of soybean seeds, as well as to analyze its correlation with the emergency under field conditions. One of the proposals was to verify if the probit analysis could be used to evaluate the quality of the soybean seed. This analysis showed to be viable for evaluation of seed quality, as presenting significant correlation with the emergency in the field; however it presents practical restrictions such as daily countings, hampering the routine. The second work aimed at the identification of the best formula for calculation of the emergency speed. In this work it was concluded that the formula proposed by Maguire is the one that presents a better correlation with the emergency in the field. In the third work, the analysis of the main components was used for discarding the variables, and after then the discriminative function of the first main component was calculated. By correlation analysis, it was verified that the discriminative function presented a significant correlation with the emergency in field, but it did not bring practical advantages to predict this characteristic. In the fourth work, the adjustment of the multiple regression equation was performed by means of Gauss-Newton's method, combining the value of the paper roll germination after a 24-hour period at 25°C and 100% relative humidity, with evaluation not considering the presence of bacteria; the percent of seeds infected by Fusarium sp.; the value of the germination in paper roll, after 24 hours in atmosphere with 42°C and approximately 100% relative humidity, considering, as germinable that seed emitting a radicule larger or equal to 2,0 cm; the percentage of the seeds in classes 6 to 8 (nongerminable) for mechanical damages, by the tetrazolium test. The adjusted model presented high correlation with germination under field conditions.

P316. Hydric stress induced by mannitol in soybean seeds with different sizes. I. 'IAC-18'

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The first event in the germination sequence is imbibition. Water uptake limitation could affect the germination velocity, decreasing that or stopping it. In water stress conditions seeds with different sizes may present different comportment. The objective of this work was to evaluate the effects of mannitol induced hydric stress in the germination of soybean 'IAC-18' classified by size in the 12 and 13 mesh. Seeds were germinated in paper embedded in mannitol solutions with different concentrations (0; 44.58; 89.17; 133.75 gL^{-1} of distilled water) that produced the hydric potentials of 0, -0.6, -1.2 and -1.8MPa. Treatments were evaluated according the following parameters: germination, first germination counting, vigour classification, hypocotil and root length and shoot and root dry weight. The experiment was conducted as completely random design with the treatments in a factorial arrangement of 2x4 (seed size x mannitol concentration). Results showed that water potential of -0.49 and -0.52MPa produced maximum germination for the largest and smallest seeds respectively. Until the water potential of -1.27 MPa the largest seeds produced the highest germination. In the lower water potentials tested there were an elevated germination of the smallest seeds. Germination was less affected than the evaluations of seedling development in the different levels of water deficit, and these parameters were decreasing with the increasing of water deficit.

P317. Current status of virus diseases of soybean in Argentina

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Argentina is one of the top soybean exporting countries in the world. As in other soybean producing regions, viral diseases constitute a serious phytosanitary problem. They may cause major economic losses, both

diminishing yields and affecting soybean exports, specially in the case of seed-borne viruses. Six viruses have been identified infecting soybean crops in Argentina since the late 1970's: *Soybean mosaic virus* (SMV), *Alfalfa mosaic virus* (AMV), *Peanut mottle virus* (PMV), *Tobacco streak virus* (TSV), *Cucumber mosaic virus* (CMV) and a Begomovirus which is being characterized. Among these, SMV is the most important, due to its high incidence (up to 40%) and wide spread in central and northern Argentina. Seed transmission rates of SMV depend on the infected cultivar, reaching values up to 46% and producing dark seed coat discoloration. AMV is also found in the main soybean producing areas of the country. Highest incidence values (up to 74%) have been observed near lucerne crops, where this virus is common. Studies conducted on Argentinian soybean cultivars revealed very low rates of seed transmission (1.5%). PMV is restricted to Córdoba province (central Argentina), where peanuts are grown, with infection levels between 1 and 12.5%. Seed-transmission has been recorded in peanuts, but not in soybean. TSV, which shows high seed transmission rates (up to 30%), is widely distributed throughout central and northern Argentina, but its incidence is rather low (0.5 – 7%). Recently, CMV has been detected on soybean and bean crops in Salta province (northern Argentina), although studies concerning its incidence and possible transmission by seed are still to be done. Finally, the presence of a species of Begomovirus affecting soybean crops in the subtropical area of northern Argentina (where high populations of the whitefly *Bemisia tabaci* occur) has been recorded. New viruses have been lately detected infecting *Leguminosae* in Argentina, such as *Cowpea mild mottle virus* in bean crops. This urges the need of continuing and expanding surveys of soybean viral pathogens, considering the outstanding role of this crop in the Argentine economy.

P318. Managing *Bean pod mottle virus* in soybeans with cultural and chemical methods

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Bean pod mottle virus (BPMV) is a common viral disease of soybeans in the North Central U.S., where the majority of U.S. soybeans are grown. BPMV infection can reduce yield, with yield losses documented between 3 and 52%. BPMV also causes mottling of the seed coat, which can reduce market grain price. Currently there are no commercial soybean varieties resistant to BPMV. The primary vector of BPMV is *Cerotoma trifurcata* (Förster) the bean leaf beetle (BLB). Two separate on-farm studies were performed to examine management options. The first study examined the effect of planting date on BPMV incidence. Replicated strips of April (early) and May (conventional) planting dates were conducted at three locations in 2001. Plant tissue samples were collected at growth stages V2, V5, and R1. There was a higher incidence of BPMV in the April than May planted soybeans for two of the three locations. At location one, BPMV incidence in the May planting was 42% lower ($p<0.001$) lower than the April planting by mid-vegetative growth stage and location two, BPMV incidence in the May planting was 16% lower ($P=0.06$) than the April planting by mid-vegetative growth stage. There was no significant difference between the April and May planting at location three by growth stage R1. The second study examined application time of a foliar insecticide lambda-cyhalothrin (Warrior at 0.32 lb ai/A) to control BLB and to manage incidence of BPMV. Soybeans were planted in early (April) to favor BLB condition in 2002 and 2003. Foliar insecticide was applied at growth stages VC, V2, and targeting F1 BLB population. BLB population counts were taken every five days from mid-April to the end of September. Plant tissue samples were taken at growth stages V2, V5, V9, R1, and R3-R4 to determine BPMV incidence. In 2002, there was no significant difference in BPMV incidence between insecticide treatments. In 2003, there was significant difference in BPMV incidence at growth stage R1 and R4. At growth stage R1, VC and V2 applications gave significantly lower ($P<0.1$) than the control with incidence being 14% and 38% respectively. At growth stage R4, the V2 and target F1 BLB application were significantly lower ($P<0.05$) with incidence being 18% and 24% respectively lower than the control plots. Overall, the V2 application significantly reduced incidence of BPMV for a longer time period than other application times. From these studies we conclude that avoiding early soybean plantings can reduce BPMV incidence. When soybeans are planted early in the season, chemical insecticides may be a useful management tool. Insecticide timing can reduce BPMV incidence, however, results are not consistent. More research is needed to fully develop an integrated management program for BPMV.

P319. Reaction of soybean cultivars to severity of leaf spot diseases and to incidence of soybean mosaic virus, at two planting dates

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The present work had as objective to evaluation of soybean cultivars for their resistance the disease: downy mildew, septoria brown spot, frogeye lef spot, powderry

mildew and soybean mosaic virus. The assay was lead in Capim Branco Farm, Uberlândia- MG, using complete randomized-block experimental design with factorial project 20x2, correspondent the cultivars and planting dates, respectively. Every other week, it was evaluated severity of symptoms of leaf spots (both diseases occurring under natural epiphytics). As for soybean mosaic virus , genotype response was evaluated based on disease incidence. One became fullfilled statistical analyses and it was concluded that the cultivars Emgopa 316, BRSGO Luziânia, Msoy 8800, Emgopa 313, BRSGO Jataí, BRSGO Santa Cruz, BRSGO Chapadões, Msoy 8411, Emgopa 315 and Conquista had been resistant to the powderry mildew (*Microsphaera diffusa*) and the genotype Msoy 6101 was susceptível, being excessively of intermediate reaction. How much to the downy mildew (*Peronospora manshurica*), the cultivar BRSGO Paraíso revealed resistant and BRSGO Luziânia susceptible, being that the other materials had presented intermediate behavior. For septoria brown spot (*Septoria glycines*) and soybean mosaic virus, one noticed that it did not have significant influence between the materials and planting dates. In relation the frogeye leaf spot (*Cercospora sojina*), all the materials in study had presented resistance reaction, not differing estatisticamente between itself. Still, for the variable downy mildew, septoria brown spot, soybean mosaic virus and frogeye leaf spot did not have significant influence of planting dates, while for powderry mildew had a bigger severity at the first planting dates (06/11/02).

P320. Reaction of soybean cultivars to severity of leaf spot diseases and to incidence of soybean mosaic virus, in different localities

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This research aimed at the evaluation of soybean cultivars for their resistance to powderry mildew, downy mildew, frogeye leaf spot , septoria brown spot and soybean mosaic virus. The assay was lead in São Gotardo, Uberaba and Uberlândia, using complete randomized- block experimental design, with 20 treatments, composites for four repetitions. Every other week, it was evaluated severity of symptoms of leaf spots. As for soybean mosaic virus, genotype response was evaluated based on disease incidence. In relation to the powderry mildew (*Microsphaera diffusa*), in Uberlândia the cultivar Emgopa 313, Jataí, Paraíso, Emgopa 314, Emgopa 316, Santa Cruz and Msoy 8411 had presented a reaction of resistance, Msoy 6101, Bela Vista and Crixás had been susceptible. For Uberaba, the genotypes Paraíso and Msoy 8411 had only presented a resistance reaction. How much to the downy mildew (*Peronospora manshurica*), in Uberlândia the cultivars Chapadões, Crixás, Paraíso and Mineiros had revealed resistant and Bela Vista susceptible. In Uberaba, the genotype Paraíso was resistant while the cultivars Msoy 8800 and Emgopa 316 had been susceptible. For septoria brown spot (*Septoria glycines*), in São Gotardo, the cultivars Msoy 8411, Emgopa 314, Emgopa 315 had presented resistance reaction while Emgopa 302 presented susceptibility. In Uberlândia the cultivars Emgopa 313, Paraíso, Emgopa 314, Emgopa 315, Luziânia, Santa Cruz and Goiatuba had been resistant while Msoy 6101 and Emgopa 302 had been suscetibles. How much the frogeye leaf spot (*Cercospora sojina*), in São Gotardo the cultivar Jataí revealed resistant and Msoy 6101, Bela Vista and Emgopa 302 had been susceptible. In Uberaba, the genotypes Emgopa 302, Jataí, Paraíso, Msoy 8411 and Chapadões had been resistant, Emgopa 316, Msoy 6101 and Ipameri had been susceptible. In relation to the soybean mosaic virus, in São Gotardo, the genotypes Santa Cruz, Jataí, Caiapônia, Mineiros and Msoy 8411 had been resistant while Emgopa 302 and Luziânia had shown susceptibility reaction.

P321. Biological and molecular characterization of an isolate of *tobacco streak virus* isolated from bud blight soybeans in Brazil

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Soybean plants with symptoms of dwarfing and bud blight were observed in commercial fields near Wenceslau Braz county, State of Paraná, Brazil. The plants were used for grafting and for mechanical inoculation. Symptoms appeared 10-12 days after the inoculation or grafting and were identical to those observed in the field. Preliminary examination of leaf tissues from diseased plants by electron microscopy revealed the presence of spherical particles ca. 30 nm diameter. The host range and serological tests identified as *tobacco streak virus* (TSV). Purified virus showed three peaks in sucrose gradient and electron microscopy revealed spherical particles with 30 nm. Coat protein has a Mr of 29.880 kDa determined in SDS-PAGE. Polyclonal antibodies were obtained against this virus. With specific primers designed based on sequence of the TSV (Cornelissen *et al.*, 1984 Nucleic Acids Res: 12, 277-282) a fragment of 1028 nt was RT-PCR amplified, cloned and sequenced. It contained an open

reading frame with 717 nt and 238 deduced amino acids, identified and associated to the coat protein and a 3' untranslated region with 287 nucleotides. Sequence comparison of the nucleotides and predicted amino acids with sequence of TSV CP from white clover (GenBank NC003845, CAA25133) showed identities of 81% and 83%, respectively. A putative Zinc-finger motif was found in the coat protein N-terminus and the 3' untranslated region (UTR) revelead a potential stem-loop structure interpersed with AUGC-motifs, a structure which may signal binding of coat protein and activation of genome replication. The phylogenetic analysis grouped thi siolate of TSV and other TSV isolates in the same branch in 96% of the replicates.This is the first report of molecular characterization of *tobacco streak virus* isolated from soybeans. It is proposed that this isolate be considered a strain of TSV and named TSV-BR.

P322. Yield responses associated with chemical control of foliar diseases on soybeans

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In the 2001/02 soybean season, field experiments were carried out at Passo Fundo, State of Rio Grande do Sul, to evaluate the yield response of soybean cultivars associated with the chemical control of powdery mildew and late season diseases (DFC). Eight of the most planted soybean cultivars were chosen and grouped as resistant (BRS 154, CD 205, CEP 33, and Ft-Abyara) or susceptible (BR 16, CD 201, RS 10, and a non-identified (NI) genotype) to powdery mildew. Several application schemes involving sprays of epoxiconazole + pyraclostrobin (OperaÒ, 0.5 L/ha) at different plant growth stages were tested. The differences in yield between sprayed and non-sprayed plots averaged 597 kg/ha for one spray (at R1) and 703 kg/ha for two sprays (at R1 and R4). Within the susceptible group, the differences were 669 and 711 kg/ha, for one and two sprays, respectively. Among the resistant cultivars, sprayed plots yielded 524 kg/ha (one spray) and 694 kg/ha (two sprays) more than those non-sprayed. The individual cultivar responses varied from 264 (BRS 154) to 441 (BR 16), 517 (CD 201), 638 (CEP 33), 679 (CD 205), 807 (RS 10), and 913 kg/ha (NI) to one spray and from 542 (CD 201) to 554 (BRS 154), 567 (BR 16), 590 (Ft-Abyara), 740 (CD 205), 830 (RS 10), 895 (CEP 33), and 906 kg/ha (NI) to two sprays. The differences between one and two sprays were statistically significant only for the group of powdery mildew resistant cultivars. These results indicate that, in the absence of soybean rust, satisfactory disease control and grain yield can be achieved with one spray of fungicide from mid (R2) to end (R3) flowering.

P323. Effect of the number of fungicide aplicattions on soybean rust (*Phakopsora pachyrhizi*)

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To evaluate fungicides efficiency on soybean rust control, with one and two pulverizations, one experiment was carried out in the 2002/03 crop season at Buritis, MG. The cultivar BRS Pétala was used. Six treatments were compared under RBC experimental design in split plots, with five replications and plot size of 10.8 m^2. The fungicides and dosages (g i.a./ha) tested were: tebuconazole (100); difenoconazole (50); fluquinconazole + mineral oil (62.5 + 187.5); azoxystrobin + mineral oil (50 + 0.5%) and pyraclostrobin + epoxiconazole (66.5 + 25). The fungicides were sprayed with a CO_2 backpack sprayer at growth stage R5.2, with 20% rust severity (% leaf area infected - %lai) and at R5.5 (only on the treatments with two applications). The soybean rust severity was high, with 97% on the check, at growth stage R6. Tebuconazole was the most efficient fungicide on soybean rust control, followed by pyraclostrobin + epoxiconazole. The second application of fungicides, at R5.5, promoted no significant gains in reducing rust infection, in the most of evaluations carried out. The fungicides delayed defoliation (D = 4.2% to 60%), and harvest maturity (HM) by 2.0 to 8.2 days, promoted significant yield increase (12.78% to 92.87%) and thousand seed weight (TSW) increases (9.7% to 56.7%), compared to the control (D = 83%; HM = 117 days; TSW = 112.52 g and Y = 1341.87 kg/ha). To the several parameters analyzed, no significant differences were observed, except for TSW, where the second application brought significant gains.

P324. Evaluation of fungicide application methods in post flowering soybeans to support recommendations for control of soybean rust, *Phakopsora pachyrhizi*, preliminary report

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Asian soybean rust is one of the most devastating diseases of soybean with yield losses of 10 to 100% reported. The disease is found primarily in the lower canopy before flowering and in the middle and upper canopy after flowering. Heavily infected plants often

prematurely defoliate causing significant yield losses. Until useful genetic resistance can be identified and moved into commercial cultivars, fungicides will be the primary means to control the disease. There is not much information on fungicide application in soybean. Fungicide use in soybean has been limited to seed treatments and a single late season foliar . With soybean rust the canopy needs to be protected from onset of flowering through pod fill. The research presented is a preliminary summary of the measurement of canopy penetration using high and low water volumes with two fungicides, Bravo and Quadris. Fungicide were applied aerially at 5 and 10 gal/ac in six locations in the southern US and by ground in three locations in the midwest US. In the ground application experiment air induction, flat fan pointed down, flat fans on drops set to spray 105° and twin jet on forward facing right angle drops set to spray 80° nozzles were compared. Field design was set up as a strip plot with at least three replications per location. Three water sensitive paper strips were placed at mid canopy across the spray swath in three locations the length of the plot. Increased water volume in both ground and aerial application improved fungicide coverage when compared to the lower application volume. Among the nozzle tips evaluated in ground applications, overhead flat fans provided the least fungicide coverage in mid canopy.

P325. Fungicide spraying for controlling powery mildew and soybean rust and its effect on yield

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During the growing season of 2002/2003, the effectiveness of fungicides in the control of powdery mildew (*Microsphaera diffusa*) and soybean rust (*Phakopsora pachyrhizi*) was evaluated in the soybean cultivar BRS 154. Yield and test weight were used as response variables. The experiment was carried out at SEEDS Experimental Area located in Carazinho, RS, Brazil. The experimental area has been under conservation tillage over the late 15 years. Fertilizers and agronomic practices were done according to official recommendations. Experimental plots measured 2.50 x 5.0 m (5 lines spaced 50 cm). The seed rate used was 14 seeds per meter. The seeds were previously treated (vitavax + thiram, 250 ml per 100 kg of seeds). The fungicides used and their doses of active ingredient per hectare were: tetraconazol, 400 ml, 500 ml and 600 ml ha^{-1}; difenoconazol, 300 ml ha^{-1}; and epoxiconazol + pyraclostrobin 500 ml ha^{-1}. A control plot without fungicide treatment was used for comparison. The fungicides were sprayed when soybean plants reached development stage R3. At such stage, powdery mildew severity was 4.5 % and traces of soybean rust were observed on the leaves. Fungicides were applied by means of a boom sprayer equipped with ten $D_2$13 nozzles spaced 20 cm apart. A volume of 200 liters of water ha^{-1} was used. The plots were mechanically harvested, and grain moisture content was set to 13 percent. The data was subject to analysis of variance. Yields lower than normal were probably due to the exceptionally late planting. Plots sprayed with Tetraconazol (500 ml ha^{-1}) showed the highest yields (1.702 kg ha^{-1}). The average yield in the control plots was 761 kg ha^{-1}. The average yield in the plots treated with tetraconazol (600 ml ha^{-1}), epoxiconazol + pyraclostrobin (500 ml ha^{-1}), and tetraconazol (400 ml ha^{-1}) were 1,436, 1,367, and 1,283 kg ha^{-1}, respectively. The plots treated with difenoconazol (300 ml ha^{-1}) had an average yield of 1,017 kg ha^{-1} and did not differ statistically from the control plot. Similar results were observed in the variable one thousand grains. The average value varied from 189.8 g (tetraconazol 500 ml ha^{-1}) to 177.5 g (control). In the control plots, maximum powdery mildew and soybean rust severity reached was 28 % and 61 % respectively. All fungicides hindered disease progress. However, a single application was insufficient to keep the diseases under control from stage R3 to physiological maturity.

P326. Evaluation of bacterial pustule resistance in certain soybean cultivars recommended for production areas in the North of Thailand

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Million tones of soybean are annually used in several industries in Thailand, either production for household consumption or animal feeds. Majority of this soybean is imported and the rest is from domestic production. Total yield produced within the country is quite low while demand is increasing. In order to obtain higher yield, good agricultural practices are emphasized and convinced to the farmers along with launching of new soybean cultivars. Rajamangala 1 (RM 1) is a recent outcome from the soybean breeding project carried out at Lampang Agricultural Research and Training Center, Lampang province, north of Thailand. This soybean cultivar is attractive to farmers due to large-sized seed, high yield, resistance to lodging and other desirable characteristics. Bacterial pustule is one of the major diseases frequently epidemic in soybean growing areas in the north. Therefore, resistance to bacterial pustule is one of the essential characteristics for this area. RM 1 has shown resistance to bacterial pustule in previous selection and yield trials under natural epidemic but the appearance may due to either genetic resistance or escape. Hence, the present study was attempted to

clarify this trait and evaluate level of resistance to bacterial pustule of RM 1 compared to other recommended soybean cultivars. Four recommended soybean cultivars and RM 1 were brought to the experiments carried out in both rainy and cool seasons. Each cultivar was grown in the experimental pot. There were three replications, ten pots per each, and arranged in randomized completely block design. At 30 days old, each plant was inoculated by spraying 20 ml of the bacterial (*Xanthomonas axonopodis* pv. *glycines*) suspension prepared at concentration of 10^8 c.f.u./ml with 0.1% of tween 80 and 0.5% of carborundum adding. Pots were placed in clear plastic chambers and mist was applied twice a day to induce high humidity. Results from both rainy and cool season were in accordance. At 30 days after inoculation, RM 1 showed no symptom of bacterial pustule and CM 2 appeared none to few lesions. While, SJ 4, SJ 5 and CM 60 showed more lesions which were significantly different ($p<0.01$) compared to those two fore-mentioned cultivars. From this study, therefore, RM 1 and CM 2 were considerably highly resistant to bacterial pustule while the other three recommended cultivars were resistant to moderately resistant. The study also revealed that resistance to bacterial pustule of RM 1 and these recommended cultivars is governed by genetic.

P327. Variation in virulence among isolates of *Xanthomonas campestris* pv. *glycines* and its distribution in India

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Bacterial pustule of soybean caused by *Xanthomonas campestris* pv. *glycines* (Nakano 1911) Dye 1978, is a serious problem in many countries. In India it causes about 50 per cent loss in yield in congenial conditions in susceptible varieties like Pb-1 and Monetta etc. Earlier there were no reports that the pathogen varies in its pathogenicity however, recently while screening a number of varieties, we observed some variation in the pathogenicity and the same was confirmed when we found that a variety which was resistant became susceptible to this pathogen in the field. This gave an assumption that the pathogen varies in its virulence. A number of isolates collected from different agro climatic zones of India and the pathogenicity was tested in a set of varieties having different degree of resistance. To test the virulence a "detached leaf inoculation' method was also developed. Fifty five isolates were collected from four agro climatic zones comprising of 11 different places of traditional and non traditional soybean growing areas. Based on the pathogenicity reactions of the differentials, ten strains were identified. Strain 6 and 8 were widely distributed throughout the area irrespective of agronomical zone, while strain 1 and 3 were having less and restricted distribution. The wide range of virulence observed at a higher frequency in the central region (traditional area known as soybean bowl of India, the Malva plateau) than in the northern and the southern regions (non-traditional areas). Isolates with low virulence were widespread over the region, whereas isolates with high virulence were detected at a lesser frequency. Variability in infected leaf area and colony-forming unit (CFU) of the pathogen per lesion was also observed. The most aggressive/virulent isolate produced the largest leaf infected area i.e. 22 mm^2 with highest population of 1.7×10^9 CFU $lesion^{-1}$, whereas the least aggressive isolate produced the smallest leaf infected area i.e. 6 mm^2 and the lowest population of bacteria i.e. 0.93×10^9 CFU $lesion^{-1}$.

P328. Effectiveness of pyraclostrobin against Brown spot disease in Soybean

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Response to the use of foliar fungicides on soybean has been a frequently asked question among soybean farmers in the soy-producing area of Argentina for the past few years. That is why the R&D Department of BASF Argentina S.A. asked specialists in phytopathology from INTA (Instituto de Investigacion Agropecuaria) to prepare this paper, which is intended to prove that the use of foliar fungicides should become commonplace in Pergamino and its service area (in the north of the Province of Buenos Aires). This is warranted by the lack of appropriate rotation, the use of no-till systems, all of which have resulted in an increase of inocculum (mainly brown spot: septoria glycines). The use of state-of-the-art fungicides offers a return that warrants the use of this technology; there is also evidence that their use in early reproductive growth stages, R3, is more effective than in some later growth stage in R5.4 (Fehr and Caviness Scale). Trials were carried out during the 2000/01; 2001/02 and 2002/03 farming years to determine the effects of the fungicide and the ensuing yield increase. Trials were carried out as per an experimental design, in fully randomised batches, with four repetitions and a plot size consisting in 4 to 9 5-meter long furrows. The fungicide used was Comet (pyraclostrobin 25%, EC) dose: 200 cc/ha + carbendazim 50%: 500 cc/ha. The % Severity of Septoria glycines at R6 in Check was between %56-70%. Average Check in 6 trials: 3389 Kg/ha, yield increase applied in R3: 488 Kg/ha, in R5.4: 332 Kg/ha.

P329. M-SOY 8000 RR - a new cultivar for Cerrados

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The soybean (*Glycine max* L. Merrill) cultivar M-Soy 8000 Roundup Ready was developed and tested under the designation of M99-50021 FRR. After preliminary tests, this cultivar was evaluated for yield and adaptation in the states of Minas Gerais, Goiás, Mato Grosso do Sul and São Paulo during the 2000/01, 2001/02 and 2002/03 crop seasons. The M-Soy 8000 RR cultivar has maturity group 8.0 with an average of 119 days from emergence to maturity in its region of adaptation. M-SOY 8000 RR has purple flower, gray pubescence, imperfect black hilum, determinate growth habit and an average of 75cm in height in its region of adaptation. M-SOY 8000 RR has resistance to frogeye leaf spot (*Cercospora sojina*), stem canker *(Diaporthe phaseolurum* f.sp. *meridionalis)* e bacterial pustule *(Xanthomonas axonopodis* pv. *glycines)*, moderate resistance to powdery mildew *(Microsphaera diffusa)* and moderate resistance to purple stain (*Cercospora kikuchii*) and brown spot (*Septoria glycines*). M-SOY 8000 RR is tolerant to the glyphosate herbicide, tolerance to root knot nematode *Meloidogyne javanica* and resistance to lodging. The average of26 testing environments, the M-Soy 8000 RR had mean yield of 3376 Kg/ha and was 4,3% superior to M-Soy 8001, 8,1% superior to EMG-316 and 8,4% superior to M-Soy 8080 RR used as experimental controls. The M-Soy 8000 RR should be cultivated in medium to high fertility soils, planted in November and with a plant density between 330.000- 370.000. Variety protection and registration for M-SOY 8000 RR has been filed in the Serviço Nacional de Proteção de Cultivares (SNPC) in the Ministério da Agricultura.

P330. M-SOY 8008 RR - a new cultivar for Cerrados

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The soybean (*Glycine max* L. Merrill) cultivar M-Soy 8008 Roundup Ready was developed and tested under the designation of M99-52183 RR. After preliminary tests, this cultivar was evaluated for yield and adaptation in the states of Minas Gerais, Goiás, Mato Grosso do Sul and São Paulo during the 2000/01, 2001/02 and 2002/03 crop seasons. The M-Soy 8008 RR cultivar has the maturity group 8.0 with an average of 121 days from emergence to maturity in its region of adaptation. M-SOY 8008 RR has white flower, gray pubescence, buff hilum, determinate growth habit and an average of 74cm in height in its region of adaptation. M-SOY 8008 RR has resistance to frogeye leaf spot (*Cercospora sojina*), stem canker *(Diaporthe phaseolurum* f.sp. *meridionalis)* and bacterial pustule *(Xanthomonas axonopodis* pv. *glycines)*, moderate resistance to target leaf spot *(Corynespora cassiicola)*. M-SOY 8008 RR is tolerant to the glyphosate herbicide, has high yield potential and good physiological seed quality. The average mean of 26 testing environments, the M-Soy 8008 RR had mean yield of 3405 Kg/ha and was 5,0% superior to M-Soy 8001, 9,1% superior to EMG-316 and 9,3% superior to M-Soy 8080 RR used as experimental controls. The M-Soy 8008 RR should be cultivated in medium to high fertility soils, planted in November and with a plant density between 300.000- 350.000. Variety protection and registration for M-SOY 8008 RR has been filled in the Serviço Nacional de Proteção de Cultivares (SNPC) in the Ministério da Agricultura.

P331. M-SOY 8045 RR - a new cultivar for cerrados

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The soybean (*Glycine max* L. Merrill) cultivar M-Soy 8045 Roundup Ready was developed and tested under the designation of M99-52245 RR. After preliminary tests, this cultivar was evaluated for yield and adaptation in the of Minas Gerais, Goiás, Mato Grosso do Sul and São Paulo during the 2001/02 and 2002/03 crop seasons. The M-Soy 8045 RR cultivar has maturity group 8.0 with an average of 121 days from emergence to maturity in its region of adaptation. M-SOY 8045 RR has white flower, tawny pubescence, black hilum, determinate growth habit and average of 78cm in height in its region of adaptation. M-SOY 8045 RR has resistance to frog eye leaf spot (*Cercospora sojina*), stem canker *(Diaporthe phaseolurum* f.sp. *meridionalis)* and bacterial pustule *(Xanthomonas axonopodis* pv. *glycines)*, moderate resistance to powdery mildew *(Microsphaera diffusa)* and moderate resistance to purple stain (*Cercospora kikuchi*) and brown spot (*Septoria glycines*). M-SOY 8045 RR is tolerant to glyphosate herbicide and tolerant to root knot nematode *Meloidogyne javanica*. The average of 18 testing environments, the M-Soy 8045 RR had mean yield of 3458 Kg/ha and was 3,7% superior to M-Soy 8001, 2,5% to EMG-316 and 7,9% superior to M-Soy 8080 RR used as experimental controls. The M-Soy 8045 RR should be cultivated in medium to high fertility soils, planted in November and with plant density

between 330.000- 370.000. Variety protection and registration for M-SOY 8045 RR has been filled in the Serviço Nacional de Proteção de Cultivares (SNPC) in the Ministério da Agricultura.

P332. Performance and description of BRSGO Indiara soybean cultivar in Goias and Distrito Federal

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BRSGO Indiara soybean cultivar was developed by a modified pedigree selection from the cross MSBR-19*2 X BR 94-23293. It was extensively evaluated under the experimental designation BRAS 97-6705 and is now recommended for planting in the states of Goias and Distrito Federal. Indiara has determinate growth habit and reaches maturity approximately 127 days after emergence. It has purple flower, tawny pubescence, yellow shiny seeds with black hila and 100-seed weight of 16 grams. It has negative reaction to peroxidase. Indiara has excellent lodging resistance and good resistance to shattering. Indiara is also resistant to frogeye leaf spot (*Cercospora sojina*), stem canker (*Diaphorte phaseolorum*) and powdery mildew (*Microspora diffusa* Cke. & Pk.). In performance trials over 2001/2002 and 2002/2003 across 18 locations in Goias and Distrito Federal , seed yield of Indiara averaged 3307 kg/ha, similar to check cultivar M-SOY 8411 and 10%, 5% and 1% greater than the check cultivars 'Conquista', 'Pintado' and 'Vencedora', repectively. It is best adapted for planting in November at plant populations of 300,000 to 350,000 plants/ha. Indiara is a high yielding and high stable cultivar.

P333. BRS Rosa soybean cultivar

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Rosa soybean cultivar was developed by a modified pedigree selection from the cross FT Guaíra X FT Estrela, made at Soybean Research center, Londrina, PR, Brazil. It is recommended for planting in the states of Goiás, Distrito Federal, Minas Gerais and Mato Grosso. It was extensively evaluated under the experimental designation BR 95-15305. Rosa has determinate growth habit and is an early maturity cultivar, reaching maturity approximately 112 days after emergence in Goias and Distrito Federal, 117 days after emergence in Minas Gerais and 110 after emergence in Mato Grosso. It has purple flower, tawny pubescence, seeds with black hila and 100-seed weight of 17 grams. Rosa has good resistance to both lodging and shattering. Rosa is resistant to stem canker (*Diaphorte phaseolorum*) and tolerant to powdery mildew (*Microspora diffusa* Cke. & Pk.). In performance trials over the years of 1998/1999 and 1999/2000 across 33 locations in Goiás/Distrito Federal, Minas Gerais and Mato Grosso Rosa average seed yield was 3164 kg/ha, 3274kg/ha e 2822kg/ha, respectively. Those means were higher than the checks 'FT 2000', 'Emgopa 316' and 'Emgopa' 302. Rosa is best adapted for planting in November at a plant population of 300,000 to 350,000 plants/ha. Rosa is an excellent option of an early maturity soybean cultivar.

P334. Soybean cultivar 'FEPAGRO 25'

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The 'FEPAGRO 25' was released for commercial planting in Rio Grande do Sul, in the 2003. It was originated from Embrapa 1 x Ocepar 13 cross which was done in Júlio de Castilhos, RS, 1992. It was evaluated as JC 9716 lineage. The segregating generations were carried out by genealogic method up to F5 generation when it was selected. Preliminary evaluations were done during 1997/98 and 1998/99 seasons. In addition, tests of planting value and use were obtained from State Experimental Net from 1999/2000 to 2002/03. The 'FEPAGRO 25' cultivar has white flower, gray pubescence, brown hilo and determined growth. The weight of 100 seeds is 16.4 grams, highly resistant to lodging, and short cicle, with 133 days long from emergence to maturity, similarly to 'IAS-5' cultivar. It is resistant to Stem Canker (*Diaporthe phaseolorum* f.sp. *meridionalis*), and moderate resistance to Powdery Mildew (*Microsphaera diffusa*) and Frog Eye (*Cercospora sojina*). It is susceptible to Brown Stem Rot (*Phialophora gregata*) and to Soybean Mosaic Virus. It is indicated to 01 and 02 (VCU) regions of Rio Grande do Sul State, corresponding to Campanha, Depressão Central, Baixo Vale do Uruguai, Serra

do Sudeste Litoral, Missões and Alto Uruguai west. The 'FEPAGRO 25' cultivar increase yield up to 5% superior to IAS-5 and CD 201 controls. It is an alternative to substitute 'IAS-5' cultivar, because of high productivity, plants 10 cm higher than 'IAS-5' cultivar and Steam Canker resistance.

P335. Soybean cultivar BRS Invernada, indicated for the states of Paraná and São Paulo, Brazil

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Soybean cultivar BRS Invernada was selected from the cross Stonewall x Delsoy 4710, carried out at Embrapa – National Wheat Research Center in 1992/93. F_1 population was advanced in the greenhouse during the winter of 1993. Segregating generations, F_2 to F_5, were conducted using the bulk population method under field conditions in no-till system. Individual plant selection was carried out in F_5, in 1996/97. Line PF 98 1429 was formed in the following growing season. In 1999, one plant from this line showing resistance to race 3 of the soybean cyst nematode (*Heterodera glycines*) was selected; it was identified as PF 98 1429-36564 and evaluated under such designation. Soybean cultivar BRS Invernada life-cycle is early, with an average cycle of 137 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has indeterminate growth habit, white flowers, and brown pubescence. The grain has bright yellow tegument and black hilum. Average 100 grains weight is 19.6 g. Average oil and protein contents are 18.9% and 41.6%, respectively. It is resistant to lodging and shattering. BRS Invernada is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), frogeye leaf spot (*Cercospora sojina*) and susceptible to powdery mildew (*Microsphaera diffusa*), brown stem rot (*Phialophora gregata*), soybean mosaic virus and to the root-knot nematodes. It shows positive peroxidase reaction. From 2000/01 to 2002/03, average grain yield of BRS Invernada was, in 17 environments of Paraná, 5.8% higher than the one of cultivar CD 202; and, in seven environment of São Paulo, grain yield was 1.6% higher than the one of cultivar CD 201, in 2001/02 and 2002/03.

P336. Soybean cultivar BRS Macota, indicated for the states of Rio Grande do Sul, Santa Catarina, Paraná, and São Paulo, Brazil

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Soybean cultivar BRS Macota was selected from the cross Ocepar 4 x Ocepar 3, carried out at Embrapa – National Soybean Research Center in 1989/90. The population was introduced in Embrapa – National Wheat Research Center in 1994/95, in F_5 generation. Individual plant selection was carried out in F_5, in the same year. Line PF 94 1526 was formed in the following growing season and evaluated under this designation. Soybean cultivar BRS Macota life-cycle is early, with an average cycle of 133 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has indeterminate growth habit, purple flowers, and gray pubescence. The grain has middle bright yellow tegument and imperfect black hilum. Average 100 grains weight is 14.8 g. Average oil and protein contents are 19.1% and 39.9%, respectively. It is resistant to lodging and shattering. BRS Macota is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), frogeye leaf spot (*Cercospora sojina*), and bacterial pustule (*Xanthomonas axonopodis* pv. *glycines*), moderately resistant to root-knot nematodes, and susceptible to powdery mildew (*Microsphaera diffusa*). It shows positive peroxidase reaction. From 1996/97 to 1998/99 and in 2001/02, average grain yield of BRS Macota was, in 24 environments of Rio Grande do Sul, 3.0% higher than the one of cultivar IAS 5. In the years 1998/99, 2000/01, and 2001/02, in nine environments of Santa Catarina, grain yield was 11.0% higher than the one of cultivar IAS 5. From 2000/01 to 2002/03, in 17 environments of Paraná, grain yield was 8.7% higher than the one of cultivar IAS 5; and, in seven environments of São Paulo, grain yield was 4.9% higher than the one of cultivar CD 201.

P337. Soybean cultivar BRS Querência, indicated for the states of Rio Grande do Sul and Santa Catarina, Brazil

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Soybean cultivar BRS Querência was selected from the cross BRS 66 x Hartwig, carried out at Embrapa – National Wheat Research Center in 1992/93. F_1 population was advanced in the greenhouse during the winter of 1993. Segregating generations, F_2 to F_5, were conducted using the bulk population method under field conditions in no-till system. Individual plant selection was carried out in F_5, in 1996/97. Line PF 98 1376 was formed in the following growing season and

evaluated under this designation. Soybean cultivar BRS Querência life-cycle is late, with an average cycle of 153 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has determinate growth habit, white flowers, and brown pubescence. The grain has dull yellow tegument and brown hilum. Average 100 grains weight is 15.8 g. Average oil and protein contents are 20.4% and 41.5%, respectively. It is resistant to lodging and shattering. BRS Querência is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), and frogeye leaf spot (*Cercospora sojina*). It is susceptible to powdery mildew (*Microsphaera diffusa*), to soybean mosaic virus and to the root-knot nematodes. It shows negative peroxidase reaction. From 2000/01 to 2002/03, average grain yield of BRS Querência was, in 23 environments of Rio Grande do Sul, 3.5% higher than the one of cultivar Fepagro RS-10; and, in eight environment of Santa Catarina, grain yield was 2.3% lower than the one of cultivar M-Soy 7501 and 7.2% higher than the one of cultivar BRS 134.

P338. The controlled deterioration test: a tool to assist plant breeders to select soybean genotypes for high seed quality

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The controlled deterioration test (CD) is an ageing technique similar to the accelerated ageing test (AA) that permit better seed moisture and temperature control during the ageing period. The seed moisture content in the CD test is adjusted previously, providing a uniform stress in all seeds under evaluation this does not occur in the AA test, where each seed moisture content is raised without control during the test period, until it reaches the equilibrium moisture content with the chamber environment. Thus, seeds may reach the equilibrium at different times and they are submitted to distinct level of stress, as well as damaged by the presence of storage fungi (e. g., *Aspergillus and Penicilium)*, that may occur during the test conditions used for screening genotypes for seed quality (41°C during 72 or 96 hours). Therefore, seed treatment is required and may interfere negatively in the selection process. The research was conducted with 29 seed lots of 13 cultivars of five vigor levels according to the tetrazolium test rank as follows: <49%, 50-59%, 60-74%, 75-84% and >85%. The experimental design was a completely randomized design and the means were compared by the Tukey test at 5% of probability. The following conclusions could drawn: i) the CD test is reliable to identify distinct vigor levels of soybean seeds, which may result from different levels of seed quality among seed lots and cultivars; ii) the accurate information provided by the CD test fulfill the requirement for use in screening soybean genotypes for high seed quality.

P339. Lignin of soybean (*Glycine max* (L.) Merrill) seed coat and their relationships with resistance to mechanical damage

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Lignin is, second to cellulose, the most abundant organic compound in the terrestrial biosphere. It is a complex polymer of hydroxylated and methoxylated phenylpropane units, linked via oxidative coupling catalyzed by peroxidases. It is a major constituent of cell walls and provides to these cells rigidity for structural support and impermeability to water. There is considerable interest in the lignin since its deposition in the seed coat tissue provides mechanical resistance and also protects the cell against microorganisms. Mechanical damage is the most important factor that reduces soybean (*Glycine max* (L.) Merr.) seed quality at harvest and processing. In this context, the seed coat lignin content was found to be high in soybean cultivars with high index of resistance against mechanical damage. Using the gravimetric method, researchers of the EMBRAPA-Soja classified cultivars as follows: resistant (Doko, FT-2, Paraná and IAS-5); moderately resistant (Santa Rosa, IAC-8; Bossier and FT-10), and susceptible (Savana, Paranagoiana and Davis). It is known that many methods have been developed for the isolation of lignin and its quantitative determination, but there is no perfect method. Lignothioglycolic acid (LTGA) preparations have been considered as best suited for the isolation and quantitative assay of lignin. In this procedure, thioglycolic acid derivatization displaces lignin from its normal covalent attachments to the cell wall and enables it to be extracted from cell walls by alkali. Acidification of the alkaline extract precipitates LTGA. After being resolubilized, LTGA can be determined quantitatively by measuring its absorbance at 280 nm. Based on this methodology, the present work was carried out to determine the lignin content of seed coats of those cultivars, and to correlate the results with the index of seed mechanical damage resistance obtained by the pendulum test. The results showed that: 1. the adopted method may be used to quantify lignin in seed coats of different soybean cultivars, 2. a proportionality between lignin content and mechanical damage resistance was observed (r^2 = 0.79), and 3. a lignin content in the seed coats above 0.36 g% is proposed to be a

reasonable indicator of resistance against mechanical damage for soybean seeds. In conclusion, the present method may be used for screening genotypes for resistance to mechanical damage in a breeding program for soybean seed quality.

P340. Lignin content and peroxidase activity in seed coat of soybean (*Glycine max* (L.) Merrill) susceptible and resistant to mechanical damage

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Soybean seed coat is very thin and low in lignin content, and provides little protection to the fragile radicle, which lies in a vulnerable position directly beneath the seed coat. Due to this fact, mechanical damage is one of the causes of great loss of seed quality of soybean at harvest and processing. In this aspect, the occurrence of genetic variability for seed resistance to mechanical damage among different soybean cultivars was demonstrated. Based on the pendulum test, researchers of the Embrapa Soja classified 12 field grown soybean cultivars as follows: susceptible (Savana, Paranagoiana, IAC-2 and Davis), moderately resistant (Santa Rosa, IAC-8; Bossier and FT-10) and resistant (Doko, FT-2, Paraná and IAS-5). There is considerable interest in the lignin since its deposition in the seed coat tissue provides mechanical resistance and also protects the cell against microorganisms. The seed coat lignin content was found to be high in soybean cultivars with high index of resistance against mechanical damage. In addition to lignin, peroxidases have been suggested to be involved in various metabolic steps such as the formation of isodi-Tyr bridges in the cross-linking of cell wall proteins, the cross-linking of pectin by ferulic bridges, and the oxidation of cinnamyl alcohols prior to their polymerization during lignin and suberin formation. Seed coats tissues may accumulate large amounts of peroxidase in the hourglass cells of the sub-epidermis and may represent at least 5% of the protein in the dry seed coat. The function of peroxidases in the seed tissue is still not well understood and, consequently, the aim of the present work was to analyze the lignin contents and peroxidases activities of six soybean cultivars and its relationships with the mechanical damage. Seeds of six soybean cultivars (Doko, Paraná, Santa Rosa, FT-10, Savana and Paranagoiana) were evaluated by spectrophotometric methods to lignin content (l = 280 nm) and peroxidase (l = 470 nm). The results showed that the lignin content and peroxidase activity in the seed coat significantly differed among the soybean cultivars. The cultivars Doko and Paraná had the highest contents of lignin and peroxidase activities while Savana and Paranagoiana had the lowest lignin contents and enzymatic activities. Relationships between lignin content or peroxidase activity and the resistance to mechanical damage were observed. In conclusion, the lignin content and the peroxidase activity may be proposed as reasonable indicators of resistance to mechanical damage for soybean seeds.

P341. Screening selected plant introductions for seed quality in the early soybean production system

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The early soybean production system (ESPS) was adopted in the Mid South USA to avoid late season drought and increase soybean yield. However, soybean maturation and harvest during periods of high temperatures can produce seed with poor quality; wrinkled, diseased, smaller sized, and impermeable seed coat. Improved cultivars with high seed quality are needed for use in the ESPS. The objective of this research was to find new genotypic sources of high seed quality suitable for use in the ESPS. Nearly 500 accessions from the US soybean germplasm collection were assayed in a furrow-irrigated ESPS planting at Stoneville, MS in 2002. Diverse accessions were selected from MGs II, III, and IV based on their geographic origin and their potential for heat tolerance. The 25 ancestor lines for all US MG II-IV cultivars were also included for comparative purposes. All seed was timely harvested and assayed for incidence of *Phomopsis*, *Fusarium*, seed wrinkling, impermeable seed coat, and percent germination in standard and accelerated-aging germination tests. There were wide differences among accessions for all traits assayed. A total of 62 accessions had a germination score of ^{3} 90%, while also having no detectable *Phomopsis*, *Fusarium*, wrinkled seed, or seed with impermeable seed coats. In contrast, no ancestor accession had a germination score of ^{3} 90% and all had detectable levels of most of the other detrimental traits assayed. This study demonstrates genotypic differences for seed quality traits and highlights potential resources for improving seed quality in the ESPS.

P342. Genetic mapping of seed shape in three recombinant inbred populations of soybean (*Glycine max* L.)

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Round soybean seed are sought-after for food-type soybean. Also the genetic control of seed organ geometry is of scientific interest. The objectives of this study were to estimate heritability and map QTLs responsible for seed shape. Three densely mapped recombinant inbred populations each with 190 segregants were used, namely Minsoy x Archer, Minsoy x Noir-1 and Noir-1 x Archer. A two rep two location experiment was conducted in Los Andes, Chile, and East Lansing, Michigan USA. Seed height (H), width (W) and length (L) of 20 seeds per entry were measured to determine seed shape. Heritability was determined by variance component analysis. A QTL was declared with a LOD score of 2.5. QTL were found in 13 of 20 linkage groups (LG): Close to 80% of the QTL were found in LG u3, u9, u13, u14 and u22. We note that LG u9 and u14 are hot points of the genome for QTL for various traits. At a resolution of 10 cM, the sum of the QTL found in all populations and both environments were 19 for L, 18 for W, and 12 for H. No a single QTL was stable across populations and environments. Only 8 were stable in at least two populations in both environments. This agrees with a significant GxE interaction detected for all traits. The amount of phenotypic variation explained varied from 14.5% for H in Chile to 65.5% for L in USA. All traits had high heritability 0.69 for H, 0.76 for W, and 0.0.66 for L even though their genetic control is complex. To achieve a round seed using a marker assisted approach would be difficult.

P343. Interrelationship study among different components for seed yield in soybean

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A set of fifty diverse genotypes of Soybean *(Glycine ma.x* (L.) Merrill) originating from different agro-geographical areas including indigenous and exotic gennplasm along with advanced breeding lines of Soybean were tested and analyzed for correlation and path coefficient for the fourteen characters. In general, phenotypic correlations were found to be smaller than the genotypic ones. Seed yield was found to have highly significant positive phenotypic correlation with dry matter weight per plant, number of pods per plant and number of seeds per pod These findings were further supported at genotypic level except number of pods which showed a positive non significant correlation. Harvest index showed a highly positive correlation with seed yield efficiency both at genotypic as well as at phenotypic level. Oil and protein content showed a highly negative correlation with each other. Protein content was found to have significant negative correlation with number of seeds per pod and a negative non significant correlation with seed yield per plant. Path analysis showed a major role of dry matter weight per plant, number of pods per plant, number of primary branches per plant and days to maturity in influencing seed yield. Dry matter weight affected seed yield both directly and indirectly. Harvest index and days to maturity had negative direct effect on seed yield.

P344. Variability, heritability and genetic gain studies for grain yield and its component in soybean *(Glycine max* (L.) Merrill)

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The present experiment dealt with the estimation of heritability, coefficient of variation, phenotypic coefficient of variation, genotypic coefficient of variation and genetic advance of 62 varieties of soybean for seventeen characters. The results revealed that the mean squares were significant for all the characters. On the basis of mean performance, significantly superior genotypes viz. MACS-330, PK-472, VLS-47, Alankar, PUSA-40, SL-295, NRC-7 and JS 71-05 were identified for various traits. In general, PCV values were higher than the GCV and ECV values for all the traits. PCV for grain yield per plant, number of seeds per plant and number of pods per plant were comparatively high, suggesting that these trait were much influenced by environment. GCV and PCV did not differ much for protein content, oil content and days to maturity, suggesting those characters were less influenced by environment, therefore, selection based on these character is expected to be effective. High heritability accompanied with high expected genetic advance for number of seeds per plant, grain yield per plant and number of pods per plant provide clear cut index of these characters in selection and improvement of soybean.

P345. Studies on genetic variability and correlation of seed longevity and its component in soybean (*Glycine max* (L.) Merril)

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The problem of seed deterioration during storage is significant in soybean seeds which result in loss of vigour & viability. Present investigation was carried out with a view to determining the seed storage potential or longevity of different genotypes of soybean after four months of storage under ambient conditions and correlates various seed characteristics with it. Twenty three advanced breeding lines of soybean were studied and graded into two lots, bold and small, according to their seed size. Standard laboratory germination test was conducted in December 2000 and continued for seventeen months i.e. up to April 2002 at monthly intervals. Study revealed significant differences among genotypes for seed longevity and vigour. Indigenous genotypes such as Kalitur and T-49 showed better longevity and vigour during storage. While hybrids derivatives involving exotic parents such as PK 317, PK 564, PK 515 and PK 1024 showed very poor performance regarding the traits under study. Among advanced breeding lines lines PK 1338 showed best performance which was almost paralleling with Kalitur and T-49 in performance. Seed size did not uniformly affect the longevity and vigour of seeds in the given genotypes. Correlation studied revealed very significant and positive correlation of per cent of sound seeds with seed longevity ($r = 0.638$) and seed vigour ($r = 0.504$; 0.582) while per cent wrinkled seeds correlated negatively with them ($r = -0.476$; -0.331; -0.312). Also 100-seed weight, per cent rupture seeds and per cent discolored seeds showed negative and non-significant correlation with seed longevity and vigour.

P346. Mapping QTLs for traits associated with drought tolerance in soybean: nitrogen fixation, canopy wilting, and yield

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Drought is a major constraint to yield of soybean in many parts of the world. Drought affects the soybean plant in many ways, including decreasing nitrogen fixation (Nfx). Improving drought tolerance, defined as improved yield in stress environments, would be very beneficial to soybean. Breeding for drought tolerance though is difficult due to temporal and spatial variation of stress, genotype by environment interaction for drought tolerance, ambiguous association of traits with drought tolerance, and complex genetics of yield and traits associated with drought tolerance. One of the most promising technologies to alleviate some of the problems in improving drought tolerance is marker-assisted selection. This requires identifying markers associated with drought tolerance per se, or traits that can be positively associated with tolerance. Two traits that may improve drought tolerance are enhanced Nfx and reduced canopy wilting during drought. We have found that low tissue ureides are associated with Nfx tolerance to drought. Our objective was to map QTL for low tissue ureides during drought, canopy wilting, and seed yield in stressed and non-stressed environments. We developed a recombinant inbred line population of 100 F5 derived lines from the cross KS4895 x Jackson. Jackson sustains Nfx during drought and has low ureides while the Nfx of KS4895 is susceptible to drought and has high ureides. Variation for canopy wilting was observed in this population as well as variation for yield in drought environments. The population has been grown in replicated trials in Arkansas (2000, 2003) and North Carolina (2002, 2003). The population has been evaluated for yield in irrigated and non-irrigated environments, leaf ureides in two environments, and wilting in four environments. Nearly 120 simple sequence repeat markers have been placed on the map and have been associated with yield, wilting, and ureides. Mapping results using data from all environments and years will be presented.

P347. Cultivar identification and diversity analysis in released varieties of Indian soybean using various biochemical and morphological characteristics

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Cultivar identification is essential for describing a new cultivar, testing genotypic purity and expediting DUS (distinctness-uniformity-stability) test for candidate cultivar. New soybean cultivars are described on the basis of their phonological and morphological characteristics in India. This necessitates large scale growth experiments, often with fully matured plants, under conditions that are as uniform as possible. Moreover, narrow genetic base in Indian released varieties has further exerted a pressure on number of distinguishing characters. Experiments were carried out to evaluate all the released varieties (75) for the

differences in their SDS-PAGE and fatty acid pattern, seed coat peroxidase reaction, seed size, seed shape, seed color, seed coat luster, hilum color, and anthocyanin coloration in hypocotyls of seedlings. Based upon SDS-PAGE pattern only two varieties could be uniquely identified, the rest were grouped into eight groups. Based on percentage composition of unsaturated fatty acids *viz.* oleic acid, linoleic acid, linolenic acid, all the varieties fell into six major groups. Seed coat peroxidase reaction classified the varieties into two groups while hypocotyl coloration divided the varieties into three groups. When all the characters were taken together, ten varieties could be uniquely identified, and the rest were grouped into twenty six groups. A dendrogram constructed based upon Nei's genetic distance using UPGMA (Unweighted Pair Group Method using Arithmetic average) showed that cultivars originating from a common genetic backgroung fell into the same cluster.

P348. Degeneration of the generative cell in soybean [*Glycine max* (L.) Merrill] as the cause of male sterility

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Male sterility in plants impairs the male gametophyte function and leaves intact the potential for female reproduction. Mutants affecting male sterility have potential applications in breeding methodology studies and for commercialization of hybrids. The presence of genes acting after meiosis and affecting the post-meiotic microspore development has never been reported in soybean. For the first time, the cytological details are provided in a spontaneous male-sterile mutation affecting the male gametophyte development, specifically the generative cell. Mutation has been detected in line BR97-17739, selected in the breeding program developed by Embrapa - National Soybean Research Center. Meiotic division and male gametophyte development were analyzed in ten male-sterile, female-fertile plants. Sterile plants were identified, flower buds were collected in ideal stage for meiotic analysis and fixed in a mixture of ethanol 95%, chloroform and propionic acid (6:3:2 v/v) for 24 h. They were then transferred to 70% alcohol and stored at 4°C until use. Microsporocytes were prepared by squashing and stained with 1% propionic carmine. Despite the high frequency of normal microspores, pollen sterility was total. After callose dissolution, microspores were released into the anther loculle and interphase nucleus was displaced from the center to one side of the cell. Displacement continued throughout normal microspore mitosis (PMI). After telophase, the hemispherical phragmoplast marked the place of cytokinesis. Typical generative cell, adjacent to the plasma membrane, and the vegetative one, containing most of the cytoplasm, were formed. In spite of the well-formed generative cell, pollen mitosis (PMII) failed to occur. The generative cell degenerated and was completely destroyed. The 3:1 segregation ratio for male sterility in this line and its progenies indicate that a single recessive gene controls mutation. Similar gametophytic mutation has never been reported in higher plants. For double fertilization in angiosperms, two sperm cells are produced in the male gametophyte after two mitotic cell divisions in the haploid phase. Posterior to meiosis, the microspore divides into a larger vegetative cell and a smaller generative one during microspore mitosis (PMI). Then the generative cell undergoes another mitotic cell division, pollen mitosis (PMII), to produce two sperm cells. During double fertilization, one sperm cell fuses with the egg cell to form the embryo and the other fuses with the central cell to form the endosperm. Male-sterile mutation provides source material for studies in plant breeding, genetics, reproductive biology and molecular biology. The available systems of male sterility in soybean have proved useful in soybean genetics and breeding.

P349. Meiotic mutations causing male sterility in soybean [*Glycine max* (L.) Merrill]

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Meiosis, a universal process in the life history of sexual organisms, provides opportunities for genetic reassortment. Molecular data suggest that this process possesses a very conservative set of genes controlling each divisional step. Mutations that selectively eliminate male reproductive function and leave female function unimpaired have potential application in hybrid seed production. Mutations affecting microsporogenesis and causing complete male sterility has been detected in some lines from Embrapa Soybean breeding program. In the line BR97-13777H, many univalents and few bivalents were found in diakinesis. The main and distinctive characteristic of this mutant was the complete inability of univalents to congregate in the metaphase plate. Scattered in the cytoplasm, univalents underwent premature sister chromatid separation, so that 80 chromatids could be easily counted. Telophases II with a varied number of different-sized nuclei were observed. The inability of univalents to congregate at the equator made us

classify it as asynaptic mutant. A desynaptic mutation has been detected in BR97-12986H. The meiotic behavior was similar to that described for the *st* series of synaptic mutants previously reported in soybean. Distinctly different in their behavior from *st* series soybean mutants, telophase I micronuclei of different sizes organized their own spindle in the second division. This behavior contributed towards an increase in genome fractionation. Several microspores and microcytes of different sizes were recorded at the end of meiosis. A mutation affecting microspore development was detected in the line BR97-13509H. The main cause of male sterility was the absence of cytokinesis after telophase II. Instead of the typical tetrads of microspores four nucleate coenocytic microspores were formed. In the line BR97-17971, analyses of microsporogenesis revealed a differential meiotic behaviour in relation to *ms2*. Sterile plants have different levels of meiotic abnormalities related to chromosome segregation. The main meiotic cause of pollen sterility was the absent or the defective cytokinesis following telophase II. After telophase II, 1 to 4 nucleate microspores underwent degeneration. Cross-sections of sterile plants showed that at telophase II the tapetal cells with large vacuoles entered degeneration. Despite callose deposition around meiocytes, sterile plants did not form tetrads. They degenerated and collapsed after callose dissolution, forming an amorphous mass. Anthers from male-sterile plants were shrivelled. Up to date, several male-sterile, female fertile soybean mutants have been reported. It is very intriguing why most of them share the same cytological characteristics although they are non-allelic. Studies of genome organisation and linkage could help us to understand better why sterile mutations of independent loci shared the same cytological expressions.

P350. A study on cyto-morphological characteristics of cytoplasmic-nuclear male-sterile lines of soybeans in Nanjing, China

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For utilization of heterosis, a number of cytoplasmic-nuclear male-sterile soybean lines along with their maintainers and restorers were developed. The cyto-morphological characteristics of the cytoplasmic-nuclear male-sterile lines NJCMS1A, NJCMS2A and NJCMS3A developed at the National Center for Soybean Improvement were studied. Male abortion of NJCMS1A occurred mainly at early binucleate pollen stage with a variation from microspore mother cell (MMC) to tetrad, uninucleate microspore and binucleate pollen stages. The abortion of NJCMS2A occurred mainly at late uninucleate microspore stage with a variation from MMC to meiosis, tetrad, uninucleate microspore and binucleate pollen stages. The abortion of NJCMS3A occurred mainly at uninucleate microspore stage with a variation from sporogenous mass to MMC, tetrad and uninucleate microspore stages. The main abnormal phenomena arising during the development of microspores and anthers for NJCMS1A and NJCMS2A were as follows: (1) the MMCs degenerated, (2) lagged chromosomes and malformed spindle appeared in microspore mother cells, (3) the nucleus of tetrads malformed, (4) the tetrads degenerated, (5) the nucleus of uni-nucleate microspores appeared malformed, degenerated or collapsed, (6) the cytoplasm of uninucleate microspores got tenuous, shrunk or collapsed, (7) the vegetative nucleus and generative cell of binucleate pollens appeared malformed, degenerated or collapsed, (8) the pellets with membrane appeared in cytoplasm of uninucleate microspores, (9) the cytoplasm of the binucleate pollens got tenuous, shrunk or collapsed, and (10) the volume of the degraded pollens was smaller than that of their maintainers, and the texture of pollens was also different from that of their maintainers. But from appearance, most of the anther tissues developed still normally, only a few anther tissues such as the tapetum, anther chamber, anther wall and vasculature did not develop normally. However, The main abnormal cyto-morphological phenomena for NJCMS3A appeared somewhat different from the above two male-sterile lines and mainly as follows: (1) the differentiation of sporogenous cells and MMCs often didn't occur, (2) the tetrads degenerated, (3) the nucleolus of uninucleate microspore was abnormally large and the nucleus of uninucleate microspore degraded, (4) the cytoplasm of uninucleate microspore turned tenuous and shrunk, (5) the vasculature cells reduced, shrunk or degenerated, and (6) the anther wall did not develop normally. The abnormal vasculature might be one of the key reasons that led to pollen abortion of NJCMS3A. In summary, there showed differences in abortion stage, abortion way and development of anther tissue among the three male-sterile lines. The abortion of NJCMS2A occurred earlier and more thorough than that of NJCMS1A, which might be due to different nuclear backgrounds since both of them shared a same cytoplasm. The abortion of NJCMS3A occurred earlier and more thorough than that of NJCMS1A and NJCMS2A, which might be due to different cytoplasmic background.

P351. Evaluating the performance of soybean varieties and experimental lines for yield, agronomic traits and pest resistance under diverse environments within Arkansas, USA, and the distribution of results

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Choosing which soybean varieties to plant is a cornerstone of any crop production system. Producer's decisions about varieties are influenced by a number of factors and are becoming increasingly complicated. Replicated experiments are carried out each year to evaluate the performance of over 150 varieties under different environments including irrigated and non-irrigated, and using different production systems. These experiments result in information about yield, agronomic traits, pest resistance and tolerance to abiotic stresses. At all locations and during all years, statistically significant differences were recorded for yield. The results of these experiments are distributed to producers, the seed industry and agricultural consultants in written reports, via e-mail attachments, and increasingly, through a web site (ArkansasVarietyTesting.org).

P352. Breeding soybeans for the food industry

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The soybean breeding program that we have been carrying out at the Federal University of Viçosa, Viçosa, MG, Brasil, aims to develop a soybean germplasm with output traits better suited to the feed and food industries. With that in mind we have been creating germplasm containing null alleles for seed lipoxygenases. Such enzymes are reponsible for the grassy beany and bitter flavor normaly associated with soybean products. By using backcross procedures we have created a soybean germplasm containing genes for high protein content (above 45% on dry matter basis). Aiming to increase the soybean oil quality we have been introducing in our germplasm genes that control reduced levels of linolenic acid (~3%) by conventional backcross and we are also working toward increasing oleic acid content through plant transformation. In respect to anti-nutritional factors, we have been introducing in our germplasm null allles for the Kunitz trypsin inhibitor (KTI) and lectin. KTI accounts for about 80% of the total soybean seed protease inhibitors. The main objective in this case is to decrease the heat treatment which is required during soyflour production specially for use in the poultry industry. To better attend the food industry we have also been selecting larger seeds with white hilum and tegument. The backcross breeding program is assisted by single seed non-destructive analysis and whenever it is convenient the selected progenies are further analysed by molecular markers (microsatellites) aiming to select genotypes geneticaly closer to the recurrent parent. The soybean germplasm we have already available from this breeding program is mostly adapted to the central part of Brazil and consists of soybean lines: (1) with absence of lipoxygenases (LOX) in their seeds, (2) without LOX and KTI, (3) with high protein content (>45% on dry matter basis), (4) with high protein content, without LOX and KTI, (5) with high protein content, without LOX, KTI and with reduced levels of linolenic acid (~3%), (6) with high protein content, without LOX, KTI, lectin and reduced level of linolenic acid. Besides, the germplasm contains several lines with other combinations of these favorable traits. In the last year we have registered and sent for protection in the National Service for Plant Variety Protection "SNPC" four new productive soybean varieties - UFVTN 101, UFVTN 102, UFVTN 103 and UFVTN 104. These varieties are devoid of soybean seed LOX and are recommended to be cultivated in the state of Minas Gerais. Two other new productive varieties - UFVTN 105 (lacking LOX) and UFVTNK 106 (lacking LOX and KTI) have also been send to be r egistered in the SNPC.

P353. Gene introgression for high protein content into soybean elite cultivars

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In Brazil, most soybean breeding programs have been oriented toward the creation of more productive varieties and to increase oil content. These two traits are negatively correlated with protein content. Throughout consecutive cycles of selection protein content was drastically reduced in the commercial soybean varieties. As protein content influences the price of soy-derived products, it is extremely important to breed not only for productivity but also for high protein content. However, the source for alleles for high protein are usually PI 's or exotic germplasm which are often avoided in breeding programs because they tend to promote reduction on productivity. The negative correlation generally found between protein content and productivity in breeding populations is attributed to two

factors: 1) the donor parents which in most cases present low productivity, and 2) the reduced number of selection cycles. One possible way to minimize the negative association between high protein and productivity is to concentrate efforts on the development of adapted germplasms with high protein and high productivity by backcross assisted by molecular markers. In a second moment, these germplasms can be used to create new high yielding and high protein commercial soybean cultivars. With this strategy in mind, this work aimed to: (a) identify crosses with good combining capacity for high protein; (b) identify better donor progenitors for high protein; (c) evaluate protein content of F2 backcross progenies by non-destructive single seed analysis; (d) evaluate selection gain in F3, based on selection made in F2; (d) determine the molecular *fingerprints* of the selected genotypes to identify the ones closer to the recurrent parents. Seven commercial varieties from COODETEC were crossed with eighteen lines of the high protein germplasm developed at BIOAGRO/UFV. The genetic hierarchy model was used; the elite varieties from COODETEC were used as recurrent parents and the high protein lines as donor parents. Variance analysis demonstrated the existence of genetic variability in all crosses and high heritability for protein content (88.7%). The best donor parents were chosen based on the mean test at 5% probability. The protein content of F3 plants derived from F2 selected seeds were confirmed by the Kjeldahl method. The gains for protein content of selected plants ranged from 9.17 to 24.86% and the genetic distance to the recurrent progenitors ranged from 0.39 to 0.67. The high protein genotypes closer to the recurrent parents will be used for the next backcross generation.

P354. Selection of soybean lines for protein, yield and seed physiological quality

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This work was carried out to study the influence of selection for high protein content on soybean seed physiological quality and yield. Four BC_1F_4 and four F_4 populations from crosses between four commercial varieties and a line bearing high protein in the seeds were used. The populations were grown at "Prof. Diogo Alves de Mello" Experimental Field, in Viçosa, Minas Gerais State, during the growing season of 2001/2002. There was a tendency of high protein content selection to negatively influence the physiological quality of the seeds, although it was possible to select materials bearing both high protein content and good physiological quality of the seeds. The estimates of correlation coefficients between protein content and grain yield were variable among the analyzed populations, with a tendency to be negative. It was possible, for the majority of the populations, to select lines of higher protein content than their respective recurrent progenitors, simultaneously, with grain yield and seed physiological quality similar to their recurrent progenitors.

P355. Correlations and path analyses in eight high protein - high yield soybean populations

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The objective of the present work was to estimate the phenotypic correlations and the direct and indirect effects of grain yield components and protein content on grain and protein yields, using eight soybean populations. These eight populations were derived from crosses of lines bearing high protein content in the seed and four commercial varieties, being four in the BC_1F_4 generation and four in the F_4 generation. The main conclusions were: *i*) protein yield per plant followed the same tendencies of grain yield per plant; *ii*) the CD201-BC population presented positive correlations of protein content with protein and grain yields; *iii*) the grain yield components presented positive direct effects on both grain and protein yields; *iv*) the number of pods per plant was, among the grain yield components, the one that presented the largest direct effects on grain and protein yields, except for the OC13-CR population; *v*) the direct effect of the protein content on protein yield was positive but small; *vi*) the grain yield per plant was the main factor contributing to protein yield per plant.

P356. Inter - and intra correlations - in soybean populations derived from crossing between commercial cultivars and exotic germplasm

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In order to study the phenotypic correlations between characters, we derived populations from a partial diallel crossing between three exotic genotypes with a high oil content (*PI181.544, PI371.611* y *PI71.465*) and six cultivars with a high yield potential (*DM3800RR, DM48, DM501, TJ2046, A5634RG y A6401RG*). In 1999/2000, the crossings were carried out in the field and the F_1 in a greenhouse, at the INTA Marcos Juárez (Córdoba). In 2000/01, eighteen F_2 populations were sown at the UNSL in Villa Mercedes (San Luis), using a randomized complete blocks design with three replications. In 2001/02 five hundred F_3 populations were sown, from which three hundred and eighty eight F_4 families were obtained through modified SSD, which were sown in 2002/03 at three planting dates. Number of days to flowering (NDF), number of days to maturity (NDM), reproductive period (RP), grain productivity (GP), plant height (PH), weight of 100 seeds (SW) and oil percentage (OP) were evaluated. The analyses of simple correlation were done according to Pearson, within and between generations. Correlation estimates between characters within each segregation generation (F_2, F_3, F_4) show that GP has positive correlations ($r^+ = 0.04$ a 0.34) with the characters of the biological cycle (NDF, NDM and RP) and of the vegetative development (PH and SW). This enables the early indirect selection for yield and generates, on conducting line opening in $F_{5:6}$, a relative increasing frequency of plants with yield potential within the populations. Nevertheless, their low values ($r^+ < 0.34$) show that the early selection of heterozygotic plants for yield must be interpreted as a complementary strategy to traditional trials. Correlations between the biological cycle characters (NDF, NDM and RP) prove to be negative between NDF/RP ($r^- = 0.17$ a 0.27) and positive between NDF/NDM and NDM/RP ($r^+ = 0.53$ a 0.74). This shows that, as a result of the plant vegetative stage prolongation, the filling of grains period shortens or remains the same, which causes those plants with a higher vegetative development not to lengthen their reproductive stage, so reducing the risk of crop loss because of their long exposure to adverse weather factors. Correlation estimates between the same characters in different segregation generations (F_2-F_3, F_2-F_4, F_3-F_4) show positive correlations ($r^+ = 0.20$ a 0.60), except for GP, whose estimate is null ($r^- = 0.01$). This shows that selection in initial generations of self-fertilization may be effective for the characters of the biological cycle, vegetative development and grain density, but not the direct selection for grain yield. Indirect selection for yield must be interpreted as a complementary strategy of selection to the traditional trials for yield.s

P357. Analyzing the geographic positions of variety trials of soybean breeding programs in the central region of Brazil

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Locations to be used in a variety trial network of a plant breeding program must be chosen in such a way that the region, for which the program is conducted, is well represented. This study was carried out in order to analyze the geographic position of variety trial locations of Embrapa Cerrados' soybean breeding programs against spatial distribution of soybean harvested area in the central region of Brazil. The variable analyzed, soybean harvested area in each county, was picked up from IBGE tables, in 2001, for every county of the following states: Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, São Paulo, Bahia, Piauí, Maranhão e Tocantins. There are 3074 counties in these nine states. In only 660 counties (21%) the soybean harvested area was different from zero. The soybean production is highly concentrated in few counties: in just 29 counties (less than 5%) it was gathered 50% of the total area planted with soybean; in 64 (10%) counties it was gathered 70% and in 153 counties (23%) it was gathered 90% of the total area planted with soybean. A geographic information system, SPRING, release 4, was used to link Brazil's county network map with the table containing soybean harvested area per county. Following this step, three maps were drawn; each one showing the regions that concentrate 50%, 70% and 90% of the total area panted with soybean, respectively. Positions of the trial network locations were marked on these three maps. The two locations, Senador Canedo-GO and Planaltina-DF, where many segregating populations are conducted from F3 to F6 generations, are outside of the three regions with the greatest concentrations in soybean harvested area. As bulks have been assayed as a hole, instead of assaying each plant, the occurrence of natural selection is expected to be happening, contributing for genotypes more adapted to theses two locations. Preliminary tests take place in seven locations. Six of them are outside of the region that concentrates 50%

of soybean harvested area, and three of them are outside of those regions responsible for 70% and 90% of the soybean harvested area. Important regions in Mato Grosso and Bahia states don't have any preliminary test locations. The final trial network includes 36 locations. Twenty-one of them (61%) are outside of the region that concentrates 50% of soybean harvested area; fifteen locations (42%) are outside of the region with 70% of the harvested area, and ten locations (almost 30%) are outside of the region with 90% of the total soybean harvested area. Taking into account the importance and the expense of conducting final field trials, this study suggests a necessary change in the position of these ten final field trials locations.

P358. Stability of soybean cultivars [(*Glycine max* L.) Mer.] for grain yield and harvest index in the south of Buenos Aires province, Argentina

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The best yielding and most stable cultivars are identified by growing cultivars in different environments. When these environments are planting dates and row spacing, these identifications are very important, because it is possible to manage the cycle of cultivars with the object to obtain best grain yield and harvest index (correlated positively) avoiding hydric stress and high air temperatures on filling grain period. The objective of this work was to estimate grain yield (GY) and harvest index (HI) stability of 6 resistant to glifosato herbicide cultivars of Maturity Groups III and IV, sown in Balcarce in 14 environments, with the test of relative yield (RY) (Yau and Hamblin, 1993). The 14 assays were planted in 2 years: 1999 and 2000, on 5 and 4 planting dates (from october beginning until december ending) and 2 and 1 row spacing respectively. The cultivars, belonging to enterprisse Don Mario, in Argentina, were: DM 3000, DM 3600, DM 3800, DM 4050, DM 4400 and DM 4800. A split plot design and a randomized complete block design with 4 replications were used in 1999 and 2000 years, respectively. Each plot was 4 rows, 52 and 35 cm apart in 1999, and 40cm apart in 2000. GY was determined in the two central furrows in each plot, and HI, as a quotient between seed weight and plant weight belonging to 1 linear meter of row in 5 out 14 assays. With RY method, the GY and the HI of each cultivar in each environment are expressed relative to the average for the environment in which it were determined, assigning a value of 100 to the latter. The standard deviations of RY and RHI of each cultivar across environments were used as a measure of stability. The most stable cultivars will be those with the smallest standard deviations. Those with values higher than 100 will be cultivars with specific adaptability to a particular environment. The standard deviations for RY and RHI ranged between 8.3 and 19 and 2.4 and 4.3, and the RY and RHI values ranged between 97 and 112, and 92 and 102. The cultivars DM 3800 y DM 3000 showed the lowest values of standard deviations and the highest values of RY and RHI, in early and late plantings, with different spacing rows, in the 2 years. The positive correlation among GY and HI was again confirmed. The cultivar DM 4400 showed the highest values of RY and standard deviations (specific adaptability to environments of high grain yield). The cultivar DM 4800 showed specific adaptability in environments of low HI, and low standard deviation. It was concluded that it was possible to select cultivars with high values for GY and HI and with low standard deviations, in different environments of the south of Buenos Aires province, in Argentina.

P359. Influence of growing conditions on the expression of breeding success: the case of soybeans in Argentina

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Success of breeding can be assessed in terms of annual relative yield change (ΔRY, %). In wheat, faster rates of breeding progress have been achieved in more favorable environments (e.g. UK) in comparison to poorer environments (e.g. Australia). This study explored the environmental influence on grain yield improvement for soybean cultivars released in Argentina between 1988 and 2000. Five soybean commercial cultivars (MGIV) released in different eras were compared in field trials sown on October 26, 2000 (Season 1) and November 10, 2001 (Season 2) in Balcarce (37°45' S, 58°8' W, altitude 130 m, southern Pampas of Argentina). These cultivars were the most widely adopted by farmers in each era. Growing conditions in Season 1 included a "favorable" environment +W+F1 (+ irrigation, + mid-season application of fungicides) and a less favorable environment -W-F1 (rainfed, no fungicides). Four growing conditions were established in Season 2, which resulted from the factorial combination of water regime and fungicide treatment, i.e. +W+F, +W-F, -W+F, -W-F. Treatments were established in a randomized block design with four (Season 1) or three (Season 2) replicates. Grain yield was measured in 3 m^2 areas in the center of each replicate. Yields were

expressed as a percentage of the average in each treatment and season. Annual relative yield change ÄRY was calculated as the slope of the linear regression between grain yield and year of cultivars release. In Season 1, average yield of +W+F crops was 4859 kg/ha compared to their -W-F counterparts which yielded 3092 kg/ha. Season 2 was cooler and wetter than Season 1, with a negligible impact of water supply. These conditions favored the development of stem rot (Sclerotinia sclerotiorum, de Bary), particularly in well watered crops which showed an incidence of 32 - 35% in comparison to rainfed crops which had between 14 and 18%. There was no consistent variation in disease symptoms with year of cultivars release (P = 0.74), and yield was unrelated to disease incidence (P = 0.54). For the pooled data, yield gain was 1.1 ± 0.39 % per year (P = 0.009). The rate for well watered crops was 1.7 ± 0.59 % per year (P = 0.01) whereas significant yield gains were undetected for rainfed crops (P = 0.30). Yield gains associated with breeding were only evident in more favorable growing conditions, as was cited for wheat. This preliminary results contrasts with sunflower, which showed a consistent increase in tolerance to diseases with year of release.

P360. Developing high productivity soybean [*Glycine max* (L.) Merrill] lines for Mexican lowland Tropics

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In Mexican Tropic (14°-23° LN) it is needed to generate new high productivity varieties under the rainfed and short photoperiod condition in growing season. The National Soybean Genetic Program recently has generated new Lines for this purpose. This first one is H88-0930 was selected from the crossing between two elite lines, following single seed (H82-1930 x H80-2535) from F2 to F5 segregate population until derivate the new line H88-0930. It is indeterminate growth, violet color flower, and big size seed (16.2 g/100 seeds). It takes 42 days to flowering; and its plant height is 76 cm with 116 days to maturity. Average yield is of 2,481 kg ha^{-1}. The other one is DM-301 that was derivate from Dois Marcos-301. It is determinate growth, with violet color flower and small size seed (12.4 g/100 seeds). It takes 46 days to flowering; and its plant height is 78 cm with 109 days to maturity. It is also, tolerant white fly insect (*Bemisia spp.*). DM-301 has a wide planting period in both summer and winter season and its yield average is 2,331 kg ha^{-1}. In field evaluation since 1999 to 2002 was found that H88-0930 and DM-301, overcome 22 and 14% respectively the yield of the most commercial used variety Huasteca 200.

P361. Conjunct analyses of results obtained to agronomic characters of soybean genotypes grown in Ipameri, GO and Jaboticabal, SP in the agricultural year 2002/2003

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One of the main objectives of Brazilian soybean breeding programs is to obtain genotypes with good agronomic characters and adaptability to soil and environmental conditions. Aiming to compare the development of soybean genotypes grown in two soybean-producing regions of Brazil, one located in Ipameri /GO (latitude 17° 15' 52" S) and another in Jaboticabal /SP (latitude 21° 19'03" S), the conjunct analyses of the results obtained to the agronomic characters studied were performed. We compared twenty-three soybean genotypes from the soybean breeding program of Departamento de Produção Vegetal - FCAV /UNESP / Jaboticabal /SP and two pattern cultivars, BRSMG 68 (Vencedora) and MG/BR-46 (Conquista). The statistical design of both experiments was randomized blocks with four replications. Plots were made up of two 0.45m spaced 4-meter lines. The soughing dates were 11/21/02 (Jaboticabal /SP) and 11/23/2002 (Ipameri /GO). The characters compared were plant height, insertion height of the first pod, lodging, weight of 100 seeds, and grain yield. A 1 to 5 grading proposed by Bonnetti (1983, Soja: Genética e Melhoramento p. 741-800) was used to evaluate lodging; 1 corresponds to almost all plants erect; 2, to all plants slightly bent; 3, to all plants moderately bent; 4, from 40 to 80% of plants bent; 5 all plants lodged. Conjunct analyses have shown no significant interaction between genotype and locality to all characters, except for lodging, which showed significant interaction at 5% of probability.

P362. Correlation between agronomic characters from soybean genotypes grown in Jaboticabal, SP and Ipameri, GO, in the agricultural year 2002/2003

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Many aspects related to the soybean botanical characters and architecture, some of which more

influenced by environmental conditions, are correlated to productivity. Aiming to study the correlation among some agronomic characters and the soybean yield, correlation analyses were performed among plant height at maturation, insertion height of the first pod, number of pods, number of branches, number of nodes, weight of 100 seeds and productivity obtained from the experiments carried out in Ipameri /GO and Jaboticabal /SP. Twenty-five soybean genotypes were analyzed, being 23 genotypes from the soybean breeding program of Departamento de Produção Vegetal /FCAV / Jaboticabal /SP and two pattern cultivars, BRSMG 68 (Vencedora) and MG/BR-46 (Conquista). In both localities the statistical design was randomized blocks with four replications. Plots were made up of two 0.45m spaced 4-meter lines. The soughing dates were 21/11/2002 and 23/11/2002 in Jaboticabal /SP and Ipameri / GO, respectively. The results showed that in Jaboticabal /SP there was a positive and significant at 1% of probability correlation among the parameters number of branches, number of pods and productivity, and at 5% of probability between weight of 100 seeds and productivity. In Ipameri /GO, there was a positive and significant at 1% of probability correlation between weight of 100 seeds and productivity.

P363. Performance of soybean cultivars in the region of Uberlândia, MG, Brazil in two years and differents sowing seasons

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This experiment was conducted in the city of Uberlândia, Minas Gerais, in Canada farm (ABC A&P group), using a randomized block design, with 4 replications. Each plot had 4 lines ,each 5 meters long, considering the two center lines and disregarding 0.5 m at each end, with userfull parcel consisted 3,6 m^2. The following characteristics were evaluated: age and height at flowering, age and height at maturation, percentage of humidity and kilograms per hectare. Sowings were carried out on two days during the seasons of 2001/02 (on November 19 and December 13) and 2002/03 (on November 20 and December 18) using several cultivars available in the market: E-316, LIDERANÇA, VENCEDORA, MSOY-8200, CONQUISTA, DM-339, SANTA-CRUZ, LUZIÂNIA, MSOY-8400, E-313, GARANTIA, MSOY-8866, MSOY-8713, DM-VITÓRIA, JATAÍ, SAMBAÍBA and MSOY-8870 These cultivars were submitted to the TUKEY test at 5% of significance. All the cultivars presented a productivity of over 3,000 kg per hectare, with excellent performance, and with no statistical difference among them. The best results were observed with cultivars LUZIÂNIA and MSOY-8400 with 3978 and 3960 kg ha^{-1}, respectively.

P364. Verification of lineages of soyben of the improvement program of the Federal University of Uberlândia

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With the objective to evaluate ancestries of the improvement program of soyben (*Glicine max*) of the Federal University of Uberlândia, experiment in Capim Branco Farm was carried through with 15 ancestries UFU, beside of 2 varieties witnesses (Carla and Msoy-8200). The used experiment was done with randomized blocks, the parcels had been constituted of a line of 6m, spaced of 0,90m between lines, having as useful parcel 5,4m^2, in four repetitions. The experiment was initiated with the sowing in the date of 12/20/2002, had been used in the treatment of fungicidal seed, cobalt + molibidenium and inoculate (*Bradyrhizobium japonicum*) The evaluated characteristics had been: Date of flowering (DF), and maturation(DM), height in flowering (HF), maturation(AM), and of the insertion of first pod (IFP), illnesses, productivity in (KGHA) and productivity for plant(IPLAN), the evaluation of the budding was made in the R_{1-2} stadium, with about 50% of the opened flowers, evaluation of the harvest in the R_{7-8} stadium, with about 95% of mature plants in the FEHR scale et al. (1971), with humidity of 12-15% in the seeds and evaluation of illnesses with note scale of 0 the 4, where 0 = plant without attack, 1 = 25% of the attacked plant, 2 = 50% of the attacked plant, 3 = 75% of the attacked plant and 4 = 100% of the attacked plant, being you consider resistant 0-1, and liable the 2,3 and 4 illnesses in field. Treatment UFU 110 presented the best one resulted how much the productivity, however not differing from treatments UFU 115, 112, the 113 and worse ones resulted had been, UFU 119 and 109 differing only from the best one resulted, how much to the test of Tukey 5%.

P365. Behavior of soybean genotypes derived from the genetic program improvement from the Federal University of Uberlândia - MG

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With the objective to evaluate soybean lineages, in preliminary assay, of the program improvement of the

Federal University of Uberlândia, six assays had been installed in Capim Branco Farm with cycles of semiprecocious, average and semilate maturation. Each experiment consisted of 15 genotypes and 3 varieties (STTB-2, Msoy-8200 and Msoy-8222). The used delineation was of randomized blocks, with the four repetitions, being each experimental parcel consisting by a line of 6 meters, spaced of 90 centimeters between lines, with useful parcel of 5.4 m^{-2}. The characteristics evaluated in the field had been: income of grains, gram for plant, stand, number of days for budding and maturation height of the plant in the budding and maturation addition height of insertion of the first string bean. For the observed results, it was verified that in 2 assays and 4 the presented data had not possessed significant difference for the test of F, 5% of probability. Through the averages observed in assays 1 and 3, it was noticed that it had difference statistics, 5% of probability, for the test of Tukey, where the lineages UFU-02-9-1172 (1949 kg Ha-1), UFU-02-1-496 (1945 kg Ha-1) and UFU-02-6-599 (2355 kg Ha-1), had gotten productive potential greater, respectively, in relation to the varieties standards. For assay 5 bigger income of grains was observed, to cultivate Msoy-82222 (2391 kg Ha-1), being the too much genotypes with intermediate behavior. In experiment 6, to cultivate them STTB-2 and Msoy-8200, had presented minor income of grains, while the UFU-02-10-1482 genotypes (2620 kg Ha-1), revealed more productive.

P366. Evaluation of ancestries of soybean in preliminary assay in the region of Uberlândia, MG

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Two experiments of soybean in pertaining the Capim Branco Farm had been carried through the Federal University of Uberlândia-MG, with the objective to evaluate the behavior soybean of lineages the program of genetic improvement of the UFU. The treatments, with cycles of average, semilated and late maturation, consisted of 15 genotypes and 3 cultivate (A-7002, DM-Vitória and Luziânia), for each assay, the used delineation was of randomized blocks, with the four repetitions. Been each experimental parcel constituted by a line of 6 meters, spaced of 0.90 meters between lines, with 5.4 useful parcel of m^2. The characters evaluated in the field had been: income of grains, gram for plant, stand, number of days for budding and maturation height of the plant in the budding and maturation and height of insertion of the first string bean. By means of the gotten data, variance analysis was become fullfilled, being the averages compared for the test of tukey with the level of 5% of probability. It can be observed for experiment 1 that lineages UFU-02-8-135, got productive value (1847 kg ha-1), being superior will cultivate them, in contrast to 4 genotypes that had presented relatively low productive potential, varying of 622 the 855 Kg/ha-1. In assay 2, the biggest income of grains was verified in three lineages (UFU-02-5-1311, UFU-02-8-1314, UFU-02-9-1315) and a variety (Luziania), with productive values of 1556, 1499, 1254 and 1162 kg.ha-1, respectively.

P367. Bioinformatics tools for sequence analysis and annotation applied to Soybean Functional Genome

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Worldwide functional genomics studies are making an important role on biotechnology for the identification of genes that can be use in the improvement of specific biological processes in plants. Large-scale gene discovery projects like that depend on high accuracy of the data. The data should not only be trustworthy but should be correctly annotated for various features it contains. In this work we report a bioinformatics system designed to process and annotate the expressed sequence tags (ESTs) obtained by the project Functional Genome of Soybean Roots at Embrapa Soybean (http://www.cnpso.embrapa.br/bioinformatica). The system is made of Perl and PHP scripts, which performs the automated sequence analysis and support the annotation process based on a MySQL database. Various Perl scripts was written to assist the sequence analysis process that includes basecalling, clustering and assembling the reads, filtering of contaminating, repetitive and low quality sequences, identification of sequence features, BLASTing and reports generation. BLAST (Altschul et al., 1997, Nucleic Acids Res. 25:3389-3402) outputs are processed and disposed on a way that is easily accessed by the personal that performs the massive handle of the data for annotation. Also, PHP scripts was written to make a friendly annotation interface through dynamical Web pages that perform the database operations needed for the complete annotation of the genes, whish comprise data retrieval aided by query searches linked to key words, data insertion, update, and generation of intuitive reports describing the results. These tools are helping to direct our work on identification, cloning and characterization of genes and regulatory sequences potentially useful in the improvement of soybean through genetic engineering. As results nearly 8,000

ESTs was obtained form cDNA clones derived from soybean roots in drought stress and nematode infection conditions. Consensus sequences are being functionally annotated and used to construct cDNA microarrays that will be useful for analyze gene expression under a broad variety of conditions. Initially we are studying drought stress and nematode infection conditions. Analysis of interactions of soybean roots with this defiance conditions will be used do identify new possible sources of resistance and tolerance. Candidate genes will be deeply studied and can be used on the production of transgenic plants. This work was supported by grants from CNPq, PRODETAB, Jircas and Embrapa.

P368. Genetic diversity of soybean in the humid tropic of Mexico using AFLP markers

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Studies of soybean *Glycine max* (L.) Merrill has revealed that this species, has a low level of genetic diversity in comparison with other self-pollinated species. In order to determine the need to introduce new germplasm for the development of new varieties, the genetic diversity of soybean from the humid tropical region of Mexico was evaluated, using AFLP markers. A total of 24 lines developed in Mexico and 9 introductions from other countries were analyzed. Results revealed that the lines did not group together according to their geographical origin. A high polymorphism level (59%) was observed and Mexican genotypes, share a high level of genetic similarity with those of Brazil. The genetic diversity index was low (33%), and similar to that reported in other studies. Although the sample of genotypes did not represent all soybean germplasm of the humid tropics, the results suggest that enough genetic variability exists to generate new cultivars, since three of the Mexican lines were more divergent than the genotypes considered phylogenetically different from other countries, which were used as controls.

P369. Regeneration rate of soybean cultivars and their susceptibility to *Agrobacterium tumifaciens* EHA101 with pPTN140 and transformation

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The soybean transformation procedure can use the *Agrobacterium*-cotyledonary node transformation system and the bar gene as the selectable marker coupled with glufosinate as a selective agent. Cotyledonaty node from 5 to 6 day germinated soybean seeds was used as explants. Then wound explants by making a cotyledonary node slicing 5 to 6 times , inoculate explants with *Agrobacterium tumefaciens* EHA101 with pPTN140, then do co-cultivation for 3 days by using co-cultivation medium, then wash the explants by using wash medium which contain antibiotic, put explants onto shoot initiation medium with 5mg/L glufosinate selection, after 2 weeks of cultivation count the regeneration rate of different soybean cultivars, after 4 weeks of cultivation check their susceptibility to *Agrobacterium tumefaciens* by doing Gus assay. According to our experiments: Heinong 35, Zhongzuo 975(Zhonghuang No.13), Hefeng 35, Heinong37, William 82 and PI361066 are better genotypes than Thorne for regeneration and transformation.

P370. VSQual: a visual system to assist the DNA sequencing quality control

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A lack of pliant software tools that support small to medium-scale DNA sequencing efforts are a major hindrance to recording and using laboratory workflow information to monitor the overall quality of data production. To solve this task we developed a series of Perl programs that makes up a package called VSQual. This package gives rise to a Web-based graphical interface, which allows us on organizing, using and monitoring the reliability of DNA sequencing workflow data generated by automated sequencers. The package is a flexible pipeline system designed to be accessible and useful to both programmers and nonprogrammers. For each DNA sequence read, the system generates an intuitive report in FASTA colored format with visual quality information of each nucleotide

position, based on Phred scores (Ewing *et al.*, 1998, Genome Res. 8:175-85): red stands for Phred score < 10; green stands for Phred score > = 10 and < 20; blue stands for Phred score > = 20 and < 30; and, black stands for Phred score > = 30. Also, on this report, a trace viewer permits an inspection of all chromatogram extension with a graphical view of Phred score for each base. A general report for each 96-well plate is produced on a plate shape figure where the sequence quality is reported as a colored button for each well. This 96-well shape report functions as a fully clickable map, giving access to each sequence on FASTA colored format and trace viewer as described above. On the 96-well report, as default, green stands for an insert fragment of 200 or more bases with Phred score > = 20, yellow stands for a vector fragment of 200 or more bases with Phred score > = 20 if the first statement was not true, and red stands for a lower quality sequence. These parameters (Phred score and fragment size) are adjustable by the VSQual user. VSQual runs on any computer platform for which Perl is available (including Linux, Unix®, Microsoft® Windows®, and Mac® OS) and manages the data from ABI sequencer to obtain the Phred .fasta, fasta.qual and .scf, and Cross_match .fasta.screen output files which is used to build the reports on HTML format that is ready to access through any Web browser. On our lab the reports are automatically produced and placed on a local Intranet, running Apache Web server, to be used by the laboratory people. An example of the VSQual reports is disposed at http://www.cnpso.embrapa.br/bioinformatica. As our lab works based on 96-well plate shape, the scripts are designed to handle 96-well plate data but it can be customized for operate 384-well plate with few script changes. This work was supported by grants from CNPq, PRODETAB, Jircas and Embrapa.

P371. Identification of soybean genotypes using microsatellite markers

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Molecular markers are useful tools for evaluating genetic diversity and determining cultivar identity. The knowledge of the genetic pool of a plant specie is important to characterize genetically cultivars that are released for the seed market. Soybean cultivars have been characterized mainly by morphological and biochemical traits. As the new cultivars are the result of crosses between elite genotypes, it has been more difficult to distinguish them. The purpose of this work was to evaluate the genetic diversity within the soybean (*Glycine max* (L.) Merr.) germoplasm collection from Syngenta Seeds Ltda, in order to determine the genetic variability among them and provide a subsidy to the soybean breeding program. Forty-nine soybean genotypes were evaluated by 19 microsatellite (SSR) markers. A total of 109 alleles were detected varying from 20 to 500bp in an agarose gel. The number of alleles per marker ranged from 2 to 7. A dendrogram based on the SSR loci profiles showed that the maximum genetic distance calculated among the soybean genotypes was 72%. The group with higher similarity showed 9% of genetic distance (BA716362-W and BA716362-P; BRSMG Garantia e BRSMG Péta-la). These results proved the high level of relationship between these genotypes, because the first group belongs to the same genealogy, only differing for flower color (white and purple, respectively). The genotypes from the second group also have some common relatives in their genealogy. The higher genetic distance (54%) was observed for the lines BA716233 and OC-18, suggesting high variability between them. The relatively small number of SSR primers were sufficient for the estimation of genetic identification of these soybean genotypes.

P372. Molecular markers linked to the juvenile locus in soybean

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Soybean [*Glycine max* (L.) Merr.] genotypes carrying the long-juvenile, LJ, trait show delayed flowering under short-day conditions when compared with their conventional counterparts, CJ. This trait is controlled by a single recessive gene, and the symbol *J/j* has been assigned for alleles conditioning the flowering response (*J-*, CJ, and *jj*, LJ). In addition to its importance in extending vegetative period under highly inductive conditions (*i.e.* short photoperiods and high temperatures), the LJ trait could be useful in studying the floral induction process in soybean. The objective of this work was the identification of molecular markers, MM, linked to the LJ locus for assisting in breeding programs aimed to the introgression of the gene. Two pairs of near isogenic lines (NIP1 and NIP2) of soybean differing in the presence of the LJ trait were used. Crosses between CJ and LJ lines within each pair were done to obtain the hybrids. The F2 individuals were classified as having the LJ or CJ phenotype by comparing their flowering date with the flowering date of their parents. CJ F2 individuals were discriminated between homozygous (*JJ*) and heterozygous (*J-*) genotypes by progeny testing at F3. Two MM

techniques were used: i) Random Amplified Polymorphic DNA, RAPD, and ii) Amplified Fragments Length Polymorphism, AFLP. For the RAPD analysis 400 random primers (oligodecamers) were assayed. Additional polymorphisms were searched for by digesting genomic DNA with the restriction enzymes *Alu*I, *Hae*III, *Hind*III, *Eco*RI or *Taq*I. For AFLP analysis genomic DNA was digested with *Eco*RI and *Mse*I enzymes. A hundred forty-four primer combinations generated about 17,400 MM. A RAPD marker, named bc357-*Hae*III, was obtained in NIP2. This marker was linked (χ^2 L = 46.32) to the locus studied, with a recombination frequency (r) of 0.13 ± 0.03. The fragment was cloned, sequenced, and converted into a sequence characterized amplified region (SCAR), and to a restriction length fragment polymorphisms (RFLP) probe. Both, SCAR and RFLP markers were linked to the long-juvenile locus (r = 0.14 ± 0.05 and 0.20 ± 0.05, respectively). Moreover, a AFLP fragment, named E44M37-272, was obtained in NIP2. It was co-dominant and linked (χ^2 L = 31.34; r = 0.27 ± 0.07) to the long-juvenile locus. All markers work in the two genetic backgrounds studied and could be used for an early detection of LJ plants in a segregating population. They can also be employed as a starting point for the isolation of the long-juvenile gene.

P373. Sequence analyses of mutagenized SSR loci and relationships between these loci and varied phenotypic traits in soybean (*Glycine max L*)

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Microsatellites or SSRs are a powerful tool for genetic analysis, genotype identification and evolution research. Objectives of this study are to analyze sequences of mutagenized SSR loci in genome of soybean mutant E182 induced by EMS and relationships between these loci and varied phenotypic traits. PCR product length differences between mutant and wild parent genome DNAs were amplified by using fifteen polymorphic primer pairs from 485 soybean SSR primers. Sequence analyses showed that di- and trinucleotide repeat number changes in fifteen SSR loci occurred in mutant genome, and these loci were Satt005, Satt117, Satt185, Satt282, Satt290, Satt420, Satt452, Satt483, Satt569, Satt579, Satt600, Satt602, Sat_086, Sat_107 and Sat_135, respectively. Trinucleotide repeat [most (ATT)n] changes were detected in the former twelve loci, and dinucleotide repeat (AT)n changes detected in the latter three loci. In fifteen mutagenized SSR loci, Satt282, Satt483, Satt579, Satt600 and Satt602 were observed to respectively delete 1-, 3-, 8-, 20- and 1 trinucleotide repeats, while microsatellite sequences in the other ten loci were inserted 1-, 6-, 6-, 3-, 4-, 3-, 8 trinucleotide repeats and 12-, 6-, 16 dinucleotide repeats, respectively. Four mutational biases were found, which were: 1) insertion mutations in repeat numbers; 2) trinucleotide-repeat changes; 3) beginning-position mutations of repeat sequences; and 3) both-flanking bases T and A of mutational positions. On the other hand, of fifteen SSR loci with repeat number variation, flanking regions of repeat sequences in seven SSR loci (Sat_107, Satt185, Satt282, Satt420, Satt569, Satt579 and Satt600) were detected to have eleven events of single base mutations. These single base mutations were consisted of 6 transitions (including four T→C and two A→!G), 2 transvertions (one A→T and one T→A), 1 insertion (one T) and 2 deletions (one A and one T). Among them, transitions were more than transvertions, and the most of base substitution types was transition of T→C. This study proved that the effectiveness of SSR multilocus mutations chemically induced by EMS was remarkable. Statistic analysis from progeny populations indicated that correlations between four mutated SSR loci (Satt117, Satt185, Satt452 and Satt483) and the varied trait of narrow leaflets were extremely significant, and so were correlations between two mutated SSR loci (Satt579 and Satt600) and the varied trait of 4-seeded pods in soybean mutant E182. Any relationships between the eight mutated SSR loci and two varied phenotypic traits of mutant were not found.

P374. Origin of embryo-like structures in soybean anther culture investigated using SSR marker

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The diploid origin of early calluses in soybean anther culture was recorded by some authors. Since the somatic tissues of mature soybean are known to be highly recalcitrant, it was assumed that, it was unlikely that embryos were derived from anther diploid tissues. However, in the course of our studies, embryo-like structures (ELS) originated from connective calluses were observed. That ELS were similar to those obtained from anthers, indicating the embryogenic ability of connective. The Satt418 microsatellite locus was examined in order to investigate the origin of ELS obtained from soybean anther culture. Four heterozygous plants derived from the cross BRQ96-3065 x BRSMG-Liderança were used as anther donors. A total of 7000 anthers were placed on the induction medium under culture conditions recommended to trigger androgenic response. After 60 days of culture, upper portion of 216 ELS were carefully cut and

transferred to a proliferation medium, in order to obtain sufficient tissue for DNA extraction. Callogenic masses originated from 114 ELS were screened for the Satt418 microsatellite locus. ELS originated from plants number 1 and 2 were exclusively heterozygous. In plants 3 and 4, heterozygous and homozygous ELS were identified, suggesting occurrence of somatic embryogenesis and androgenesis in the same system. This unexpected morphogenic response seems to be genotype-dependent and confirm that anther culture is a limited system to trigger androgenesis in soybean, since ELS can be originated from diploid tissue (Supported by CNPq, FAPERGS and CAPES).

P375. The diversity of storage protein components affected by soybean genotypes, years and locations

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The objective of the study was to determine the range of the contents of glycinin(11S) -conglycinin(7S) and the ratio of glycinin(11S)/ -conglycinin(7S) in diferent soybean genotypes and to estimate the impact of year and location on the components of 11S, 7S and the ratio of 11S/7S. The results showed that the subunits of storage protein in the different genotypes were significantly different. The 11S and 7S protein from overseas were different in contrast to those from china, and the genetic variation of overseas soybeans was wider than that of china. The protein band patterns of different types of soybeans were similar. The ratio range of 11S/7S in the whole germplasm that was used altered from 1.34 to 3.7, and the average ratio was 2.36. Significantly negative correlation existed between 7S and 11S proteins. The variances for 7S protein, 11S protein and the 11S/7S contributed by location, variety, year, location × variety and variety × year were significant ($P < 0.05$).

P376. Bioassay method for identifying and detecting genetically modified soybean

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There are several commomly used GMO testing protocols, including biological tests, as well as ELISA and PCR tests, for herbicide and insect tolerance. Growers and end-users should consider the advantages and disadvantages of the various testing methods before harvest. Exporters should probably resign themselves to the most rigorous testing protocol, to anticipate the additional scrutiny their products will receive overseas. Large food processors are currently using a combination of tests for identity-preserved (IP) grains. The herbicide bioassays could be used to detect GMO herbicide tolerant traits in Roundup Ready and Liberty Link soybeans and corn. The current test involves placing seeds in a germination media, moistened with a diluted solution containing the herbicide, or spraying the herbicide on seedlings. Seeds that test positive for the presence of the herbicide-tolerant GMO trait will germinate and develop normally, whereas those that die or not develop normally will be GMO-free. Because it is relatively inexpensive, this procedure is widely used by seed producers and grain companies exporting soybeans in the USA. Therefore, the main goal of this research was to test a modified herbicide bioassay for soybean tolerant to glyphosate. Four hundred seeds of conventional soybean, cv. BRS 133 and BRS 214 and RR soybean, cv. BRS Baliza, were imbibed in a solution of 400 ppm glyphosate (i.a = 360gL-1) for 6 hours in the laboratory room. After treatment, seeds were germinated in a paper rolls with four replications at 25° C, for 3 days. The seedlings were classified as a normal, abnormal and susceptible to the herbicide. The trials were replicated six times in order to validate the protocol. The susceptible seedlings presented reduced growth and no secondary roots and the abnormal seedlings are due to low vigor. The RR soybean germinate 96% against 0% (zero) for conventional soybeans. The test showed significant differences between conventional and RR soybean, facilitating the distinction among treatments. The great advantage of this modified protocol was that results could be obtained in three days against six days as it was proposed before. Besides the low cost and a quicker test, the herbicide bioassay seems to be a promising test for detecting GM soybean by seed producers, end-users and exporters. Researchers are being carried out at Embrapa Soja in order to reduce the test time for one day.

P377. Monitoring GMO soybean cultivation in Brazil

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In Brazil the cultivation of GMO soybean is prohibited by law. However, soybean fields planted with GMO illegal seeds from Argentina have been detected, especially in the state of Rio Grande do Sul. In other states, such as Mato Grosso and Mato Grosso do Sul only minor areas with transgenic soybean have been detected. The Federal Government authorized the commercialization of the GMO seeds harvested in 2003 and more recently the cultivation of GMO seeds for 2003/2004 was also authorized. However, the soybean

producer can only use his own seeds for this purpose. This measure was especially intended to attend the soybean growers from the state of Rio Grande do Sul. Up to the present moment, no in depth evaluation of the real situation of GMO planting in Brazil has been made. In this sense, we have evaluated samples of soybean seeds used for the agricultural year 2002/2003 collected in four brazilian states (Mato Grosso, Paraná, Rio Grande do Sul and Minas Gerais). Approximately 2.500 samples were obtained from seed analysis and certification laboratories, and from cooperatives, and analyzed for the presence of the RR gene by the polymerase chain reaction technique. Fourty-two percent of the samples were from Mato Grosso representing more than four million 50 kg seed bags; 39.5% from Rio Grande do Sul sampled from a total of 11,000 samples sent for analysis in the state; 8.4% from Paraná sampled from about 200 growers of the state and 10.1% from Minas Gerais sampled from soybean producers in 12 counties. Our results showed that only samples collected in the state of Rio Grande do Sul presented GMO seeds. In this state 19.7% of the samples analyzed were GMO positive. These results confirm that a large proportion of the soybean seeds planted in this State is transgenic. However, there is certainly a bias in these results considering that the samples analyzed were those that follow the regular procedures for seed certification. We conclude that there is a direct correlation between seed certification and the non-GMO origin of the seed samples. It is clear that the growers of GMO soybean seeds are not using the legal system for seed analysis and certification. As support to this idea, it is noteworthy that around 20% of the seeds sent to the certification laboratories in Rio Grande do Sul in the agricultural year 2002/2003 were only sent for germination analysis.

P378. Growth and lignification evaluation of Roundup-resistant and non-resistant soybean (*Glycine max* (L.) Merrill) cultivars in response to ferulic acid

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RR (Roundup resistant) soybean is characterized by having an introduced gene, which encodes the glyphosate-tolerant EPSP synthase. This enzyme takes part of the phenylpropanoids via, which is responsible for the synthesis of most secondary metabolites, essential aromatic aminoacids and lignin. In the non-resistant cultivars, glyphosate binds the molecule of this enzyme and blocks its activity. In this work, growth and lignification of CD-201 and CD-214RR cultivars (seeds provided by Cooperativa Central Agropecuária de Desenvolvimento Tecnológico e Econômico Ltda – COODETEC, Cascavel, PR, Brazil) were compared before and after a treatment with ferulic acid. This is an allelochemical compound of the group of phenolic acids, which is widespread in nature and known for its effects on lignin synthesis enhancement and plant growth reduction. The questions this work intended to answer were whether the Roundup-resistant soybean presented a similar behavior to the non-resistant cultivar after ferulic acid treatment and whether this Roundup resistance would provide more resistance to the effects of phenolic acids. Experiments were set up using four replications of 25 three-day-old seedlings. Roots length were measured and seedlings were transferred to containers filled with 200mL of Hoagland's nutrient solution, containing or not 1mM-ferulic acid. After incubation (24 hours; 12-h photoperiod; 25°C, 280 mmol m^{-2} s^{-1}), roots were measured and fresh and dry biomass were determined. Lignin quantification of dry roots was conducted through the use of a quantitative assay for protein-free lignin measured by thioglycolic acid reaction. The results showed that ferulic acid reduced the seedlings root growth (50% for CD-201 and 42% for CD-214RR) and the fresh biomass (8% for CD-201 and 14% for CD-214RR), in comparison to controls ($P<0.05$). Fresh biomass was 10% higher in CD-214RR control group and 2.9% higher in treated seedlings, comparing to CD-201 seedlings ($P<0.05$). There were no influence of cultivar or treatment on dry biomass and lignification.

P379. Detection and quantification of GMO residues in grains and derived foods

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The demand for analysis for the presence of transgenic residues in grains and derived products in Brazil has increased dramatically in the last few years. This is a direct consequence of the restrictions on import of GMO products by the European Community and of the illegal use of the Round-up Ready (RR) soybeans in the state of Rio Grande do Sul. To attend this demand, researchers at the Biotechnology Institute (BIOAGRO) of the Federal University of Viçosa developed and optimized techniques based on the polymerase chain reaction (PCR) to detect and quantify GMO residues in foods, and the same time created the company AgroGenética to perform the analyses. In this work we give an overview of the results obtained by AgroGenética since the year of 2000. We understand this overview will give an idea of the presence of GMO

in grains and derived products consumed in Brazil and exported to other countries. For the qualitative analyses, DNA samples were extracted by the Wizard method (Promega) and the transgenes (or sequences associated to them) were amplified with specific primers. To detect the RR gene, three primer-pairs were used: one annealing to the CaMV 35S promoter region, one to the coding region, and one to the NOS terminator region. Following amplification the DNA fragments were separated in 3% agarose gels containing ethidium bromide, and visualized under UV light. For the quantitative analyses, DNA samples were extracted with the PreMan-Ultra kit (ABI) or by an in-house procedure depending on the type of product analyzed. The DNA was quantified by real-time PCR using the TaqMan® methodology. The sequence amplified was the CaMV 35S promoter region which is present in most GMO released for commercial use. In the year 2000 the main products sent for analysis were soybean and corn grains, and also different kinds of soy-derived protein products. After that year, the products analyzed included seasonings, oil, corn starch, mixtures for cake, lecitin, and rations for animals. In 2001 the first analyses of meat products were done. In 2002, 12.3% of all analyses corresponded to meat products. There was a gradual increase on samples which were positive for the presence of GMO residues. In 2000, only 5% of the total samples analyzed were positive for GMO. That figure raised to 11.5%, to 28.5% and to 32.3% in the years of 2001, 2002, and 2003, respectively. Within the different classes of products, the soybean grains had the highest increase on the number of positive samples. It increased from 12.96% in 2000 to 64.2% in 2003. Our data confirm that despite the prohibition on the cultivation and commercialization of GMO products in Brazil they are present in the country at least since 2000.

P380. Behavior of soybean [*Glycine max* (L.) Merr.] genotypes transformed with the AHAS gene which confers tolerance to the herbicide imazapyr

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The transformation of the soybean [*Glycine max* (L.) Merril] cultivars BR-16 and Doko with the gene AHAS isolated from *Arabdopsis thaliana* resulted on the development of genotypes tolerant to imazapyr. In order to compare the conventional genotypes BR-16 and Doko (no sprayed) with their transformed counterparts (sprayed with imazapyr 100 g ae/ha) a trial was conducted in the greenhouse in the winter of 2001 (sowing occurred in july 2001). At harvest, the plants were divided in three thirds and the number of pods and seeds counted, the seeds weighted and the average number of seeds per pod determined. The genotype BR-16-AHAS was much more affected than Doko-AHAS when the genotypes were compared with their conventional counterparts. Since that the effect of the gene AHAS and the effects of the herbicide could not be separated, another experiment, only with the two AHAS genotypes (BR-16-AHAS and Doko-AHAS) and the application of zero and 100 g ae/ha of imazapyr during the summer (seeding occurred in December 2001) was conducted. The same observations made in the winter experiment were made and also, the height of the plants and the number of nodes were recorded. In this trial, the relative responses of the two genotypes were similar to the winter results, but the herbicides effect differed mainly on the most affected position in each genotype. Doko in the summer produced fewer pods in the medium third and, in the winter, in the upper third. The herbicide imazapyr applied on the dosage of 100 g ae/ha on transformed tolerant soybean with the AHAS gene may induce the development of sterile pods, mainly on the nodes located on the upper parts of the plants. The effect is due to the herbicide and not to the inserted gene and is more visible in winter conditions (lower temperatures and short-day conditions). This effect is very pronounced on BR-16 and less evident on Doko. Field trials should be done to evaluate the risks in commercial conditions.

P381. Genetic similarity between soybean cultivars released in Brazil, using AFLP markers

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Genetic similarity between soybean cultivars was studied applying the AFLP (amplified fragment length polymorphism) technique to 317 soybean cultivars released in Brazil from 1962 to 1998. Genetic similarity (GS) coefficients were estimated according to Nei and Li (1979) and the cultivars were clustered by the UPGMA (unweighted pair group method using arithmetic averages) method. The parentage coefficients of 100 cultivars released between 1984 and 1998 were calculated and correlated with the GS coefficient obtained by the markers. AFLP analysis showed approximately 394 bands, 78 of which were polymorphic, with a mean number of 13 bands per primer combination. The GS coefficients varied from 0.17 to 0.97 ($x=0.61$), with 56.8% of the coefficients being above 0.60 and only 9.7% equal or down than 0.50. The similarity coefficients have remained constant during the last three decades. Bootstrap analysis indicated that the 78 polymorphic markers were

sufficient to assess the genetic similarity among the 317 cultivars, due to the relatively low coefficient of variation (7.7%). Dendrogram interpretation was hindered by the large number of cultivars used, but it was possible to detect groups of cultivars formed as expected from their genealogy. Another dendrogram, composed of 63 cultivars, allowed a better interpretation of the groups. Cophenetic correlation was 0.60 and 0.70, respectively, in the 317 and 63 cultivar dendrograms. Parentage coefficients between the 100 cultivars varied from zero to one (x=0.21). However, no significant correlation was detected between the parentage coefficients and the genetic similarity by AFLP (r=0.12). The results showed the efficiency of AFLP markers in large scale studies of genetic similarity and are discussed in relation to the soybean breeding in Brazil.

P382. The physiology changes of soybeans after transfer of *ipt* gene into soybean by Ti plasmid after inoculaing with SMV no.1

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Three cultivars of soybean of Heilongjiang Province have been transformed with ipt gene into the soybean plants. The ELISA was used to study the endogenous hormonal amount and their balance condition and physiological change after the ipt gene being transformed into soybean plants. The results showed that the content of MDA became lower and the activity of SOD enzyme became higher after the transformation ipt into soybean plant cell by inoculation with SMV No.1. The amount of endogenous IPA IAA GA, were higher in the soybean plant transformed with 7SL – ipt. The amount of endogenous IAA ABA were higher in the soybean plant with 8SL – ipt and caused mophologicol change of the plant and increasing resistante to diseases of soybean.

P383. Identification of Msh1-homologue genes in soybean, rice, tomato and common bean

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The nuclear gene Msh1 (MutS homologue 1), recently cloned in Arabidopsis (Abdelnoor et al., 2003, PNAS 100:5968-5973), is involved in regulation of the copy number of subgenomic mitochondrial DNA molecules created by ectopic recombination in a process known as substoichiometric shifting. The Arabidopsis genome contains several other MutS homologues, but MSH1 protein is the only one that is targeted to both mitochondria and chloroplast and the predicted computer-based structure of this protein is very similar to the *E. coli* MUTS. We have isolated and sequenced the full-length homologous Msh1 genes in soybean, rice, tomato, and common bean to better understand their structure and function in plants. The tomato and soybean genes were obtained based on EST sequences identified by similarity to the Arabidopsis Msh1 gene and by RT-PCR of total RNA from leaves. The rice Msh1 was identified by searching the rice BAC sequences database and the coding sequence was confirmed by RT-PCR. The bean Msh1 was isolated from a BAC library, using a sequence of the soybean Msh1 gene as probe. Similar to Arabidopsis Msh1, all of them are comprised of 22 exons with very well conserved size and splicing position. Phylogenetic analysis using ClustalW showed that these genes have an overall identity of about 60% at the protein level. Based on computer prediction analysis they are predicted to be targeted to mitochondria. Additionally, several other ESTs have been identified in other plant species (barley, wheat, potato, tobacco, sorghum, maize and medicago), and show high homology to the sequenced Msh1 genes. The alignment of all of these MSH1 proteins has allowed us to identify specific conserved domains that might be very important for their proper function in plant mitochondria.

P384. Hydrolysis of soybean raffinose oligosaccharides by α-galactosidases from different sources

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The intake of soybean grains and its derived products usually leads to unpleasant symptoms, including flatulence. It results from the anaerobic metabolism of α-1,6-galactosides of raffinose (RO: Raffinose Oligosaccharides) that is generally present in legume seeds. The removal of these sugars would have a positive impact in soybean food consumption. The enzymatic hydrolysis of RO by α-galactosidase (EC 3.2.1.22, α-D-galactoside galactohydrolase) seems to

be the most promising strategy for reducing RO content in soy-products. The objective of this research was to verify the efficiency of α-galactosidases from different sources to hydrolyze RO present in fat free soybean flour and soybean molasses. The α-galactosidases tested were purified from soybean and *Tachigali multijuga* germinating seeds, and also from *Aspergillus terreus* and *Penicillium griseoroseum*. In the purification process, the enzymatic extract from soybean seeds was submitted to cryoprecipitation, acid precipitation, fractionation with ammonium sulphate, gel filtration and ion exchange chromatography. The purification factor was 19.74 fold with an enzymatic activity recovery of 36.64%. Maximum a-galactosidase activity was detected at pH 5.0 and at 50 °C. The enzyme preparation maintained near 90% of its original activity after pre-incubation at 40 °C for 4 h. The K_{Mapp} values for hydrolysis of rNPGal, melibiose and raffinose were 0.47 mM, 1.46 mM and 3.43 mM, respectively. The highest enzyme activity was observed with rNPGal, followed by raffinose, stachyose and melibiose. Galactose, SDS, $CuSO_4$, raffinose, stachyose and melibiose inhibited the enzyme activity. Incubation of soy-flour with the active enzymatic preparation for 8 h at 40 °C, led to a reduction of 100% and 53% in the raffinose and stachyose contents, respectively. Treatment of the same soy-flour sample with a-galactosidases from *T. multijuga*, *A. terreus* and *P. griseoroseum*, reduced the levels of raffinose by 72%, 100% and 66%, and the levels of stachyose by 49%, 100% and 100%, respectively, after an incubation period of 8 h, at 40 °C. The reduction in the amount of RO present in soybean molasses, treated with the soybean enzymatic preparation was 100% and 58% for raffinose and stachyose, respectively. Our study demonstrated that the a-galactosidases tested were able to substantially reduce the RO levels present in soybean products, indicating a possible use of these enzymes for establishing a process to improve the nutritional value these products.

P385. Introduction of genes that confer drought stress tolerance in soybean [*Glycine max* (L.) Merril] by biobalistic

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The soybean crop moves the Brazilian economy from the primary sector to the industry, generating many direct and indirect jobs. However, yearly billions of dolars are lost due abiotic and biotic stresses occuring during the crop cycle. Abiotic stresses, precisely drought, is one of the main causes of yield losses. Aiming to minimize this damage, scientists are using biotecnology methods, introducing genes in plants to improve tolerance to drought stress. The plant drought response is regulated by a complex of genes generating a variety of tolerance mecanisms. The complexity of such responses make difficult of using classic breeding methods in the development tolerant varieties. However, genetic engineering of key genes in key metabolic pathways has succeded in incresing drought tolerance in many crops. Our objective was to introduce in soybean the expression cassets pRD29:DREB1 and pE35S:P5CS-129A, using an Embrapa's patent method of Biobalistics that confer dehydration tolerance in plants. DREB1A (Dehidration Responsive Biding Element Protein) is a transcription factor responsible by the activation of genes involved in the drought, freezing and saline stress response; P5CS-129A is also a key enzime in the pathway for proline production. Proline increasing in the cytosol has been related to the cell turgor preservation and protection of cell structures during dehydration by scavenging oxidative radicals. The transformed plants have been generated and tested by PCR. More than 2590 embryos were transformed until now. Nineteen plants were PCR positives for the AHAS gene and none PCR positive plants were detected until now for the p35S:P5CS-129A construct. Number of insertion copies and expression levels will be tested in the positive plants. Physiological characterization in drought conditions will be carried on in promissing events.

P386. Funcional genomics of soybean roots

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Dehydration during drought triggers molecular events that result in physiological, morphological and developmental responses in plants. Induced genes during cell dehydration are normally related to mechanisms of cell dehydration tolerance. Protection of cell structures, changes in cell osmotic potential, expression regulation of the other genes, metabolization of produced compounds by the stress are among the gene products induced during drought. The objective of this study was isolation and study on genes expression in soybean roots during dehydration. cDNA

libraries were prepared with mRNA obtained from roots submitted to dehydration conditions. About 3200 expressed genes have been sequenced and stored *in vitro* and *in silico*. Comparison of these sequences with the sequences deposited in the GenBank allowed identification of probable gene functions and categorization of genes for use as molecular markers in plant breeding programs or as key genes in metabolic pathways that potentially could improve drought tolerance. The following probable gene-related functions were: metabolism, cellular protection, gene expression regulation, cellular signaling, transport, cellular structure, cell division, proteins related to stress response and unknown proteins. The access to this data can be done though the site www.cnpso.embrapa.br/bioinformatica. Unique sequences identified in the data bank are been selected for microarray analysis at Universidade Estadual de São Paulo-UNESP.

P387. Agronomic issues associated with soybean iron deficiency chlorosis

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Iron-deficiency chlorosis (IDC) of soybean is a common problem on calcareous soils with high pH. Field conditions that cause the deficiency are unpredictable from year to year, and indoor screening results are not repeatable in the field. This study was conducted to evaluate plant and soil characteristics associated with IDC. This knowledge might help us to make management recommendations, develop indoor screening methods, and develop efficient breeding strategies. Ten lines from a cross between two parents that varied for visual IDC ratings were evaluated, along with the parents, in a field where soybeans were known to exhibit IDC consistently, and uniformly each year. Four-row plots were grown in a randomized complete block design with 4 replicates. Plant and soil samples were collected from each plot 4 times during the growing season, beginning on July 2, when susceptible plants were chlorotic, and ending on August 22, when susceptible plants had recovered from chlorosis. A visual rating scheme of 1 (no chlorosis) to 5 (severe chlorosis) was used. Samples were oven-dried and stored until processing. Total C, N, S, Fe, and P concentrations were determined for plant samples. For soil samples we determined available Fe, pH, soluble salts based on electrical conductivity (EC), and P. Analysis of variance, regression, and correlation analyses were used to evaluate the data. Significant differences existed for chlorosis ratings, and among rating dates. Ratings across dates ranged from 1.5-2.5, and ratings among entries from 1.4-2.8. Significant entry effects were found for N, S, and P, and significant sampling date effects for all nutrients. N and S increased by 9% at peak chlorosis (3 August). At peak chlorosis, decreases were observed for C (10%), Fe (7%), and P (9%). Additional decreases were observed for samples taken on 22 August when plants had recovered. In multiple regressions, N, C, S, Fe, and P collectively explained 36% of the variation among chlorosis ratings. We observed significant sample date effects for available Fe, P, pH, and EC. There was 6.5% more available Fe, 7.8% more soluble salts, and 3.8% higher pH at peak chlorosis. Both pH and EC declined when plants recovered from chlorosis, Regression analyses indicated that response of these genotypes were affected by soil availability status of the elements studied, as well as assimilation and interactions of the nutrients in the plant tissues. Increases in pH and soluble salts probably played a major role in chlorosis symptoms. Since available Fe increased simultaneously with pH and EC, it appeared that pH and EC may have interfered with the assimilation of Fe by the plant. Assimilation of C, N, S, and P in the plant appeared to have played some role in the plants ability to use iron.

P388. Critical levels of copper for soybean in cerrado soil

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In micronutrient (Zn, Mn, Cu and B) fertilization trials performed since 1997 at two sites in the Balsas, MA, region, copper was the only micronutrient shown to constantly increase soybean yields. Recommended doses and critical levels of Cu in the soil have been assessed using the Mehlich-1 extracting solution, in a Red-yellow Latosol (LVAd). Although both sites has the same soil types one is a sandy clay loam (27% of clay) and the other has clay texture (55% of clay). In the sandy clay loam critical Cu levels were determined in the growing seasons of 2000/01 and 2001/02 while in the clay soil they were determined only in the 2001/02. The Cu doses that gave the Maximum Economic Yield (MEY) were approximately 1 kg/ha of Cu in the sandy clay loam and 6.5 kg/ha in the clay soil. The critical levels for the Mehlich-1 solution in the sandy clay loam were 0.39 mg/dm^3 and 0.59 mg/dm^3 of Cu in the growing seasons of 2000/01 and 2001/02, respectively. In the clay soil, the critical level was 0.78 mg/dm^3 of Cu. The higher critical level for Cu given in the clay soil, may be related to its higher organic matter (OM) content (57.5 g/kg) compared to the sandy clay loam soil (29.3 g/kg OM), as well as to its higher MEY doses. The fact that the critical levels of Cu and the critical range recommended (0.5 and 0.80 mg/dm^3) vary with soil texture means that texture dependent recommendations should be developed to maximize efficiency of fertilizer use.

P389. Leaf and seed application of cobalt and molybdenum, with and without inoculant, in the soybean culture

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Two experiments were initiated to study the cobalt and molybdenum application, with or without inoculant, in soybean. The experiments were carried out in Oxisol, in two locations in the Minas Gerais State. Soybean was cultivated during about 20 years and at the first year, respectively, for each location. The cultivar MG/BR-46 (Conquista) was used. A complete randomized block design, with seven treatments and four replications were used. The treatments were: TT = Control (without Co, Mo and inoculant); T1 = Co and Mo leaf application, without inoculant; T2 = Co and Mo seed application, without inoculant; T3 = Co and Mo leaf application, with inoculant; T4 = Co and Mo seed application, with inoculant; T5 = Co and Mo + biological fungicide (all of them applicated in the seeds), with inoculant; and T6 = treatment usually done in the farm. In the 20 years-old area, only the leaf application of Co and Mo + Inoculant (T3) differed from the control treatment (without Co, Mo and inoculant) ($P<0.05$). In the first year-old area, the treatments with inoculant (T3, T4, T5 and T6) showed more significantly yield than the treatments without inoculant. In both locations, the best treatment was the application of Co and Mo in the leaf + inoculant (T3). In all the cases, Co and Mo in the seeds presented fewer yields than the application of these nutrients in the leaf.

P390. Differential response of soybean genotypes to manganese deficiency

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Our previous experiments have shown considerable variation among soybean genotypes in visual symptoms and growth in response to Mn deficiency. For example, PI227557 was much more sensitive to Mn deficiency than the cultivar Biloxi. The present investigation was, therefore, undertaken to further analyze the differential response elicited by Mn deficiency on the leaf chlorophyll concentration and on the ultrastructure of chloroplasts and nodules of these two contrasting soybean genotypes. Seeds were inoculated with *Bradyrhizobium japonicum* (Cell-Tech, Liphatech, Milwaukee, USA) and germinated in soil. Five-day-old seedlings were transferred to 1-L flasks half filled with an air-bubbled nutrient solution, devoid of N, and containing either deficient (0.3 mM) or adequate (6.6 mM) Mn concentrations. Plants were grown in a greenhouse with natural photoperiod and 28/20°C day/night temperatures. Leaf chlorophyll concentration measured on 5-wk-old plants grown on the adequate Mn solution was greater for Biloxi than PI227557. On the deficient Mn, chlorophyll concentration in Biloxi leaves was significantly decreased but no further decline was observed in PI227557. A differential response between genotypes to Mn concentrations was also observed at the chloroplast ultrastructure level. Leaf cells of Biloxi growing at adequate Mn did not exhibit any structural abnormalities with normal-shaped chloroplasts containing 3-4 starch grains. In contrast, leaf cells of PI227557 grown on adequate Mn had a massive proliferation of the Golgi apparatus, an abnormal enlargement of the endoplasmic reticulum cisternae, and chloroplasts were swollen and loaded with starch grains and ferritin-like crystals. Genotypic differences were further detected on deficient Mn, with Biloxi plants displaying elongated chloroplasts with a marked decline in grana size and an increase in the length of non-appressed lamellae. Deficient Mn in Biloxi also resulted in a decreased number of starch grains in the chloroplasts, a disruption of the nuclei membrane and an abnormal enlargement of mitochondria. In the PI227557, Mn deficiency was associated with destruction of chloroplasts, which showed disintegrated grana constituted only by a large stroma and the presence of large numbers of osmiophilic globuli. A total absence of starch grains and ferritin-like crystal also characterized those chloroplasts. On the other hand, nodule ultralstructure was only altered in PI227557 on the Mn deficient treatment. The peribacteroid membrane in this case was disrupted, symbiosomes were degraded and bacteroids did not contain poly-b-hydroxybutyrate grains. Overall, these marked differences between genotypes indicate that attention must be given to genotypic differences when developing cultivars that may be grown on Mn-deficient soils.

P391. Differences concerning efficiency in the manganese use by soybean

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In many fields of soybean production nutritional factors can hinder the full expression of the cultivars productive

potential. One of them is the low manganese availability in soils with a high pH level, inducing a deficiency in the soybean. However, genotypic differences concerning the efficiency in the use of micronutrients can exist. Besides this, different cultivars can respond differently to the availability of manganese. There is some evidence of genetic variability concerning the efficiency of soybean when developing in manganese-lacking soils and its nutritional demands in relation to this micronutrient. Therefore, it is important to identify genotypic differences in soybean concerning the efficiency in the use of Mn, providing effective means of controlling this problem that affects many regions in Brazil where soybean is cultivated. In addition, cultivars tolerant to manganese deficiency could be a choice when soybean was cultivated in soils lacking this micronutrient, given the identification of the genetic control of the character. For better understanding of the behavior of soybean concerning efficiency in the manganese use, a study was carried through in Uberlândia, Brazil, with 33 soybean cultivars recommended for the Central region of Brazil. The set included cultivars with distinct maturation cycles: semi-early, medium, semi-late and late. In addition, cultivars from distinct breeding programs were used, in order to get more samples of the genetic variability in the Brazilian soybean germ plasm. The experiment was installed during the growing season of 2000/2001, on an area of clayey dystrophic red latosoil, presenting 0,8 mg/kg^{-1} of manganese, where deficiency in manganese use had already been detected in previous soybean crops. The experimental design consisted of randomized blocks with three replications, in a factorial layout of 33 x 2 (33 cultivars, with no application of manganese or receiving 6 kg/ha^{-1} of manganese through foliar application, using manganese sulfate). The characteristics evaluated were: visual symptoms, foliar levels of manganese and grain productivity. The variance analysis demonstrated a significant interaction between cultivar and level of manganese for the three evaluated characteristics. This behavior was more evident when a cultivar was compared to others within its maturation group. The conclusion was that cultivars of semi-early maturity cycle were more responsive to manganese application and did not tolerate low availability of manganese. As to cultivars of late maturity cycle, they are less responsive to manganese application, but they tolerate the low availability of this nutrient. Manganese deficiency reduces soybean grain yield; the intensity of this deficiency, however, is different for each cultivar.

P392. Biostimulant effect on seeds germination, seedlings vigor and root growth of soybean (*Glycine max* (L.) Merrill)

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The experiment was carried out in the Plant Physiology Laboratory of the Department of Biological Sciences at ESALQ-USP. Soybean seeds (*Glycine max* (L.) Merrill cv. IAC-8-2) were used, and the biostimulant Stimulate (0,009% of kinetin, 0,005% of gibberellic acid, and 0,005% of indolbutyric acid) at the following concentrations 1.0; 2.0; 3.0; 4.0 e 5.0 ml/0.5 kg of seeds, and 3.0 ml of distilled water/0.5 kg of seeds as control (concentration zero of Stimulate).The objectives were to evaluate the effects of the Stimulate on the seeds germination, seedlings vigor and root growth, as well as to establish the product concentration for seed treatment of the product applied by seeds. Germination and vigor tests were carried out on the seeds and seedlings, observing the germination percentage, the percentage of normal seedlings, percentage of abnormal seedlings, length and dry mass, and emergency seedlings in the sand were observed. Rizotrons were used to evaluate the radicular plant system growth in green house conditions. The experiment design adopted was completely randomized with 6 treatments (concentrations) and four replications. The results were analyzed using regression to the variables that presented at least one difference between the evaluated concentrations. The conclusion achieved at this study was that the 3.5 ml Stimulate/0.5 kg of seeds of the concentration has resulted in the maximum quantity of normal seedlings. An increase of 55.3% at the seedlings dry mass was achieved with 4.1 ml/0.5 kg of seeds of the biostimulant concentration. The maximum vertical radicular growth was achieved at the 1.3 ml/0.5 kg of seeds of the concentration. The rizotron method has provided quick, easy and successive quantitative and qualitative evaluations of the soybean radicular system. (Supported by Stoller do Brasil Ltda).

P393. Evaluation of the agronomic effectiveness of different rates and application methods of Stimulate in soybeans

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With the aim of evaluating the agronomic effectiveness of different rates and application methods of Stimulate on soybeans (*Glycine max* L.), the present field work was developed under direct seeding in a experimental area on UEPG School Farm in Ponta Grossa - PR in the growing season of 2001/2002. A randomized block design was employed, with ten treatments replicated four times. The treatments were: 1- Control; 2-

Stimulate (250 ml/100 kg of seeds, TS - seed treatment); 3- Stimulate (500 ml/100 kg of seeds, TS); 4- Stimulate (750 ml/100 kg of seeds, TS); 5- Stimulate (500 ml.ha $^{-1}$, SP - spray over the seed row, during seeding); 6- Stimulate (1000 ml.ha $^{-1}$, SP); 7- Stimulate (1500 ml.ha^{-1}, SP); 8- Stimulate (250 ml.ha^{-1}, FL - foliar spray at stage V5); 9- Stimulate (500 ml.ha^{-1}, FL), and 10- Stimulate (750 ml.ha^{-1}, FL). The soybean cultivar was CODETEC 206 and the evaluation included: emergence speed, in days, to reach 50% of the plot population; germination rate at 10 days after seeding; number of pods per plant; yeald and weight of 1000 beans. It was observed that the application of Stimulate composed of three plant regulators, containing 0.009% kinetin (cytokinin), 0.005% gibberelic acid (gibberellin) and 0.005% índole butyric acid (auxin) is agronomically efficient for the soybean crop (*Glycine max* L.). The seeds wich received the Stimulate treatment before seeding (TS) and over the seed row (SP) emerged sooner than the control and the other treatments, and showed a greater number of germinated seeds at 10 days following seeding. The number of pods per plant and the weight of 1000 beans in the treatments with Stimulate were higher than the control treatment. Yeald was positively influenced by the Stimulate treatments, as it was found an increase of 1,389 kg.ha^{-1} between the best outcome, treatment 9 (3,634 kg.ha^{-1}), and control (2,245 kg.ha^{-1}). The product allows for different options for utilization, wich is desirable according to the management system that will be employed.

P394. Stimulate as growth regulator for soybean crop

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Growth regulators have been used in agriculture since a long time, concerning he discovery of auxin in 1940. In this case the use of three different regulators was held in order to achieve growth in apical and lateral organs , besides the development of vascular tissues for better distribution of carbohidrates and nutrients. The objective of the present paper was to evaluate the behaviour of Stimulate (cytokinins + giberelic acid + indol-butiric acid) in soybean development. The trial was carried out in Londrina- PR at 23°18'S of latitud on an oxissol . Stimulate was applied in three different manner, mixed with the seeds at the doses of 0.25 ;0.5 and.0.75 l/100 Kg of seeds, sprayed in the furrow at the doses of 0.5;1.0 and 1.5 l/ha and foliar application at the doses of 0.25;0.5 and 1.0 l/ha on V 5 stage. Four evaluation were made, percentage of emergence at 6 and 15 days after planting, number of pods per plant at R 6 stage, yield per parcel and weight or 1000 seeds. All treatments showed improvements in visual aspects of the plants, increase in number of pods per plant and as consequence increase in yield and the weight of the seeds, although with a decrease in emergence speed, which normalized as the time passed. The product Stimulate (0,09 g of cytokinin + 0,05 g of giberelic acid + 0,05 g of indol-butiric acid), used as growth regulator in seed treatment at the doses of 0,25;;0,5 and 0,75 l/100 kg of seeds, or applied in seed furrow at the doses of de 0,5, 1,0 e 1,5 l/ha, or foliar sprayed showed significant increases in soybean yield of cultivar BRS 123.

P395. Liming and manganese on the soybean crop in soils of the southwest of Goiás, Brazil

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Available manganese has been a widespread problem in the Cerrados soils, for both excess, due to the high natural contents of the element in the soils, and for deficiency, usually induced by overliming in conventional tillage system or by surface liming in the direct cropping system. This work aimed to evaluate the effects of liming and manganese rates on growth, dry matter yield, and mineral nutrition of the soybean (*Glycine max* L. Merrill, cv. EMGOPA-316) and the possible substitution relationships among liming and manganese rates on two representative soils from Rio Verde, Goiás, Brazil. A pot experiment was undertaken at the Agronomy School (EA/UFG), using an Oxisol (Latossolo Vermelho Amarelo Distrófico) and an Ultipsamment (Neossolo Quartzarênico Distrófico). A completely randomized experimental design was used, in a 5x5 factorial treatment design (liming and manganese rates), with three replications. The studied soils showed serious nutritional shortcomings, both for their high acidity levels and excess of exchangeable Mn. Treatments without liming provoked widespread Ca and Mg deficiencies, smaller dry matter yields of shoot and roots of soybean and manganese toxicity, with visual symptoms in soybean leafs. Partial derivatives of the response surfaces for dry matter allowed to calculate the following critical points: a) Oxisol: liming = 6,06 t ha^{-1} and Mn = 10,02 mg kg^{-1}, with a stationary point (maximum yield) of 33,92 g pot^{-1}; b) Ultipsamment: liming = 2,88 t ha^{-1} and Mn = 10,24 mg kg^{-1}, with a stationary point of 38,72 g pot^{-1}. The isoquants of the response surfaces evidenced a no-lineal substitution relationship between manganese and liming, being possible to obtain maximum total yields with no Mn but not with no liming. Close correlations among Ca and Mg contents in the studied soils and in soybean leafs have been found, but not for Mn. One may

conclude that liming is essential both as soil acidity neutralizer and a source of Ca and Mg in plant nutrition; application of Mn on these soils is unnecessary, even toxic to the soybean crop.

P396. Silicon accumulation and changes in rhizospheric pH raised by soybean and rice growth in rizoboxes

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Silicon has been considerated an element that able to cause beneficial effects to plant development, although it has been questioned it's inclusion in essentials elements list. The advantages use of silicon in vegetal species growing has been seen when there are accumulation in leaf tissue of some species graminaes, resulting in higher resistance to biotics and abiotics stresses. Absorption and deposition mechanisms of silicon in vegetal tissue have not been totally elucidated yet, being necessary research more detailed that includes vegetal physiology. The study of processes that happen in soil-root interface (rhizosphere) has been a tool used to elucidate these questions. For this, it was developed a study in green house, using a chernossolic eutrofic Red Nitosoil (0-20 cm) under pH 6,5 has been keeped in conditions of humidity and temperature controlled to evaluate the influence of rhizospheric pH in silicon acumulation on vegetal tissue of rice and soybean. These species were seeded in rizoboxes bottle, cultivating up to 30 days. After, it was evaluate silicon concentration ($CaCl_2$ – Korndörfer, 1999) in soil and leaf tissue and rhizospheric pH was determined by Agar neutral method (pH indicator vehicle – 0,75%), $CaSO_4$ (1 mM) adding red of bromocresol pH indicator – 0,06% to regulate pH to 6,0 using NaOH (red color). After neutral Agar application in rhizospheric soil, it was seen sharp changes in rhizospheric coloration. For rice, the rhizosphere became purple, because this specie allowed environment alcalinization. In soybean, the rhizosphere became yellow (acid), possibly to protons exsudation. pH-H_2O determination in soil rhizospheric showed that pH increase caused a significative increase in silicon availability to plants. Thus silicon quantification in soil ($CaCl_2$) showed that silicon quantity in non rhizospheric soil was smaller that silicon in rhizospheric soil. For soybean Si/mg^{-1} quantity passed of 77,5 (soil) to 108,7 (rhizosphere) and rice passe of 31,9 (soil) to 102 (rhizosphere). Total silicon determination in leaf tissue for two species showed that rice accumulated 5,5% of dry weight, that was higher that soybean accumulation (0,9%). However, soybean accumulated higher silicon quantity in root (2,7%) when comparated with rice (1,5%). Thus it is concluded thar rhizospheric pH influenced in silicon availability, but, it's absorption, translocation and mainly deposition in vegetals tissue was related to specie physiology, it's adaptation and with silicon function in vegetal tissue.

P397. Planting date and duration of the setting pod period in determinate and indeterminate soybean cultivars

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Soybean (*Glycine max* (L) Merril.) yield is associated with duration of setting pod period (i.e., days between R1 and R5). The objective of this experiment was to examine the effect of planting date on the duration of the setting pod period and light interception in soybean cultivars with different growth habit. Two determinate (A5520 RG and A6019 RG) and five indeterminate (DM 3100, DM 3700, DM 4600, TJ 2049 and A 4303) soybean cultivars were planted at three planting dates (October, November and December) in the North of Pampas Region (31° 50' S, 60° 31' W, 110 m altitude) in field trials using a row spacing of 0.44 m. The duration of the setting pod period and light interception at the beginning and the end of the setting pod period were analyzed. For determinate cultivars, the relationship between planting date (i.e., days after October 1st) and the duration of the setting pod period was lineal and indicated that a delay of 10 days in planting soybean resulted in one day reduction of the that period. However, for indeterminate cultivars, the relationship was curvilinear and showed that maximum duration of the setting pod period occurred when soybean was planted 53 day after October 1st. Although light interception for all cultivars at the end of setting pod period was always greater than 90%, light interception of indeterminate cultivars at the beginning of this period was less than 60%. Our results indicate that there would be room for increasing yield when indeterminate cultivars are planted in the middle of November and row spacing is reduced.

P398. Using remote sensing to estimate soybean leaf area

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Soybean leaf area is directly related to yield. Research has shown that a leaf area index (LAI) of

approximately 4.0 is needed to maximize yield potential. Above this level, yield increases little, but yield is linearly related to LAI less than 4.0. Leaf area index can be used to select cultivars, adjust seeding rates or row spacing, and determine insect defoliation thresholds. However, obtaining LAI information from multiple fields can be difficult and time consuming. Our objective was to determine if the normalize difference vegetation index (NDVI) obtained from infrared photographs could be used to estimate soybean LAI. Experiments were conducted in 2002 and 2003. Data showed a very strong relationship of NDVI with soybean LAI.

P399. Evaluation of growth and development of soybean cultivars from maturity groups II to V, as a function of planting date, at Villa Mercedes-San Luis-Argentina

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The expansion of the area of production of soybean in the province of San Luis-Argentine, with or without irrigation, the availability of new glyphosate tolerant soybean cultivars for all the maturity groups (MG) recommended and the widening of the planting dates (PD) range, increased the demands of information of the best MG - PD combinations for all the environments in which the soybean could be planted in this province. In order to evaluate the growth and development of soybean cultivars from different MG depending of PD, an experiment with three PD (Oct 23, Nov 29 and Jan 9) was conducted at Villa Mercedes (San Luis-Argentine) in the crop year 2002/03. Fifteen soybean cultivars from MG II to V were evaluated in rainfed soil with a 1.80 m deep water table. We applied a randomized split plot design. PD was the main factor and cultivar the subfactor, with four replications. The dates of VE, R1, R5, R7 and R8 were registered. Development was characterized through the length of the periods: emergence-flowering (VE-R1) and emergence-physiological maturity (VE-R7). At R8 were determined total aerial biomass (TAB), harvest index (HI), grain yield (GY) and their components: pod number/m^2 (PN), seed number/m^2 (SN), seed weight (SW). Plant height at flowering (PHR1) and at maturity (PHR8), and number of nodes on the main stem at flowering (NNR1) and at maturity (NNR8), were determined. Variables were analyzed through ANOVA and Multiple Regression (Stepwise). Means differences were compared through Tukey test ($\alpha = 0.05$). The *PDXcultivar* interaction was analyzed and calculated the response of each variable as a function of PD. ANOVAs detected, in every variable, differences ($P < 0.01$) for PD, cultivar, and PDXcultivar interaction. The life cycles of MG IV and V sown in January were interrupted by early frosts. The relationship between the studied variables and PD was linear and decreased with the PD delay, from October to January. The GY of MG III surpassed the other MG at the three PD. Cultivars Aw2886RR, DM3000RR, DM4600RR, A4910RG and A5520RG showed their highest GY at November PD, due to higher SN and HI. The other cultivars reached their highest GY at October PD. From Oct 23 onwards, average TAB diminished 42.7 kgxha^{-1} with each day of PD delay, while GY diminished 29.3 kgxha^{-1}. GY showed positive correlation with SN, SW, PN, PHR8 and NNR8, but low correlation with PHR1 and NNR1. Stepwise procedure of Multiple Regression showed that SN and SW are the variables with the best relation with GY variations. In January PD the short cycle cultivars (MG II to IV) reach neither enough PHR8 nor NNR8 for a high grain production, and longer MG (V to VI) do not finish their life cycle before the occurrence of the first frosts.

P400. Response of the soybean crop to the loss of apical dominance brought about by climatic and/or biotic adverse conditions at early development stages

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Soybean plants exhibit leaves with axillary buds which are similar by nature to the stem main site of development (apical bud), able to develop into branches and bloom, or to remain dormant. If the apical bud is damaged, one or more axillary buds may be vitalized and perform the function of the apical bud. This soybean property makes the crop able to recover after being damaged by hail, late frosts or hare attacks, and — under certain managing conditions — match the yield of healthy crops. The understanding of the crop response to such calamities, which frequently occur in San Luis (Argentine), would make it possible to decide in favor of or against the reseeding of the affected plot. In order to study the soybean crop response to the loss of the apical dominance brought about by climatic and/or biotic adverse conditions, two experiments with neither water nor nutrient restrictions were carried out in 2000/01 and 2001/02 crop years. In the first one (Exp. I), four soybean cultivars affected at stage V2 by a late frost were tested, and in the second one (Exp. II), the apical portion of the main stem was cut at stage V1 and V2. The treatments effect were studied through plant height (PH), number of nodes (NN), number of pods (PN), number of seed (SN), seed weight (SW), total aerial biomass (TAB), and grain yield (GY). The response of the different

cultivars to the late frost was also examined. Variables were analyzed through ANOVA, Tukey test ($\alpha = 0.05$) and Multiple Regression (Stepwise). Two to three days after the loss of the apical dominance, the axillary buds were vitalized and developed into more than a dominant stem per plant. In Exp. I, GY showed differences ($P < 0.01$) between cultivars but not between treatments and treatment-cultivar interaction. In every cultivar, the affected plants showed GY similar to that of the non affected ones; the same was observed for SN and SW. There were differences ($P < 0.01$) for PN and NN between affected and non affected plants, but these variables did not show significant correlation with GY. In Exp. II, those plants affected by apical debudding developed more than one dominant stem, against a single stem of the control plants. In both experiments, the affected plants (by frosts or cutting) showed higher NN (potential sites for pod development) which, in no case, resulted in a significant increase of PN, SN and/or GY. This confirms the hypothesis that the loss of apical dominance in soybean crops with neither water nor nutrient restrictions at vegetative stage of growth, do not affect their final yield.

P401. Differential wilting among soybean recombinant inbred lines and associated quantitative trait *loci*

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Differences in the onset and severity of canopy wilting during water-deficit stress have been reported among soybean genotypes. Wilting differences may be associated with genotypic differences in traits such as water use efficiency, rooting patterns, or leaf morphology. It is unknown whether delayed wilting is beneficial to yield. Eighty-one recombinant inbred lines (RIL) from a cross between soybean cultivars 'KS4895' and 'Jackson' were visually rated for wilting (0 = no wilting, 5 = severe wilting) in a non-irrigated field study at Stuttgart, AR in 2000. Wilting scores ranged from 1.7 to 4.3. DNA from RIL was screened with 135 simple sequence repeat (SSR) markers that were determined to be polymorphic for parental DNA. Statistical analysis indicated that five SSR markers were significantly associated with wilting. KS4895 and Jackson contributed three and two fast wilting alleles, respectively, of the five total alleles associated with wilting. Four RIL with a majority of the five markers representing the fast wilting allele and four with a majority of slow wilting alleles were selected as potential wilting extremes for further evaluation. The parents, four slow wilting RIL, and four fast wilting RIL were grown at Stuttgart, AR in 2002 and 2003 in replicated field plots with 19 and 80 cm spacing between rows. It was hypothesized that if greater lateral rooting contributed to slow witling, then genotypic differences would be greater on wide-row plots, but that deeper rooting genotypes would have an advantage regardless of row spacing. Wilting was not influenced by row spacing either year, indicating that differential lateral rooting was probably not responsible for wilting differences. Both years, the four RIL with fast wilting alleles wilted faster and more severely than did the RIL with slow wilting alleles. Although Jackson and KS4895 contributed two and three of the fast wilting alleles, respectively, Jackson wilted more severely than KS4895 both years.

P402. Evaluation of the plasticity of soybean (*Glycine max* (L.) Merrill) under effect of variability of space arrangements

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This research had as purposes to evaluate the soybean plant adaptations (plasticity) to different space arrangements and identify the best space arrangements for higher yields of cultivar MG/BR 46 (Conquista). The experiment was carried out at the experimental fields of Escola Superior de Agricultura "Luiz de Queiroz" (USP/ESALQ), São Paulo State University, in Piracicaba-SP, during the 2001/2002 growing season. The 30 treatments consisted of different space arrangements, combining 6 row spacing (0,20; 0,30; 0,40; 0,50; 0,60; 0,70 m) with 5 different population (70.000; 140.000; 210.000; 280.000; 350.000 plants/ha), in a complete randomized blocks design with subdivided plots and three replications. The evaluated characteristics were: final plant height; height of the first pod; number of branches per plant; number of pods per plant; number of grains per plant; lodging; mass of 1,000 grains and yield. The main conclusions are: a) the number of pods is the best related component to yield per plant, being directly influenced by plant population; b) for the studied variation in population, the population increase by reducing the row spacing or the increase in the density of plants in the line, consists in handling strategy to increase final plant height and height of the first pod, more compatible mechanized harvest; c) the cultivar MG/BR – 46 (Conquista) presents wide plasticity, adjusting its yield components to the different space arrangements, without significant yield changes.

P403. **Time to achieve closed canopy and leaf area index of soybean (*Glycine max* (L.) Merrill) under effect of variability of space arrangements**

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This research had as purposes to evaluate time to achieve closed canopy and leaf area index of soybean and identify the best space arrangements for higher yields of cultivar MG/BR 46 (Conquista). The experiment was carried out at the experimental fields of Escola Superior de Agricultura "Luiz de Queiroz" (USP/ESALQ), São Paulo State University, in Piracicaba-SP, during the 2001/2002 growing season. The 30 treatments consisted of different space arrangements, combining 6 row spacing (0.20; 0.30; 0.40; 0.50; 0.60; 0.70 m) with 5 different population (70.000; 140.000; 210.000; 280.000; 350.000 plants/ha), in a complete randomized blocks design with subdivided plots and three replications. The evaluated characteristics were: time to achieve closed canopy; leaf area index and yield. The conclusions are: a) the cultivar MG/BR – 46 (Conquista) cultivated under 0.20 to 0.60 m row spacing shows a leaf area index maximum at the begging of seed-filling stage (R_5); b) the leaf area index becomes higher proportionally with the increase of population; c) the increase of soybean plant population by the reduction in row spacing is an efficient method of weed control from 0.50 m spacement; d) for each row spacing there is a better plant population to achieve higher yield.

P404. **Row spacing and seeding rate effects on soybean yield in Minas Gerais State, Brazil**

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In general, plant population is specific for each new cultivar, although there is also environment effect. The objective of this work was to determine the optimum soybean population level and seeding rates for high yields in three Brazilian soybean cultivars. These experiments was carried out in the following locations: Experimental Farm Getúlio Vargas, in Uberaba (743 m altitude), Experimental Station of Cooperativa Agropecuária Mista do Programa de Assentamento Dirigido do Alto Paranaíba Ltda, in Rio Paranaíba (1100 m altitude), and Capão da Onça Farm, in Conceição das Alagoas (500 m altitude). The Brazilian cultivars BRSMG Renascença, BRSMG 68 and BRSMG Garantia were evaluated in 0.45, 0.30, 0.25, 0.20, and 0.15 m row spacing combining seeding rates to obtain plant population ranging from 100.000 to 400.000 plants/ha. Plant population near to 240,000 plants/ha produced higher yields for BRSMG 68 and BRSMG Garantia. At the common row spacing used in Brazil (0.45 m), plant populations higher than 240,000 did not increase grain yield. The early-maturing soybean cultivar BRSMG Renascença showed more yield in higher plant population than another cultivars. Narrow row spacing was more profitable than wider ones.

P405. **Analysis of soybean yield variability considering soil, weather and crop factors in Southern Santa Fe, Argentina**

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Soybean yields usually vary between years and sites. This variation determines different environments (E) which affect crop yield. Moreover, the variability associated with the environmental factors can change from site to site as well as its effects on yield. To identify the factor/s limiting yields in this context is complex. On the other hand, actual and potential yield gap could be less if growers had more knowledge of environmental restrains affecting the crops. The present study aimed to: i. Characterize E in terms of soil, weather and yield variables; and ii. Identify limiting factors that affect yield components in E. Trials were conducted in 10 and 9 sites during 2001/02 and 2002/03 growing seasons, respectively (19 E combining site with year). Soil (physics and fertility), weather conditions (precipitation, radiation, temperature) and crop (phenology and growth dynamic factors) variables were determined. Water level in each E was measured using a neutron probe. Genotypes were ADM4800 RR and A5520 RG. Grain yield, seed number and seed size were determined at harvest. Analysis of variance, cluster analysis (CA), principal component analysis (PCA), simple correlation analysis (SCA) and partial least square regression (PLS) were performed on the data set. Yield ranged between 4612 $kg.ha^{-1}$ and 2255 $kg.ha^{-1}$. Clustering on yield results in four groups (G1R = 4480; G2R = 3839; G3R = 3206 and G4R = 2459). Clustering on seed number and seed size result in 4 (G1S = 2475; G2S = 2161; G3S = 1858 and G4S = 1396) and 3 groups (G1P = 184.8; G2P = 166.2 and G3P = 154.2), respectively. The 84 % of the environments were in G2P and G3P clusters, while only 21% were included in the G3S and G4S, indicating

yield was mainly restricted for the lower seed size in most environments. Soil variables show a more important physical deterioration than chemical. A CA and PCA done with soil variables indicated E differentiated principally because of compaction variables. Many high yielding E as well as most of the lower yielding E belong to sites with poor soil conditions. This weak relationship between soil characteristics and yield could be explained by of adequate soil water levels during the growing seasons. PLS was applied to relate crop variables to seed number or seed size of the E component. For seed number, results indicated that Maizales 02 and Rueda 02 were negatively associated with crop growth rate and radiation interception at R5, Amenabar 02 was positively associated with plant density, lodging and total dry weight at R2, and other four E were positively associated with crop growth rate. In the case of the rest of the E it was impossible to distinguish any clear association. For seed size, variations could be explained in a few cases (Maizales 02, Rueda 02, EEA Oliveros 02, Oliveros 02, Murphy 02 and Cararañá 03). In conclusion, further environmental variables for better understanding the soil – weather – crop relationships should be studied.

P406. Evaluation of soybean cultivars in macro plots in northwestern Argentina

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The area with soybean in northwestern Argentina (NWA) is of approximately 700,000 hectares, which are distributed in the provinces of Tucumán, Salta, west of Santiago del Estero and southeast of Catamarca. A wide range of environments and soil types characterizes this extense territory. Management of the soybean crops is also variable within this region. Sustainable soybean production in NWA requires the use of cultivars adapted to those conditions, with high yield potential and good performance against prevalent pests and diseases. The last decade was marked by a continuous replacement of soybean cultivars, caused by disease epidemics, environment changes, the appearance of transgenic soybeans and the availability of a great number of cultivars offered by breeding companies. From the 1997/98 to the 2002/03 growing seasons, regional testing of commercial soybean cultivars in macro plots was carried out annually al different locations of NWA. The objective of this set of experiments was to evaluate adaptation and yield potential of commercial soybean cultivars in large-scale plots. Collaborators in these tests included technical consultants and researchers from privates companies and public institutions. In each experiment, cultivars of late maturity groups (MG) (VII, VIII and IX) were planted apart from those of early MG (IV, V and VI). Each plot consisted of 1,000 m² with rows spaced 0.5 m apart. Control plots, consisting of the most widely used cultivar in the region, were located at each side of the test plots. Yield data was corrected by a normalization index to minimize the differences by soil variations. Finally, the calculated normalized yield was used to carry out a descriptive analysis about the performance of the different cultivars. Results obtained during the 2000/01, 2001/02, and 2002/03 growing seasons, at 13 representative locations of the NWA soybean area, indicated that late maturity cultivars (MG VII and VIII) had the best performance due to yield potential and adaptation to environmental conditions. A very good performance of indeterminate, early maturity cultivars (IV and V) was also observed. It is important to mention that for these early maturity varieties it is necessary to take into consideration aspects such as planting date, population density, and row spacing. The cultivar A 8000 RG showed the highest average yield for the 3 growing seasons. Nevertheless, other cultivars had average yields that did not differ significantly from that of A 8000 RG, such as A 7636 RG, A 4910 RG, A 8100 RG, and Munasqa RR. The information obtained from this set of experiments has been widely used by farmers and consultants in NWA as a tool in the selection of new cultivars to be planted.

P407. Response of soybean cultivars of maturity groups III, IV and V to reduction row spacing in spring planting in Tucumán and its area of influence

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In Tucumán an its area of influence (southeast of Catamarca and west of Santiago del Estero), there are approximately 15,000 hectares of grain crop area under irrigation with central pivot equipment. The disposal of water all year along allows farmers to choose among different production alternatives, wich should be profitable enough to afford the costs of this thecnology. Because of the great profitability of soybean [*Glycine max* (L.) Merr.] in recent years, its spring production under irrigation could be a good alternative for the region. Cultivars that belong to Maturity Groups (MG) IV to VI and indeterminated stem present the best perfomance in this model. MG V and VI cultivars are harvested too late to plant a summer soybean crop successfully. On the contrary, MG IV cultivars have a more suitable harvest date, but they reach less height, do not cover space between rows, and have intermediate yields. The purpose of this research was

to determine if narrowing row spacing from 0.52 m (commonly used in northwestern Argentina) to 0.25 m, the productivity of the indeterminate MG III and IV cultivars, could be compared to those achieved by MG V varieties, with the additional advantage of being harvested before, making possible a normal production of the following summer crop. The trials were conducted during 2000, 2001, and 2002 under irrigation with a central pivot equipment in Los Altos, Catamarca. The experimental design was a split-plot with three replications. Two row spacing (0.25 and 0.52 m) were evaluated in the main plots, while MG III to V cultivars were evaluated in the subplots. Some of the cultivars that belong to MG III and IV, by narrowing the row spacing to 0.25 m, reached similar or higher yields than those achieved by MG V varieties at 0.52 m row spacing. This behavior is very important because the earliest cultivars (MG III an IV) were harvested 15 days before the MG V cultivars, resulting in a better date for planting the summer crop at its best yield potential.

P408. Genotype-environment interaction of maturity group IV and VI cultivars in the Argentine Pampean Region

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INTA has being managing since 1980 the National Network of Evaluation of soybean cultivars (RECSO). Annually, all market available cultivars are tested for their agronomic, phenological and sanitary characteristics, at the level of each maturity group (MG) and for productivity and genotype-environment interaction (GE) for Regions and Sub-regions. In the present work, the GE of cultivars of GM IV and VI was determined in the Pampeana North and South regions. Cultivars were planted either in one or two locations of the Sub-region in two campaigns (2001/2 and 2002/3). In the assays of MG IV 18 trials in 2 cultivation Regions were evaluated: Pampeana Norte with 4 sub-regions and Pampeana Sur. For MG VI 14 trials of 4 Sub-regions of the Pampeana Norte region were evaluated. For statistical assesment the univariate analysis of Shukla and AMMI-GGE was applied. It was evaluated components of genotypes variance, years, areas, locations and their interactions. In experiments of MG IV the variation among genotypes represented 3% of the total variation, the environmental effect produced 87% of the variation and the interaction genotype-environment was responsible for 10% of it. Within the variation of the environment, 13% was due to ecological areas and the remaining 74% was due to location and year. Within 10% of the interaction, 2% is due to genotype x year and 8% is genotype for each assay, which also represents the most complex interactions. The analysis AMMI-GGE showed that the cultivars with higher yields were TJ2049, DM4600 and DM4800 presentings very low interaction with the environment. The first 2 principal components only explained 56% of the variation of genotype plus genotype x environment, evidencing a structure with small and complicate interaction. In the assays of MG VI the variation among genotypes represented by itself 4% of the total variation, the environmental effect was 82% and the interaction genotype-environment was 14%. Within that 82% of the environmental effect, 17% was due to ecological areas and the remaining 65% to location in area and year. For both MG this seems to be a particular effect of environment not depending on area nor year. Within 14% of the interaction 3% is due to genotype x area and 11% is genotype x assay, which also represents the most complex interactions. The analysis AMMI-GGE showed that the cultivars with highest yields were A6445RG, A6019RG and RAR605 with very low interaction with environments. The first 2 principal components explain 71% of the variation of genotype plus genotype x environment. Results show the reduced GE detected by RECSO, for both MG and the analyzed Sub-regions; and also, the important influence of the environmental conditions. The interaction MG by environments is being evaluated in another network.

P409. Spatial and temporal variability of soybean plants in community

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Spatial and temporal representation of the variability present in productive characteristics of soybean plants grown in community may facilitate the understanding of the parameters determining high crop yields. The objective of this work was to quantify and correlate the variability of grain production by the plant itself and the primary production components, by geostatistical analysis. Three experiments were carried out at the Estação Experimental Agronômica of the Universidade Federal do Rio Grande do Sul (EEA-UFRGS), in Eldorado do Sul, RS, Brazil, in the growing seasons of 1997/98, 1998/99, and 1999/00. The experiment consisted of an area of 70 m², demarcated at random in a no-till soybean crop field. The cultivar used was FT-Abyara (determinate growth habit, mid-season) managed as in a farm field. At harvest, the position of soybean plants present in the area was

marked by a system of cartesian coordinates, attributing coordinates (X and Y) for each plant. The plants were collected and the area occupied by each plant, as well as dry matter production, harvest index, height, branch number, production, and production components, was determined. The data was evaluated by general descriptive analysis, correlation, regression, and geostatistical techniques. By the use of geostatistic, semivariograms and maps of variability were obtained for the characteristics determined. The results showed to be possible, using geostatistical techniques, to identify areas with variability even when using data of individual plants. Spatial and temporal variability of attributes of soybean plants exist even in small areas, especially for dry matter. The harvest index shows little spatial dependence, i.e., the characteristics of the area have little influence over it. The results showed that the number of fertile pods per plant, mainly those in the branches, is the main production component determining plant production. The fertile pod number by plant presents a spatial correlation with the area of highest production plants. The components number of grains per pod and grain weight showed small spatial dependence and are less important in the determination of the production variability by plant. The branches are important for the spatial determination of grain production by plant and grain yield. Geostatistics is, therefore, an important complementary tool for understanding how plants characteristics vary in space and time.

P410. **Photosyntheses, N_2 fixation and growth of a supernodulating soybean genotype, Sakukei 4**

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Most of the supernodulating genotypes bred so far have not been practically useful due to their inferior yeild. The supernodulating soybean genotype Sakukei 4 which was recently isolated from Enrei is potentially high-yielding. We characterized its leaf nitrogen (N) content, photosynthesis and growth at different developmental stages and under different dosages and types of N fertilizer, and compared it to its parental cultivar Enrei and the non-nodulating line En1282. Sakukei 4 had, both at the pod expansion and at the seed filling stage, higher N contents per leaf dry weight and per leaf area, and exhibited higher apparent photosynthetic rates (AP) than the normal and the non-nodulating genotype. The nodule activity per plant was higher in Sakukei 4 than in Enrei during the reproductive stage. These traits varied less with growing conditions (field- or pot-grown) and doses or types of N fertilizer applied in Sakukei 4 than they did in the other genotypes. The superior ability of Sakukei 4 to maintain high leaf N and AP, however, did not enhance its growth performance, which tended to be inferior to that of Enrei. Moreover the photosynthesis of Sakukei 4 was sensitive to water stress (excess and deficient) than that of Enrei. Further studies are needed to define cultivation conditions to exploit the desirable traits of Sakukei 4 and to clarify the mechanism controlling the unique traits of Sakukei 4.

P411. **Growth characteristics of a promising supernodulating soybean cultivar, Sakukei 4**

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The supernodulating soybean cultivar Sakukei 4 was previously characterized by its superior ability to maintain high leaf nitrogen content and photosynthesis, even when grown in a soil of low fertility. Despite these desirable traits, the growth performance of Sakukei 4 was inferior to that of its normally nodulating parental cultivar, Enrei when grown in a cool region. The objective of the present study was to characterize in further detail the vegetative growth of Sakukei 4. In a first experiment, the growth of Sakukei 4 and its parental cultivar Enrei was compared under various rates of nitrogen fertilizer. The dry weight of plant parts was greater in Enrei at lower rates of N than in Sakukei 4, but it was vice versa at higher rates of N. The number and weight of nodules were far greater in Sakukei 4 than in Enrei at any rate of nitrogen. These genotypic differences were significant on DAS (days after sowing) 39 and became greater at the flowering stage. In a following experiment, therefore, more detailed growth analyses were made during an earlier growth stage (DAS 31-46). During this period, all the growth parameters (RGR, NAR and LAR) were lower in Sakukei 4 than Enrei and the related non-nodulating line En1282, whereas the leaf photosynthetic rate at any leaf position was higher in Sakukei 4. The dry matter partitioning to each plant part excluding nodules was similar in all three genotypes. The rate of leaf area expansion of Sakukei 4 during this period was significantly slower than the other genotypes. These results suggest that the inferior growth of Sakukei 4 prior to flowering is probably due to excessive dry matter partitioning to nodules and depressed capability of leaf expansion and root growth, which might limit dry matter production of the whole plant during pre-flowering stage.

P412. Effects of waterlogging on photosynthesis of a supernodulating soybean genotype, Sakukei 4

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Waterlogging is a major limiting factor for crop production in humid regions. In Japan, prolonged rainy period or heavy rainfall in the field with poor soil drainage converted from paddy field often hinders the vegetative growth and thereby causes a reduction of the seed yield in upland crops. A magnitude of reduction of growth and yield caused by waterlogging varies with the crop species, genotype and growth stage. Previous studies revealed that Sakukei 4, a promising supernodulating soybean cultivar bred in Japan, exhibited comparable or better growth and yield than its parental cultivar Enrei or the other supernodulating lines in a certain growing condition. The object of the present study was to examine the effects of waterlogging on photosynthesis, nitrogen fixation and water absorption capacity of root in Sakukei 4. The first experiment, where the effects of waterlogging on photosynthetic rate and acetylene reduction activity (ARA) were examined, showed that Sakukei 4 and Enrei exhibited a significant decline of photosynthetic rate and ARA with time after treatment, irrespective of aeration or not. The decline of ARA caused by waterlogging in both cultivars was more pronounced than that of the photosynthetic rate, indicating that nitrogen fixation is more sensitive to waterlogging than photosynthesis in soybean. Both cultivars showed a positive correlation between photosynthetic rate and ARA; with the correlation closer in Enrei. In the second experiment, the association of photosynthetic rate with exudation rate from the base of the stem was examined under waterlogging condition. Photosynthetic rate and exudation rate in the two cultivars remarkably declined with time after treatment, but the positive correlation of the two parameters was statistically significant only in Sakukei 4. These results suggest that the pronounced decline of photosynthetic rate in Sakukei 4 under waterlogging condition appeared to be more closely related to a poor capacity of water absorption than the capacity of nitrogen fixation in this genotype.

Contributed Papers

ISPUC

C094. Soybean-based wood adhesive resins as fiberboard binders

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Urea-formaldehyde (UF) resins are the main binders for panel production for interior uses such as decking, paneling and furniture. UF-bonded panels are not moisture resistant and emit formaldehyde at elevated temperature and humidity conditions. Melamine-urea-formaldehyde (MUF) resins are typically used today to improve moisture resistance and reduce formaldehyde emissions from particleboard and medium density fiberboard (MDF). Commercial MUF resins normally contain at least 25% expensive melamine, and therefore are more costly than UF resins. The objectives of this study are to develop and evaluate MUF co-polymerized soybean-based resins as MDF binders. Four MUF resins containing 24%, 20%, 17%, and 15% melamine were formulated for comparisons. Four Soybean-based MUF (SMUF) resins also were formulated in such a manner that these resins contained, based on solids, 50% MUF and 50% soy flour hydrolyzates. Boards bonded with neat MUF resins met the US product standards for Grade 160 (exterior) MDF while boards bonded with SMUF resins met standards for Grade 130 (interior) MDF. On the average, boards bonded with MUF and SMUF resins had similar bending properties, but boards bonded with SMUF resins had 30% lower internal bonding strength that was the only deficiency for SMUF boards to meet the ANSI Grade 160 MDF requirements. However, SMUF resins can be used to produce interior panels with much better moisture resistance than boards bonded with UF resins. Boards bonded with SMUF resins also emit considerably less formaldehyde than boards bonded with UF resin. It is concluded that SMUF resins are cost competitive for production of interior particleboard and fiberboard.

C095. Changes in quality factors during lactic acid fermentation of soybean milk

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In the last few years interest in the benefits of soybean in the prevention and control of chronic diseases has increased all over the world and many of its constituents has been demonstrated to have, either positive or negative, effects on human nutrition and health. Among them, the isoflavones have been reported to have a strong effect in controlling the cholesterol concentration in the human blood, the calcium concentration in bones and the development of some times of cancer. The soybean isoflavones found in the soybean are in the glycoside form, which are not as easily absorbed as their aglycosidic forms. Other soybean compounds of interest are the oligossacharides raffinose and stachyose, that can not be digested or absorbed, causing gas formation in the intestine as a consequence of their fermentation by the intestinal microorganisms. Soybean milk fermentation has been used to improve soybean taste and, thereafter, soybean consumption but little attention has been given to the changes in the concentration of these compounds during the fermentation process. The objective of this experiment was to determine the capacity of 15 different lactic acid bacteria to hydrolyze isoflavones to their aglycosidic form as well as their capacity to use oligossacharides as an energy source. The parameters evaluated were: microorganism growth, pH lowering capacity, lactic acid formation, sugar consumption, isoflavone hydrolysis capacity and total viable cells after 15 days of storage at 4°C. Soybean milk was prepared from Tachinagara variety (10% total solids). All of the microorganisms evaluated were able to grow in soybean milk but *Streptococcus thermophilus* IFO 13957, *Lactobacillus casei* subsp. *casei* JCM 1134 and *Lactococcus lactis* subsp. *lactis* JCM 5805 were not able to consume sugars, to lower the pH or to produce lactic acid. *Bifidobacterium breve* JCM 1192, *B. bifidum* JCM 1255 and *L. casei* subsp. *rhamnosus* IFO 3425 showed the best activity to hydrolyze daidzin and genistin to daidzein and genistein, respectively.

C096. **Production of soy protein products in Russia: strategies of development**

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JSC "Technomol Foods" is one of the designers of the Program "Soya of Russia" which specifies the basic directions of agrarian and industrial policy in the area of production of soybeans and soy proteins up to 2010. It is also a member and an initiator of the foundation of non-commercial organization- "Soy Union of Russia" created for implementation of the Program. In 2003 the Program was approved by the Ministry of Agriculture and Foodstuffs of RF and supported by the Agrarian Committee of the Russian State Duma. Construction of industrial enterprises for production of different types of soy proteins, expansion of soybean breeding in Russia, complex development of markets of soy protein products and R&D activities in the area of novel technologies of edible soy products and additives, health products included, are among the main objectives of the Program. The total annual capacity of new enterprises should exceed 200 thousand tons of soy protein products to the year of 2010.The current and future status of the Russian soy protein industry will be discussed. JSC "Technomol Foods" is the single company in Russia, which has started the industrial production of textured proteins starting from soybeans using a technology of texturization of grinded soybean cake obtained by ExPress® technology. The annual capacity of the plant is 20,000 tons of soybeans. Finished textured soy proteins are used by local meat processing and canning enterprises. Besides textured soy proteins the plant manufactures high quality partially defatted soy flour, natural soy oil and feed additives. According to the Program several similar operations will be constructed in Russia. Constructions of industrial enterprises for production of soy isolates, functional soy concentrates, defatted soy flour, powdered soy milk and different types of high protein feed additives are included to the strategic plans of the Program. Domestic and international companies interested in the Program will be attracted for implementation of its different stages. The Program will result in a growth of industrial production and usage of edible soy proteins. Increase of a profitability of agricultural production, development of high-tech technologies of soybean production and processing, decrease and/or complete elimination of the existing deficit of proteins in diets of Russians and improvement of structure of nutrition of Russian population, meeting the demand of domestic customers in high protein feeds and vegetable oils, less dependence of Russia from imported edible proteins and food products – these will be the projected benefits of the Program fulfillment.

C097. **Developing new soy products in Australian foods market**

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Despite soybeans unique chemical composition, good nutritional value, functional health benefits and versatile end uses, at the present, especially in Australia, only a small proportion of annual soybean production is used for direct food consumption. A number of constraints are associated with the food uses of soybeans that result in low consumer acceptance. These constraints include unpleasant grassy or beany flavour, flatulence, poor protein digestibility due to trypsin inhibitors, instability of soy oil to oxidation, and low levels of sulphur-containing amino acids. Traditionally, two main approaches have been adopted to address constraints associated with food utilization of soy foods: innovative industrial processing, and plant breeding that also involves mutagenesis and genetic engineering. However, other approaches are needed to fully overcome these constraints, including marketing efforts, scientific and medical discoveries, consumer education, and change in dietary habits.

C098. Relative efficacy of different herbicides in soybean

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The weed competition with soybean at an early stage of crop growth is crucial and causing a yield loss up to 35 to 77 per cent. The control of weeds either through intercultivation or manual weeding is not always feasible on account of incessant rains during crop season in the major soybean growing areas covered under vertisols and associated soils. The situation warrants use of herbicides to optimize soybean production. Although the pre-plant incorporation (PPI) and pre-emergence (PE) herbicides are under recommendations but still need of suitable post-emergence (POE) herbicides in soybean has constantly been felt. Therefore, the present study was undertaken to evaluate new post-emergence herbicides for their effectiveness and performance in comparison to recommended herbicides and cultural control methods. A field experiment was conducted in vertisols of Madhya Pradesh, India during 1996 and 1997 to evaluate the relative efficacy of various herbicides in soybean. Twelve treatments comprising of alachlor @ 2 kg /ha (PE), trifluralin @ 1 kg/ha (PPI), pendimethalin @ 1 kg/ha (PE), fenaxyprop-p-ethyl @ 50 and 70 g/ha (POE), propaquizafop @ 50 and 75 g/ha (POE), imazethapyr @ 75 and 100 g/ha (POE), anilophos @ 1.5 kg/ha (POE), two hand weedings at 30 and 45 days after sowing (DAS), and weedy check were laid out in randomised block design with 3 replications. All the weed control treatments significantly reduced the weed load as compared to weedy check and anilophos. The weed control efficiency of all the treatments was higher at 60 DAS as compared to 30 DAS except trifluralin @ 1 kg/ha, fenaxyprop-p-ethyl @ 50 g/ha and anilophos @ 1.5 kg/ha (POE) suggesting that the residual control was less in these herbicides. In general, weed persistence index (WPI) was higher at 30 DAS than 60 DAS. The crop resistance index (CRI) values at 60 DAS, showed that alachlor @ 2 kg/ha had the highest value which was at par with remaining treatments. On comparing the weed management index (WMI), propaquizafop @ 50 g/ha and imazethapyr @ 100 g/ha possessed highest values at 30 and 60 DAS revealing their edge over POE herbicides. Most of the treatments except propaquizafop @ 50 g/ha and imazethapyr @ 100 g/ha showed negative values of agronomic management index (AMI). The maximum relative agronomic efficiency (RAE) and relative efficacy (RE) was associated with imazethapyr @ 100 g/ha followed by with propaquizafop @ 75 g/ha (POE). Results revealed that the application of post-emergence herbicides namely imazethapyr @ 100 g/ha and propaquizafop @ 75 g/ha was found to be most efficient in minimizing the weed load, improving weed control efficiency, weed management index, integrated weed management index, relative agronomic efficiency and relative efficacy. Post-emergence application of anilophos @ 1.5 kg/ha was found to be less efficient in controlling weeds as well as promoting seed yield. Application of post-emergence herbicides were equally effective as cultural practices and pre-emergence herbicide i.e. pendimethalin.

C099. Effect of sowing period in grain yield and agronomic characteristics of soybean

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The sowing period changes significantly the phenologic and phenometric characteristics in soybeans, mostly in areas in south of Brazil. An experiment was conducted at Fundacep-Fecotrigo, (Cruz Alta, RS, Brazil) in 2002-2003 growing season, and consisted by six sowing dates between 23 October and 14 January, spacing at near each 15 days, with 17 soybean genotypes (early, medium and late cycle). The objective was to evaluate the number of days from emergence to physiologic maturation (NDM), the plant height and the grain yield. To facilitate the application of equations and interpretation of data, sowing dates were transformed in a continue scale of time, with 23 October is the day 1 and 14 January is the day 83. There were tested several equations to find a correlation by sowing date with the grain yield, height plant and NDM. The best fit to yield occur with the quadratic function $Y = 673.16 + 0.064X - 0.013X^2$ ($r^2 = 0.98$), and reveal that the day 26 (corresponding, in the Calendar date, at 17 Nov) would be the best date to sow soybean. Comparing the yield between sowing dates, there was not significant difference when the soybean was sowed between 23 Oct. and 12 Dec. However, there was a decrease in the production after that last date. The plant height was correlated with the sowing date, and estimated by equation $Y = 56.942 + 2.068X - 0.028X^2$ ($r^2 = 0,95$). According this equation, the taller plants would be got with the sowing in the day 36 (corresponding at nov/28). The NDM reduced lineally with the increase in the sowing date (more late sowing, more short time to soybean grow), and the equation $Y = 144.0 + 0.477X$ ($r^2 = 0.96$) was adjusted to data. The grain

yield increased whit the increase in the plant height, with a Pearson's correlation of 0.73. The soybeans sowed at 23 Oct. presented high yield (3927 kg.ha^{-1}), but these plants were smaller than the ones sowing in later dates. This result is explained, at least in part, because of NDM medium was superior at 140 days, presenting a compensatory physiologic effect, regarding the low stature of plants. Conclude that the sowing dates between 20 Oct. and 10 Dec. do not differed in the grain yield, while can to have changes in the plant height and in NDM.

C100. New types of soybean rhizobial inoculants and their performance in first-time soybean fields over the last decade

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In the province of Ontario, soybean production has expanded rapidly into cooler, shorter-season areas. As soybeans were introduced into new fields, inoculation with *Bradyrhizobium japonicum* has increased yields by about 30% compared to uninoculated control plots. Each year, we have grown field trials evaluating inoculants. Generally, we test at two locations, one with conventional tillage and one no-till. Both locations are prepared to be low in available soil N. Trials are conducted on growers' farms using randomized complete block designs with four replications. No-till plots are planted with field-scale equipment but small-plot machinery is used to plant the conventional-tillage plots and to harvest all plots. We have averaged about 15 commercial inoculants per year in these trials, including several types of carriers: non-sterile peats (23.3), granular peats (30.7), sterile carrier peats (31.7), sterile liquid inoculants [used both on-seed (35.0 and in the seed furrow (36.7)]. The performance of these inoculants has increased in the order shown and the percentage yield increases over the uninoculated controls are shown in parentheses. Pre-inoculated seed treatments are in their fourth year of testing but do not yet perform as well as most other inoculants. Performance of inoculants is correlated with the the numbers of rhizobia delivered per seed. High-yielding treatments consistently have high seed protein contents and low seed oil contents. Best inoculants have typically increased seed protein, compared to uninoculated controls, from about 320 to 400 mg/g and decreased oil from about 230 to 200 mg/g. Performance of inoculants has been similar in conventional and no-till situations. Once established, *B. japonicum* populations remain in most Ontario soils for years and attempts to change strains have not been successful. Responses to inoculation in fields which have already grown soybeans have averaged about 5%, which often is not significant at $P>.05$.

C101. New patented growth promoter technology to enhance early season soybean development and grain yield

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New soybean growth promoter technology based on the U.S. patents 5,549,718 and 5,646,018 has been developed and field tested. The natural bacterial promoter compound has been purified, formulated and assayed via HPLC to provide field efficacious concentrations ranging from 0.000001 to 0.001% w/v of the active lipo-oligosaccharide compound (nod factor). Purified material has been applied as a liquid formulation to soybean seed at the time of planting. Multi-year field evaluations have demonstrated an early season growth enhancement that includes improved stand, early season vigor, earlier root nodule formation with both applied and indigenous *Bradyrhizobium japonicum* independent of soil temperature, earlier canopy closure and improved grain yield. A liquid formulation has been commercialized (Optimize™) that utilizes Cell-Tech® as the carrier, and is custom applied on seed at a retail facility to ensure uniform application and grower convenience. Cell-Tech included as the carrier, with *Bradyrhizobium japonicum*, ensures sufficient nodulation on fields with or without a history of soybean production. The liquid formulation is applied to soybeans at the rate of 125 ml/45.4 kg seed. The material may be combined with compatible fungicides and applied 30 days before planting. The Optimize formulation in the U.S. has increased plant stand compared to the control from 70.8 to 76.4%, vigor (1 to 9 relative scale) from 4.8 to 6.5, nodulation from 21.1 to 24.4 nodules per plant, decreased days to canopy closure from 70.4 to 67.4, and increased grain yield in 22 trials by 343 kg/ha (10.1%). Four trials in Argentina in 2003 provided an average grain yield increase of 402 kg/ha (12.2%).

C102. Partial resistance to *Phytophthora sojae*: genetic *loci* and potential mechanisms in soybean

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Phytophthora sojae causes seed, root and stem rot of soybeans in all of the soybean production regions of the world. The severity of this disease is highly dependent on presence of environmental conditions suitable for infection and disease development. Fourteen *Rps* alleles have been identified in soybean that provide resistance to *P. sojae* in a race-specific manner. Widespread deployment of *Rps* alleles resulted in shifts in *P. sojae* races, and decreased effectiveness of the *Rps* alleles. In contrast, 'partial resistance' is not race specific, and should be independent of shifts in the *P. sojae* population. Thus, efforts to incorporate partial resistance, also referred to as tolerance, field resistance and horizontal resistance, into soybeans should be increased. In the laboratory, partially resistant inoculated seedlings show a reduced lesion growth rate, fewer rotted roots, and slower disease progress than highly susceptible cultivars. The performance of 12 soybean cultivars with partial resistance, with or without *Rps* alleles, to different populations of *P. sojae* was evaluated in 7 environments at various levels of disease pressure. There was a highly significant genotype by environment interaction, due in part to variable disease pressure. Soybean cultivars that had the fewest plants with Phytophthora stem rot and highest yields across environments were those with moderate levels of partial resistance in combination with either *Rps*1k or *Rps*3a. Two QTLs on molecular linkage groups (MLG) F and D1b+W of Conrad were identified in three populations. The QTL on MLG F explained 32.4, 35.0, and 21.4 percent of the genotypic variation for the Conrad x Sloan, Conrad x Harosoy and Conrad x Williams populations, respectively. The QTL on MLG D1b+W explained 10.6, 15.9, and 20.7 percent of the genotypic variation for the same three populations, respectively. The QTL on MLG F appears to be of more value based on the percent of genotypic variation explained. These results indicate that QTLs for partial resistance to *P. sojae* map to different regions in soybean than do the known *Rps* loci. Marker assisted selection may expedite the process of combining *Rps* alleles with partial resistance in high yielding cultivars. To begin to define molecular mechanisms and defense responses associated with partial resistance to *P. sojae*, constitutive expression of seven defense-related genes in fourteen cultivars with low, moderate and high levels of partial resistance was determined using RNA blot analysis. There was no relationship between constitutive expression of defense-related transcripts and partial resistance to *P. sojae* as measured by lesion growth rate in either soybean roots or cotyledons. The direction of future research efforts will be discussed.

C103. Sudden death syndrome of soybean is caused by two distinct species within the *Fusarium solani* species complex in the United States and in Argentina

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Soybean sudden death syndrome has recently become a serious problem for the commercial production of this crop in North and South America. Strains of *Fusarium* as the causal pathogen of soybean sudden death syndrome isolated in the United States and Argentina, i.e., *F. solani* f. sp. *glycines*, were examined morphologically and phylogenetically. They were compared with typical strains of *F. solani*, including biological species within the *Nectria haematococca* species complex comprising mating populations I-VII, and those of *F. solani* f. sp. *phaseoli* isolated from root rot of bean in the US. Maximum parsimony analysis of DNA sequences from the nuclear ribosomal intergenic spacer region and the single copy nuclear gene translation elongation factor 1-a indicated that SDS of soybean in the US and Argentina is caused by two phylogenetically distinct species. Detailed morphological comparisons of conidial features revealed that these soybean SDS pathogens and *F. solani* f. sp. *phaseoli* have a unique aerial conidial structure, i.e., forming septate conidia with a foot-cell on tall and mostly simple aerial conidiophores. They also have limited production of aseptate ellipsoidal conidia on short aerial conidiophores. The Argentinean soybean SDS pathogen forms septate sporodochial conidia longer than those of the soybean SDS pathogen in the US and *F. solani* f. sp. *phaseoli*. The soybean SDS pathogen in the US also has comma-shaped sporodochial conidia. Based on other features, the soybean SDS pathogen within the US and Argentina and *F. solani* f. sp. *phaseoli* isolated from American bean are characterized as the following three new spp.: *F. virguliforme*, *F. tucumaniae* and *F. phaseoli*, respectively (Aoki, et al., 2003, Mycologia 95(4): 660-684).

C104. Influence of planting date and genotype on late season diseases and yield of soybean in Tucumán, Argentina

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The occurrence of soybean diseases in northwestern Argentina has increased gradually over the last 15 years. The late season disease complex, a combination of various diseases that becomes most noticeable in the mid to late reproductive stages, can cause significant yield losses. The objective of this study was to evaluate the influence of planting date and soybean genotype on development of late season diseases (LSD) and yield. Field tests were conducted in San Agustin, Tucumán, Argentina. Twelve genotypes (Maturity groups VI to XI) were evaluated in the 2000/01 growing season and 15 genotypes were evaluated in the 2001/02 season, with four planting dates (PD) in each season. The experimental design was a randomized complete block with 3 replications. Plots consisted of four, 6-m rows, spaced 0.5 m apart. Disease severity was evaluated in 10 plants per plot every 3 weeks, with the aid of a standard area diagram. Severity values were used to calculate the area under the LSD progress curves (AULSDPC). Brown spot (*Septoria glycines*), leaf blight (*Cercospora kikuchii*), bacterial blight (*Pseudomonas savastanoi* pv. *glycinea*), downy mildew (*Peronospora manshurica*) and frogeye leaf spot (*Cercospora sojina*) were the main LSD during the first season, while brown spot, bacterial blight, downy mildew and target spot (*Corynespora cassiicola*) predominated during the following season. LSD progress curves started at 35 days after planting (DAP) with severity values for the first planting date that ranged from 2% to 12% and 2% to 8%, for the 2000/01 and 2001/02 seasons, respectively, and reached maximum values at 75 DAP, with 25% to 42% and 16% to 42%, for the first and second growing seasons, respectively. As planting was delayed the LSD progress curves were flatter and the epidemics started later. For the fourth PD, severity values at 35 DAP ranged from 0.5% to 2% and 0% to 6% for the 2000/01 and 2001/02 seasons, respectively. As in the first planting date, the maximum values were recorded at 75 DAP with values from 9% to 16% and 15% to 31%, for the first and second season, respectively. Average reduction of AULSDPC between the first and last PD was 30% for 2000/01 and 63% for 2001/02. There was a significant interaction for AULSDPC between PD and genotype for both growing seasons. Yields decreased as planting was delayed. Average yield reductions between the first and last PD were 60% for 2000/01 and 36% for 2001/02.These results indicate that the risk of high LSD levels can be minimized by late plantings, although this results in significant yield reductions.

C105. Web-based soybean disease diagnosis system

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Soybean is one of the three most important oilseed crops in India. Presently it is grown in an area of about 6 million ha with a production of 6 million tons. However, the average productivity of soybean has remained low (about 1t/ha). Soybean crop is highly vulnerable to diseases incurring heavy losses in yield. In India diseases are considered as one of the most important biotic factors leading to low productivity. Though, substantial information on major diseases of soybean and their management is available in the form of literature, it is quite time consuming and not readily available comprehensively in user friendly manner to the different clientele like students, research scholars/ workers, extension personnel/trainers, entrepreneurs and farmers. Therefore, need was felt to compile the available information in the form of a database in order to develop a computerized symptom-based disease diagnosis system for correct instant identification of diseases and their appropriate integrated management at right stage. To make it accessible to versatile users at global level the system has been designed using web-technologies viz. Active server pages (ASP), HTML, JAVA etc. To keep the soybean disease data in systematic-easy to retrieve manner and to facilitate the updation of the data, a Soybean disease data management system has been developed using Visual Basic (6.0) at front-end and SQL Server 2000 at back-end. Disease identification in the system is based on symptoms observed visually, by magnifying lens, by microscope and by laboratory tests as well. Other factors such as weather temperature, humidity, rainfall, soil moisture, temperature, pH etc. are also being taken into account. Additionally, the system also provides information on pathogen, economic loss, areas where the disease is prevalent etc. It facilitates the confirmation of the diagnosed disease through colored pictures (pictorial-identification of disease). To start with, the system is designed to cover 25 major soybean diseases of India but it has provision to include more newly emerging diseases. The system besides serving as a Ready-Reckoner-Kit for diagnosis and management of Indian soybean diseases for different clientele will also

be of immense value in increasing and stabilizing the yield of soybean. This will also be a good source of soybean disease information for research workers and can also be used as an educational and training tool in specific courses in plant pathology. The system will soon be linked with the institute web-site (www.nrcsoya.com) so that the users can use it from different locations all over world through INTERNET.

C106. National soybean variety regional trials and approval system in China

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Soybean is sensitive to photo-thermal regimes and the varieties are adaptable with limited area. To ensure the safety of variety utilization and promote the extension of new varieties, the Chinese government paid attention to the establishment of the regional trials and approval system of soybean varieties. In the early 1950s, China began to conduct soybean variety regional trials and then the national system for regional trials and approval were gradually established and improved. **1. National soybean variety regional trials** - Based on the environmental conditions, sowing types and farming systems of soybean producing area in China, four regions for variety trials were classified as follows: Northern Spring-sowing Soybean Region, Yellow River-Huaihe River and Haihe River Valleys Summer-sowing Soybean Region, Southern Spring-sowing Soybean Region, and the Northwest-Northern China Spring-sowing Soybean Region. After 2002, the vegetable soybean varieties were included in the national soybean variety trials in order to meet the increasing demand to the maodou (edamame) varieties. In 2003, the total number of the locations for the national soybean variety regional trials was 115, and the variety number was 84. All new or introduced soybean varieties must pass the regional trials before their release. The varieties applying for regional trials have to meet the following requirements: 1) selected or discovered and then improved; 2) distinct from the existed varieties; 3) stable in genetic characteristics; 4) uniform in morphological and biological characters; 5) designated with a suitable name. Besides the national regional trials, the provincial soybean variety trials are also conducted in the major soybean producing provinces in China. **2 Procedures for approval of new soybean varieties** - According to the Law of Seeds of the People's Republic of China, the compulsory approval system is conducted for the release of new soybean varieties. Without the approval from the authorities, no commercial advertisement and seed trade are admitted. The approval can be obtained from two independent pathways both at national and provincial levels, respectively. The Ministry of Agriculture organizes the National Crop Variety Approving Committee and the provinces have their own crop variety approving committees. Until 2003, the National Soybean Variety Approving Committee approved 93 soybean varieties for release. Some of the approved varieties are playing important role in soybean production in China.

C107. Post flowering photoperiod regulates leaf senescence, seed filling and maturation in soybean

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Soybean development is controlled by environmental factors, mainly by photoperiod and temperature. Up to now, photoperiod effects on flowering have been well studied but the performances and mechanism of post-flowering photoperiod responses have not been fully understood. In the present study, we investigated postflowering photoperiod responses of three soybean varieties in four separate experiments. Long-day (LD) treatments from beginning bloom, beginning pod or beginning seed delayed the maturation of late soybean variety. When flowers and pods were removed, short-day (SD) treatment promoted leaf senescence. The dates of leaf senescence in various varieties appeared to depend mainly on maturity group or photoperiod sensitivity. The leaf senescence in response to photoperiod was greater in late varieties than in early varieties. Long days delayed seed maturation and leaf senescence of Zigongdongdou (a late variety) plants with only the SD-induced leaves produced before flowering. Results of night-break with far-red and red light demonstrated that phytochromes are functional as receptors of photoperiod even after flowering. It was proposed that the regulation of photoperiod on development of soybean is effective from emergence through maturation, and the postflowering photoperiod signals are also mediated by phytochromes similar to that before flowering. The flowering reversion in late soybean varieties under LD is a direct result of LD and may not be due to secondary effect of abscission of pods and flowers. Soybean leaves cannot only receive SD signals but also LD signals; furthermore, the LD effects can reverse the SD effects and vise versa. Photoperiod can influence flowering induction, floral organ initiation and development even after floral commitment.

C108. Evaluation of soybean germplasm for photoperiod insensitivity

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Photoperiodic response of soybean [*Glycine max* (L.) Merr.] is a major factor determining the latitude and time of sowing to which soybean cultivars can be grown. In India, soybean is extensively grown as a rainfed crop around a latitude range of 16-26° N and has a potential to expand in the range of 12 to 32° N. Being a rainfed crop it's planting at a location also varies from year to year depending on the onset of monsoon (rainy season). Because of very high sensitivity to photoperiod, all the released Indian soybean cultivars have a narrow range of adaptation across latitudes and planting times. Therefore, identification of genetic sources that are insensitive to photoperiod was considered important From the available indigenous and exotic collections, 522 germplasm lines were evaluated for their response to short (<13.2 hrs) and long (17 hrs) photoperiods under field conditions. For short photoperiod, germplasm lines were grown under ambient photoperiod at Indore (22.44° N) during rainy season (July to October). The ambient photoperiod at planting till last germplasm line was harvested ranged from 13.2 to 11 hrs. For extended photoperiod of 17 hrs, in another set of these lines planted under field conditions, light was extended by incandescent bulbs hanged 3 feet above the canopy. Data on number of days from planting to appearance of first flower (R1 stage) and subsequent reproductive stages were recorded for all the lines grown under ambient and extended photoperiods. Under ambient photoperiod all the lines flowered and reached to maturity. The average days to flowering and physiological maturity was 40 and 89 days with a range of 23-59 and 68-114 days, respectively. As against this, out of 522, only 54 (10%) germplasm lines could flower under extended photoperiod till the experiment was terminated (120 days after planting) due to onset of winter season. Among the 54 lines, which flowered under extended photoperiod, the average days to flowering was 66 days with a range of 26-102 days. Out of these 54 lines, only 3 lines viz. EC 325097, EC 333897 and MACS 330 showed no delay in flowering under extended photoperiod as compared ambient photoperiod. Hence, these lines were identified as photo insensitive and could be utilized in breeding programmes aimed at developing cultivars with wider adaptability across latitudes and planting time. Besides flowering, other reproductive stages were also found to be highly sensitive to photoperiod as out of 54 lines, which flowered under extended photoperiod, only 5 could reach to maturity. In rest of the lines further reproductive development stopped at various growth stages ranging from pod initiation (R3 stage) to seed initiation stage (R5) under extended photoperiod.

C109. Genetic base of Indian soybean varieties - status and strategies

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Genetic uniformity is a matter of serious concern to plant breeders and a more diverse genetic background in currently grown cultivars is warranted to provide insulation against the unexpected outbreak of biotic and abiotic stresses. The pedigrees of Indian soybean varieties indicate 76 ancestors with 18 appearing more than once with 10 of these contributing to 72.67% of ancestry. There is a decrease in the average number of parents per variety in cultivars released before 1980 to those released during 1981-90 and 1991-2000. Bragg was the most frequently used ancestor and occurred as a direct parent in 15 of 66 pedigrees. The mean coefficient of parentage and range indicate a narrow diversity among the varieties. Most of the Indian soybean varieties come from a few exotic introductions and breeding lines generated using the exotic introductions and the native land races. These were then repeatedly crossed with the existing cultivars and were further crossed among themselves. This led to a sort of inbreeding within a selected group of genotypes and has contributed to the decline in the average number of parents per variety. This trend of narrowing genetic base of the Indian soybean varieties is a major concern and challenge put forward to the Indian soybean breeders. This challenge may be met through widening the genetic base of the soybean varieties through (i) Augmentation of the available genetic base through tapping of resources from global gene fund (IPGRI) through MOU's and Material Transfer Agreements (MTA's), that would facilitate directed introductions. (ii) Consolidating the national germplasm collections, evaluation and establishment of a core collection. (iii) Pre-breeding and germplasm enhancement through advancing segregating lines developed by utilizing various donors possessing resistance to insects (girdle beetle, defoliators), diseases, better seed quality (increased viability, bold seeded ness, increased longevity) and food quality. (iv) Enhancing genetic diversity at farm level by farmer participatory approaches.

C110. Evaluation of redundance possibility in Chinese genebank and the genome diversity in homonynic accessions

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There are abundant collections of soybean in China. More than 23000 accessions of soybean germplasm resources are stored in Chinese National Genebank. Many of them, however, are entitled the same name. Are they homonymous or different? Is it valuable to store all of them in Genebank? Whether is it reasonable to use these materials to establish core collection? In this study, 6 major groups were selected and analyzed. They are serials of Mancangjins, Xihuangdous, Tanerdans, Niumaohuangs, Xiaozihuangs and Pingdinghuangs. At the meanwhile, some of their parents, relatives and accessions that originate from the same province were compared for genetic diversity. A total of 13 agronomic traits and a set of 60 core primers were used to characterize differences between the homonymic accessions, to determine the evolutionary relationship between each other, and to compare the differences. For Mancangjins, there were 19 accessions were selected.151 alleles with average 6.6 alleles per locus have been detected by 23 pairs of SSR primers which come from the 60 core primers. All of 19 accessions named Mancangjin can be differentiated by only 5 loci. The genetic relationship of Mancangjins with their supposed parents Jinyuan and Huangbaozhu were compared. It is conceivably speculated that ZDD00078 and ZDD00924 are derived from the cross between Huangbaozhu and Jinyuan (Yan Zhe et al. 2003, Journal of Plant Genetic Resources). Similarly, there are obvious differences between all homonymy accessions at both phenotypic and molecular levels. Relatively, more differences were observed at the DNA level compared to the phenotypic level. The results indicated that there might be less redundancy and more genetic diversity, and it is valuable to store all of them in National Genebank. Therefore each of accessions can be taken as different individuals and used to establishing core collection.

C111. Establishment and evaluation of soybean (*Glycine max*) core collection in China

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China owns the most soybean germplasm in the world, and it becomes urgent task to evaluate and utilize the collection efficiently. The core collection was proposed by Frankel and Brown (1984) and completed by Brown (1989), which provided a novel method for germplasm study. Since then, more than 30 species have established core collection (Cui, 2003). Based on the phenotypic and molecular data for Chinese soybean germplasm, the genetic diversity were analyzed for summer sowing soybean (Cui et al., 2003A), spring sowing soybean (Lin et al., 2003; Li et al., 2003) and autumn sowing soybean (Xie et al., 2003) and were compared between three planting types (Xie et al., 2003A), different regions of the same planting types (Li W. et al., 2003; Li L. et al., 2003), and accessions from different provinces (Guan et al., 2003; Ning et al., 2003). It is important to use genetic diversity on establishing core collection (Qiu et al., 2002). Based on the agronomic traits of 23587 cultivated soybean, 20 primary core collections were set up to compare with the whole collection, the best sampling strategy and proper sampling ratio were determined (Qiu et al., 2003). The primary core collection was tested on its representative for the whole collection at both morphological and molecular level (Cui et al., 2003B; 2003C; Zhu et al., 2003). In order to estimate the primary core collection properly, the minimum number of the core SSR loci was screened (Wang B et al., 2003; Xie et al., 2003B) and used to evaluate for all primary core collection (Wang L et al., 2003; Lin et al., 2003; Luan et al., 2003; Cui et al., 2003B; Li W. et al., 2003; Li L. et al., 2003; Guan et al., 2003; Ning et al., 2003; Xie et al., 2002; Zhu et al., 2003). Meanwhile, several sub collections were set up in order to meet the needs of soybean breeding, which include the subcollections for breeding parents (Zhang et al., 2003), soybean mosaic virus resistant accessions (Mi et al., 2003), soybean cyst nematode resistant accessions (Wang et al., 2003) and good quality (high protein; high oil) accessions. In order to test availability of the subcolleciton, the frequencies of accessions with lacking 28K or high 11S/7S ratio were compare between the subcollection with high-protein and high-oil content and reserved collections. The results indicated that prior collection had higher ratio for the targeted traits, which included the novel cultivated soybean lacking subunit. It indicates that the collection will also play a very important role in mining gene, functional genomics study, and breeding.

C112. Primary detection of genetic diversity between Huanghuai and Southern summer soybean

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China owns the most soybean resources in the world. There are 11597 accessions of Summer sowing soybean, accounting for 49% in Chinese soybean germplasm. Chinese Summer sowing soybeans were divided into 2 different ecotypes: southern summer soybean and huanghuai summer soybean. It would be valuable to evaluate the genetic diversity of these accessions. In this experiment, 187 accessions from southern summer soybean(SSS)and 181 accessions from Huanghuai summer soybean(HSS) were analyzed for their genetic diversity, furthermore, comparison would be processed between these two groups. A total of 15 agronomic characteristics and 60 core SSR loci were used to analyze genetic diversity among 368 summer accessions. By the agronomic characteristics. HSS had higher genetic diversity than that of SSS for both simpson (PIC) and shannon-weaver (H') indexes (PIC $_{HSS}$ =0.532 PIC sss =0.484; H'$_{HSS}$ =0.989 H'sss =0.870). The total alleles and average alleles per locus were the same for 480 and 10.67 in both HSS and SSS. The locus with the most alleles and least alleles are satt590 and sct-188 in both HSS and SSS. The higher genetic diversity was also observed at the DNA level for HSS (PIC$_{HSS}$ =0.9942 PICsss =0.9934; H'$_{HSS}$ = 5.505 H'sss = 5.4333). The results indicated that HSS is more abundant than SSS in genetic diversity in both agronomic characteristics and SSR markers. By clustering analyzing separately, 35 and 34 accessions were deleted from HSS and SSS in keeping all the alleles.Clustering together with 107 and 112 accessions from HSS and SSS ,These results indicated that: the most accession were clustered into two groups by ecotype region of HSS and SSS. However 33 HHS accessions were clustered in the SSS group,also,10 SSS accessions scatted in the HSS group. Possibly, cultivated soybean evolved differently by different ecotype region. These results provide the very important information for establishing Chinese collection and studying origin of cultivated soybean.

C113. Study on production of vegetable soybeans in China

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The vegetable soybean named 'maodou' has been planted and utilized for a long history. The word 'maodou' can be traced to Ming Dynasty in17th century. Since then it is found in the references extensively. Chinese vegetable soybeans involve spring soybean, summer soybean and autumn soybean planted in different area around the country. Most of spring vegetable soybeans varieties are introduced abroad, summer and autumn vegetable soybean varieties are mainly landraces. Before 1980s, the planting area of vegetable soybeans was scattered, which actually met the needs of local market and farmers. Since then vegetable soybean developed rapidly because of domestic and international market demand increased greatly. With the rapid development and advantage economic benefit in vegetable soybean production, soybean breeders pay more and more attention to the vegetable soybeans breeding and production. Firstly, landraces and introduced varieties were used as parents to improve qualities and yield of vegetable soybean. A series varieties will be utilized in the near future. Moreover the regional test plan of spring vegetable soybeans has been included in the national region test plan. Secondly, protective cultivation and other technology were used to improve the yield of fresh vegetable soybean. Thirdly, selection of harvesting time in the morning and evening can ensure the quality of fresh pod. At present, we still have problem about the production of the vegetable soybean. Varieties with excellent quality and resistance to soybean mosaic virus are in short supply, which resulted in instability of the yield. So breeding high quality, high and steady yield soybean varieties, and enhancing the construction of reproduction base are the keys of the development of vegetable soybean.

C114. Genetic variation for green pod yield and sugar contents among vegetable soybean genotypes

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In addition to oil and soyfoods, soybean [*Glycine max* (L.) Merr.] is also produced for vegetable use. The importance of consuming vegetable soybean for the prevention of chronic diseases is well documented. Vegetable soybean must taste good and possess other positive sensory qualities to be accepted by the consumers. The objective of this study was to determine green pod yield, yield components and individual and total sugar content of vegetable soybean

genotypes. Thirty-one soybean genotypes from maturity groups III to VI were planted in a RCBD with four replications at Randolph Research Farm of Virginia State University, Petersburg, Virginia. The genotypes were harvested at green pod stage (R6-R7). Plant height, green pod yield, hundred pod weight, and pod dimensions (pod length, width, and thickness) were determined. Pod samples were taken and analyzed for individual (glucose, fructose, sucrose, stachyose, and raffinose) sugars. Significant genotype and genotype x year interactions (GYI) differences ($P < 0.05$) were observed for the agronomic traits measured and individual and total sugars analyzed. In spite of significant GYI there were genotypes that showed consistently with high sugar content during the three growing seasons. Moderate to high heritability estimates were observed for green pod yield and pod dimensions. However, low heritability estimates were observed for the sugars analyzed. In general, the correlation of most individual sugars with total sugar was significant and positive. Moreover, the associations of plant height, hundred pod weight, and pod dimensions with sucrose and total sugar were significant and positive. These correlations suggested that one or combinations of hundred pod weight (pod size) and pod dimension could be used as indirect selection criteria in identifying genotypes with high sucrose and/or total sugar contents.

C115. Integrated nutrient management practices for enhancing productivity of soybean - wheat cropping system

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The increasing costs, associated environmental hazards and lack of sustainability in yields under sole application of fertilizers are raising concerns in crop production. The reducing soil organic matter in the tropics and subtropics and consequent multiple nutrient deficiency are the main reasons for lack of sustainability and declining productivity. The national average productivity of soybean is much lower (1.1 t ha^{-1}) than the Asian average (1.3 t ha^{-1}) and world average (1.8 t ha^{-1}). To support the national policy to boost soybean production, it is required to integrate organics and inorganics in nutrition programme to achieve enhanced sustainable production of soybean. Keeping this in view, field investigations were carried out during 2001-02 and 2002-03 on integrated nutrient supply system (INSS) in soybean – wheat cropping system under rainfed conditions at Main Agricultural Research Station, UAS, Dharwad. The two years pooled data showed that, application of organics *viz.*, crop residues @ 5 t ha^{-1}, farm yard manure (FYM) @ 5 t ha^{-1} alone and in combination with micro nutrients recorded significantly higher yield as compared to no organics. Application of crop residues and FYM alone have substituted 50 per cent of recommended dose of fertilizer (RDF) of soybean. The combination of crop residues with FYM and 50 per cent RDF was significantly superior (2990 kg/ha) over RDF alone (2732 kg ha^{-1}). Crop residues with 50% RDF (2696 kg ha^{-1}) was on par with 100% per cent RDF (2732 kg ha^{-1}). Whereas, FYM with 50 per cent RDF (2872 kg ha^{-1}) was significantly superior over only RDF. The improvement in yield was consistent with application organics. Further, combined application of crop residues and FYM with micro-nutrient, zinc sulphate has enhanced the yield significantly (3213 kg ha^{-1}) which was 18 per cent higher over RDF alone. The response of chemical fertilizers in soybean was enhanced when they are applied in combination with organics. The RDF recorded significantly higher yield as compared to 50 per cent RDF and control. Wheat was grown as a sequence crop after soybean during *rabi* season. Significant residual effect of these organics was noticed on the yield of wheat. This showed that residual effect of organics on the soil fertility which enhanced the availability of nutrients and also improved the soil organic matter and soil environment. The paper critically presents the effects of integrated nutrient management practices in soybean – wheat sequence cropping system under rainfed conditions for maintaining productivity and sustainability.

C116. Phosphatase activity in soils under soybean based cropping systems with contrasting management histories

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Currently, there is a considerable interest in the use of soil enzymes as biological indicators of soil quality as they have microbial and ecological significance and respond rapidly to changes in soil management. A large proportion of total P in soils exists in organic form. The cycling of organic P in soils determines P availability and long-term sustained crop productivity. The mineralization of organic P is mediated by phosphatase that hydrolyzes C-O-P ester bonds. The mineralization of soil S depends on the amount and form of total S and other soil properties, which are influenced by cropping systems and management history. The objective of the present investigation was to assess a) the status and activity of acid and alkaline phosphatase in soils with contrasting management histories under soybean cropping system and, b) the relationships

between phosphatase activity and soil properties. A total of 27 soils under soybean based cropping system with contrasting management histories (Cropping systems and nutrient management) were sampled within a 40 km radius from National Research Centre for Soybean, Indore. Field moist samples were sieved (< 2 mm) and stored at 5 °C until analysis for pertinent biological and biochemical properties. Wide variations in physico-chemical properties and the amount and forms of P were observed as a consequence of contrasting management histories under soybean based cropping system. The acid phosphatase activity ranged from 77 to 393 with a mean value of 246-μ g p-nitro phenol g^{-1} soil h^{-1}, while alkaline phosphatase activity varied between 55-597 with a mean value of 331μ g p-nitro phenol g^{-1} soil h^{-1}. Dehydrogenase activity varied between 0.09 to 0.51 with a mean value of 0.27-μ mol TPF g^{-1} soil $24h^{-1}$. Microbial biomass C also varied between 108 to 477 mg C kg^{-1} soil contributing to 2.9 to 4.8% of organic C .The biomass P varied from 2.9 to 33.0 mg C kg^{-1} soil. Irrespective of the cropping systems, management history involving manurial treatments (poultry and Farmyard manure) had higher phosphatase activity and biological parameters in soils included in the study. Much of the variation in phosphatase activity in these soils was explained by organic carbon and MB-C. It is also to be noted that phosphatase activity and MB-C also had a positive and significant relationship with dehydrogenase activity. Moreover, a strong relationship between phosphatase activity and clay content were also observed. Results showed that phosphatase activity was significantly correlated with NaHCO3-Pi and Po and NaOH-Pi and Po and total P. In conclusion, the strong association of phosphatase activity with forms of P, total organic C, clay content and biological parameters observed in the present study indicates that the phosphatase activity can be used as an index to monitor the effects of soil and crop management on P cycling for sustained system productivity.

C117. Temporal distribution of pod production in soybean

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Variation in soybean (*Glycine max* L. Merrill) yield caused by the environment is usually a result of changes in pods and seeds per unit area. In spite of the importance of this yield component, the mechanism(s) regulating pod and seed number are not well understood. Pod and seed number are clearly related to the assimilate supply and to the characteristics of the sink, but the temporal distribution of flower and pod development may also play an important role. Temporal distributions were characterized on field grown plants of several cultivars by marking all of the pods that were ≥ 10 mm long at three-day intervals. A different marking color was used for each interval and the color on the mature pods characterized the temporal distribution by establishing when that pod was beginning growth (i.e., ≥ 10 mm). Pods that survived to maturity were initiated over a longer period in an indeterminate cultivar (~ 35 d) than a determinate cultivar (~25 d). Increasing plant density reduced pods per plant by nearly 50%, but had no effect on the temporal distribution of pod formation. The timing of pod formation on the branches coincided with pod formation on the main stem of determinate and indeterminate cultivars. In spite of the long pod formation period, 75% of the mature pods initiated development in 10 (determinate cultivar) to 15 d (indeterminate cultivar). The effect of stress on pod formation profiles is currently under investigation to further explore the temporal distribution of pod formation and its relationship to pod number and yield.

C118. Effect of no tillage cropping and soybean transgenic cultivars resistant to glyphosate on the weed communities of the Rolling Pampas

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The introduction of new technologies (no tillage cropping and soybean transgenic cultivars resistant to glyphosate) to Argentina, together with market factors, resulted in an increase in the area cropped with soybean. During the summers of 1995, 1998, 1999, 2001 and 2003, we carried out 120 weed surveys in soybean crops, to evaluate the changes in the weed communities of the Rolling Pampas through the period in which the adoption of these new technologies was occurring at an exponential rate. We carried out the surveys in fields selected randomly on highlands from the central area of the Rolling Pampas, covering a surface of approximately $5x10^4$ ha. Except for the first 20 m near the field-fences, we sampled the whole area recording all weeds in each field. Weeds with constancy (proportion of fields in which a given species occurs in the survey) values <5% were eliminated from the analysis. Species richness was 37, 53, 35, 32 and 24 for 1995, 1998, 1999, 2001 and 2003, respectively. After an initial increase from 1994 to 1998, species richness decreased at a rate of -5 ± 1.8 species per year (r^2 = 0.80), associated to the expansion in the use of the new technologies. *Althernantl·ra*

philoxeroides, Polygonum convolvulus, Setaria parviflora and *Jaborosa integrifolia,* that were present in the soybean weed communities previous to 1998, were not observed in the more recent more surveys, in which *Sida rhombifolia, Cyperus rotundus, Eleusine indica* and *Gleditsia triachantos* appeared as new components. *Melilotus albus, Fraxinus* sp. and *Euphorbia peplus* were surveyed for the first time in 2001 and *Commelina erecta* was surveyed for the first time in 2003. When the first floristic surveys were carried out, the continuous use of no tillage was rare since cropping was carried either with a continuous conventional or with a particular rotation of conventional and no tillage cropping systems. This may explain the high number of species recorded at that time. Soil tillage especially excluded long life-cycle species and no tillage favored establishment of herbaceous and woody perennial species, which may avoid herbicide damage or may recover from its effects. At a landscape level, heterogeneity in agricultural mosaic is related to species richness, thus the homogenization caused by the dramatic expansion of the new technologies reduced it. The increase in soybean area using a quite uniform crop management strategy affected weed biodiversity. We still have to evaluate the impact of these changes in the weed community's structure on the functional aspects of the agroecosystem. These services are largely biological, therefore their persistence depends upon maintenance of biodiversity. When these ecological services are lost, due to biological simplification, the economic and environmental costs can be quite significant.

C119. Response of soybean crops to NPS management practices in Argentina

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Soybean (*Glycine max* (L.) Merril) production systems in Argentina are performed all along the country on varied soil types and under different soil nutrient availability conditions. Although positive grain responses to rhizobia inoculation and P or P+S fertilization practices have been described in most of the argentine production areas, combined NPS management practices are not widely adopted. Our objective was to determine the contribution of inoculation and fertilization practices on soybean grain yields among field environments in Argentina. The study was performed during the 2002-03 production season in 26 experimental dryland sites mostly in soybean rotated fields located in the Northwestern, Northeastern and the Pampas region. In each site, strips with P, PS, and S fertilization were established with and without inoculation under usual farmer's management practices. In average, 8 kg ha^{-1} and 11 kg ha^{-1} of P and S were the fertilization rates, respectively. Nodulation (total number of nodules per plant) during early reproductive growth stages and crop grain yields at physiological maturity were measured. The results were analyzed using ANOVA and LSD mean comparison test. Soybean grain yields varied between 1538 and 5037 kg ha^{-1}. Although most of the sites were rotated with soybean crops, mean nodulation and grain yields were greater in the inoculated treatments. Mean grain response to rhizobia inoculation was of 178 kg ha^{-1}, equivalent to 6.7 % increment over the treatments without inoculation. In general, crop response to inoculation was not significantly affected by the fertilization treatments. Soil extractable P levels varied between 5.1 and 60.0 mg kg^{-1} and were partially related with the crop response to P or PS fertilization. Averaged over the sites with significant effects of fertilization practices, the mean responses to P, S and PS treatments were of 216, 380, and 467 kg ha^{-1}, respectively. Soil organic matter or extractable $S\text{-}_{SO4}$ contents partially explained the overall trends in soybean response to S fertilization. In general, the P, S or PS fertilized crops, independently of the inoculation practice, showed greater nodulation than the untreated plots. In two sites, the effects of N fertilization effects on nodulation and grain yields were evaluated. It was observed that N fertilization inhibit nodulation and reduced grain production. The magnitude of the grain responses to inoculation and to fertilization practices described in this study are in agreement with others performed in Argentina and worldwide. However, further research is required to adjust the diagnostic criteria for P and PS fertilization requirements in highly productive soybean crops.

C120. Productivity of soybean genotypes as influenced by nitrogen and sulphur levels

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The productivity of second most important oilseed crop of India i.e. soybean is low (1 t/ha) against 2.3 t/ha of world average. Unbalanced nutrition has been found to be one of the important reasons for it. Being leguminous crop, soybean is capable of meeting out its most of the nitrogen requirement itself but needs supplementation at initial stage as well as pod filling stage which is normally uncared. Adequate sulphur supply has been found to improve N-utilization and thus enhancing photosynthetic efficiency and productivity of oilseed crop. Therefore, an attempt was made to study the effect of balanced and

continuous supply of N and S on productivity of soybean genotypes in Malwa region of Madhya Pradesh. A field experiment was conducted at NRC for Soybean, Indore during rainy seasons of 2000 and 2001 on Vertisols. The experiment consisted of three varieties i.e. JS 335, Ahilya 4 and PK 416 and 6 levels of nitrogen (N) and sulphur (S) as $N_{20}S_0$, $N_{20+20}S_0$, $N_{20}S_{40}$, $N_{20}S_{20+20}$, $N_{20+20}S_{20+20}$ and $N_{20+20}S_{20+10+10}$. N and S were applied through di-ammonium phosphate and gypsum, respectively as per treatment. First application of N and S was done at sowing by placement while, second and third split application of S (as per treatment) were done at 30 and 60 days after sowing by side dressing. The split application of N was made at 60 days after sowing (DAS) by side dressing. Pooled results (2001 and 2002) revealed that the significantly highest seed yield was recorded with JS 335 followed by PK 416 and Ahilya 4. Variety JS 335 gave higher yield to the tune of 25.6% over PK 416 and 34.4% over Ahilya 4, while PK 416 gave higher yield by 7% over Ahilya 4. Application of 40 kg nitrogen (20 + 20) increased the seed yield to the tune of 10.6% over recommended dose of nitrogen (20 kg/ha as basal). Application of sulphur @ 40 kg/ ha increased the yield by 17.5% over control. However, split application of sulphur and nitrogen did not show any appreciable effect on seed yield of soybean. Application of 20 kg N + 40 kg S /ha as basal produced the maximum seed yield of soybean. Interaction effect of genotypes and N and S levels was found significant. The maximum seed yield was recorded with JS 335 + 20 kg N + 40 kg S/ha as basal application, while the lowest yield was recorded with PK 416 + 20 kg N + 0 kg S/ha. Energy analyses showed that the JS 335 was found most energy productive and energy efficient than rest of the genotypes. However, the application of $N_{20}S_{40}$ was the most energy productive and energy efficient followed by $N_{20}S_{20+20}$. The maximum protein content was observed in genotype JS 335, while Ahilya 4 possessed the highest oil content. Protein content of soybean did not differ significantly due to S and N treatments, while sulphur application significantly increased the oil content as compared to control. Split application of sulphur showed relatively higher values of oil content than their basal application.

C121. Phosphorus and sulfur fertilization effects on nodulation and soybean grain yields

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Nitrogen (N), phosphorus (P) and sulfur (S) are the major nutrients limiting soybean (*Glycine max* (L.) Merril) grain yields in Argentina. Although field research trials show that the yearly use of inoculants facilitates the adequate N nutrition of the crop , inoculation is not a widely adopted practice. Several studies suggest that the lack in P and other nutrients availability interferes with the N fixation processes reducing the response to inoculation. Soybean grain response to P and S fertilization is recent and it shows variable results. The objective of this study was determine the contribution of P and S fertilization on nodulation and grain yields in 2 soybean crops under different previous management practices (continuous agriculture and alfalfa (*Medicago sativa* L.) rotated agriculture). The sites are located in Videla, (Santa Fe, Argentina) in Typic Argiudols with similar soil organic matter (24,1 and 26,0 g kg^{-1}), soil extractable P (Pe, 9.0 and 7.9 mg kg^{-1}) and *S-SO*$_4$ (2.0 mg kg^{-1}) levels at planting,. There were 12 treatments (3 P fertilization rates (0, 8 y 16 kg ha^{-1}) with 0 or 10 kg ha^{-1} of S on inoculated or untreated seed) established when planting the crops in November, 2002. The number of nodules per plant in vegetative growing stages and the grain yield production of the crops were determined. In each site, the experimental design was in randomized complete blocks with 4 replicates and ANOVA and LSD mean differences test were performed for analyzing the data. The number of nodules per plant (2.8 to 12.2) increases in response to inoculation and P or S fertilization. Averaged over the fertilization treatments, inoculation increases nodulation by 24% while averaged over the inoculation treatments, fertilization increases the number of nodules by 44 % equivalent to 2 or 3 more nodules per plant, respectively. Maximum nodulation was achieved with approximately 14 mg kg^{-1} of available P (Pe + fertilizer P rate). Soybean grain yields (2767 to 4794 kg ha^{-1}) were positively related with the number of nodules per plant. Phosphorus fertilization improved grain yields by an approximately 10 % equivalent to 380 kg ha^{-1} with a mean P efficiency use rate of 33 kg of grain (kg P)$^{-1}$. Grain yield responses to S fertilization and to inoculation varied between the experimental sites. In the site under continuous agriculture, the use of inoculants enhanced the response of the crop by 194 kg ha^{-1}, equivalent to 5 % of yield increment. The grain response to the application of 10 kg ha^{-1} of S was smaller in the pasture rotated soil than in the site under continuous agricultural practices, 229 and 834 kg ha^{-1} respectively. The lack of inoculation response and the smaller response to S fertilization in the rotated is mostly attributed to a greater release of N and S due soil organic matter mineralization after tillage. In the conditions of this study, it is concluded that soybean N management through inoculation and P and S fertilization practices promote nodulation and soybean grain yields with a greater response in fields under continuous agricultural practices.

C122. Impact of technological interventions on soybean in India: a success story

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Experiments were carried out to assess the performance of four improved soybean varieties and to produce good quality seeds in the farmer's field with farmers-scientists participatory approach in the Bhagora village of Indore district under Technology Assessment and Refinement Project. About 4.2 q/ha of MAUS 47, 8 q of NRC 12 and 1.6 q of NRC 37, 4.8 q of NRC-2 were provided to the selected farmers covering 24 ha during the year 2001 and 2002.The cost of other critical inputs was met by the farming community. The scientists of this centre trained the farmers in respect of intercropping system and seed production techniques along with other aspects of production technology. The farmers were imparted the knowledge on roughing based on morphological character of each variety. They were also given knowledge on the deterioration of seed quality on account of field weathering and on importance of timely harvesting. A good understanding of appropriate method of seed storage and significance of conduct of germination tests was also given to them. The trained farmers were adopted the recommended seed production technologies and could realize average seed yield of 11.62 to 31.13 q/ha depending on variety in spite uneven distribution and deficit rainfall of 70% during 2001 (786.4 mm in 21 days) and 2002 (675.6 mm in 19 days). The farmers-scientists interactions helped the farming community to have varietal cafeteria approach in soybean, which forms one of the basic components of sustainability. The farmers were motivated to exchange the quality seed with fellow farmers. The efforts made has not only saturated the adopted village with quality seed of improved varieties but they have been able to supply seed to the neighboring farming community of Ambachandan, Dewas, Depalpur and Narsinghpur. nearby villages also. The farmers have been able to raise their income by selling soybean as seed. Thus the seed production of soybean by adopting farmers' participatory approach on the seed village concept became successful effort to spread the use of good quality seed. This innovative approach can be adopted to solve the problem of availability of quality seed of soybean and subsequent potato and wheat crops on which this type of intervention was also given.

C123. Agribusiness expansion into the Brazilian Amazon

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In recent years, the agribusiness sector has become one of the main economic driving forces behind agricultural frontier expansion process in the Brazilian Amazon. In the 2001-2003 period grain production to 13 million tons per year in the north of Mato Grosso state, with the area under cultivation increasing from 31,000 to 42,000 km^2. This expansion has been stimulated by several factors the growth in international demand (and prices) for soybean, devaluation of the Brazilian Real, reduction of transport cost due to new routes for commercialization, high productivity in the Cerrado area, and development of new soybean varieties suited to humid climatic conditions in the Amazon. The objective of this work is to identify the possible areas of agribusiness expansion in the Brazilian Amazon considering physical and economic variables such as infrastructure, topography, climatic conditions, soils, markets, production, prices, and transport cost. Preliminary results indicate that the soybean agro-industry is expanding into rain forest regions in easter-central Amazonia, near Santarém, Belterra, and Alenquer, where the Belterra clay formation provides flat topography and physical structure suitable for mechanized agriculture. Conditions for production expansion are being promoted mainly by grain trading companies, such as Cargill, Bunge, ADM and Maggi Group that are investing strongly in these regions by providing production financing, building storage units and ports, and participating directly in the pavement of roads as Cuiabá-Santarém through of roads consortia.

C124. Production and economic sustainability of improved soybean production technologies under real farm conditions

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Front line demonstrations (FLDs) under the scheme of "Oilseed Production Programme (OPP)" funded by Department of Agriculture and Cooperation, Government of India, were initiated in the year 1989-90 through All India Coordinated Research Project on Soybean (AICRPS) with its 15 centres spread over the entire country in varied agro-climatic regions. The major objective of the FLDs is to transfer the first hand knowledge on improved production technology i.e. full package (IT) to the farmers under the direct supervision of the scientists. The demonstrations were laid out on 0.4 ha land and compared with farmers' practice (FP). During the span of 14 years (1989 to 2002), a total of

2641 demonstrations were laid out by the cooperating centres of AICRPS including the Coordinating Unit at National Research Centre for Soybean, Indore. The results indicated that an average highest yield achieved by adoption of IT was 2492 kg/ha and the corresponding value under FP was 1846 kg/ha. The mean productivity levels varied from 1540 to 1991 kg/ha with an average of 1798 kg/ha under IT which was 41.98% higher than yield achieved under FP. Sustainability yield index (SYI) revealed that the IT were more sustainable than the FP. The trend analysis indicated the negative linear growth rate over the years in case of yield, percent increase in yield over FP, incremental benefit cost ratio (IBCR) and production efficiency (kg/Re) indicating that the yield levels are turning out to be static. While the average cost of cultivation, additional cost of cultivation over FP, additional returns over FP showed increasing trend (positive) over the years. The yield gap II (difference between demonstration plot yield minus farmers managed plot yield) showed a negative trend, which declined by 33.24 kg/ha yearly and showed the inclination towards adoption of technologies by the farmers. The linear growth rate indicated that the additional cost was increasing at faster rate than additional returns (Rs/ha). However, on an average expenditure of Rs. 1573 on IT fetched Rs. 4188 over FP. The IBCR varied from 2.47 to 4.60 with an average of 3.08. The production efficiency showed that the rate of declinement was slightly higher in IT than FP. However, the average production efficiency was identical in both IT and FP. The 14 years results clearly indicated that if the farmers adopt the IT, the additional production of 2.96 million metric tonnes could be achieved at national level.

C125. Participatory rural appraisal of soybean growers in India

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Soybean (*Glycine max* L.merril), the crop of nutraceutical values has successfully introduced itself in the cropping system of farmers of the Central Part of India which alone share 80 per cent of the area under the crop in the country. Concerted efforts of the scientists and research workers under the network of All India Coordinated Research project on soybean, a approach which was started way back in 1967 by the visionary policy makers has brought a significant changes among the socio-economic status of the soybean growers. There has been a tremendous increase in case of area, production and productivity of the crop in the last three decades along with some production constraints like incidence of insect-pests, diseases, poor seed germination, marketing and managerial aspect at the farmers' level. A Participatory Rural Appraisal (PRA exercise) was hence conducted in three villages of Indore district namely, Arjun Baroda, Bhagora and Kelod to study the problems of soybean growers for designing the strategy for the dissemination of improved soybean production technology. All the tools and techniques of PRA agro ecosystem analysis were employed by a multidisciplinary team of scientists. It was observed that farmers of these villages grow three crops in a sequence (soybean-potato-wheat/chickpea/vegetable); hence they are in need of early soybean maturing variety (85-95 days) so as to enable them for sowing of subsequent crops ie, potato and wheat/chickpea/vegetables. It was also noticed that the crop usually is infested by four major pest viz. blue beetle (*Cneorane sp*), stem fly (*melanagromyza sojae*), green semilooper (*Chrysodeixis acuta*) and girdle beetle (*Obereopsis brevis*). The lack of knowledge about the management strategy of these insects was observed to be the second major problem. Weed management was reported to be a third major and important problem for the farmers. Since the soil of the region belong to Vertisol group, it makes difficult for the farmers to control the weed population by popular weed control measures (hand weeding and hoeing) particularly during heavy rainy days. Hence technology regarding dissemination of compatible chemical weed control measures in soybean crop is needed. The concerted efforts by R&D agencies are needed to take the available technologies of insect-pests, diseases and weed management in an integrated manner, development and dissemination of early maturing short duration varieties along with techniques of improved production technology is needed so as to increase the per unit productivity of the farmers and their further enhancement in socio-economic status.

C126. Adoption of improved production technology of soybean in India

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Soybean (*Glycine max* L.merril), an important cash crop ranked second among the oilseeds covers an area of about 6 million hectares in the country. Majority of the soybean growing area falls under central part of India, which includes states like Madhya Pradesh, Maharashtra and Rajasthan. The crop has successfully emerged out victorious since three decades of its commercial introduction in the region. Hence, to study the adoption and related constraints, a study was conducted in Maharashtra state. The methodology included validation of recommended package for cultivation of soybean crop, interaction with farmers to seek data on adoption

of recommended package/technological components followed by them and scoring of data for working out Adoption Index (Total score obtained by the respondents/Maximum score that could be obtained X 100). The study revealed that farmers instead of adopting full package adopt only single components of the recommended technology as per their need and suitability. The extent of adoption of the recommended technology was observed around 69 per cent. The farmers adopted this relatively new crop because of its characteristics like earliness, less efforts for cultivation, use of previous season's harvested seed, fertility maintenance status, more profit, assured yield and higher market price than the other competitive crops. The factors other than economic motivation for the adoption of technology were small land holding wherein the crop suits better than other crop, their educational status and social participation and their risk orientation as the crop is less risky and grow with minimum input, care and maintenance. It is concluded from the study that the factors which shown significant relationship with the adoption of improved soybean technology are to be looked into seriously which designing the strategies its dissemination among the farmers. Also concerted efforts are needed to take the technology to the doorstep of small and marginal farmers to be more effective in raising the productivity levels keeping in view the average land holding of Indian farmer (1.57 ha).

C127. Assessment of soybean production technologies in the Malwa region of India

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Studies conducted in different agro climatic zones under All India Coordinated Research Project on Soybean to standardize suitable management techniques at different stages of plant growth resulted in location-specific production technologies in Soybean. The production technologies developed by the research institutes has to be assessed in the farmers' field to enhance the productivity and to uplift the socio-economic status of the farming community. Experiments were carried in a participatory approach involving farming community and scientists to evaluate the eight production technologies in 100 farmers' field of Bhagora village of Malwa region during *Kharif* 2002.The methodology included were based on the prevailing agro-ecosystem, the farming system has been identified ,assessed the technological intervention in the mode of On-Farm Testing and Verification trial in the thematic areas of Natural Resource Management, IPM, IPNS. The results revealed that Intercropping of soybean + maize (4:2) has produced the yield of 12.60 q/ha and 7.15 q/ha respectively. The soybean (NRC-12) equivalent yield was 15.62 q/ha. Nearly 27 percent yield increase was observed in intervention plot comparing with local practice (i.e. soybean + maize in mixture). Further the technology was found to be highly acceptable to the farmers. Use of PE insecticide Command @ 4 lit/ha produced 9.85 q/ha of yield with cost benefit ratio of 1.36. To have varietal cafeteria approach and to test the performance the new varieties of soybean, NRC-2 and NRC-37 have been experimented. The farmers preferred the variety NRC-2, as its performance was better than traditional varieties (20.66% increased yield). Training by the institute helped to produce good quality seed of new variety NRC-37 and its further spread to the nearby villages. Experiment conducted on the use of phorate application during sowing @ 10 kg/ha followed by Triazophos 0.8 lit/ha has controlled the girdle beetle incidence and produced yield of 11.34 q/ha. At the same time the removal of girdle beetle from the plant by manually produced 11.30 q/ha. The unbalanced use of fertilizer by farmers reduces the soybean yield. Hence the intervention on IPNS has been carried out. The results indicated that following recommended dose of fertilizer either in the form of FYM and in organic fertilizers or completely recommended inorganic fertilizers (20:26.2:16.6:20:6) NPKSZn increased the yield from up to 15% than the farmers practice. The reversible MB plough developed by the NRCS was tested in five farmers field. The yield performance of soybean in the trials plot was good (15.60 q/ha) with less weed incidence.

C128. Technology transfer to produce a good quality soybean seed at community level: implication for income generating

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Farmers in certain areas of Lampang province, north of Thailand survived their living by growing rice, soybean and vegetables. The farmers kept soybean seed from last crop for planting in the next crop or sometimes bought from their neighbors who also did in the same manner. Consequently, the seed quality became poor. Rajamangala 1 is a soybean variety that these farmers prefer due to its desirable characteristics such as high yield, resistance to diseases and large-sized seed. Accordingly, to solve problem of seed and increase income for better living, this operation research was carried out. The purpose was to transfer a technology of seed production that

would help farmers to produce good quality seed enough for their own use and also sale to other soybean growers in their community or outsides to earn more income. The process of technology transfer in this study consisted of 1) establishment and development of soybean seed production group. 2) attending training courses covering essential aspects such as seed production skills, post-harvest techniques, seed quality testing, and product promotion for marketing. 3) producing soybean seed under supervision of the researchers. The research area is at Nikom-Pattana sub-district, Muang district, Lampang province,Thailand. Thirty farmers were selected using purposive random sampling technique. Questionnaires and face to face interview were used for data collecting. Income per year regarding to soybean seed production, both before and after technology transfer, was used to indicate achievement of the project. Statistical analysis was performed and results were shown as percentage, mean and t-test. After one year of project operation, the farmers had established and developed a group of soybean seed producers and set up a revolving fund. In rainy season (July to November 2002) and dry season (January to May 2003) on farm size about 60 rai (1 hectare = 6.25 rai), they could produced seed approximately 13,971 and 15,730 kilograms, respectively. Levels of knowledge and skills on production processes, marketing, and accounting were found to increase correspondingly with the rise of their income. When considered to income from soybean production after participating this program in one year, it was increased approximately 42 % which was highly significant ($p < 0.01$). All soybean farmers participated in this study have shown ability to produce soybean seed of good quality. This operation research implied that success in technology transfer could be achieved through integrated activities as a complete process. The important points were to motivate them to solve their problems, encourage their self-confidence, enhance participation in all activities, especially in planning and decision making, implementation, benefit and evaluation, which consequently strengthened their group. Furthermore, increasing income would enable them to stand on their own and sustain their community, finally.

ISPUC

P413. Soybean segregation according to isoflavone content using an alternative method: near infrared spectroscopy

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Soybean isoflavone content and composition is usually determined by HPLC method. In this study we investigated the possibility to estimate total isoflavone content of whole soybean seed using near infrared spectroscopy (NIRS). Total isoflavone content of 500 samples was analyzed by HPLC (mean = 5.33 mg/g; minimum: 1.74mg/g; maximum: 10.35 mg/g; standard deviation: 1.41).The same samples were analyzed by NIRS. The spectra of each sample was recorded every two nanometers from 400 nm to 2498 nm using a Foss Nirsystem 6500 ™ spectrometer. The database was split into two sets, one for calibration (375 samples) and one for validation (125 samples). The calibration model was obtained using an artificial neural network. The results for R square and standard error for calibration and validation were respectively: RSQ = 0.75; SEC = 0.68; RSQ = 0.74; SEV = 0.75. These preliminary results indicate that using NIRS method we can rapidly segregate sets of soybean seeds with high isoflavone content from sets with low isoflavone content. Further investigation are undertaken in order to optimize this segregation by the determination of several ranges of isoflavone content. Indeed, i) calibration database is extended up to 1000 samples representing more pronounced variability (seeds from different location, environmental and crop managing condition...); ii) statistical treatment of the calibration database will be improved by using new mathematical methods. In conclusion, NIRS is an efficient way for high and low isoflavone rapid discrimination and can be a useful tool for breeding program or industrial quality control. However, further investigations are necessary to optimize this method.

P414. Fungicide effect in soybean sensorial characteristics in two environments

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Although Brazil is the second biggest world producer of soybean, the consumption of this legume as protein source in our country is very low, being practically to be considered worthless. The exotic soybean flavor to the Brazilian palate, caused mainly for the action of lipoxigenases, has contributed for its limited acceptability. The rejection can also occur in function of a deterioration of some characteristics of quality. It is known that environmental conditions influences in the concentration of proteins and isoflavones, being able also to modify the grain flavor. Regions with higher altitudes and, consequently, lower temperatures are indicative of soybean grains with better flavor. The arising of new illnesses in the Brazilian soybean fields, as *Phakopsora pachyrhizi*, has demanded for more fungicide treatment and its influence on the grain flavor is not known. This work had the purpose to carry out a sensorial analysis in relation to the palatability of two soybean cultivars, BRSMG Robusta and BRSMG Garantia, sowed in Uberaba (760m) and Sacramento (1000m), Minas Gerais State, with and without the fungicides Epoxiconazole + Pyraclostrobin (25 + 66.5g/ha), when the soybean was in $R_{5.4}$ stage. The study was based on a scale, varying of 1 (very bad) to 9 (very good), in a completely randomized design with seven replications. After cooking, the samples were grinded with the purpose to promote a homogenization of the grain flavor. Data were transformed to square root. There was significant difference between locations ($P = 0.039$). The grains produced in Sacramento, independently of the cultivar, had better averages of flavor than those produced in Uberaba. It was also observed significant difference between cultivars ($P = 0.031$), with BRSMG Garantia showing better flavor than BRSMG Robusta. The fungicide application reduced the acceptability of soybean grains ($P = 0.469$), probably, for the presence of some residue in the grains.

P415. Soybean and Brazil nut beverages colour variation during storage

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The shelf life study of a new product is very important to understand the changes that can occur during the storage period, and to define the shelf life of the product. The nutritional, microbiological, physical and visual aspects, including colour, should be considered.

Two beverages made from soymilk (filtered soymilk or whole soymilk) and Brazil nut milk were elaborated, considering the good flavor and the high content of sulfur amino acid of the latter. The soybean beverages used in this study were prepared from IAS-5 variety soybeans (*Glycyne max* L. Merril) from 2000-2001 crops and Brazil nut (*Bertholletia excelsa*) harvested in 2001. The basic process for the beverages made from soymilk and Brazil nut milk had the following steps: filtered soymilk (dehulled soy cooking, grind in hot water, and homogenization) or whole soymilk (dehulled soy cooking, grind in hot water, and filtration), 30% or 40% of Brazil nut milk (grind in hot water and filtration), addition of sugar (3%) and salt (0.2%), followed by homogenization at 4000psi. The products were stored at 5°C and 25°C during four months. The colour instrumental analysis was carried out by measuring the reflectance in a S & M Colour Computer model SM-4-CH Suga, in the Hunter system. The colour parameters measured in association with the white plate (L = 90.21; a = -2.38; b = 1.40) were: L = luminosity (0 = black and 100 = white); a (-80 to zero = green, from zero to 100 = red); and b (-100 to zero = blue; from zero to +70 = yellow). Four replicates were carried out for each sample. Linear Models were statistically used to the experimental design and had as main components: time of storage, temperature and their interactions. Tukey and T-Student ($p<0.05$) tests were performed for means comparisons. During the storage period all investigated colour parameters were significantly different. The initial results showed L values decreasing over the time for both beverages, under 5°C and 25°C storage temperatures. For the other parameters, the a values maintained negative values (green colour) at 5°C in filtered soymilk, however, this behavior did not happened at 25°C. For b values, the beverages at 5°C and at 25°C obtained similar levels of yellow at 120 days of storage. For whole soymilk the a values at 5°C decreased significantly up to the 60th day of storage, increasing the red value after this period. For the beverage kept at 25°C, there were significant changes during the storage with an increasing in the red value after 90 days of storage. The b values had significantly increased at 120 days of storage at 5°C and 25°C. Based on the luminosity and darkness, the beverages stored at 5°C were considered more stable than those stored at 25°C.

P416. Ultrafiltration of soybean crude oil micelle by ceramic membrane

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The application of separation process by membranes in vegetal oils is developing aiming at economy of energy, chemical reagents and reduction of effluent treatment. Differently of the traditional process, this technology can operate at low temperatures allowing minority constituent preservation with nutritional importance and natural antioxidant substances, besides guaranteeing the absence of oxidation products, thus being able to result in high quality oils. In this work, the ultrafiltration use was studied in substitution to the conventional degumming, 20 L of crude soybean oil contends about 800 mg.Kg-1 of phospholipids, in ratio of 25%(v/v) in hexane, submitted to the ultrafiltration in pilot unit endowed with bomb of lobes and ceramic (alumina) multichannel membrane (19 channels), with diameter of 0,025m, length of 1m, permeation area of 0.2 m^2 and pore diameter of 0,01mm. It was applied statistical delineation in response surface methodology (RSM) using a central composite rotatable design, 2^2 order whose independent variable had been tangential speed and transmembrane pressure, while the phospholipids concentration represented the dependent variable. The tangential speed varied from 2.9 to 3.9 m/s and the transmembrane pressure from 1.2 to 2 bar, resulting rejections around 99% of phospholipids (Method AOCS Ca 12-55, 1993, adapted for Antoniassi & Esteves, 1995). The permeation flow varied from 21 to 41 L/m^2h and the factor of concentration was about 4. The gotten permeate oil was submitted to the chemical analyses, presenting a preservation of values of tocopherols (Method AOCS Ce 8-89,1993) with small reduction of the acidity (Method AOCS Ca 5a-40, 1993) and color (Lovibond method AOCS Cc 13e-92, 1993), in relation to the crude oil.

P417. Deodorization of soybean oil degummed by ultrafiltration using a ceramic membrane

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Deodorization is the last step in the processing of vegetable oils, the objective being to produce an oil of a quality considered acceptable according to a series of specifications based on the law and regional preferences. Physical refining reduces the loss of neutral oil and produces no wastewater requiring treatment. However, this process is not suitable for soybean oil due to its high phospholipid content. The objective of this research was to carry out a physical refining process on crude soybean oil containing about 800 $mg.kg^{-1}$ phosphorous, substituting the classical degumming step with the ultrafiltration of oil-hexane micelles (25% v/

v). The ultrafiltration step was carried out in a Netsch pilot unit with a multi-channel (19 channels) ceramic (alumina) membrane with a diameter of 0.25m, length of 1m, permeation area of 0.2m² and pore diameter of 0.01µm. Using a tangential velocity of 3.58 m/s and trans-membrane pressure of 1.8bar, a phospholipid rejection rate of 99% was obtained (AOCS, 2003), with a permeation flow rate of 55 L/m²h and concentration factor of 3.4. After recovery of the solvent by vacuum distillation, the oil was deodorized in a pilot-scale deodorizing unit for a period of 1.5 h after the temperature of the oil had reached 200°C, using nitrogen as the stripping gas and a vacuum of 12mm Hg. The resulting oil presented 0.22% FFA (as oleic acid), a color of 34Y/3R/0.5B on the Lovibond Scale (5 ¼ " cuvette), 0.6 meqO_2/1000g oil and 1221 mg/kg total tocopherol. When submitted to a sensory analysis (N = 40), the oil obtained showed no significant ($p \leq 0.05$) differences for the attributes of taste and aroma as compared to refined soybean oil.

P418. Full fat soybean as a source of proteins and energy in broilers diets. Effects on performance and carcass quality

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Full fat soybeans (FFS) are a good source of energy (3700 to 3900 kcal/kg) due to their high oil content (18 to 22%) with high digestibility (92-96%).FFS has a high protein content (33 to 37%),with a relatively well balanced profile of amino acids (aa.) which fullfills the requirements of ideal protein for broilers except for sulfur aa. The use of raw soybeans is restricted however by the presence of anti-nutritional factors (anfs),essentially trypsin inhibitors which affect performance when consumed by poultry. A number of heat treatments have been developed for soybeans to reduce anfs. Properly heat-treated FFS can be an efficient and profitable ingredient (easy to handled compared to other sources of fat and oils) for feeding broilers with no impairment on performance. The effects of the nutritive value of FFS on bird performance have been reported in various studies; only few however revealed the effects of processing methods on energy and aa availability. Recent advances in soy protein technology supply a variety of soybean co-products with different proximate analysis and nutritive value which have been tested in poultry diets .Several methods with carefully controlled and reliable processes have led to highly valuable products. Beside quality control assessments ,the differences in nutritive value and quality of these treated products are ultimately determined by chick bioassays. Only few investigations revealed the effects of processing methods on energy and aa availability. Although substantial improvements in nutritional value can result from these treatments, FFS inclusion rates in broilers diets still depend upon the physical form of the diets; most authors recommend higher inclusion rates in pelleted diets. Numerous studies have demonstrated that properly processed FFS can be used efficiently by poultry ; others have been compared the use of FFS and SBM in broiler diets. Several experiments conducted in our laboratory have shown that extruded FFS can be used in broiler diets fed in mash form without adversely affecting performance. In other investigations, FFS has been shown to replace up to 100% SBM plus added oil with no effects on growth performance at any stage of production. This review emphasises the nutritive value of FFS in relation to recently developed processing methods, its utilization in broilers diets and the major issues affecting performance. It is concluded that dietary FFS inclusion rates can reach up to 25% with no major effects on performance .No changes in carcass yield ,fat or protein contents are observed in broilers fed FFS as compared to those fed control diets. Significant reductions in abdominal fat deposition are observed with a reduction in liver weight but not in liver lipids. Higher levels of polyunsaturated fatty acids are observed in carcasses of broilers fed FFS.

P419. Ruminal degradation of soybean with different processing methods

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Beef cattle grazing tropical pastures usually requires protein supplements, mainly during winter or dry season. Whole soybean and soybean meal can be used as protein supplements under those conditions. To characterize the ruminal degradation of soybean subjected to different processes, in situ ruminal degradations trials were conducted. Two rumen-cannulated steers were used in two period (4 replication per type of material). Whole soybean was subjected to different processing methods: native whole soybean without temperature treatment (NWS); whole soybean exposed to dry heat (110° C for 30 minutes) DH110; whole soybean exposed to dry heat (160° C for 30 minutes) DH160; whole soybean exposed to steam heat (110° C for 30 minutes) SH110; extruded whole soybean (EXS) and soybean meal (SBM). Samples were cracked before introduced to nylon bags of 10 x 21 cm (Ankon Co., NY) with an average pore size of 30 x

70 ?m. The open side of bags was closed using a rubber stopper (no. 8) which was secured with two rubber bands (no. 18). Five grams of CGM (as fed basis) was weighed directly into one nylon bag. Bags were placed inside a polyester bag (38 cm x 45 cm) that was attached to the ruminal cannulae through a plastic string. Incubation time were 0, 4, 9, 24 and 48 hours. All bags were removed at the same time, and rinsed several times with tap water in a 20-L container until the water appeared clear. Bags were then washed individually under tap water and dried in a forced air oven at 55° C, air equilibrated and weighed. Percent of DM and CP remaining at each incubation time were analyzed in model including animal, period and type of material. At 4 hours of incubation, percent of DM remaining were similar for DH110, DH160, SH110 (78.9, 78.8 and 81.6%, respectively), whereas remain DM for NWS was lower (73.1%) than heat-treated soybeans. Percent DM remaining was lower than the others for SBM and EXS (63.0 and 59.9%). Similar trends were observed for CP. At 9 hours of incubation, percent of CP remaining were similar for DH110, DH160, SH110 (82.3, 90.9 and 81.3%, respectively), whereas remain CP for NWS and EXS were lower (70.3 and 63.8%) than heat-treated soybeans. Lowest percent of CP remaining was for SBM (47.9%). At 24 hours of incubation, percent of CP remaining were different for DH110, DH160, SH110, (13.1, 29.3 and 38.9 respectively), whereas remaining CP for NWS and SBM were lowest (11.5 and 13.8%). Remaining CP was similar for EXS (26.4%) and DH160. It is concluded that best protection against CP ruminal degradation was achieved by steam heat, followed by extrusion and dry heat at 160°C, for 24 hours of incubation.

P420. Technical dissemination and information exchange on soybean products for monogastric feeds

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In much of the world soybeans or soybean products provide up to 75% of the protein in diets for monogastric animals such as poultry and swine. The importance of soy protein has increased even further in recent years, due to the policy of certain governments and consumer groups that poultry feeds be free of animal by-products. As a result, it has become even more essential to fully understand the nutritional contribution of soy products and be ever more cognizant of concerns based on quality control parameters. A considerable body of information exists in the scientific literature. However, at the present time, existing knowledge and aspects of developing technology are reported in an extremely diverse set of scientific journals and popular publications. To facilitate rapid access to existing technology and new developments, a web site has been developed (with the following objectives: 1) to provide a bibliography of key papers and presentations currently available in the scientific literature, 2) to provide specific information on quality control tests and procedures, 3) to provide an opportunity for specialists in the area of soybean usage to exchange information on an informal basis, and 4) to list areas where research is currently lacking and studies could be fruitfully designed. The purpose of this web site is to facilitate access to all needed aspects of soybean usage in monogastric diets, how to design quality control programs to maximize the efficiency of soybean usage, and serve as an ongoing forum for those developing new technology in the field of soybean protein for monogastric animals.

P421. Adhesiveness and water-resistance properties of modified soy proteins for wood applications

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Various forms of wood utilization represent an extremely large and diverse market for adhesives. Soy protein adhesives from renewable resources recently have been considered as alternatives to replace formaldehyde-based adhesives that have caused environmental and toxicity problems. Modification of soy proteins has previously focused on improving their functional properties for food applications, little for wood. The objective of this paper was to investigate the adhesiveness and water-resistance properties of soy protein isolates modified by different concentrations of: 1) urea and guanidine hydrochloride (GH); and 2) sodium dodecyl sulfate (SDS) and sodium dodecylbenzene sulfonate (SDBS); and applied on walnut, cherry, and pine plywoods. Emphasis was placed on the effects of varying solutions of urea (1,3,5,8 M) and GH (0.5, 1, and 3 M). Soy proteins modified by 1 and 3 M urea showed greater shear strengths than did unmodified protein. The 3 M urea modification gave soy protein the highest shear strength. Soy proteins modified with 0.5 and 1 M GH gave greater shear strengths than did the unmodified protein. The 1 M GH-modified soy protein gave the highest shear strength. Compared to the unmodified protein, the modified proteins also exhibited higher shear strengths after incubation with two cycles of alternating relative humidity, and zero delamination rate and higher remaining shear strengths after three cycles water soaking and drying. These results indicate that soy proteins modified with urea and GH enhance water resistance as well as adhesive strength. Secondary structures of globule proteins may enhance adhesion

strength, and the exposure of hydrophobic amino acids may enhance water resistance. Proteins modified by 3 M urea or 1 M GH may have higher content of secondary structure and move exposed hydrophobic amino acids, compared with other modifications or unmodified proteins. Possible mechanisms for the effects of SDS and SDBS also are discussed.

P422. The research of plasticization of organic acids to soy protein isolate

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In this thesis, the processing technology of the soy protein isolate degradable material and the mechanism of affecting factors were studied. It studied the mechanism of plasticizing soy protein isolate for organic acid closely and all-sidedly in the paper;compared the water absorption and processing flowability of the material which was plasticized by organic acid and glycerol respectively,and compared the characteristics of soy protein isolate degradable material which was plasticized by several kinds of organic acids;Then studied the effects of moulding time ,moulding temperature ,moulding pressure and the percentage of organic acid plasticizer on the tensile strength ,elongation and water absorption of soy protein isolate material during hot-pressing. The optimal conditions of the soy protein isolate modified by different organic acids plasticizers were obtained by orthogonal experiments. The degradable material by plasticization of organic acids took on lower water absorption0higher elongation and worse flowabilit comparing with the material by plasticization of glycerol. But the tensile strength had few changes. It arrived in a conclusion which organic acid is a very valid plasticizer through the experimentations.It can replace the glycerol in some fields. In addition, To decrease the water absorption, some reagents were used to modify soy protein isolate and it made gteat progress.Water absorption has decreased to 30% by lots of attempts. To improve the tensile strength ,a great number of plasticizers were attempted and the mechanism of improving tensile strength was studied.The value of tensile strength was 50MPa at the highest.

P423. Sources of soybean resistance to *Sternechus subsignatus*

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The gall-maker and stem borer, *S. subsignatus*, rose from a minor to an important pest as soybean fields expanded to new areas and cultivation systems changed. The chemical control of this pest is difficult due to its concealed habit in the pre- and post-embryonic stage. Therefore, other control alternatives are necessary, specially in large fields. Hence, sources of soybean resistance to *S. subsignatus* have been searched for at Embrapa Soybean, Londrina, Paraná State. Thirty genotypes were tested under greenhouse and field conditions in completely randomized no-choice and randomized block multiple-choice design experiments. Tests were performed during four seasons with different genotypes each year, as genotypes not showing resistance were replaced by others of interest. The susceptible control genotypes used in the 1999/00 and 2000/01 seasons were 'Embrapa 4' and 'BR-16'in 2001/02 and 2002/03. In 2002/03, besides greenhouse tests (no-choice and multiple-choice), a field-cage test was performed with artificial infestations of *S. subsignatus* adults. Genotypes were not significantly different from the control genotype at any season in no-choice test. In general, multiple-choice tests promoted a better discrimination between genotypes than no-choice tests. In the 1999/00 season, greenhouse multiple-choice test, BRQ 96-3065 and PI 227687 were less damaged by *S. subsignatus* than other tested genotypes. In the 2000/01 greenhouse multiple-choice test, PI 227687, BRQ-96-3065 and BR-95-1159 were less damaged than others, but only PI 227687 was significantly different ($F = 4,42$; $P < 0,001$) compared to the control ('Embrapa 4'). In 2001/02, the total damage (feeding marks + leaf cut + oviposition + dead plant) was lower in 'IAC-100', PI 171451, PI 227687 and 'IAC-24' than in 'BR-16'. In the 2002/03 season, greenhouse multiple-choice test, the most resistant genotypes were PI227687, BRQ 96-3065, KI-S 601 and Ocepar 17. In the field, during this season, PI227687, BRQ 96-3065 and CS 201 performed better in the presence of *S. subsignatus*. The results suggest that non-preference is one of the resistance mechanisms of soybean to *S. subsignatus*. Futhermore PI 227687 appears to be a source of potential resistance to be used by breeders in insect resistance programs. Other genotypes such as BRQ 95-3065 and PI 171451 also showed some potential, but to confirm this more studies are necessary.

P424. Resistance of elite soybean lines to stem fly (*Malanagromyza sojae* Zehntner)

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Stem fly (*Malanagromyza sojae* Zehnt.) is a serious insect-pest of soybean in India. Infestation in the early stage of growth results in death of seedlings whereas in grown up plants stunted growth is observed due to stem tunneling by the maggots. The infestation reduces grain yield by 25-30 per cent (Kundu and Srivastava, 1992). Soybean varieties show varying degree of stem fly infestation due to host plant resistance. Present studies include the results of field experiments conducted during 1998, 2000 and 2002 to screen elite soybean lines for their resistance against major insect-pests. A total of 107 lines were planted in Randomized Block Design with three replications. Each line consisted of three rows of 3 m length per replication with 45 cm and 5 cm distance between and within rows, respectively. Soybean cultivars PK 1029 was included as stem fly susceptible check. Data were recorded on total plant height and length of stem tunneled by stem fly at physiological maturity stage. Percentage values for stem tunneling were transformed into angular values and subjected to analysis of variance. Soybean lines were categorized for resistance as per AICRPS (2001). Susceptible check variety PK 1029 recorded 34.75%, 30.66% and 38.52% stem tunneling values during 1998, 2000 and 2002 experiments, respectively, which were above economic threshold level (26%) as determined by Venkatesan and Kundu (1994). The results indicated 27 lines to be highly resistant, 8 lines resistant, 19 lines moderately resistant, 31 lines low resistant, 4 lines susceptible and 18 lines highly susceptible to stem fly. TS 98-21, TS 98-91, JS 92-12, JS (SH) 93-48, JS (SH) 93-01, Himso 1578, UGM 47, JS (SH) 93-37, MAUS 64-1, DSb 5, AMS 97-1, NRC 52, KB 221, JS 94-65, MACS 871 and UGM 20075 were found to be promising lines for resistance against stem fly. These lines can be used as donors in development of stem fly resistant soybean varieties.

P425. Molecular characterization of whiteflies (*Bemisia tabaci* Gennadius) associated with soybean crops in Geminivirus infected areas of Argentina, Brazil and Paraguay

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At present the complex of the whiteflies is one of the principal plagues of the Brazilian, Argentine and Paraguayan agriculture. The whitefly is an insect of tropical and subtropical areas,. The damage caused by them, is direct by the adult as well as by the nymphs, and indirect by the transmission of Phyitovirus. The dispersion of the white fly in Brazil occurred in a rapid way. Currently it is present in 24 states of the Federation in addition to Federal District. The damage caused by this plague in several regions is over US$10 billions resulting in serious consequences for the Brazilian agriculture. In Argentina its advances is also alarming, it has been found in provinces of the central area of the country, being noted together with them the appearance of Geminivirus. The knowledge of the genetic variability of the whiteflies populations is essential for establishing the adequate strategies of control and managing of this important plague. This work was accomplished in the framework of the project PROSUL in EMBRAPA CENARGEN and had as objective, to identify and analyze the genetic variability of whiteflies populations originated from different geographical regions of Argentina, Paraguay and Brazil and to relate them to the presence of Geminivirus. With the object to collect the whiteflies, different localities of Argentina, Paraguay and Brazil were visited. Samplings were accomplished in soybean crops and in the case that not whiteflies were found, samples were taken from weeds, growing nearby the soybean crop. The adults were separated by sex, and only the females where proceeded for DNA extraction and RAPDS method was applied. The results evidenced a meaningful genetic variability between the analyzed populations, confirming the B biotype masterfullness in Brazil and detecting A biotype persistence in Argentina and Paraguay. resisting the invasion of the B biotypes populations. These results suggest there are possible failings in the adaptatives mechanisms of the B biotype to domain argentines and paraguaian agroecosystems, showing important subsidies to future investigations about these inhibition factors for its establishment. High incidence of Geminivirus was observed in the same places from where flies were collected therefore the excellent transmission capacity of such populations can be deduced.

P426. Is the nucleopolyhedrovirus of *Anticarsia gemmatalis* (AgMNPV) ineffective to infect AgMNPV resistant host larva midgut cells?

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Anticarsia gemmatalis is a key pests of soybean in Brazil. It has been controlled by a nucleopolyhedrovirus (AgMNPV), which is widely used as a microbial insecticide in the country. The constant and increase use of this biological insecticide in some regions have caused concerns about the possibility of selection of viral resistant populations. Although this phenomenon has not been detected in the field yet, a laboratory *A. gemmatalis* populations has been selected for high resistance to the AgMNPV. It is known that midgut is considered one of the most important barriers against viral invasion, before systemic infection can be caused in various tissues if the virus succeeds in reaching the host larvae hemocele. Our work aim to verify whether or not the AgMNPV invades and infects the midgut cells of resistant larvae, comparing the ultrastructure of the midgut epithelial cells from the susceptible (SL) and resistant (RL) *A. gemmatalis* infected larvae. The susceptible and resistant strains of *A. gemmatalis* were reared on artificial diet, under laboratory-controlled conditions at Embrapa Soja, Londrina-PR, Brazil. The AgMNPV used as inoculum was incorporated into the insect diet at 60,000 oclusion bodies/ml of diet. The midguts were collected up to 120h post infection, processed and analyzed under transmission electron microscopy. The columnar cells were the most affected among the different midgut epithelial cells. In the SL, this cells shows many morphological signs of cellular damage from 24 hours after infection, mainly at the proximal midgut region. However in RL, this cells exhibited minor morphological damages up to 120 hours. Polyhedra were visualized in the midgut of both SL and RL from 96 hours of infection, but the amount of viral structure were always higher in SL, affecting the midgut epithelial cells and tracheal cells, as well as attached hemocytes (mainly plasmatocytes and granulocytes). Our results showed that the AgMNPV, in fact, invade RL cells. However, the virus did not affect these insects as they did with the susceptible ones, allowing development and survival of RL. The mechanism interfering with the virus infection progress in the midgut cells of RL is still unknown. This work has been supported by FAPESP and PRONEX (MCT/Finep/CNPq).

P427. **Geographic variation in susceptibility of *Epinotia aporema* (Lepidoptera: Olethreutidae) and *Rachiplusia nu* (Lepidoptera: Noctuidae) to *Bacillus thuringiensis* toxin *Cry*1Ac in Argentina**

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In Argentina, insecticides are used extensively in soybean to control lepidopteran pests. Two of the more important of these are *Epinotia aporema* (Walsingham) and *Rachiplusia nu* (Gueneé). As an alternative to synthetic insecticides, Monsanto Company has been developing a transgenic Bt soybean that has been genetically modified to express a synthetic, Cry1Ac-like protein derived from *Bacillus thuringiensis*. The commercial adoption of Bt soybean would present an opportunity to enhance current integrated pest management tactics in soybean. However, before Bt soybean is adopted, it is desirable to gather baseline data on the susceptibility of the target pests to Cry1Ac. This would serve as a first step toward the development of resistance monitoring programs to be implemented after commercialization of Bt soybean. In this study, geographic variability in susceptibility of field collected *E. aporema* and *R. nu* to *B. thuringiensis* toxin Cry1Ac was studied. Field populations of *E. aporema* (four sites) and *R. nu* (3 sites) were collected from main soybean production areas of Argentina and established in the laboratory. Bioassays were conducted by exposing neonate larvae to treated (diet incorporation) artificial diet. Eight or ten concentrations of Cry1Ac were tested against 64 neonate *E. aporema* or *R. nu*, respectively. Bioassays were incubated at 26 ± 2 °C and evaluated after 7 days by recording larval mortality and growth inhibition (unable to reach 3rd instar). Assays were replicated three to four times, and the resulting mortality and growth inhibition data were analyzed by probit analysis. Among the *E. aporema* populations evaluated, LC_{50} and LC_{95} values ranged from 0.26 to 0.68 µg/mL and 4.93 to 17.32 µg/mL, respectively; while for *R. nu* they ranged from 0.56 to 1.8 µg/mL and 2.01 to 5.93 µg/mL, respectively. This represents variability in susceptibility to Cry1Ac of approximately 3-fold for each species. In terms of larval growth inhibition, *E. aporema* populations exhibited EC_{99} values ranging from 0.09 to 0.18 µg/mL, while for *R. nu* they ranged from 1.35 to 4.61 µg/mL. This represents 3.4-fold and 2.0-fold variability in susceptibility to Cry1Ac by *R. nu* and *E. aporema*, respectively. Variability in Cry1Ac susceptibility was similar in *R. nu* regardless of whether measured by larval mortality or by growth inhibition, and although significant differences in susceptibility among populations were observed, the differences were small (< 4-fold). No significant differences in susceptibility among *E. aporema* populations were detected when measured by larval mortality, but significant differences were detected when measured by growth inhibition. Since populations of these two pests have not been previously exposed to extensive applications of *B. thuringiensis* insecticides, the differences detected among populations for each species reflect inherent variability in susceptibility to Cry1Ac.

P428. **Effects of row width on the abundance and populations dynamic of *Rachiplusia nu* (Lepidoptera: Noctuidae), *Anticarsia gemmatalis* (Lepidoptera: Noctuidae) and predaceous arthropods, in soybean crop**

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No-till sowing, the use of early maturing varieties and the narrowing of row width modified the environmental conditions for the populations growth of pest and natural enemies The objective of this study was to evaluate the incidence of row width on the relative abundance and populations dynamic of soybeans lepidopteran pest and foliage dweling predaceous arthropods. A randomized complete blocks field design were used with six replications. Three treatments were evaluated: 26, 52 and 70 cm row width . Experimental units with 7.5 m width and 24 m length were used. Every 7-10 days, samples of pest lepidoptera and predaceous arthopods were taken from V5 to R6 using the vertical beat sheet sampling method. Six samples were done for each experimental unit and sample date (a total of 8). Each insecta species was discriminated according to the different stages of development. In the case of the spiders, there was no discrimination according to species and/or stage of development. In the vegetative stage the most abundant defoliating specie was *Rachiplusia nu*, while in the reproductive stage the most abundant was *Anticasia gemmatalis*. The abundance of larvae of defoliating lepidoptera was significantly affected by row width, being higher in lower widths. In the case of *R. nu* both the small and the big larvae were more abundant in the lower width. *A. gemmatalis* showed a different behaviour for both categories of larvae; in the lower row width, only the small larvae were more abundant, which leads to the conclusion that there was a higher death rate that prevented them from becoming big larvae. The two most abundant groups of predators were the complex predaceous hemiptera (59%) and the spiders (38%). The most abundant predaceous hemiptera were: *Nabis capsiformis* and *Orius insidiosus*. The population of predaceous hemiptera was 38.8 and 47.5 % higher at

26 cm as compared to that at 52 and 70 cm respectively. The spiders were not affected by row width.

P429. Compatibility of agrochemicals with the entomopathogenic fungus *Metarhizium anisopliae* (Deuteromycotina: Hyphomycetes)

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The entomopathogenic fungus *Metarhizium anisopliae* is a natural control agent of several beetles, *Phyllophaga* spp., (Scarabaeidae), *Diabrotica speciosa*, *Maecolaspis* sp. (Chrysomelidae) in soybean agroecosystems. The use of fungi as microbial control agents usually shows high variability, because they are highly influenced by environmental factors. The joint application with agrochemicals may help improving their potential as control agents. The synthetic substances could act as stressor agents and facilitate the action as infectious diseases. We studied the compatibility of insecticides and fungicides with *M. anisopliae* isolates. Agrochemicals were mixed at the recommended rates per hectare considering a application volume of 100 L ha^{-1}. Recommended rates in 100 ml of sterile distilled were: Regent 800WGâ (fipronil, 25, 50, and 100 mg a.i.); Karate zeon 50CSâ (lambda-cyalothrin, 0.83, 1.66, and 3.33 mg a.i); MatchCEâ (lufenuron, 7.5 mg a.i); Certero SCâ (triflumuron 62.5 mg a.i.); Provado 200SCâ (imidacloprid, 69.3 mg a.i); Standak FSâ (fipronil, 10 mg a.i); Provado Duo SCâ (imidacloprid + beta cyfluthrin, 8.39 mg a.i); Dipterex 500CSâ (trichlorfon, 400 mg a.i); Dissulfan CEâ (endosulfan, 87.5 mg a.i); Actara 250WGâ (thiamethoxan, 37.5 mg a.i); Dimilinâ (diflubenzuron, 7.5 mg a.i); Previcurâ (propamocarb, 288.8, 433.2, and 577.6 mg a.i). Conidia of 12-14 days colonies of the isolates CNPSo-Ma12, CNPSo-Ma64, CNPSo-Ma136, CNPSo-Ma468 were produced on potato dextrose agar (PDA) medium. Conidia were exposed to agrochemical suspensions for four hours under gently vortex and suspensions were nebulized over a thin layer of PDA medium (with streptomycin) distributed on slides. Each treatment was replicated four times. Slides were incubated at 26 ± 2 °C in wet chambers for 24 h in the darkness. Germinated and ungerminated conidia were counted (ca. 100) after 18 and 26 h interval under a contrast phase microscope at 400 x magnification. Data were analyzed with Sigmastat software using ANOVA, and means were compared with Student–Newman–Keuls method test at 5%. Agrochemicals ordered from the less to the most deleterious, considering percentages of conidial germination inhibition were, propamocarb, lambda-cyalothrin, fipronil (Regent800WG), imidacloprid, lufenuron, triflumuron, diflubenzuron, thiamethoxan, fipronil (Standak FS), imidacloprid + beta-cyfluthrin, trichlorfon and endosulfan. Possibly the eight first products can be used simultaneously with *M. anisopliae* to control the referred pests.

P430. Ecological impact of insect-protected soybeans (transgenic Bt) on foliage dweling predatory arthropods under different insecticide regimes

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Insect-Protected Soybeans (IPS) line 781 that has been genetically modified to express a synthetic, Cry1Ac-like protein derived from *Bacillus thuringiensis*. The objective of this study was to compare the relative abundance and populations dynamic of soybeans pest and foliage dweling predatory arthropods, in IPS line 781 and parental control variety A3237, under different insecticide treatment regimes. Two years (2000 and 2001) field trials were established at two locations in Argentina: Fontezuela (Buenos Aires) and Oliveros (Santa Fé). At each site, three control regimes were included for both lines: Regime_A, no insecticide treatment, Regime_B, conditional application if the non-lepidopteran pests reached the Economics Threshold Level (ETL) and Regime_C, conditional application if the lepidopteran pests reached the ETL. The experiment was designed in the field as a Factorial Randomized Complete Block Design, with two factors: 2 lines and 3 insecticide regimes . Each treatment was evaluated in four replicate plots (25 X 25 meters). The vertical beat sheet sampling method was used for foliage-dwelling non-target arthropods and target pests, from V3 to R6, with 7-10 days interval. In both years, at either sites, the ETL for non-lepidopteran pests were not reached, so Regime B for non-lepidopteran control was not applied. At Oliveros site *Anticarsia gemmatalis* always reached the ETL and at Fontezuela site, only in trial 2000, *Epinotia aporema* reached the ETL. IPS line 781 provided an effective control of the key lepidopterans pest: *A. gemmatalis, E. aporema* and *Rachiplusia nu. Geocoris sp., Orius insidiosus* and spiders and *O. insidiosus, Nabis capsiformis* and spiders were the most abundant foliage-dwelling arthropods at both sites in 2000 and 2001 trials, respectively. when no insecticide was applied, both years at either site, there was no significant difference in the relative abundance of the foliage dweling predatory arthropods between IPS line 781 and parental control variety (A3237). At the Fontezuela site , application of the Lepidopteran control insecticide (Regime C) resulted in significantly reduction of predatory arthropods during 2000. Similar trend was observed throughout the growing season

in 2001. At the Oliveros site, the effects of insecticide regime on these taxa were non-significant which may be due to the relatively late application insecticide.. These data indicate that a higher abundance of predatory arthropods in fields growing with IPS line 781 as compared to fields of A3237 treated with insecticide. Thus transgenic insect protected soybeans may provide an important tool in continued efforts to improve integrated pest management strategies.

P431. Selectivity study of the insecticide Chlorfluazuron on the beneficial arthropod fauna in a soybean no-tillage crop grown in a savannah soil

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Studies on selectivity of insecticides and their doses for the beneficial arthropod fauna present in the soybean crop are of paramount importance amongst the pest management strategies for this crop. This experiment, conducted in a commercial area at the Capim Branco farm located at Uberlândia County, was installed over an R2 stage soybean crop, sowed with cultivar Conquista under a no-tillage planting system. It was evaluated the selectivity of the insecticides acephate (150.0; 187.5; 225.0 and 300.0g a.i/ha) and lambdacyhalothrin (7,5 a.i./ha) on the beneficial arthropod fauna in this agronomic system. The experiment was installed as a randomized complete-block design with six treatments and four replications and 162.0m^2 experimental plots, in which a pre-evaluation was performed by means of four samplings per plot with the beat panel. The three definitive evaluations were done on the second, fourth and seventh days after the application of the products and their respective doses, by counting the main predatory species as they occurred and also assorting them in groups. The means were compared according to Tukey's (5%) test and the percent reduction was calculated using Henderson & Tilton's formula. It was verified a reduction of 29 - 35% in the arthropod fauna during the sampling period and a grade of two was attributed to all treatments with predominance of 63% arachnids, 10% of Hemipterans, 9% of Dermapterons, 8% of Hymenopterons and 7% of Coccinelideons, which was evidence of a good performance of the insecticide acephate in the preservation of the beneficial arthropod fauna in this crop.

P432. Insecticide efficacy for controlling velvetbean caterpillar (*Anticarsia gemmatalis*) Hübner, 1918 (Lep, Noctuidae) in soybean

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During the growing season of 2002/2003, the effectiveness of insecticides in the control of velvet bean caterpillar (*Anticarsia gemmatalis*) was evaluated in the soybean cultivar BRS 154. The experiment was carried out at SEEDS Experimental Area located in Carazinho, RS, Brazil. The experimental area has been under conservation tillage over the late 15 years. Fertilizers and agronomic practices were done according to official recommendations. Experimental plots measured 2.50 x 10.0 m (5 lines 50 cm appart). The seed rate was 14 seeds per meter. Seeds were previously treated (vitavax + thiram, 250 ml per 100 kg of seeds). Insecticides and doses of commercial product per hectare were: teflubenzuron (Nomolt) 50 ml and 75 ml; diflubenzuron (Dimilin) 60 ml; alfa cypermetrin (Fastac) 120 ml and BAS 324 WAI, 80 ml and 100 ml. A non treated plot was used for comparison. The insecticides were applied by means of a boom sprayer, eqquiped with ten D_2 13 spaced 20 cm appart.by the time soybean plants reached development stage R3. A volume of 200 liters of water ha^{-1} was used. Percent of velvet bean control was estimated using the Abbot formula. Percent of defoliation were assessed at 4 and 14 days after spraying. The plots were mechanically harvested, and the grai moisture content was set to 13 percent. The yield and the one thousand grains weigth were also evaluated. The data were subjected to analysis of variance. The plots sprayed with Fastac insecticide showed high yield (4,404 kg ha^{-1}), 34.7 % higer from the control plots (3,269 kg ha^{-1}) and did not differ from BAS 325 WAI at 80 ml and 100 ml and Dimilin 60 ml with yields of 4, 324 kg ha^{-1}, 4,213 kg ha^{-1} and 4,075 kg ha^{-1} respectively, 29.5 %, 28.8 % and 24, 6 % superior from the yield of the non control plots. These insecticides did not differ from the Nomolt at 50 ml and 75 ml. Velvet bean caterpillar control did not differ between the isecticides tested ranging from 61 % (Nomolt at 50 ml) to 73 % (Fastac at 120 ml). At the first evaluation defoliation percentage varied amongst treatments from 27.5 % (BAS 325 WAI at 80 ml and 100 ml) to 51.2 % in the check treatment. In the second evaluation the defoliation percentage in the non treated plots was 90 %. Among treatments, the defoliation percentage varied from 15 % to 18 % (BAS 325 WAI) at 100 ml and 80 ml, respectively.

P433. Efficiency of insecticides to control velvetbean caterpillar *Anticarsia gemmatalis* (Hueb, 1818)

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Velvetbean caterpillar is found at all growing places as the most important pest on soybean crop in Brazil. It were evaluated, in Bandeirantes-PR, insecticides to control velvetbean caterpillar on cultivar Embrapa 48 at spacing of 0,45 m between rows with 18 plants per meter. Experimental design was randomized blocks with 6 treatments, 4 replications and plot with 45 m^2. The pulverization was done once when the crop was at stagium R_2 with following treatments in a.i./ha: clorfluazuron (Atabron 50 CE) 3,75; 5 and 7,5 g; triflumuron (Certero) 14,4 g; acephate (Orthene 750 BR) 150 g and control (with no spraying) For applications it was used a CO_2 sprayer, with X_4 nozzle, pression of 60 lb/pol^2, and volume of 200 L/ha. Evaluations were done by pre-counting, and at 02, 04, 07, 10 and 15 days after application, with 2 randomized samples per plot using "cloth-method", counting alived caterpillars, small and bigs ones, falled on cloth. It was concluded that: a) The insecticides acephate (Orthene 750 BR) 150 g at 02, 04, 07 and 10 days; clorfluazuron (Atabron 50 CE) 3,75; 5 and 7,5 g and triflumuron (Certero) 14,4 g a.i./ha at 04, 07 and 10 days after application showed more than 81% of efficiency in control small and big caterpillars, on soybean crop; b) The insecticides and doses had not caused toxicity on plants.

P434. Impact of the insecticide permethrin and lambdacyhalothrin on the survival and progenie of *Anticarsia gemmatalis* Hübner 1818, (Lepidoptera: Noctuidae), applied in commercial plantation of soybean

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The cultivation of the soybean is one of the main agricultural activities of Brazil, and the caterpillar *Anticarsia gemmatalis* is considered the main foliage-feeding pest. The insecticides are very used to the control of the pest. The work had as objective to evaluate the effect of Tifon 250 SC (permethrin 8,75 g.a.i..ha^{-1}) and Karate Zeon (lambdacyhalothrin 5,25 g.a.i..ha^{-1}) on populations of remaining caterpillar the application, collected three days after. The applications were made in portion of 800 m2 in commercial plantation cultivated with soybean. The evaluations were made in 10 aleatory points, and the infection level was of 30 caterpillar for ground-cloth. The application were accomplished with manual spryer propelled by CO2, equipped with conical jet beaks, gauged for 150 l.ha^{-1}.Three days after the application new evaluation was proceeded to verify the efficiency of the products, and 100 remaining caterpillar of fifth and sixth instars larval were collected, that they were transferred for artificial diet in tubes of rehearsal of 2,5 x 8,5 cm, in laboratory with temperature of 25 ± 1oC and RU 85 ± 5%, where they were maintained until the metamorphosis. The pupae were heavy and identified the sex 24 hours after the metamorphosis. The variables observed were the pupal and larval viability and pupae weight. The deformities of the larvae, prepupae, pupae and adult were classified in agreement with Rodriguez (1985). The evaluations in relation to the longevity were accomplished with 10 couples, (a couple for cage), fed with honey solution and beer at 10 and 25%, respectively. It was considered precocious death adults that survived until the fourth day and they were not considered for evaluation of the longevity. The numbers of the eggs was made each two days, to study viability it was used 20 eggs of second and third posture in number of 10 repetitions. The results were analyzed through the analysis of the variance and the averages compared by the test of Duncan with 5% of mistake probability. It was verified that the insecticide permethrin and lambdacyhalothrin promoted 70 and 88% of control of the caterpillar to the three days after the application, respectively. The longevity was affected, adults originating from of the treatment with insecticides lived on the average 14 and 16 days, in comparison to the 23 days of the witness, the treatment with lambdacyhalothrin affected the variable viability of eggs, being reduced for 67%, in comparison to 96% of the witness. The permethrin didn't carry in damage of another variables, it produced 248 caterpillar for female, while the witness produced 194 and the treatment lambdacyhalothrin 94. The treatment with insecticide permethrin promoted an increase in the aggressiveness of the plague, because the plague reproduced in a smaller space of time, and it still stimulated the reproductive potential of *A. gemmatalis,* however the lambdacyhalothrin reduced that potential.

P435. Impact of the insecticide lufenuron and *Bacillus thuringiensis* on the survival and progenie of *Anticarsia gemmatalis* Hübner 1818, (Lepidoptera: Noctuidae) applied in commercial plantation of soybean

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The cultivation of the soybean is one of the main agricultural activities of Brazil, and the caterpillar *Anticarsia gemmatalis* is considered the main foliage-feeding pest. The work had as objective to evaluate the effect of Match CE (lufenuron 5,25 g.a.i..ha^{-1}) and Dipel PM (*Bacillus thuringiensis* 5,6 g.a.i..ha^{-1}) on populations of remaining caterpillar to application, collected in the three days after. The applications were made in portion of 800 m2 in commercial plantation cultivated with soybean. The evaluations were made in 10 aleatory points, and the infection level was 30 caterpillar for ground-cloth. The application was accomplished with manual spryer propelled by CO2, equipped with conical jet beaks, gauged for 150 l.ha^{-1}. Three days after the application, a new evaluation was proceeded to verify the efficiency of the products, and 100 remaining caterpillar of fifth and sixth instars larval was collected, which they were transported to the laboratory, temperature of 25 ± 1oC and RU 85 ± 5%, being transferred for artificial diet in tubes of rehearsal of 2,5 x 8,5 cm, where they were maintained until the metamorphosis. The pupae were heavy and identificaded the sex 24 hours after the metamorphosis. The variables observed were to larval viability, pupal and pupae weight. The deformities of the larvae, prepupae, pupae and adult were classified in agreement with Rodriguez (1985). The evaluations in relation to the longevity were accomplished with 10 couples, (a couple for cage), fed with honey solution and beer at 10 and 25%, respectively. It was considered death precocious, adults that survived until the fourth day and they were not considered for evaluation of the longevity. The numbers of the eggs was made each two days and to study the viability it was used 20 eggs of second and third posture in number of 10 repetitions. The results were analyzed through the analysis of the variance and the averages compared by the test of Duncan with 5% of mistake probability. It was verified that the insecticide lufenuron and *Bacillus thuringiensis* promoted 78 and 77% of control respectively, of the caterpillar 3 days after the application. The insecticide lufenuron promoted defects like retention of the larval morphologic characters in 34% of the prepupae, 34% of premature mortality in adults, reduction in the adults' longevity for 16,5 days compared with the witness that lived on the average 23 days, the variable viability of eggs was affected, being reduced for 59%, in comparison to 96% of the witness. About the numbers of the caterpillar generated by female, the population treated with the insecticide lufenuron produced 99 caterpillar on the average for female; the insecticide *Bacillus thuringiensis* produced in it measured 265, while the witness produced 194. The insecticide lufenuron provokes deleterious effects and it reduces the reproductive potential in remaining caterpillar of *A. gemmatalis* indicating to be a promising insecticide in the integrated control of the plague, while the *Bacillus thuringiensis* increases that potential.

P436. Impact of the insecticide endosulfan, clorpyrifós and spinosad on the survival and progenie of *Anticarsia gemmatalis* Hübner 1818, (Lepidoptera: Noctuidae) applied in commercial plantation of soybean

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The cultivation of the soybean is one of the main agricultural activities of Brazil, and the caterpillar *Anticarsia gemmatalis* is considered the main foliage feeding pest. The work had as objective to evaluate the effect of Thiodan CE (endosulfan 122,5 g.a.i..ha^{-1}), Lorsban 480 BR (clorpyrifós 84 g.a.i..ha^{-1}) and Tracer (spinosad 8,16 g.a.i..ha^{-1}) on populations of remaining caterpillar to application, collected to the three days after. The applications were made in portion of 800 m2 in commercial plantation cultivated with soybean. The evaluations were made in 10 aleatory points, and the infection level was 30 caterpillar for ground-cloth. The application was accomplished with manual spryer propelled by CO2, equipped with conical jet beaks, gauged for 150 l.ha^{-1}. Three days after the application a new evaluation was proceeded to verify the efficiency of the products, and 100 remaining caterpillar of fifth and sixth instars larval was collected, which they were transportaded to the laboratory, temperature of 25 ± 1oC and UR 85 ± 5% ± 1oC,being transferided for artificial diet in tubes of rehearsal of 2,5 x 8,5 cm, where they were maintained until the metamorphosis. The pupae were heavy and identified the sex 24 hours after the metamorphosis. The variables observed were larval and pupal viability and pupae weight. The deformities of the larvae, prepupae, pupae and adult were classified in agreement with Rodriguez (1985). The evaluations in relation to the longevity were accomplished with 10 couples, (a couple for cage), fed with honey solution and beer at 10 and 25%, respectively. It was considered death precocious, adults that only survived until the fourth day and they were

not considered for evaluation of the longevity. The numbers of the eggs was made each two days and to study the viability it was used 20 eggs of second and third posture in number of 10 repetitions. The results were analyzed through the analysis of the variance and the averages compared by the test of Duncan with 5% of mistake probability. It was verified that the insecticide endosulfan, clorpyrifós and spinosad promoted 76, 81 and 74% of control of the caterpillar respectively, 3 days after the application, the insecticide endosulfan, increased the medium production of eggs for female for 406 eggs, against 202 of the witness. The insecticide clorpyrifós and spinosad reduced the viability respectively for 74,5 and 61%, in relation to the 96% of the witness. The number of caterpillar generated by female was 399 for endosulfan, 100 for clorpyrifós, 79 for spinosad and 194 for witness, in such a way that the first increased the reproductive potential and the two last decreased, indicating be promising for the integrated control of the plague.

P437. Efficacy of insecticide betacypermethrin (Akito 100 CE) for velvetbean caterpillar (*Anticarsia gemmatalis)* control on soybean crop

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Velvetbean Caterpillar (*Anticarsia gemmatalis)* is considered one of the most important pests on soybean crop in Brazil, causing damage since vegetative up to flowering stage. To evaluate the efficacy of different insecticides for *Anticarsia gemmatalis* control on soybean, the experiment was carried out in Bandeirantes county, Paraná State, Brazil, on variety Embrapa-48, planted at spacing of 0.48 m among lines with 16 plants per linear meter. The experimental design was complete randomized blocks with 6 treatments, 4 replications. The plot size was 40 m^2. The insecticides were sprayed on plants at R.2 stage and the treatments in g a.i./ha were: betacypermethrin (Akito 100 CE) at 7.5 and 3.0; betacypermethrin (Akito 100 CE) at 3.0 + chlorfluazuron (Atabron 50 CE) at 2.5; chlorfluazuron (Atabron 50 CE) at 2.5; lambdacyalothrin (Karatê zeon 50 SC) at 3.0 and untreated check. For application was used CO_2 back pack sprayer, X_4 conic nozzle, pressure of 60 psi and spraying volume of 200 l/ha. The evaluations were made in pre evaluation, at 2, 4, 6 and 11 days after treatment (DAT), though 2 random sampling in two linear meter per plot, counting the number of small and large aliving velvetbean caterpillar. Based in the results, it was possible to conclude: a) The treatments with betacypermethrin (Akito 100 CE) at 7.5 g; betacypermethrin (Akito 100 CE) at 3.0 g + chlorfluazuron (Atabron 50 CE) at 2.5 g; chlorfluazuron (Atabron 50 CE) at 2.5 g and lambdacyalothrin (Karatê zeon 50 SC) at 3.0 g.a.i./ha were efficient for large Velvetbean Caterpillar control up to 6DAT. b) betacypermethrin (Akito 100 CE) at 3.0 g + chlorfluazuron (Atabron 50 CE) at 2.5 g; chlorfluazuron (Atabron 50 CE) at 2.5 g were efficient for large Velvetbean Caterpillar up to 11 DAT. c) betacypermethrin (Akito 100 CE) at 3.0 g, betacypermethrin (Akito 100 CE) at 3.0 g + chlorfluazuron (Atabron 50 CE) at 2.5 g and chlorfluazuron (Atabron 50 CE) at 2.5 g were efficient for small Velvetbean Caterpillar up to 11 DAT. d) Tank mix of Akito + Atabron at 3.0 + 2.5 g.a.i./ha and Atabron at 2.5 g.a.i./ha showed the largest period of control for small and large pest. e) None of chemicals was phytotoxic for the crop.

P438. Reaction of soybean genotypes to severity of leaf spot diseases on early and medium cycle in regional assay

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This research aimed at the evaluation of soybean 24 genotypes, early and medium cycle, of the Program of Improvement of Soybean of the UFU, in phase of regional assay, comparing with the follow cultivars: UFV 19, Conquista, Msoy 8800 and Msoy 8411. The assay was carried through in Araguari, São Gotardo, Uberaba and Uberlândia, consisting of four replications, in complete randomized-block experimental design. Every other week, it was evaluated severity of symptoms of leaf spots (both diseases occurring under natural epiphytics). In relation to the powderry mildew, in Uberaba and São Gotardo check UFV 19 and Conquista, respectively, had presented resistance reaction. In Uberlândia, seven ancestries and the checks UFV 19 and Conquista they had revealed resistant. For Araguari, the four check and ten ancestries had presented resistance reaction. How much to the severity of the frogeye leaf spot, in São Gotardo, genotype UFU 23 presented resistance to the patógeno. In Araguari, the cultivar Msoy 8411 and seven ancestries had been resistant, while that in Uberlândia Msoy 8411 and 21 ancestries had presented resistance reaction. For downy mildew, in Uberlândia and Uberaba two ancestries had revealed resistant. In Araguari, four ancestries had presented one better behavior how much to the pathogen. For São Gotardo, 19 ancestries and the cultivar Msoy 8411 they had been resistant, being that ancestry 14 was distinguished as resistant in all the evaluated places. How much to the illness septoria brown spot, in Uberlândia and Araguari, was distinguished the genotype UFU 23.

P439. **Reaction of soybean genotypes to severity of leaf spot diseases on semilate and late cycle in regional assay**

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The present work, had as objective to evaluate 24 genotypes of soybean, semilate and late cycle, of the Program of Improvement of Soybean of the UFU, in phase of regional assay, comparing with the follow cultivars: Emgopa 313, Garantia, Suprema and DM 339. The assay was carried through in Araguari, São Gotardo, Uberaba and Uberlândia - MG, consisting of four replications, in complete randomized-block experimental design. Every other week, it was evaluated severity of symptoms of leaf spots (both diseases occurring under natural epiphytics). In relation to the powderry mildew, in Uberaba genotypes Emgopa 313 and UFU 1 had presented resistance reaction. In Uberlândia, the genotype UFU 24 revealed resistant. For São Gotardo and Araguari - MG, the cultivars Emgopa 313 and Garantia they had presented resistance reaction. How much to the severity of the frogeye leaf spot, in São Gotardo, genotype UFU 23 presented resistance to the pathogen. For downy mildew, in Uberlândia the ancestry 22 and checks DM 339 had been resistant. In Araguari, the genotypes 1, 4 and 16 had presented resistance reaction. In relation septoria brown spot, in São Gotardo and Araguari, the genotypes had not differed between itself.

P440. **Effect of the potassium application in covering and different times of control of the final cycle diseases under no-tillage system of soybean**

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The severity of the final cycle diseases (FCD) in plants with symptom of potassium deficiency is considerably bigger that in normal plants; such diseases can cause losses the culture of the soy reducing the income of grains. In areas with monoculture it has a still bigger increase of the incidence of the FCD. This assay was carried out objectifying to evaluate the effect of different times of application of fungicide for control of the final cycle diseases, with and without fertilization of covering of KCl, in the agronomics characteristics of the soy, in no tillage system. The area presents a description of six consecutive years under no tillage system of soybean. The experiment was carried out in the São Bento da Ressaca Farm, in the city of Frutal-MG. The cultivar Conquista with 14 seeds for meter was used, spaced the 45 cm between rows. The soil fertilization was 300 kg ha^{-1} of the formularization 00-20-20. The seeds had been inoculated with *Bradyrhizobium japonicum* recommended for the "cerrado" and they had not received treatment with fungicide. In the assembly of the experiment, split plot design was used. The fertilizations had constituted the plots made use in the randomized block design, with 4 replications and the times of fungicide application had constituted subparcels. The experimental plot was formed by ten rows with 20 meters of length. The two m^2 of the two rows central offices of each plot, had constituted the useful area. One became full filled 2 treatments of fertilization (control without fertilization and application of KCl), and 4 different times of fungicide application (control without application, R5.0, R5.5 and R6.0). The KCl, granulated, was applied in covering, the throwing in the corresponding dose the 30 kg of K_2O ha^{-1}, in the V6 stage. The applications of the fungicide had been made with the Benomyl product (250 g ha^{-1}), in stages: R5.0, R5.5 and R6.0; a tractorized pulverizer was used, applying the volume of the 200 L ha^{-1}. The analyzed characteristics had been: plant height, the first rod height, number of knot for plant, number of rod for plant, index of harvest, weight of one hundred seeds and grain yield. It was observed that: a) the variance analysis was not significant for the attributes plant height, height of the first rod, number of knot for plant, index of harvest and weight of one hundred seeds; b) the SCOTT-KNOTT test showed to have significant difference for numbers of rod for plant and grain yield, being these greaters in the treatments that had received fertilization from KCl in covering; c) Although not to present significant difference, the applications of fungicide in the R5 stage, in the presence or absence of KCl, provided to greater grain yield.

P441. **Effect of different times of control of the final cycle diseases and potassium application and cobalt + molybdenum in covering in the soybean crop**

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The final cycle diseases (FCD) can more than cause considerable losses the culture of the soy reducing the yield in 20%. Low soil fertility and the nutritional unbalance influence in the health of the plants,

becoming them more susceptible the pathogen. The objective of this work was to verify the effect of different times of application of fungicide for control of the final cycle diseases (FCD) and the fertilizations in covering with K and Co + Mo on some agronomics characteristics of the soy. The experiment was carried out in an area of first year of culture in the São Bento da Ressaca Farm in the city of Frutal-MG. The cultivar EMGOPA-313 with 12 seeds for meter was used, spaced the 45 cm between rows. The soil fertilization was 450 kg ha^{-1} of the formularization 00-20-20. The seeds had been inoculated with *Bradyrhizobium japonicum* recommended for the "cerrado". In the assembly of the experiment, split plot design was used. The fertilizations had constituted the plots made use in the randomized block design, with 4 replications and the times of fungicide application had constituted the subparcels. The experimental plots was formed by ten rows with 20 meters of length. The two m^2 of the two lines central offices of each plot, had constituted the useful area. One became full filled 4 treatments of fertilization (without fertilization, KCl, CoMo and KCl+CoMo), and 4 different times of fungicide application (without application, R5.0, R5.5 and R6.0). The application of CoMo was made in the V5 stage, with tractorized pulverizer using 250 mL of commercial product CO-MO98 in a volume of 200 L ha^{-1}, corresponding to a dose of 5,1 g ha^{-1} de Cobalt and 34,5 g ha^{-1} of Molybdenum. The KCl, granulated, was applied in covering, the throwing, in the corresponding dose the 30 kg of K_2O ha^{-1}, in the V6 stage. The applications of the fungicide had been made with the Benomyl product (250 g ha^{-1}), in stages: R5.0, R5.5 and R6.0; a tractorized pulverizer was used, applying the volume of the 200 L ha^{-1}. The analyzed characteristics had been: plant height, first rod height, number of knot for plant, number of rod for plant, index of harvest, weight of one hundred seeds and grain yield. In the conditions of this experiment, it can be concluded that it did not have significant difference of the different times of fungicide application and of the treatments of fertilization in the evaluated characters. However, in the average, the treatments that had received the fertilization with potassium in covering, had an addition in the productivity of 300 kg ha^{-1}.

P442. Soybean yield under the effect of natural occurrence of *Septoria glycines* Hemmi and *Cercospora kikuchii* (Matsu. & Tomoyasu) Gardner diseases with and without chemical control

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The occurrence of late season leaf diseases caused by the fungus *Septoria glycines* and *Cercospora kikuchii* is easily identified in field. However, there is a need of precise information to quantify the damage and yield losses as well as to define the best occasions for fungicide applications. With the purposes: to evaluate the effect of these diseases on yield and to identify the best soybean growth stages for chemical control, were installed field experiments at Fazenda Areão (ESALQ/USP), in Piracicaba - SP. The soybean cultivar MG/BR - 46 (Conquista), susceptible to both diseases was sown in a complete randomized blocks design in factorial 2 x 3 (two fungicides: benomyl and tebuconazole and three application stages: R_4, $R_{5.3}$ e R_6) and three extra treatments (control without application, fortnightly application of benomyl and fortnightly application of tebuconazole), at three replications. The severity, the pod number per plant, the seed number per pod, the mass of 1,000 seed and yield were determined. Based on the obtained results in three consecutive crop seasons (1999/2000, 2000/2001 e 2001/2002), it was possible to conclude that: a) the fungicides benomyl and tebuconazole may be used to control these diseases; b) it was not possible to determine the most appropriate growth stage for fungicide application, which result in yield gain; c) under severity below 10% there are not relation between this variable and the mass of 1,000 seed and yield.

P443. Influence of cultivar cycle on foliar diseases control efficiency of pyraclostrobin + epoxiconazole

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The influence of cultivar cycle on foliar disease control was evaluated from experiments set up with 10 soybean cultivars. Efficiency of Pyraclostrobin + Epoxiconazole, Azoxystrobin and Pyraclostrobin + Propiconazole were compared based on efficiency control of late season diseases, percentage of green leaf area, percentage of defoliation and yield. Fungicides were sprayed at R_4 soybean development stage. Total control treatment included sprayings at all reprodutive stages (R_1, R_2, R_3, R_4, R_5). Information regarding difference between any treatment to the total control is important to determine how close to the ideal performance one can be. Efficiency of Pyraclostrobin + Epoxiconazole to control late season diseases was not influenced by soybean cultivars cycle. Even timing of spraying was the same for all cultivars, what could allow different inoculum level among cultivars, Pyraclostrobin + Epoxiconazole showed consistent performance on preserving green

leaf area and reducing defoliation. As a consequence, yield of early and late cultivars sprayed by Pyraclostrobin + Epoxiconazole was similar to the total control whereas on middle cultivars difference was 10.42%. It is important to consider that among tested cultivars some are susceptible to most foliar diseases which suggest the efficiency of Pyraclostrobin + Epoxiconazole on control them. Also, ability of Pyraclostrobin + Epoxiconazole to keep higher performance despite cultivars cycle and different level of diseases severity suggests to be an alternative to any chemical control program that include control of powdery mildew, late season disease and rust.

P444. Efficiency of pyraclostrobin + epoxiconazole to control late season diseases on soybean

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In order to evaluate the efficiency of Pyraclostrobin + Epoxiconazole to control late season diseases on CEP 33 and CD 205 soybean cultivars, experiments located at Itáara/RS were carried out. Efficiency of Pyraclostrobin + Epoxiconazole was determined based on percentage of green leaf area, percentage of defoliation, weight of 1000 seeds and yield. Fungicides were sprayed once at R_1/R_2, R_3/R_4, R_4/R_5 and twice at R_1/R_2 + R_3/R_4, R_1/R_2 + R_4/R_5 and R_3/R_4 + R_4/R_5 soybean development stages. It was not observed a significant difference between one or two sprays of Pyraclostrobin + Epoxiconazole on most parameters evaluated. However, yield of both cultivars was significantly influenced by two sprays of Pyraclostrobin + Epoxiconazole. Lenght of cultivar cicle might have a signficant role on fungicide efficiency. Early sprays were more effective to increase yield on CEP 33 whereas later sprays increased yield of CD 205. Disease management might cosider fungicide spray at R_1/R_2 on middle cicle cultivars. In such case, one spray was enough not only to get best performance on yield but also to control late season diseases. On the other hand, on late cicle cultivars two fungicide sprays produced larger yield increasing and a significant disease control. Percentage of defoliation and green leaf area were closely related to yield increase. Fungicide efficiency should be determined based on both disease severity and foliar components. The preventive control of diseases adjusted to cultivar's cicle can allow a superior yield response for most cultivars.

P445. Acibenzolar-S-Methyl (ASM) as an alternative to control foliar diseases in soybean

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Foliar diseases in soybean might reduce yield up to 20%. Disease control may be possible by genetic, cultural and chemical methods. Chemical control might be improved by products which act as systemic acquire resistance inducers. Utilization of Acibenzolar-S-Methyl (ASM) in a program to control soybean foliar diseases in soybean was tested. A field trial was carried out in order to evaluate the efficacy of Acibenzolar-S-Methyl (ASM) sprayed on IAS 5, CD 201 and RS 10 cultivars. Acibenzolar-S-Methyl (ASM) was sprayed along with Difenoconazole and Azoxystrobin fungicides at R3, R4 and R5.1 growth stages. It was evaluated disease severity, effect on duration of green foliar area, and yield components. Difenoconazole and Acibenzolar-S-Methyl (ASM) sprayed at R3 and R4 stages increased the control of late season diseases, similar to Azoxystrobin + Acibenzolar-S-Methyl (ASM) sprayed at R5.1 stage. Difenoconazole + Acibenzolar-S-Methyl (ASM) sprayed at R4 and R5.1 stages enhanced the green leaf area, whereas Acibenzolar-S-Methyl (ASM) sprayed alone caused the larger defoliation. IAS 5 cultivar did not show yield response to any treatment. Difenoconazole + Acibenzolar-S-Methyl (ASM) in R4 stage was the best treatment to improve yield of CD 201 and RS 10 cultivars.

P446. Diseases control in the soybean crop with fungicides of different chemical groups

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To evaluate the agronomic efficiency of different fungicidal groups, as well as different formulations in the powdery mildew (*Microsphaera diffusa*), brown spot (*Septoria glycines* Hemmi) and frogeye leaf spot (*Cercospora sojina* Hara) control in the soybean crop (Glycine max L.), experiments were installed in the Ponta Grossa city, State of Paraná, in the crop of 2001/2002, with the cultivar BR-16. The fungicidal treatments were

pyraclostrobin (300 and 400 ml.$^{-ha}$); pyraclostrobin + epoxiconazol (600 and 750 ml.$^{-ha}$); tebuconazol (1000 ml. $^{-ha}$); fenpropimorph (500 ml. $^{-ha}$); elementary sulfur (2500 g.$^{-ha}$) and control without treatment. Differences were not observed among doses in the treatments pyraclostrobin and pyraclostrobin + epoxiconazol in the foliar spot diseases control, characterized as the best products used in the experiment. The pyraclostrobin treatments, isolated and in mixture with epoxiconazol, they presented smaller fall of leaves that the control treatment and the other treatments until the last evaluation. Through the results obtained for the area under disease progress curve (AUDPC), it was evident the need of the control disease, with value of 526.28 for the control treatment, while the best fungicides treatments, pyraclostrobin and pyraclostrobin + epoxiconazol, in whole the appraised doses, varied from 50.21 to 80.13. For the powdery mildew control similar behavior was observed, mainly in the treatments with pyraclostrobin fungicide, isolated and in mixture with epoxiconazol. An only application of elementary sulfur was shown efficient in the powdery mildew control in the beginning evaluations, however, a second application is necessary of the third evaluation time so that the control if it maintained equal to the other fungicidal treatments. The treatments with the strobilurin molecule presented smaller fall of leaves that the control, characterizing in an increment in the crop cycle that varied on the average of 7,4 to 7,9 days. The best productivity was obtained for the treatment with pyraclostrobin in the rate of 100 ml a.i.$^{-ha}$, although the weight of 1000 grains is characterized as better parameter to evidence the interference of the disease. Through him it is observed that most of the fungicidal treatments went superiors the to witness. Through AUDPC the need of control of the disease was verified, with value of 1.207,31 for the control treatment, while the treatments with fungicides varied from 75,87 to 661,53. Phytotoxicity effects was not observed to the soybean crop.

P447. Evaluation of fungicides for the control of the soybean powdery mildew (*Microsphaera diffusa*) in winter crop

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The objective of this work was to evaluate the agronomic efficiency of the fungicides in the control of the soybean powdery mildew in the 2003 winter crop, in Uberaba/MG. Two rehearsals were accomplished, being applied the same treatments in that the residual and healing effect of the products was evaluated. In the first rehearsal three sprays were accomplished, in R.3 stage and the other ones two, with 15 days interval. In the second rehearsal it took place two sprays, in R.3 and R.5.1. stages with MG/BR-46 Conquista, with eight treatments, disposed in randomized blocks, with four repetitions. Each experimental unit was constituted by four lines of 7,0 m, spaced in 0,50 m. The useful area was considered the two central, discarded lines 0,50 m of each extremity. The application of the products was made with costal sprayer, at constant pressure, using 136 L/ha and the fungicides and the dosagens (g. i.a. /ha) tested they were: Flutriafol (50 and 75); Pyraclostrobin + Epoxiconazole (91,5); Tebuconazole (100); Difeconazole (50); Fluquinconazole (62,5), together with an absolute witness, Flutriafol (75). There were not statistical differences in the two rehearsals, for all fungicidal treatments, even so superiors to the witness, where in this the severity of the diseases of cycle end reached (DFC) 30%, the mildew powdery severity and rust reached 70%. The rust was detected in the beginning of the flowering and its evolution was slow and all the fungicidal treatments were effective. In both rehearsals, when it happened the first spray, the powdery incidence was smaller than 20% of the area to foliate and it stayed very low after the fungicidal treatments, checking the effectiveness of the same ones, once in the witness the incidence was of 70% of the area to foliate. There was not increment in the revenue and in the weight of 100 seeds. This is due to the fact that in the winter cultivation, the low temperatures cause a fall in the productivity and consequently a decrease in the revenue and in the weight of 100 seeds.

P448. Efficacy of the ready mixture containing the fungicides Pyraclostrobin and Epoxiconazole (Opera) in the control of end cycle diseases on soybeans

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The occurrence of diseases in the end of soybeans cycle, like *Cercospora kikuchii*, *Septoria glycines* and *Corinespora cassiicola*, can be descript with high importance in Brazil, mainly in the last decade, because the planted area increment and the regional climatic conditions. Is true also that the pathogens incidence had increased, affecting the production. This trial was done with the objective to evaluate the ready mixture efficacy of the fungicides Pyraclostrobin + Epoxiconazole in the control of the end cycle diseases on soybeans. The trial was installed on January 2003 in Dourados city Mato Grosso do Sul State / Brazil. The variety used was Embrapa 48, receiving only one

application at the grow stage R4 (end of flowering). Randomized block design was carried out in the trial, containing 6 treatments with 4 repetitions and 60m² for each plot. The carried out treatments were; 1- Untreated ; 2- Pyraclostrobin + Epoxiconazole (91,5 g a.i./ha) ; 3- Pyraclostrobin + Epoxiconazole (109,8 g a.i./ha), 4- Azoxystrobin (50 g a.i./ha), 5- Propiconazole + Trifloxystrobin (62,5 + 62,5 g a.i./ha) and 6- Carbendazim (250 g a.i./ha). To apply the treatments it was used a knap sack CO_2 sprayer and 200 l/ha water volume were sprayed. The evaluations were done at 30 and 45 days after application, evaluating the damage by the diseases in percentage of the foliar area attacked. The harvest of the treatments were done to evaluate the production impact of the pathogens incidence with each treatment. By the results it's possible to conclude that the ready mixture of Pyraclostrobin + Epoxiconazole even at 91,5 g i.a./ha rate, could offer an excellent control of *C. kikuchii*, *S. glycines* and *C. cassiicola*, being better than the others treatments. Some others important aspects observed in the Pyraclostrobin + Epoxiconazole treatments, were the greening effect, residual control and leaves retention, with positive reflects in grains stuffing and yield. None tested treatment caused crop injury.

P449. Progress and challenges in management of *Sclerotinia sclerotiorum* on soybean

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Sclerotinia stem rot (SSR) on soybean, caused by *Sclerotinia sclerotiorum*, is a major yield-reducing disease in the northern soybean growing regions in the United States. Current disease management strategies include cultural practices and variety selection. In terms of research, screening and breeding for disease resistance has been a major focus of many breeding programs. Since high levels of physiological resistance have not been reported, addressing the need for successful, long term management has been more difficult. This difficulty may be in part due to problems associated with the perennial nature of the fungus in soil, wide host range, pathogen population structure, variability in isolate aggressiveness, low correlations between field and greenhouse evaluations, lack of widely adopted screening techniques, and difficulty in identifying the multiple genes involved in the resistance response. To address these problems, five major research efforts are currently underway: 1) *S. sclerotiorum* isolates are being characterized, and variability in isolate aggressiveness is being assessed, 2) 18 soybean lines with promising levels of resistance are being evaluated at multiple locations with a core set of isolates, 3) the technical merit of controlled environment screening techniques to indicate field performance is being assessed, 4) quantitative trait loci associated with SSR resistance are being identified and mapped, and 5) microarray analysis is providing information about soybean genes involved in the resistance response. A long term solution to SSR on soybean involves the development of highly resistant varieties, better understanding of the pathogen, effective screening technologies, and identification of resistance genes.

P450. Soybean cultivar BRS Raiana, indicated for the states of Paraná and São Paulo, Brazil

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Soybean cultivar BRS Raiana was selected from the population originated from the cross PFBR 8818890 x BR 89-9591, carried out at Embrapa – National Wheat Research Center in 1992/93. F_1 population was advanced in the greenhouse during the winter of 1993. Segregating generations, F_2 to F_5, were conducted using the bulk population method under field conditions in no-till system. Individual plant selection was carried out in F_5, in 1996/97. Line PF 98 1095 was formed in the following growing season and evaluated under this designation. Soybean cultivar BRS Raiana life-cycle is early, with an average cycle of 137 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has determinate growth habit, white flowers, and brown pubescence. The grain has bright yellow tegument and black hilum. Average 100 grains weight is 15.8 g. Average oil and protein contents are 22.0% and 41.0%, respectively. It is resistant to lodging and shattering. BRS Raiana is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), frogeye leaf spot (*Cercospora sojina*), and soybean mosaic virus, and moderately resistant to powdery mildew (*Microsphaera diffusa*). It shows positive peroxidase reaction. From 2000/01 to 2002/03, average grain yield of BRS Raiana was, in 13 environments of Paraná, 2.9% higher than the one of cultivar CD 202; and, in seven environment of São Paulo, grain yield was 4.7% higher than the one of cultivar CD 201.

P451. Soybean cultivar BRS Sinuelo, indicated for the states of Rio Grande do Sul, Santa Catarina, and center-southern and southwestern regions of Paraná, Brazil

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Soybean cultivar BRS Sinuelo originated from the cross Sharkey x {FT-5 x [Dourados-1*8 x Ocepar 9]} carried out at Embrapa – National Soybean Research Center. The population was introducted in Embrapa – National Wheat Research Center in 1995/96, in F_4 generation. Segregating generations, F_4 and F_5, were conducted using the bulk population method. Individual plant selection was carried out in F_5, in 1996/97. Line PF 98 1217 was formed in the following growing season and evaluated under this designation. Soybean cultivar BRS Sinuelo life-cycle is medium, with an average cycle of 146 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has determinate growth habit, white flowers, and brown pubescence. The grain has dull yellow tegument and brown hilum. Average 100 grains weight is 18.3 g. Average oil and protein contents are 18.5% and 42.8%, respectively. It is resistant to lodging and shattering. BRS Sinuelo is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), frogeye leaf spot (*Cercospora sojina*), powdery mildew (*Microsphaera diffusa*) and soybean mosaic virus. It shows positive peroxidase reaction. From 2000/01 to 2002/03, average grain yield of BRS Sinuelo was, in 22 environments of Rio Grande do Sul, 5.9% higher than the one of cultivar BRS 66; in eight environment of Santa Catarina, grain yield was 3.3% higher than the one of cultivar Embrapa 48; and, in six environments of center-southern and southwestern regions of Paraná, grain yield was 2.4% higher than the one of cultivar Embrapa 48.

P452. Soybean cultivar BRS Tebana, indicated for the states of Rio Grande do Sul, Santa Catarina, and center- southern and southwestern regions of Paraná, Brazil

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Soybean cultivar BRS Tebana was selected in a population originated from the cross (PFBR 8817007 x RS 6-Guassupi) x FT-Abyara, carried out at Embrapa – National Wheat Research Center in 1992/93. F_1 population was advanced in the greenhouse during the winter of 1993. Segregating generations, F_2 to F_5, were conducted using the bulk population method under field conditions in no-till system. Individual plant selection was carried out in F_5, in 1996/97. Line PF 98 1081 was formed in the following growing season and evaluated under this designation. Soybean cultivar BRS Tebana life-cycle is medium, with an average cycle of 147 days from emergence to maturity, when seeded in mid-November in the Rio Grande do Sul. It has determinate growth habit, white flowers, and gray pubescence. The grain has middle bright yellow tegument and light brown hilum. Average 100 grains weight is 16.8 g. Average oil and protein contents are 17.7% and 41.0%, respectively. It is resistant to lodging and shattering. BRS Tebana is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), frogeye leaf spot (*Cercospora sojina*), and soybean mosaic virus. It is susceptible to powdery mildew (*Microsphaera diffusa*) and to the root-knot nematodes. It shows positive peroxidase reaction. From 2000/01 to 2002/03, average grain yield of BRS Tebana was, in 22 environments of Rio Grande do Sul, 4.8% higher than the one of cultivar BRS 66; in eight environment of Santa Catarina, grain yield was 4.4% higher than the one of cultivar Embrapa 48; and, in six environments of center-southern and southwestern regions of Paraná, grain yield was 1.7% higher than the one of cultivar Embrapa 48.

P453. Soybean cultivar BRS Torena, indicated for the states of Rio Grande do Sul, Santa Catarina, and center-southern and southwestern regions of Paraná, Brazil

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Soybean cultivar BRS Torena was selected in a population originated from the crossing of (PFBR 87 866 x CEP 20-Guajuvira) x (RS 7-Jacuí x RS 6-Guassupi), carried out at Embrapa – National Wheat Research Center in 1992/93. F_1 population was advanced in the greenhouse during the winter of 1993. Segregating generations, F_2 to F_5, were conducted using the method of bulk population method under field conditions in no-till system. Individual plant selection was carried out in F_5, in 1996/97. Line PF 98 1015 was formed in the following growing season and evaluated under this designation. Soybean cultivar BRS Torena life-cycle is semi-late, when seeded in mid-November in the Rio Grande do Sul. It has determinate growth habit, purple flowers, and gray pubescence. The grain has dull yellow tegument and light brown hilum. Average 100 grains weight is 17.1 g. Average oil and protein contents are 17.3% and 38.8%,

respectively. It is resistant to lodging and shattering. BRS Torena is resistant to stem canker (*Diaporthe phaseolorum* f. sp. *meridionalis*), brown stem rot (*Phialophora gregata*), frogeye leaf spot (*Cercospora sojina*), and bacterial pustule (*Xanthomonas axonopodis* pv. *glycines*). It is susceptible to powdery mildew (*Microsphaera diffusa*) and to the root-knot nematodes. It shows negative peroxidase reaction. From 1999/2000 to 2001/02, average grain yield of BRS Torena was, in 18 environments of Rio Grande do Sul, 10.0% higher than the one of cultivar Fepagro RS-10; in eight environments of Santa Catarina, grain yield was 3.6% higher than the one of cultivar M-Soy 7501; and, in seven environments of center-southern and southwestern regions of Paraná, grain yield was 11.4% higher than the one of cultivar M-Soy 7501.

P454. Determination of storage potential of soybean seeds using different stress tests

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Soybean seeds have a tendency to deteriorate under various biotic and abiotic stresses during their production and storage leading to rapid decline in quality of seeds. Present investigation was carried out with a view to evaluate different stress tests viz. Accelerated Aging Test (AAT)' Methanol Stress (MS) and Hot Water Stress (HWS), in soybean to help in predicting seed storability status in advance. Twenty three advanced breeding lines of soybean were selected and graded into two lots; small and bold, according to seed size. Germination percentages of fresh seeds were calculated after subjecting them to various stresses in three replications. Results revealed significant differences among genotypes for seed longevity under different stress conditions. Genotypes viz., Kalitur, T-49, PK 1338 and JS 335 encouragingly performed better under all stress tests while PK 472, PK 564 and PK 327 performed poorly. All the stress tests were positively and significantly correlated with seed storability. Highest correlation coefficient value was observed in AAT (r = 0.612) followed by MS (r = 0.534) and HWS (r = 0.505) with laboratory germination at nine months of storage. Correlation study suggested best prediction of storability status of soybean seeds was possible through AAT followed by MS and HWS.

P455. Genetic diversity in Indian varieties of soybean (*Glycine max* (L.) Merrill)

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The genetic divergence for 62 Indian varieties of soybean for seventeen characters was estimated using Mahalanobis D^2 statistic. The results revealed that 62 varieties were grouped into fifteen clusters out of which nine were monogenotypic. The highest intercluster distance was observed between cluster 15 and 9 followed by cluster 15 and 14. Grouping pattern of the varieties suggested no parallelism between genetic divergence and geographical distribution of the varieties. Among the 17 characters protein percentage contributed maximwn to the genetic divergence followed by nwnber of pods per plant and seed yield per plant. The varieties MACS-330, PK-472, VLS-47, Alankar, Pusa- 40, SL-295, NRG-7 and JS 71-05 have been identified as useful donor to get segregants for yield and its component on the basis of genetic divergence analysis. PK -472 has been identified as the most potential parent for hybridization programme. The varieties included in the cluster with maximwn inter cluster distance were obviously genetically more divergent irrespective of their place of origin. The varieties with high mean values of character in any cluster as well as high D2-value between cluster can be used either for direct adoption or for hybridization in order to breed for better genotypes of soybean.

P456. Genetic variability and correlation studies for flower production, abscission rate, yield and yield components in soybean (*Glycine max* (L) Merrill)

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The investigate the extent of genetic variability for flowering traits viz. Flower production, flower span (days), rate per day flower production, and reproductive abscission (by taking difference between total flower production and matured pod developed) along with seed yield and other yield contributing traits, sixteen genotypes of soybean with different growth habits were used for this study. Grain yield per plant showed highly significant positive correlation with dry matter weight, number of pods per plant, seed yield efficiency and harvest index. Total flower production/plant showed highly significant positive association with flower production per day, number of flower dropped, number of pods per plant and number of seeds/pod. Reproductive abscission exhibited significant positive correlation with number of flowers dropped whereas it, showed significant negative correlation with number

of pods per plant and dry matter weight. High to moderate broad sense heritability was reported for most of the characters viz. oil per cent, total flower production, days to flowering, number of primary branches, number of pods per plant, protein per cent and number of seeds per pod; whereas, abscission rate, harvest index and dry matter weight per plant exhibited low heritability. Jupiter, a genotype with indeterminate growth habit possessing highest grain yield i.e. 38.22 g/plant had lowest reproductive abscission rate (34.6%). Though highest number of flower i.e. 462 were produced by PK-1241 (semi-determinate genotype), 317 flowers dropped, consequently the reproductive abscission rate was high i.e. 68.95 per cent. Low to moderate reproductive abscission rate i.e. 53.9, 53.91, 54.63, 59.61 per cent was recorded in PK-1024, T-49, PK-262 and PK-1042, respectively. These genotypes possessing high flower production with low to moderate abscission rate could be considered for yield improvement in soybean breeding programme.

P457. Family selection on soybean for yield and protein

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The present work aimed to show the possibility of selection of soybean families bearing high protein content in the seeds without decreasing the grain yield. Four RC_1F_4 and four F_4 populations were used. Each of these populations was originated from the crossing of a high protein material and a commercial variety. The population means, heritabilities, correlation coefficients and gains by direct selection were estimated. The main conclusions were: *i)* it was possible to select families presenting both high protein content in the seeds and high yield; *ii)* the CD206-CR population presented families with the highest protein content in the seeds and despite the presence of high heritability for protein content and intermediate for grain yield, the negative genetic correlation between them did not allow their simultaneous selection.

P458. Advance in soybean lines development for conditions of the Eastern Croatia

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The evaluations of agronomic values of new developed soybean elite breeding lines in comparative tests with check cultivars over wide range of environments are indicator of achieved genetic advance within the breeding program. The improving of genetic basis has significantly contributed to improvement of soybean production and further genetic improvement of cultivars, respectively. In this paper will be given the results of testing new developed soybean elite breeding lines in comparison with check cultivars through analysis of level and stability of grain yield, protein and oil content in grain, as well as theirs adaptability and tolerance on principal soybean diseases. The researches were conducted during the three-year period (2000-2002) at the experimental field of The Agricultural Institute Osijek (Croatia) and involved three sets of soybean genotypes (lines and checks) depending of maturity group (MG): Set1– MG 0, Set2 - MG I and Set3 - MG II. The tested promising lines has developed from different hybridizations within the soybean breeding program at the Institute and derived from previously cycle of selection on the basis of their performances. Checks are released cultivars of Institute that have grown in commercial production in Croatia. The trials were design as randomized complete block with 3 replicates. The occurrence and intensity of principal soybean diseases were determined during researches: downy mildew (*Peronospora manshurica*) at R_2 stage and pod and stem blight (*Diaporhte phaseolorum* var. *sojae*), stem canker (*Diaporthe phaseolorum* var. *caulivora*) and Sclerotinia stem rot (*Sclerotinia sclerotiorum*) at R_8 stage. Diseases intensity was evaluated visually at field and recorded on a 1 to 9 scale. Detection and identification of pathogen presence was evaluated in laboratory using standard phytopatological methods and with biomolecular method for pathogens from *Diaporthe/Phomopsis* Complex. The obtained results of biometrical analysis in these study showed that the most tested elite breeding lines had significantly higher grain yield, protein and oil content in relation on checks in MG 0, I and II. Additionally, many tested promising lines, except high-yielding and good grain quality, also had good stability in analyzed traits, wide-general adaptability and high tolerance to major pathogens affecting soybean production in our country. In general, these data indicate on achieved genetic advance in grain yield, grain quality and tolerance on principal soybean diseases within our breeding program. Also, the best new developed elite breeding lines make good genetic background for further improving of soybean production in our country as well as for further genetic advance in soybean germplasm.

P459. Agronomic performance of soybean cultivars grown in Jaboticabal, in the agricultural year 2002/03

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The present research aimed to evaluate some agronomic characters of 22 soybean cultivars grown in Jaboticabal/SP. The experiment was installed at the teaching and research farm of Faculdade de Ciências Agrárias e Veterinárias/UNESP/Jaboticabal-SP, in November 2002. The statistical design was randomized blocks with four replications. Plots were made up of four 0.45m spaced 5-meter lines. Only the two central lines were considered as the useful plot. Cultural practices were made according to the technical recommendations to the soybean crop. The following agronomic characters were studied: number of plants per meter, lodging, yield, plant height, insertion height of the first pod and cycle. The cultivars were: IAC 24; IAC 18; IAC 23; IAC 22; IAC 8-2; IAC 19; BRS 184; BRS 134; BRS 154; BRS 156; BRS 137; M-SOY 8001; M-SOY 7501; Embrapa 48; CD 208; CD 209; CD 201; V-MAX; MG/BR- 46(Conquista) and BRS MG 68(Vencedora). Among the cultivars studied here, the ones with plant height below 65cm, considered by Bonetti (1983, Soja: Genética e Melhoramento p. 741-800) as compatible to the mechanical harvest, were BRS 134, M-SOY 7501 and Embrapa 48. The latter also showed insertion height of the first pod below 10cm, which can bring harvest losses. Most of the cultivars were classified as early, but some were semi-early (IAC 18, BRS 156, BRS MG 68(Vencedora), M-SOY 8001, CD 205) and others average (IAC 24, IAC 8-2, MG/BR- 46, IAC 19). Low levels of lodging were observed in all cultivars. The cultivar BRS MG 68(Vencedora), had the highest yield (5043 kg/ha), but not significantly different by the Tukey's test at 5% of probability, from CD 205, BRS 133, M-SOY 7501, Embrapa 48, BRS 134, IAC 24, BRS 184, IAC 19, CD 209, MG/BR 46(Conquista), BRS 137, BRS 154, BRS 156, IAC 18, IAC 22, M-SOY 8001.

P460. Behavior of soybean genotypes grown in Ipameri, GO, Brasil, in the agricultural year 2002/2003

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The soybean has overcome other economically important crops in Brazil, being very important for the country's trade in the last few years. The expansion of this crop is due in great part to the development and selection of adapted to different latitudes. It is important then to study the behavior of genotypes in many regions. The present work aimed to evaluate the agronomic characters of 23 genotypes from the soybean breeding program of Departamento de Produção Vegetal of the Faculdade de Ciências Agrárias e Veterinárias /UNESP /Jaboticabal /SP, in field conditions. The experiment was carried out at the farm "Lago Azul", Ipameri /GO. Besides the 23 genotypes, two cultivars were included as pattern, BRSMG 68 (Vencedora) and MG/BR-46 (Conquista). The soughing date was 11/23/2002. The statistical design was randomized blocks with four replications. Plots were made up of two 0.45m spaced 4-meter lines. The agronomic characters evaluated were the plant height at maturation, insertion height of the first pod, number of branches, lodging, weight of 100 seeds, number of nodes, cycle, and grain yield. To evaluate lodging a 1 to 5 grading proposed by Bonnetti (1983, Soja: Genética e Melhoramento p. 741-800) was employed; 1 corresponds to almost all plants erect; 2, to all plants slightly bent; 3, to all plants moderately bent; 4, from 40 to 80% of plants bent; 5 all plants lodged. The results showed that the genotypes JB 9540021 and JB 9550027-2 have high levels of lodging, and therefore are susceptible to harvest losses. All genotypes showed good performance for the characters plant height at maturation and insertion height of the first pod. Plant heights were over 65 cm and the insertion height of the first pod above 10 cm. The genotype JB 9510037 had the highest weight of 100 seeds (16,19g) while JB 9590023-1 the lowest (11,71g). The highest yields were found in the cultivar BRSMG 68 (Vencedora) (4521 kg/ha) and in the genotypes JB 930310-1 (4488 kg/ha) and JB 940310-2 (4410 kg /ha), which significantly differed from the least productive ones: JB 940413-2 (3215 kg/ha) and JB 940413-1 (3195 kg/ha).

P461. Behavior of soybean genotypes grown in Jaboticabal, SP, Brazil, in the agricultural year 2002/2003

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The soybean is the most important oil-rich grain of the world because of its nutritional properties and diverse uses in industry and diet. Due to the great importance of this crop, breeding programs are always looking for genotypes with desirable agronomical characters and,

if possible, adapted to distinct environmental conditions. For this, genotype competition experiments must be carried out in many localities, especially in those of interest to the soybean crop. This research aimed to evaluate 23 genotypes from the soybean breeding program of Departamento de Produção Vegetal - Faculdade de Ciências Agrárias e Veterinárias /UNESP / Jaboticabal /SP. The experiment was conducted in field conditions and comprised 25 treatments, 23 genotypes and two cultivars used here as patterns: BRSMG 68 (Vencedora) and MG/BR-46 (Conquista). The soughing date was 11/21/2002. The statistical design was randomized blocks with four replications. Plots were made up of two 0.45m spaced 4-meter lines. Fifteen plants per meter were left after thinning out in the soybean stage V3, to uniformize the initial population. The agronomic characters evaluated were the plant height at maturation, insertion height of the first pod, number of branches, lodging, weight of 100 seeds, number of nodes, cycle, and grain yield. To evaluate lodging a 1 to 5 grading proposed by Bonnetti (1983, Soja: Genética e Melhoramento p. 741-800) was employed; 1 corresponds to almost all plants erect; 2, to all plants slightly bent; 3, to all plants moderately bent; 4, from 40 to 80% of plants bent; 5 all plants lodged. The genotype JB 95500272 showed high level of lodging. All genotypes had plant height above 65 cm, minimum recommended by Bonnetti (1983, Soja: Genética e Melhoramento p. 741-800), as well as the insertion height of the first pod always higher than 10 cm, what is desirable according to Bonnetti (1983, Soja: Genética e Melhoramento p. 741-800) because it is adequate to mechanical harvest. The genotype JB 940310-2 showed the lowest weight of 100 seeds (10,15 g), and the cultivar MG/BR-46 (Conquista) the highest (15,53 g). The cultivars BRSMG 68 (Vencedora) (4075 kg/ha), MG/BR-46 (Conquista) (3855 kg/ha) and the genotype JB 9510038 (3545 kg/ha) were the most productive, significantly differing from JB 9510035 (2272 kg/ha) and JB 9510031-2 (2234 kg/ha), by Tukey's test at 5% of probability.

P462. Selection of soybean cultivars [*Glycine max* (L.) Merrill] as summer crops for Southern Minas Gerais State

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In order to generate information to aid technicians and producers in the determination of cultivars to be planted in Lavras Country in summer time. The present work was carried out at the experimental area of Federal University of Lavras, Lavras, MG, Brazil an a Red Latosol (LVdf), in 2002/2003 growing season, to determine soybeans cultivars, as summercrops, for Southern Minas Gerais. The experimental design was a randomized block casualized with three replications. The 45 cultivars (treatments) used in the experiment was: Doko, Pioneira, Virtuosa, Conquista, FT-104, Monarca, Monsoy 108, Monsoy 109, FT-Abyara, Performa, Liderança, Monsoy 8400, Confiança, Splendor, UFV-16, Garantia, Renascença, IAC-19, FT-2000, IAC-21, CAC-1, Monsoy 8411, Suprema, Segurança, Aventis 7002, Paiaguás, Carrera, Santa Rosa, BRS-Celeste, DM 339, BRS Carla, BRS Milena, BRS MG 68, BR-9 Savana, AV 2056-7, STTE 02, AV. 1043, Monsoy 8866, Monsoy 8329, Monsoy 9010, Embrapa 48, Emgopa 313, Emgopa 314, Tucano, BRS 136. All tested cultivars showed good grain yields, specially BRS MG 68 (4395 $kg.ha^{-1}$), Paiaguás (3897 $kg.ha^{-1}$), AV 2056-7 (3780 $kg.ha^{-1}$), Monarca (3646 $kg.ha^{-1}$) and FT 2000 (3498 $kg.ha^{-1}$). Soybean plant and first pod height, taken by harvest time, was in the range of 0,68m to 1,53 m and of 0,08 m to 0,29 m respectively. Lodging induces were also satisfactory for all cultivars tested. Seed quality of the cultivars was avaluated and ranged from 1,6 to 3,6 in a 1-5 scale. Such variation was be atributed to different climatic conditions and processing time the cultivars with different life cycle underswent.

P463. Essay with lineages for the test of genotypes for conference of bigger productivity

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At times when the demand for food has increased gradually with the increase in the planet population, soybean culture has been a great source of research for the whole world. This essay was installed at UFU (Universidade Federal de Uberlândia) on December 20, 2002, with 15 lineages and 2 witnesses (Msoy 8200 and Carla). The experiment was performed in randomized blocks, with 4 repetitions and each plot consisted of 1 line (6 m long), with 0.90 m between lines; in each plot 0.90 m X 6 m were considered for evaluation, making a total of 5.4 sq. m. Seeds were treated with Fungicide, Cobalt + Molybdenum, and *Bradyrhizobium japonicum*. Productivity ($Kg\ ha^{-1}$) was evaluated for individual plants, with the evaluation of the budding occurring in R_{1-2}, with about 50 % of open flowers; harvest was carried out in R_{7-8} with about 95 % of ripe string beans in the FEHR scale et al. (1971), with humidity of 12-15 % in the seeds. The following parameters were also evaluated: number of days until budding and maturation, height of budding, maturation and the insertion of the first string bean, as well as diseases. UFU-98, UFU-99, UFU-103 and UFU-100 lineages were considered the most productive according to the Tukey test at 5 % of significance, ahead of the witnesses, being thus considered better than the witnesses.

P464. Competition among soybean cultivars within the breeding program at UFU

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Due to the incorporation of new areas where soybean [*Glycine max* (L) Merril] is being grown, and the need of expansion to regions with different environments, there is a constant search for the development of new cultivars adapted to each region. This experiment was carried out in Uberlândia, Minas Gerais with the purpose of evaluating soybean cultivars from the Improvement Program developed at the Federal University of Uberlândia (UFU). A randomized block design was used, with 6 cultivars and 1 witness (DM-339), with 3 replications and 4 sowing densities (11,14,17 and 21 seeds per meter). Each plot was composed of 4 lines (5 meters long), and the two central lines were considered, while 0,50 m was disregarded at each end. Plant weight and the weight of 100 seeds, as well as the production per hectare (in kg) were evaluated. Considering plant weight, the cultivar UFU-5 showed an average weight of around 21.88 g; the best performance was obtained with a sowing density of 14 plants per meter. Regarding the weight of 100 seeds the witness DM-339 obtained an average of 15,80 grams, and the best performance happened with a density of 14 plants / m. Statistical differences in productivity were not observed; even so, the cultivar UFU-6 produced around 3580 Kg/ha and the density of 17 plants / m showed the best performance among the cultivars studied. For better performance, sowing should be carried out with a density of around 14 seeds per meter, since lodging usually happened when the plants were submitted to higher densities.

P465. Verification of lineages of soyben of the improvement program of the Federal University of Uberlândia

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With the objective to evaluate ancestries of the improvement program of soyben (*glicine Max*) of the Federal University of Uberlândia, experiment in Capim Branco Farm was carried through with 15 ancestries UFU, beside of 2 varieties witnesses (Carla and Msoy-8200). The used experiment was done with randomized blocks, the parcels had been constituted of a line of 6m, spaced of 0,90m between lines, having as useful parcel 5,4m², in four repetitions. The experiment was initiated with the sowing in the date of 12/20/2002, had been used in the treatment of fungicidal seed, cobalt + molibidenium and inoculate (*Bradyrhizobium japonicum*). The evaluated characteristics had been: Date of flowering (DF), and maturation(DM), height in flowering (HF), maturation(AM), and of the insertion of first pod (IFP), illnesses, productivity in (KGHA) and productivity for plant(IPLAN), the evaluation of the budding was made in the R_{1-2} stadium, with about 50% of the opened flowers, evaluation of the harvest in the R_{7-8} stadium, with about 95% of mature plants in the FEHR scale et al. (1971), with humidity of 12-15% in the seeds and evaluation of illnesses with note scale of 0 the 4, where 0 = plant without attack, 1 = 25% of the attacked plant, 2 = 50% of the attacked plant, 3 = 75% of the attacked plant and 4 = 100% of the attacked plant, being you consider resistant 0-1, and liable the 2,3 and 4 illnesses in field.Treatment UFU 110 presented the best one resulted how much the productivity, however not differing from treatments UFU 115, 112, the 113 and worse ones resulted had been, UFU 119 and 109 differing only from the best one resulted, how much to the test of Tukey 5%.

P466. Evaluation of fifteen lineage of soybean UFU in preliminary test in Uberlândia, MG, Brasil

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The experiment was realized in the farm Capim Branco, propriety of University of Uberlandia in Uberlandia-MG-Brazil to analyze the characteristics: number of days by flowing (DF) and maturation (DM) e insertion of first green bean (AIV), productivity $kgha^{-1}$ (KGHA), productivity by plants (IPLAN), more over the valuation of diseases in the fifteen lineage of soybean UFU and two witness (Carla and Msoy 8200) into the preliminary test.The sowing was happened in 2002/20/12, with fertilizing of 435 $kgha^{-1}$ the formulation 0-28-18 about 0,2% of Zn. The seeds was treated with fungicide + Co + Mo and inoculate by *Bradyrhizobium japonicum*.. The delineation used was the randomized blocks with four repetions, plot with one line of 6 meters spaced of 5,4 meters². The valuation of flowering was maked in the stage R_{1-2}, with approximately 50% the flowers opening. The observation of disease in the dcagram scale which varies of 0-4, by according severity the grades: The resistents was considered the grades 0-1 and susceptibles the grades 2-3 and 4. The harvest

was executed in stage R_{7-8} with aproximatily 95% of green brans matuned by scale FEHR et al. (1971) and humidity among 12-15%. The best performance in relation of productivity was lineage UFU-145 with 2026,8 Kg.ha^{-1} what differed the lineage UFU-146, which differed the lineage UFU-148. The worst valuation in relation of productivity was the lineage UFU-140 with 435 Kg.ha^{-1} what differed the lineage UFU-150 comparisons using Test of Tukey 5%.

P467. Development of soybean genotypes in preliminary assay in Uberlândia, MG

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Two assays in Capim Branco Farm of the Federal University of Uberlândia had been lead, with the objective to evaluate, in preliminary assay, lineages UFU comparing them with cultivating standards (Emgopa-316, Carla and Msoy-8200), pertaining to the maturation cycles precocious/semiprecocious and medium. The used delineation was of randomized blocks, with four repetitions. The first experiment was composed of 13 and the second of 16 treatments, being each experimental parcel consisting by a line of 6 meters, with spaced of 90 centimeters between lines, with useful parcel of 5.4 m^{-2}. The characteristics evaluated in the field had been: income of grains, grams of plant, stand, number of days for budding and maturation height of the plant in the budding and maturation and height of insertion of the first string bean. After accomplishment of the analysis of variance and test of average, concluded that: the materials, for both the experiments, had presented significant differences for the test of Tukey 5%. In the first assay, lineages UFU-02-19-1765 and UFU-02-16-1762, had gotten greater income of grains (1126 and 1017 kg.ha-1) respectively, when compared with the standards (Emgopa-316, Carla and Msoy-8200), being that the excessively material ones had presented intermediate productive potential. In second assay the, to cultivate had shown them to minor productivity in relation to all the analyzed genotypes, with prominence for lineage UFU-02-7-210, that if it showed with greater income of grains (2331 kg.ha-1).

P468. Evaluation of behavior and description of soy lineages at UFU in preliminary essay in 2002/2003

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This experiment was conducted during the years of 2002/2003 with the intention to evaluate soybean (*Glycine max*) lineages within the breeding program at Universidade Federal de Uberlândia in a preliminary assay. The experiment was installed on Capim Branco Farm, with 15 UFU lineages and 3 witnesses (DM-339; JATAI and LUZIÂNIA), in a randomized block design with four repetitions. Each plot consisted of one row (6 m long) with a distance of 0.90 m between rows and a density of 100 seeds per row.The main diseases affecting soybean (*Cercospora sojina*, *Septoria glycines* and *Microsphaera diffusa)* were rated on a scale from 0 to 4 where 0 = plots where all the plants were healthy; 1 = plots where plants were lightly infected up to the lower third; 2 = plots where plants were lightly infected up to the medium third; 3 = plots where plants were infected up to the higher third; and 4 = plots where plants were infected up to the apex. Plants rated 0 and 1 were considered resistant and those rated 2, 3 and 4, susceptibles. Lineages UFU if had held of bonanza form, with prominence for lineds UFU-32, UFU-39, UFU-35 and UFU-44, where these had been considered resistant to all the diseases, while the susceptible witnesses had been the *Microsphaera diffusa*,. Lineages UFU-32 and UFU-38 had presented meetings superior average income the 2800 kg.ha^{-1}, followed of lineage UFU-39 that statistically it did not differ from the Jataí witness.

P469. Evaluation of different lineages of soybean UFU in preliminary assay in Uberlandia, MG

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The experiment was installed in the Capim Branco Farm of the University of Uberlândia, with the objective to evaluate, in preliminary assay, different lineages UFU. The treatments had been placed block-type randomized in parcels of a line of six meters with four repetitions, spaced of ninety centimeter between lines with useful parcel of 5, 4 m^{-2}. The following characteristics had been evaluated: number of days for budding and maturation, height in the budding, height in the maturation and height of insertion of the first string bean, illnesses, productivity for plant (kg ha^{-1}), and productivity in general (kg ha^{-1}). The seeds had been dealt with fungicide, Co + Mo and *Bradyrhizobium japonicum*. The evaluation of the budding was made when the soy plants were in the

vegetative stadium R1-2, with about 50% of the open flowers. The harvest was made in the R7-8 stadium, with about 95% of mature string beans observed in scale FEHR et al. (1971), with humidity of 12-15% in the seeds. For evaluation of illnesses a note scale was used of 0 to the 4 where: 0-without prominence, 1-25% of the attacked plant, 2-50% of the attacked plant, 3-75% of attacked plant and 4-100% of the attacked plant. Plants that had gotten notes 0 and 1 had been considered with resistance, and plants with notes 2, 3 and 4 had been considered whitout resistence. The treatment that got productivity better was UFU-89 with 2.211 kg ha^{-1}, although not to differ of some treatments in the test from Tukey with significance 5%. The worse treatment was the UFU-81 with 522 kg ha^{-1}, not differing from some treatments. The witnesses had gotten intermediate performance.

P470. Evaluation of soybean lineages in a preliminary essay deriving from the breeding program at UFU

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This experiment was installed on Capim Branco farm with the objective to evaluate the behavior of soybean(*Glycine max*) lineages within the breeding program at Universidade Federal de Uberlândia. The experiment was carried out with 15 UFU lineages and 3 witnesses (DM-339; JATAI and LUZIÂNIA), on December 20, 2002. A randomized block design with four repetitions was used, with each plot consisting of 1 row (6 m long) and spacing of 0.90 m between rows, as well as a density of 100 seeds/6m. The following characteristics were evaluated: number of days until budding (DF) and maturation (DM), height at budding and maturation, evaluation of the budding occurred in the R_{1-2} stadium, with about 50% of the open flowers and the harvest in the R_{7-8} stadium, with about 95% of ripe string beans according to scales FEHR et al. (1971), with humidity of 12-15% present in the seeds; height of the insertion of the first string bean (AIV), productivity (Kg.ha^{-1}), productivity per plant (IPLAN) and main diseases affecting soybean (*Cercospora sojina* , *Septoria glycines*, beyond *Microsphaera diffusa*) were also evaluated. A rating scale from 0 to 4 was used, where 0 = plots where all the plants were healthy; 1 = plots where plants were lightly infected up to the lower third; 2 = plots where plants were lightly infected up to the medium third; 3 = plots where plants were infected up to the higher third; and 4 = plots where plants were infected up to the apex. Plants rated 0 and 1 were considered resistant and those rated 2, 3 and 4, susceptibles. All the lineages studied were considered resistant to *Cercospora sojina*, *Septoria glycines* and *Microsphaera diffusa*; in general they showed more resistance than the witnesses. The productivity in UFU-59 and UFU-60 lineages reached more than 2300 Kgha^{-1} in average.

P471. Promising soybean inbred lines in dark red latosols on savannas of Roraima, during planting year of 2002

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Soybean crop at the savanna ecosystem ("lavrados") of Roraima is expanding markedly due to arrival of farmers coming from western-center Brazil, seeking for new agricultural frontiers. Roraima detains around 1.500.000 ha of land as savanna, with topography and vegetation characteristics favorable to complete mechanization of the productive process. In a general way, these areas are flat or showing small declivity and its soils present low natural fertility. Twenty four soybean inbred lines have been assessed in trials carried out at Embrapa Roraima´s experimental field, which originated from selections carried out in three populations conducted by Bulk method, deriving from Embrapa Soja´s Breeding Program. The trial was installed in October, 2002, with supplementary irrigation for the period to harvest. The experimental design was completely randomized blocks with four replicates, BRS Sambaiba as the local cultivar. Each plot consisted of four rows 5 m long, 0,45 m apart one from the other. The fertilization consisted of 450 kg.ha^{-1} of 02-20-20 (NPK), applied in the sowing row. The seeds were treated with fungicides, inoculated with *Bradyrhizobium japonicum* and sowed immediately. Agronomic characteristics were assessed as follows: number of days from emergency to flowering and maturation, plant height, first pod insertion height, plant population and grain yield. Three inbred lines - RR02-15, RR02-23 e RR02-04 – presented high productivity, superior than the performance of BRS Sambaiba which produced 4.077kg.ha^{-1}. RR02-15 was the most productive, with production of 4.707kg ha^{-1} (78,4 sc.ha^{-1}). Seventeen inbred lines showed productive performance similar to local cultivar.

P472. Soybean maturity groups in Brazil: stability and cultivar classification

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Maturity classification is an important concept to provide the best allocation of resources for soybean genotype research and commercialization. This study evaluated the maturity stability of 48 midwestern and 40 southern Brazilian commercial cultivars tested in 8 southern locations and 9 midwestern locations. All trials were planted in the first part of November to eliminate the effect of the long juvenile trait in the midwestern cultivars. The genotype x environment interaction, although significant, was much lower than the individual effects of environment and genotype. The effect of latitude was more important than that of altitude in influencing the number of days to maturity (NDM). Utilizing the methodology of Eberhart & Russell, the most stable genotypes and, consequently, the most suitable checks for each maturity group classification were, for the southern region: NK8350 - Spring (5.2), NK412113 – V Max (6.0), CD207 (6.0), CD210 (6.4), BRS-184 (6.9), CD208 (6.9), BRS-154 (7.2), BRS-133 (7.2), CD209 (7.4), BRS-134 (7.5), CD205 (8.0), and for the midwestern region: CS935142 – Carrera (7.5), M-SOY 8001 (7.9), Conquista (8.2), FMT Tucunaré (8.3), Monarca (8.5), DM339 (8.7), FMT Nambu (8.9), Elite (9.1), M-SOY 9001 (9.1), and DMNobre (9.2). Results of investigations conducted to date indicate that the use, in Brazil, of maturity groups to classify soybean genotypes, could become an efficient method for describing relative maturity on a broad environmental basis.

P473. Soybean cultivar adaptability and stability in the Northern Brazilian "Cerrados" according to the Lin & Binns (1988) methodology

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Variations in the productive performance of genotypes due to genotype x environment interactions assessed in different environments have been detected during selection processes. The stronger the interaction, the more erratic the cultivar performance. Adaptability and stability analyses reduce the effects of genotype x environment interactions, improving genotypic performance differentiation. Lin & Binns (Lin & Binns, 1988, Canadian Journal of Plant Science, 68:193-98) propose a methodology for the analysis of the adaptability and stability of genotypes, using the *Pi* index. The *Pi* accumulates the behavior of a tested genotype with the genotype having the best performance in each environments. Thus, the smaller the cultivar *Pi* magnitude, the greater its adaptability and stability. As the *Pi* statistics has variance properties, it weighs the behavior deviations of cultivars efficiently, is easily interpreted, attractive for plant breeders. In a study carried out during the last four cropping seasons (1999/00,2000/01,2001/02 and 2002/03), in the Northern Brazilian "Cerrados", the genotypic behaviors of eight soybean cultivars developed by Embrapa were evaluated. The cultivar BRS-219 (Boa Vista) (*Pi* = 10.308; productivity = 3.058 kg/ha; early maturity) showed the best adaptability among the genotypes studied. BRS Sambaíba (*Pi* = 37.401; productivity = 2.897 kg/ha; medium maturity), BRS Candeia (*Pi* = 40.900; productivity = 2.968 kg/ha; medium maturity), and BRS Tracajá (*Pi* = 43.662; productivity = 2.892 kg/ha; early maturity) also reveled higher ability in low latitude regions. BRS-165 (Seridó RCH) (*Pi* = 72.145; productivity = 2.948 kg/ha; late maturity) was the late maturity cultivar with the best performance, showing the best relative average stability. BRS Juçara (*Pi* = 423.232; productivity = 2.404kg/ha; medium maturity) and BRS Babaçu (*Pi* = 220.771; productivity = 2.644 kg/ha; late maturity) showed the highest *Pi* values, thus representing the least adaptable cultivars to the region under study. BRS-164 (Pati) (*Pi* = 154.616; productivity = 2.754 kg/ha; early maturity) showed a high *Pi*; however, this cultivar is recommended for fertile soils together with the use of modern production technologies. In general, the region's hydric regime, characterized by concentration of rains in a short period of time, contributed to the higher productivity level of the early and medium maturity soybean cultivars.

P474. Genotypes-environments interactions in soybean in the State of Mato Grosso, Brazil

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The objective of this research was to evaluate the magnitude of the genotypes x environments interaction (GxE) and its consequence in the phenotypic adaptability and the stability of 86 soybean genotypes belonging to three maturity cycles (19 early, 29 medium and 38 late), through three methodologies (Lin and Binns, Eberhart and Russell and AMMI-Additive Main Effects and Multiplicative Interaction) with emphasis on the grain yield. Trials, sown in November 2001, in five locations in the State of Mato Grosso (Rondonópolis, Pedra Preta, Campo Verde, Campo Novo do Parecis e Nova Mutum) were tested. In each location three trials for each maturity cycle were evaluated. For each environment the trial was set up in randomized complete blocks design with three replications, each of them consisting of two central lines of five meters long flanked by two border lines. In the identification of the most stable genotypes, for the method of Lin and Binns, the highest stability was associated with the highest yield, or either this method can be used to select genotypes more stable associating them it the averages of the genotypes. The linear regression of Eberhart and Russell detected stable genotypes of general adaptability. AMMI analysis showed a high significant pattern of the GxE interaction (60% of original square sum of the GxE interaction) and the presence of noises was low, evidencing that main part of the observed total variation for the interaction was important to explain the behavior of the genotypes. The graphical interpretation of AMMI analysis was efficient to explain the stability of genotypes, and environments, what was not possible for the other methodologies. The genotypes more stable and simultaneously, higher yields were: FMT-41102, Conquista, EMG-302 (early); FMT-43115, Crixás, DM-309 (medium) and FMT-43308, Bela Vista, Kaiabi (late).

P475. Evaluation of soybean genotypes at four planting dates and plant population, in Uberlândia, MG

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Fifteen soybean genotypes were valuated at four planting dates and plant densities regarding the following agronomic traits: number of days flowering (NDF), number of days to maturity (NDM); first pod insertion height (AI), lodging (AC) and grain yield. The experiment was installed using randomized complete block design with three replications. Genotypes were organized in three maturity growps. Early: Emgopa 316, Goiânia and GOBR 95-322; Medium: Luziânia, Santa Cruz, Crixás, Emgopa 315 and Conquista; Late: Paraíso, Emgopa 313, Goiatuba, Bela Vista, Jataí, Garça Branca and GOBR 97-2850. Luziânia and Crixás were the most productive materials for all planting dates and plant densities. Sowing carried at 20/21/01 resulted lower values for all evaluated traits. Genotype, planting dates and planting densities showed significant interactions, complicating the interpretation of the results and their pratical applications. Sowing at 20/10/01 was related with significant reduction on the mean of all evaluated traits. The best grain yields were obtained at plant densities of 250 and 300.000 plants and sowing dates of 30/11/01 for early and 9/11/01 for late materials. Most of the evaluated genotypes showed higher lodging at 9/11/01 planting date.

P476. Oil and protein content characterization of five soybean (*Glycine max*, merril.) cultivars in different locations in Argentina

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Argentina's soybean production and planted area have increased substantially in recent years. For the 2003/2004 season the predicted soybean area is 13.0 to 13.5 million ha. The crop is primarily utilized by in country processors to produce meal and oil which are exported to numerous countries. Soybean quality as defined by oil and protein content is an important factor in soybean commercialization. Ongoing research is investigating new uses and markets for soybean products. The objective of this study was to characterize the oil and protein content of 5 commercial soybean cultivars. The varieties were A4303RG, AW4403, ADM4800, A5520RG, and AW5581. The tests were conducted during 2 growing seasons (2001/2002 and 2002/2003) and in 10 environments representative of the main soybean growing areas of the provinces of Buenos Aires (9 de Julio, Fontezuela, Salto, and Villegas), Santa Fe (Casilda and Maggiolo), and Cordoba (Hernando, Jesus Maria, Corral de Bustos, and

Berrotaran). The plots were planted using a randomized complete block (RCB) design with 2 replications. Each plot was 4 m long and 4 rows (2.8 m) wide. The experiment was mechanically planted, non-irrigated, and maintained in a pest-free condition. The center 2 rows of each 4 row plot were harvested with a research combine, and samples from each plot were analyzed utilizing near infrared transmittance (NIT) to determine protein and oil content. Statistical analyses were performed using SAS based on a 2 factor model (varieties and locations). Statistical differences were determined using Duncan's Mulitple Range Test at the 5 % level. The variety X location interaction was not significant for protein or oil (p 0.7924 and 0.9943, respectively). There were statistically significant differences among varieties for protein and oil percentage ($p < 0.0001$ for both traits), indicating a genetic component for these traits, which was consistent across locations. The main effect of locations was also significant for both protein and oil percentage (p 0.0321 and 0.0165, respectively). Protein content was similar across locations with the exception of Berrotaran, Cordoba which had significantly lower values. Oil content was also similar across locations with one exception, 9 de Julio, which had a significantly lower value. Regression analysis indicated a negative relationship between protein and oil content ($b = -1.03584$, $p < 0.001$ and $R^2 = 0.549$). The results indicate that differences between cultivars for protein and oil content are consistent across locations, an important consideration when characterizing the quality components of Argentine production. The results also indicate that location also has a significant effect on the traits studied, although it is of lesser magnitude than the genetic component. The negative relationship between protein and oil content that has been reported in numerous investigations was also confirmed in this study.

P477. Interaction genotypes x sowing periods in lines of soybean

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Genotype by environment interaction (GE) is common in soybean, which means that quantitative traits are affected by locations and sowing dates. There are many methods that can be applied by plant breeders for a better understanding of interaction GE. Among those, the partitioning of interaction GE in its simple and complex components may be used to choose the most appropriated selection method for soybean lines. However, this work had as objective this evaluation, as well as application of the Fisher's test to verify the coincidence of selected lines in different sowing dates. The experimental material involved 25 soybean lines with high degree inbreeding (F_9), sowed in three different dates (October/21/98, November/09/98 and December/11/98) at the experimental station of the Escola de Agronomia/UFG, Goiânia-GO. A randomized complete blocks design with three replications per sowing date was used. IAC-100, OCEPAR-4 (parents involved in the crosses), MTBR-45 (Paiaguás) and EMGOPA-313 (recommended cultivars for the region) were used as check varieties. The following traits were evaluated: days to flowering, days to maturity, period of grain growth, spotted seeds, 100 seeds weight and grain yield. Based on the traits evaluated, the ten highest yielding lines in each date were identified. The mean square of interaction was partitioned in its simple and complex components, followed by the estimation of Spearman's correlation coefficient for each pair of environments and the Fisher's test. In addition, the direct expected progress with the selection (40 and 20% intensity selection) was calculated for each sowing date, separately (specific selection). The indirect expected progresses from first and third dates were estimated with basis on second date (indirect selection from second date and expected response from other dates, that is, a generalist selection). In accordance with the mean square partitioning of the interaction GE, it was verified, for all the evaluated traits, that the major part of the mean square of the interaction GE was the complex portion. Which means a difficulty in the selection of adapted promising genotypes to a larger period of cultivated soybean in the region. Despite the partitioning of interaction and the Fisher´s test be useful in the study of the interaction GE, they must not be the only methods used to choose the type of selection by the breeders.

P478. Genotype environmental interaction of soybean cultivars in the central Brazil

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The purpose of this research was to evaluate the behavior of twenty-eight soy genotypes [*Glycine max* (L.) Merrill], cultivated at two planting dates and three places in the Central Brazil's "Cerrado". It was a randomized complete block statistical design with four repetitions and the experimental unit consisted of four lines of five meters long spaced 0,45 m from each other. The useful parcels consisted of eight linear meters in the center of it. The trials were carried out of in the agricultural year of 2000/1 and sowing

occurred in the months of November and December, in Goiatuba,GO and Uberlândia,MG. In Goiatuba,GO it was placed only on São José do Pontal Farm while in Uberlândia,MG the research was carried out on the Canadá and Capim Branco farms. The twenty-eight cultivars evaluated belonged to three following maturity groups: three were semi-early (Confiança, E 316 e Msoy 6101) eleven belonged to the medium maturity group (Aventis 7003, Carla, E 315, Milena, Conquista, Liderança, Segurança, Vencedora, Msoy 8001, DM 247 e UFV 19) and fourteen belonged to the semi-late group (Aventis 7002, Suprema, Celeste, E 313, E 313 RCH, Garantia, Msoy 8800, Msoy 9001, Msoy 8400, Msoy 8411, DM Vitória, DM 309, DM 339, e UFV 18). The adaptability and stability study revealed that majorit of the cultivars showed a wide adaptability and general stability. Among the cultivars, some as the Msoy 8800, E 313 RCH, DM 339, Celeste and Garantia shows average productivity above 3.200 kg/ha. It was shown similar results for the three adaptability and stability methods Wricke, 1965; Eberhart and Russell, 1966 and Cruz et al., 1989) what made possible to achieve a better an reliable characterization of the behavior of the studied cultivars. The Programs of Soy Improvement have prioritized the productivity of grains with lesser interaction between genotype and environment, therefore the majority of cultivars had shown ample adaptability to environments and general stability. The cultivars with specific adaptation also had shown themselves as productive and indicated for specific environment conditions as are the sub-regions and or micro regions, with different types of soil, differences of altitude, climate and presence of pathogens.

P479. Yield stability and adaptability of soybean lines in the conditions of Goiás State savannahs - Brazil

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Studies of phenotypic stability and adaptability seek to identify differential responses of genotypes to the environmental variations, in specific or general conditions. The present research results of those studies, applied to experimental lines of soybean. Thus, it aims to identify productive, stable and adapted materials at the area of Goiás State savannahs, that have potential to be recommended as a commercial variety. The material of this study was eight final variety trials (environments), conducted at the soybean producing area of the state, in crop year 2001/2002, coordinated by Convênio Goiás (CTPA/Embrapa/Agência Rural-GO). Each trial was set up in randomized complete blocks design with four replications, constituted of twenty-eight genotypes of medium maturity group (21 lines and 7 check varieties). The data of grains yield (kg/ha) was analyzed by AMMI and Lin & Binns methods. The choice of the multiplicative term number of the AMMI model was obtained by predictive evaluation cross validation procedure. Twenty randomization cycles were executed, resulting to the selection of AMMI1 model. This model identified the genotypes BRA97-6705, Vencedora and MSOY-8411 as adapted to favorable environments. Also identified the genotypes Aurora, BR95-004377, BRAS97-14355 and Gralha as adapted to unfavorable environments. The genotypes MGBR98-32513, BRAS98-17608, MGBR98-3463 and GOBR96-004186 were closer of the zero value in the first interaction axis (IPCA1) of AMMI biplot graph, being considered as stable genotypes. Those lines also showed low estimates for the interaction Pi parameter of the Lin & Binns method, with prominence for the line GOBR96-004186, which was considered the most stable by this method. The significant correlation between IPCA1 scores and Pi estimates confirms the agreement of two methods about phenotypic stability. The experimental line BRA97-6705 showed highly productive, stable and adaptation to favorable environments, having a great potential to be recommended as a commercial variety. The high performance of the checks Vencedora, MSOY-8411 and Conquista evidences the good quality of the materials that are already planted in the region.

P480. Developing high productivity soybean [*Glycine max* (L.) Merrill] lines for Mexican lowland Tropics

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In Mexican Tropic (14°-23° LN) it is needed to generate new high productivity varieties under the rainfed and short photoperiod condition in growing season. The National Soybean Genetic Program recently has generated new Lines for this purpose. This first one is H88-0930 was selected from the crossing between two elite lines, following single seed (H82-1930 x H80-2535) from F2 to F5 segregate population until derivate the new line H88-0930. It is indeterminate growth, violet color flower, and big size seed (16.2 g/100 seeds). It takes 42 days to flowering; and its plant height is 76 cm with 116 days to

maturity. Average yield is of 2,481 kg ha^{-1}. The other one is DM-301 that was derivate from Dois Marcos-301. It is determinate growth, with violet color flower and small size seed (12.4 g/100 seeds). It takes 46 days to flowering; and its plant height is 78 cm with 109 days to maturity. It is also, tolerant white fly insect (*Bemisia spp.*). DM-301 has a wide planting period in both summer and winter season and its yield average is 2,331 kg ha^{-1}. In field evaluation since 1999 to 2002 was found that H88-0930 and DM-301, overcome 22 and 14% respectively the yield of the most commercial used variety Huasteca 200.

P481. Growth and development of soya bean cultivars of MG IV to IX sown in november up to january at Cerrillos (Salta, Argentina)

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At Cerrillos in the Experimental Station Salta, INTA, Salta province (24°54' S – 65°29' W, 1250 m a.s.l.) a trial was set up to characterize growth and development of soya bean cultivars of MG IV to IX along with four sowing dates (SD) during cycle 2001-2002. Twelve cultivars, 9 with determinated (D) and 3 indeterminated growth (I), all tolerant to gliphosate, were used as follows: DM 4400RR and DM 4800 RR (I) of MG IV; DM 50048 RR, DM 5520 RG and Maria 55 RR (I) of MG V; A 6445 RG of MG VI; A 7321 RG, A 7636 RG and MS RR (I) of MG VII; A 8000 RG and Anta 82 of MG VIII; and 9000 RG of MG IX. SD were as follows: 27/11/01; 17/12/01; 08/01/02 and 28/01/02. For each SD a completely randomized block test was used, with 3 replicates and plots with 4 furrows at 0.52 m distance and 6 m length. Dates of following phenological states were recorded: VE, R1, R5, R7 and RS. Heigth, number of nodes and yield was recorded at maturity. Data were analyzed by means of ANOVA, and mean values were compared by Duncan test (p = 5 %). Soil was Cerrillos series (Udic Ustocrept) with OM 2.21 %; total N 0.13; extractable P 12 ppm; K 0.73 meq/100 and ph 7.0. A commercial fungicide and innoculum with peat was applied on seeds. Rainfall registered a 15 % deficit between November and June in relation to average values, being higher in January. Maximum values for yield were between 12/10 and 17/12, with 4250 and 4650 kg/ha respectively. In relation with prevailing meteorological conditions best combinations MG-SD were obtained on SD in November with A 6445 RR and in January with A 7636 RR.

P482. Polymorphic molecular markers in two soybean lines carrying major resistance genes to stem canker

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Soybean stem canker, SSC, caused by the fungus *Diaporthe phaseolorum* var. *meridionalis*, is a very destructive disease that caused severe damage in the 1996/97 and 1997/98 growing seasons in the main soybean producing areas of Argentina. Two major dominant alleles for resistance (*Rdm1* and *Rdm2*) have been found in cv. Tracy-M. We started this project aimed to the detection of molecular markers, MM, associated with these resistance genes, which could be useful for marker-assisted selection in breeding programs. Two inbreed lines, possessing one or the other allele in the homozygous state, were used. R-1 (*Rdm1* gene) and R-2 (*Rdm2* gene) lines were F4 derived from a cross between Tracy-M and J77-339 (susceptible genotype). Two MM techniques were used: i) Random Amplified Polymorphic DNA, RAPD, and ii) Amplified Fragments Length Polymorphism, AFLP. Genomic DNA extraction was carried out by the CTAB method, with some modifications. Four hundred random primers (oligodecamers) were assayed and 11 RAPD primers (2.75%) resulted polymorphic. Each AP-PCR (Arbitrarily Primed-PCR; RAPD) reaction was separated either in agarose (2-2.5%) and polyacrilamide (5%) (DNA Amplified Fingerprinting, DAF) gels. From the 217 total bands obtained by DAF only 16 (7.37%), which resulted polymorphic, were selected to analyze their possible linkage to the genes of interest. Also, 166 random primers combinations of AFLP markers (20 nucleotides per oligomer) were assayed. Of these, 118 were non-polymorphic but 48 (28.92%) polymorphic combinations of primers were found. The total number of bands obtained by AFLP was 4138. Of these, 344 fragments (8.31%) were polymorphic but only 99 (2.39 %) were of interest (*i.e.* were in genotypes carrying resistance genes). Sixty-five bands (1.57%) only appeared in R-1 and Tracy-M, meanwhile 34 (0.82%) only appeared in R-2 and Tracy-M. In order to assess the linkage of the MM generated with the resistance genes studied, different sets of recombinant inbreed lines, RILs, are being developed. For that purpose, R-1 and R-2 lines were crossed with each other and with their susceptible parent (J77-339). Molecular polymorphisms between the lines and among them and the J77-339 parent are being used to identify the hybrids.

P483. Identification of DNA Marker associated with soybean rust resistance

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Soybean rust (*Phakopsora pachyrhizi* Syd.) is a major problem for soybean growing in tropical area. The fungus could cause a considerable loss to the soybean production. Resistance sources has been identified through the field and lab inoculations in Chiang Mai, Thailand. One hundred and eighty F2 plants derived from a cross between the resistant variety 'CM60-10KR-71-PS-21' and the susceptible cultivar 'Sukhothai2' were used for genotyping using AFLP and SSLP markers. Sixty-two and 83 polymorphic AFLP and SSLP loci were used to analyze this population. Disease scoring were done in both laboratory and field for each F2 individual and F3 families. Genotypic and phenotypic data were analyzed using JoinMap and MapQTL genetic analysis package for the linkage group construction as well as the QTLs identification. A single QTL contributes to the resistance in 'CM60-10KR-71-PS-21' with high LOD score was identified in all of the disease screening trials.

P484. Molecular mapping of a gene conferring resistance to soybean rust

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Soybean rust, caused by *Phakopsora pachyrhizi*, is a foliar disease of soybean [*Glycine max* (L.) Merr.] that occurs in production areas around the world and can cause severe losses to the farmers. At the moment, four genes (Rpp1 to Rpp4) that confer resistance in soybean to soybean rust have been identified in germplasm and plant introductions. This study was conducted to identify molecular markers linked to the resistance gene present in resistant soybean FT-2. A population of 116 $F_{2:4}$ genetic families, from the cross of cultivar FT-2 and susceptible cultivar Davis, was evaluated under greenhouse conditions for soybean rust phenotypic reaction and identified as resistant, segregating or susceptible. DNA from the parents was screened with 230 simple sequence repeats (SSR) primer pairs. Fourteen markers showed polymorphism in the parents and were used to screen 116 F_2 plants that originated the progenies evaluated to disease reaction. Putative linked markers, that cosegregated with soybean rust reaction phenotypes, amplified by the primers Satt 277, Satt 307 and Satt 460, were mapped, respectively, 22.3 cM, 12.5 cM and 41.0 cM away from the resistance gene. These markers are located on the soybean C2 linkage group (LG), that need to be better explored in order to identify molecular markers more closely related.

P485. Soybean rust diversity in northern Thailand

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The investigation on diversity of soybean rust (*Phakopsora pachyrhizi* Syd.) in the Northern Thailand was conducted. Soybean rust isolates were collected from different susceptible soybean varieties in four different growing areas in Chiang Mai province, namely, San Sai (SS), Samoeng (SM), Prao (PR) and Mae Taeng (MT). Rust isolates were purified and increased in laboratory and used in race identification. Purified spores were collected for DNA extraction and used in genotype analysis using molecular markers i.e. AFLP and RAPD. PCR amplification using an ITS primer pair (Frederick *et al.*, 2002) yeilded a major fragments of about 650 bp. These ITS DNA fragments of each isolate was cloned into pGEMT-easy and subsequently verified for its DNA sequences. The variation of soybean rust in Thailand was observed in comparison with the study of Thai isolate collected back in 1976.

P486. Microsatellite markers linked to soybean cyst nematode resistance, race 3, in a cross between two Brazilian cultivars

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The identification of QTLs associated with SCN resistance would be useful in breeding programs using marker-assisted selection, speeding up the selection and eliminating the environmental effect. Microsatellites markers (SSR) have been presented as a powerful tool due to their efficiency, automation capability and low cost. The objective of this work was to identify SSR markers associated with QTLs for resistance to SCN, race 3. The study was based on 88 $F_{2:3}$ families derived from a cross of two Brazilian soybean cultivars: BRSMG Segurança (susceptible) x BRSMG Liderança (resistant). SCN bioassays were performed under greenhouse conditions and the plantlets were inoculated with 4000 eggs. The Female Index (FI) was used to evaluate the SCN reaction. Twenty-two polymorphic microsatellite markers (in a total of 313 markers) were used to construct the linkage map employing MAPMAKER software, using a minimum LOD score of 2.5 and a maximum distance of 50cM. The Cartographer program was used to detect markers linked to QTLs. After that the SAS GLM procedure was employed to analyze the association between four detected markers and the putative resistance loci by Single Mark Analysis. Two microsatellite markers, Satt309 ($P<0.0001$; $R^2=29.5\%$) and Sat163 ($P<0.0001$, $R^2=24.3\%$), were strongly linked to one QTL conferring SCN resistance. This locus is located in the molecular linkage group (MLG) G. Other two markers, Satt241 ($P=0.0011$; $R^2=16.3\%$) and Satt573 ($P=0.0006$; $R^2=16.7\%$), also revealed association with another SCN resistance locus, although they were reported as belonging to different MLGs. In both loci the resistance alleles were originated from the resistant parent. In the MLG G the SCN resistance alleles, race 3, were dominant, while in the other MLG they were recessive. A two-way ANOVA for the closer markers to both QTLs (Satt309 and Satt241) accounted for about 43% of the phenotypic variation in the SCN resistance, and showed only additive effect. The selection efficiency, using a FI cutoff equal to 10%, only for homozygous families, varied from 42.9% to 65.0% when compared with the phenotypic selection.

P487. SCAR marker for assisted selection to soybean cyst nematode

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Cyst nematode is one of the main soybean pathogen, with a great number of races of easy dissemination and long survival. The resistant genotype selection through conventional techniques is lengthy and requires too much labor. In this aspect, assisted selection by molecular markers is quick, efficient and does not require the contamination of the cultivation area. RAPD markers were identified at UNESP/FCAVJ (Mauro et al., 2001, Rev. Ceres 48:565-571), associated to genes (QTL's) that award resistance to cyst nematode (race 3), through the segregant "bulk" technique. Two primers (OPE-02_{900PB} and OPR-13_{470pb}) were discriminative for F_2 progenies and cultivars selection, where the resultant fragment from OPE-02 (900pb) was converted into a SCAR marker. The RAPD reactions for restoring this marker had PCR buffer (10mM Tris-HCl pH 8,3 and 50mM KCl); 2,5mM MgCl2; 02mM of dNTP's; 30 ng of primer; 100 ng of genomic DNA, 1 U of *Taq DNA Polymerase* and Milli-Q water. The program used in the PCR was: 1 minute at 92°C; 1 minute at 35 °C; 2 minutes at 72°C, repeated 42 times, ending with 10 minutes at 72°C and stabilizing at 4°C. The samples were applied to agarose gel and stained with ethidium bromide. After the 900 pb band was restored and isolated from the gel, the conversion to SCAR consisted of: DNA purification, Vector "T" cloning, transformation, DNA plasmidial preparation and sequencing, therefore constructing an specific primer for the polimorphic region, resulting in a 21 pb sequence. This primer was tested in a resistant cultivar (Renascença) and a susceptible one (BR-16), from the RAPD validation tests. Many changes were made in the protocol, resulting in the use of 75 ng of primer, annealing of two minutes at 58-59°C, noticing the fragment presence in the susceptible cultivar and absence in the resistant one. Such is due to the fact that this marker is close to the resistance locus rhg1 in the linkage group G, and therefore expressing itself in the susceptible genome, due to the dominant nature of the RAPD marker. New tests were conducted with resistant cultivars (Tucunaré and Renascença) and susceptible ones (Bacuri, FT-2, Cristalina, Conquista, FT-Estrela, FT-2000, Embrapa 48, COODETEC-201, OCEPAR-4, FT-Cometa and BR-16), to confirm the obtained results. The resistant cultivars did not present

a 900pb fragment, which appeared in all susceptible ones. The perspectives for assisted selection with the SCAR marker are promising, since it was obtained from a discriminative RAPD marker for segregant populations and cultivars.

P488. Molecular markers for powdery mildew (*Microsphaera diffusa*) resistance in soybean

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Nowadays powdery mildew is one of the most important soybean culture's diseases, causing production losses of up to 40% in affected areas. The conventional resistant cultivars selection methods require a lot of work, the right pathogen conditions and are ultimately not precise. The assisted selection of molecular markers is a quick, efficient and safe process. To understand the resistance mechanism, seven populations resultant of parental crosses resistant and susceptible to powdery mildew were evaluated (RxS): Renascença X BR-16, CAC-1 X EMBRAPA 48, MGBR 95-20937 X IAC-Foscarin-31, CAC-01 X BR-16, Conquista X IAC-Foscarin-31, Conquista X EMBRAPA 48 e Conquista X BR-16. Eighty plants from each F_2 population were evaluated, having their DNA extracted by the CTAB method for BSA (Bulk Segregant Analysis) by random RAPD markers. In each cross, resistant (0-10% of foliage infection) and susceptible plants (at least 90% of infection) were grouped for bulk composition, as to powdery mildew reaction (Yourinori, 1997, EMBRAPA Doc., 13p). The RAPD reactions for polymorphic identification had: PCR 1X buffer (10mM Tris-HCl pH 8,3 and 50mM KCl); 2,5mM MgCl2; 0,2mM of dNTP's; 15 ng of primer; 100 ng of genomic DNA, 1U Taq Polimerase and Milli-Q Water. The program cycle consisted of 42 one-minute cycles at 92°C, one minute at 35°C and two minutes at 72°C, and a extension cycle of 10 minutes at 72°C to then stabilize at 4°C. The amplified fragments were analyzed by electrophoresis in agarose gel stained with ethidium bromide. Studying segregant populations, a dominant gene with two alleles controlling heritability resistance to powdery mildew was found, with a 3:1 segregation (resistant: susceptible) in the F_2 generation. Such results were confirmed by the acceptance of the tested hypothesis by the qui-square for each population and by the test insignificance of heterogeneities among the populations (42,06%). In the RAPD reactions with resistant and susceptible bulks, DNA from the Renascença X BR-16 population was used, and of the 120 primers tested, nine turned out to be polymorphic. During individual bulk plants analysis, only two primers were discriminative, with fragments of 300 and 500 pb respectively, present in the Renascença cultivar and in all resistant progenies, and absent in BR-16 and in the susceptible progenies. The markers co-segregated with the powdery mildew resistance in the evaluated cross for all the tests that were made, the next step being the conversion into an specific marker for the assisted selection.

P489. Genetic expression of soybeans: *Meloidogyne javanica* interaction, revealed by analyses of microarrays

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The root-knot nematode, *Meloidogyne javanica* is an economically important pathogen of soybeans. Effective management of the nematode is often dependent on the use of resistant genotypes. The genetic interactions are complex and poorly understood. The use of cDNA Microarray technology promises to accelerate rapidly our undestanding of infectious disease processes, by allowing the examination of thousands of genes and gene products, simultaneously. To explore the plant genes putatively involved in the events of nematode-plant parasitism, we used Affymetrix GeneChips to conduct expression profiling of the early stages of infection of soybean genotypes. The infection experiments were conducted with three treatments: mock infected, resistant soybean genotype JF 7056 infected and suscetible soybean genotype 266-S infected with second stage juveniles – J2 of *M. javanica*. RNA obtained from the roots of each treatment was used to construct cDNA libraries, used for late sequencing. About 1000 unique sequences cDNA were chosen to be plotted in Microrray slides. Target cDNA was labelled by reverse transcription and incorporated with aminoallyl modified dUTP. A total of six hibridizations were performed. Sequences analised identified genes related to nematode resistance (ex: gene Hs1pro $^{-1}$), and other stresses.

P490. Microsatellite insertion in a heat-shock protein-promoter region (*Gmhsp17.6-L*) in soybean plants resistant and susceptible to *Meloidogyne javanica*

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It is estimated that 11% of annual global losses in production of soybean [*Glycine max* (L.) Merr.] is caused by nematode parasitism. In Brazil, nematode species in the genus *Meloidogyne* represent a serious yield constraint in many regions. Control measures, such as the development of resistant cultivars, are essential for the maintenance of acceptable productivity levels. Therefore, with the objective of identifying genetic polymorphisms between resistant and susceptible genotypes to the root knot nematode, *Meloidogyne javanica*, a population of twenty-five highly resistant lines and twenty-six highly susceptible lines, derived from a cross between resistant (PI 595099) and susceptible (BRS 133) genotypes were tested for microsatellite markers (SSR). Significant polymorphic markers were cloned and sequenced in an attempt to identify possible genomic regions responsible for the reaction to the nematode. Among 97 loci initially analyzed, 21 were polymorphic between the parents and seven showed high differential frequency ($P<0,10$) into the resistant population. In the F linkage group, where other quantitative trait loci (QTLs) conferring resistance to nematodes have already been reported; the SSR loci 176 Soy HSP, Satt 114 and Satt 423 showed significant correlation with the number of galls observed on soybean roots. The QTL analysis in this group showed the presence of at least one gene located next to the 176 Soy HSP marker, with a Lod of 27.5. The resulting fragment of this marker amplification was cloned, sequenced, and checked for homology by using the NCBI Blast. The analyzed sequence showed 100% homology with the promoter region of a heat-shock protein (HSP) found in soybean, *Gmhsp17.6-L* (M11317). Primers were designed using the entire gene sequence available in the *GenBank*, with the objective of generating bands in both resistant and susceptible genotypes. All resulting fragments were sequenced and showed homology with the promoter region of the *Gmhsp17.6-L* gene. We observed a microsatellite region (AT_n repetitions) inside the promoter region of this gene, but the number of repetitions was different in each genotype tested, suggesting a possible correlation between the insertion length in the promoter and resistance or susceptibility to the nematode. After that, aimingto check the expression of this gene, a RPA (Ribonuclease Protection Assay) was performed. The results showed that both resistant and susceptible genotypes seemed to express the *Gmhsp 17.6-L* gene. However, the length of the microsatellite insertion in the promoter region might alter the levels of expression.

P491. Microsatellite molecular markers associated with selection process of soybean resistant genotypes to *Meloidogyne javanica* and *Heterodera glycines*

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Nematodes species, especially *Meloidogyne javanica* and *Heterodera glycines* cause serious reduction on soybean yield all over the country in Brazil. Development of resistant cultivars is the easiest and most economic control method for the farmers. The molecular marker assisted selection of nematode resistant plants can accelerate the soybean breeding process. In earlier studies, the *loci* 176 Soy HSP and Satt 114 makers were identified, showing significant correlation with the nematode resistance (*M. javanica*) of soybean plants. QTL analysis indicated the presence of at least one gene located next to the 176 Soy HSP marker, with a Lod of 27.5. All of the gene extension covered by the Satt 114 and 176 Soy HSP (8.3 cM) markers presented high Lod values, ranging from 22.6 to 27.5. Satt 163 from the G linkage group was used to select resistant plants to *Heterodera glycines*. Previous studies show that there is a significantly association of this marker with *rhg1* resistant gene. Because these markers can effectively help the selection process of plants which have genes of interest, DNA extraction and amplifications of *loci* 176 Soy HSP and Satt 114, from 104 lines highly resistant and 19 lines highly susceptible, resulting from the cross PI 595099 X BRS 133, were performed. Sixty-four susceptible plants and 42 resistant plants to *Heterodera glycines*, race 3, resulting from the cross PI 595099 X Coodetec 201, had their DNA extracted and amplified with Satt 163 marker as well. The efficiency of plant selection with resistance to *M. javanica* based on the *loci* 176 Soy HSP and Satt 114 was 96,6% and 96,2%, respectively, and the efficiency combined was 100%.

The efficiency of plant selection with resistance to *Heterodera glycines* based on the loci Satt 163 was 81,1%.

P492. Sequencing of nib protein of a *potyvirus* (*Soybean Yellow Shoot Virus* - SYSV) detected in *Glycine max* L. (Merrill)

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The *Soybean yellow shoot virus* was first detected by Deslandes (Summa Phytopathologica, 10:25-26. 1984. res.) in soybean (*Glycine max* L Merrill) experimental fields of EPAMIG, located in Lavras–MG-Brazil. Preliminary studies revealed that SYSV was a *Potyvirus*, with biological properties different from *Soybean mosaic virus* (SMV). Some tested soybean cultivars, as Numbaira, showed high susceptibility to SYSV and resistance to SMV, while others, as Doko, showed resistance to SYSV and susceptibility do SMV. It indicated a difference between the SYSV and SMV host interaction. In this work 861 nucleotides (287 aminoacids) of NIb protein of SYSV were cloned, sequenced and compared with 13 others *Potyvirus* genome sequences available in the Gene Bank. The SYSV presented a highest aminoacid sequence homology (97%) with one severe SMV isolate from China (Huangzhou), 96 % with SMV isolates Aa15-M2, Aa and isolate N and 95% with SMV isolates G2, Huanghuai, G7H and G5. The smallest homology was with others *Potyvirus*: WMV (91%), ZMV (90%), BCMNV (85%), BCMV and ZYMV (81%). In both dendogram and phylogenetic tree the SYSV was located in a distinct and separate branch, together with the severe isolate from China (Huangzhou), showing a highest identity, when compared with the others isolates. The whole SYSV nucleotide sequence is being cloned and sequenced, which will permit a better understanding of its viral genome.

P493. Kinetic analysis of cholinephosphotransferase and lysophosphatidylcholine acyltransferase from soybean seeds

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The biosynthesis of fatty acids involves a series of reactions that, in plant cells, occur in the plastids and in the smooth endoplasmic reticulum. This last compartment contains enzymes which catalyse the biosynthesis of triacylglicerols, the major components of the oil fraction. It is a well-established fact that temperature affects the levels of fatty acids in plant seeds. For instance, the levels of polyunsaturated fatty acids, specially linolenic acid, are increased when plants are exposed to low temperatures. However, the mechanism by which temperature influences the accumulation of these compounds is not known. In soybean seeds the levels of linoleic and linolenic acids depend on the biosynthesis rate mediated by desaturases and the availability of these fatty acids for oil synthesis is mediated by CDP-choline: 1,2 - diacylglycerolcholine phosphotransferase (CPT) and Acyl-CoA: lysophosphatidylcholine acyltransferase (LPCAT). To better understand the mechanism controlling the incorporation of polyunsaturated fatty acids in the oil fraction in soybean seeds, the biochemical and kinetic characterization of CPT and LPCAT were conducted. The understanding of such mechanism is essential for identifying genes that can be genetically manipulated to create cultivars with modified fatty acid content, which is one of the goals of the breeding program being conducted at BIOAGRO/UFV. Soybean seeds of commercial cultivar CAC-1 were used as enzyme source. CPT and LPCAT activities were determined by measuring the radioactivity incorporated into the products phosphatidyl-[^{14}C]choline and phosphatidylcholine-[^{14}C]oleoyl, respectively. The linearity of the reaction catalyzed by CPT was kept for a period of 10 minutes, the optimum reaction temperature was 30 °C and the K_{mapp} and V_{maxapp} values were 2.3 x 10^{-4} mol.L^{-1} and 89.3 nmoles of CDP-choline incorporated into diacylglycerols per minute, respectively. For LPCAT, the linearity of the reaction was kept for a period of 25 minutes, the optimum reaction temperature was between 10 and 15 °C, with an additional peak around 25 °C, and the K_{mapp} and V_{maxapp} values were 7.6 x 10^{-4} mol.L^{-1} and 28 nmoles of oleoyl-CoA incorporated into lysophosphatidylcholine palmitoyl per minute, respectively. The presence of more than one activity peak for LPCAT indicates the existence of enzyme isoforms, suggesting that some of them might present higher activity levels under low temperatures which would contribute to increase the polyunsaturated fatty acid content in the oil fraction. This enzyme would be a good candidate for genetic manipulation of the soybean fatty acid content.

P494. Germination of developing soybean seeds is directly related to ABA concentration in the embryonic axis

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The rate of germination of developing soybean seeds separated from their parent plant increased with seed age. The objective of this work was to test the hypothesis that Abscisic Acid, ABA, concentration into the embryonic axis, [ABA]e, controls the germination of developing soybean seeds excised during their linear phase of growth. Developing seeds were excised at 25, 30, 35, 40 and 45 days after anthesis, DAA, and incubated in Petri dishes on filter paper saturated with distillated water, at 27 °C. Incubation time to 50 % germination, tG50, was measured. The [ABA]e was measured by solid phase radioimmunoanalysis using the monoclonal antibody DBPA1. At harvest [ABA]e was 10.9, 5.4, 2.5, 2.1 and 0.34 mgABA.gdw^{-1} for 25, 30, 35, 40 and 45 DAA seeds, respectively. Forty-five days old seeds were at physiological maturity, PM. Seeds at PM had similar [ABA]e than mature dry seeds, and was used as control. Curves of [ABA]e decay with time were obtained for each age. The [ABA]e below which germination was no longer inhibited was named ABA critical, [ABA]c. The [ABA]c was 1.15, 1.52, 1.54 and 1.66 mgABA.gdw^{-1} for 25, 30, 35 and 40 DAA seeds, respectively. The tG50 of seeds from 25 to 40 DAA was a direct function of [ABA]e - [ABA]c. The relationship between ABA]e - [ABA]c and tG50 was represented by the linear equation: tG50 = 7.96x + 73.17; (R^2 = 0.87). To validate this equation, another experiment was carried out in which different levels of [ABA]e were obtained by washing seeds of 25, 30, 35 and 40 DAA during 0, 6, 12 and 24 h, before incubation. Observed and calculated values for tG50 fitted the 1:1 ratio (R^2 = 0.85). Thus, the time an excised, developing seed, requires to complete its germination process (*i.e.* radicle protrusion) is equal to the time needed for its [ABA]e to fall to its [ABA]c. This time depends upon: i) the [ABA]e at the moment of excision, ii) the [ABA]c, and iii) the rate of [ABA]e decay during incubation. Meanwhile the first and second components changes with seed age, the last one changes with the incubation conditions.

P495. Genetic diversity and symbiotic efficiency of an indigenous *Bradyrhizobium japonicum* field population

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Composition and characteristics of rhizobial natural field population are of great importance in the soybean production, particularly when introducing commercial inoculant strains under natural conditions. The main aim of the present investigation was to identify and to characterize indigenous soybean rhizobia isolated from different field sites in eastern Croatia. PCR-RFLP of 16S rDNA clearly showed that almost all isolates can be determined as *B. japonicum*. Fifteen rhizobial strains were characterized and compared with reference and/or type strains representing *B. japonicum*, *B. elkanii*, *B. liaoningense* and *Sinorhizobium fredii*. Cluster analysis of combined RFLP patterns obtained with three restriction endonucleases, revealed that fourteen soybean isolates were identical with *B. japonicum* type and reference strains. Only one isolate (63) was grouped together with *S. fredii* type strain into second major cluster although they differ at similarity level of 0.62. All isolates were further characterized by RAPD fingerprinting that enabled strain differentiation. Among *B. japonicum* strains high level of diversity was determined. Dendrogram derived from RAPD profiles showed that all indigenous strains could be divided into three main groups. Most of isolates, including *B. japonicum* type and reference strains, were grouped within the first major cluster that could be further subdivided into two groups with almost equal strain number. The other major cluster consisted of only two related but not identical *B. japonicum* isolates (54 and 65). During the two years investigations in field experiments, the symbiotic efficiency of all rhizobial isolates was evaluated. In both years, seed inoculation with particular indigenous strains caused signifcant increase of nodule number and nodule dry weight. The best nodulation was achieved by using the same strains (54 and 65) that formed separate group of bradyrhizobia based on their RAPD profiles. Seed inoculation with the isolate that considerably differed from all other strains based on RFLP profiles, resulted in significantly lowest values for nodule number and dry weight. The application of various indigenous strains caused also significant differences in seed yield. The lowest seed yield was determined on variants inoculated with those two indigenous strains that gave the best nodulation. The application of these two strains also resulted in significantly lower values for seed protein content. Seed yield and seed protein content were also significantly lower with strain 63 in comparison with the most of other isolates. The results from field experiments showed that strains isolated from natural population significantly differ from each other regarding their infectiveness and symbiotic efficiency.

P496. **Detection and identification of *Phomopsis meridionalis* in soybean seeds by using PCR**

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The *Phomopsis* / *Diaporthe* complex has been responsible for significant losses in yield and seed quality every year in Brazil. In this complex, the problem of identification is compounded by the fact that much diversity and variation occurs in terms of both morphology and pathogenicity, even within populations. For these reasons, the use of DNA techniques has shown to be a very important tool to develop an accurate, sensitive and quick test to detect, identify and distinguish the *Phomopsis meridionalis* from the other species which comprise the *Phomopsis* / *Diaporthe* complex.. The design of a pair of specific PCR primers that amplified uniquely the correct fragment common to *P. meridionalis* also demonstrated the use of these primers in a diagnostic seed health test (Jaccoud Filho, 1996, Ph.D. Thesis; Jaccoud Filho *et al.*, 2002. RAPP 10:287-331). The sensitive assays using genomic DNA and the specific primers have shown that for PCR amplification, as little as 1pg of template can be detected. The sensitivity can be increased tenfold by using nested PCR primers. Experiments using the PCR specific primers to detect *P .meridionalis* in artificial infected soya bean seeds, seeds from artificially infected plants and naturally infected soya bean seeds were carried out. The efficiency of PCR amplification appears to be inversely correlated with the length of seed soaking. Despite problems of inhibitory effects on the PCR using seed-soak liquor, the fragment could still be amplified from infected seed samples and visualised on an gel. It is clear that the major advantages of the PCR-based techniques are the time saved and the great specificity in detecting the target pathogen within a seed sample that may contain other pathogens and saprophytes. The ability to detect around 100 fg of *P. meridionalis* DNA shows how sensitive the PCR can be for detection and diagnostic purposes.

P497. **Contribution to the study of the *Phomopsis* / *Diaporthe* complex of soybean seeds by using morphological and DNA profile**

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The *Phomopsis* / *Diaporthe* soybean fungi complex occurs frequently in several production regions and has been responsible for losses in yield and seed quality. This complex in Brazil includes the following species: 1-*Phomopsis sojae* (Pod and Stem Blight and Seed Decay), 2-*Phomopsis phaseoli* f. sp. *meridionalis* (Souther Stem Canker) and 3-*Phomopsis longicolla* (Phomopsis Seed Decay) [Jaccoud-Filho, 1996, ISTA-CAB]. The study of the morphological characteristics has shown: *Phomopsis sojae* normally produce floccose, fluffy mycelium that darkened from white to light brown with age, pycnidia with short or absent beaks, alpha and beta conidia in varying ratios, depending on the isolates; *Phomopsis meridionalis* showing dense, appressed mycelium, light to dark-brown and frequently had strands of chlamydospores, pycnidia with long cracks and absent beak, only alpha conidia with atypical shape; *Phomopsis longicolla* had floccose, dense mycelium, mostly white and may develop darkened to greenish yellow areas with age, globose and black pycnidia with long beaks. In this complex, the problem of identification is compounded by the fact that much diversity and variation occurs in terms of both morphology and pathogenicity, even within populations. For these reasons, the use of DNA profile has shown to be very important. RAPD-PCR amplifications carried out by using different sources of DNA templates (extracted DNA, mycelium and conidial suspension) produced good amplification and clear banding patterns. Phylogenetic relationships have been deduced using RAPD banding patterns. To do this, each band is treated as a morphological character and the relatedness can be measured by the bands the isolates shared.

P498. **Somatic embryogenesis and analysis of correlative factors of agronomic characters**

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In this article, much work has been done for studying the strain of soybean, totally including 10 varieties from the three provinces of north-east china and Yangtze river area. Somatic embryogenesis was induced by immature cotyledons in Ms medium containing 2,4-D{40mg/L} for four weeks and then transferred to the Ms medium containing 2,4-D{20mg/L} for another four weeks. The relationship of agronomic characters and frequency of callus and somatic embtyogenesis was studied. The result showed that the 100-seed weight is significant positively correlated with the size of the explant {r = 0.989593}, and the effect of them to the embryogenesis are all significant; The effect of growing stage and the time of the choice of explant is significant also, and the correlation between them is significant positively {r = 0.964764}. The scope in the choice of explant can be decided according to the agronomic characters of different genotype soybeans.

P499. Construction of plant expression vectors containing binary insect resistance genes *Bt Cry*lA (a) + pta or *Bt Cry*lA (c) + pta

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Plant expression vectors p3300- CrylA(a)-pta and p3300- CrylA(c)-pta with binary insect resistance genes were constructed by inserting expression cassettes of Bt CrylA(a) gene or Bt CrylA(c) which were cut from pGEM-4Z plasmids with restriction enzyme Hindb! and pta gene expression cassette obtained by PCR method into Hindb! and Sma'!sites of pCAMBIA3300 respectively, which also contains bar gene cassette encoding phosphinothricin acetyltransferase (PAT). The CrylA(a) or CrylA(c) genes were under the control of Ubiquitin promoter and NOS terminator and the pta gene was under the control of CaMV 35S promoter and NOS terminator respectively. Leaf discs of Nicotiana tobacco were infected by Agrobacterium tumefaciens strain LBA4404 containing these plant expression vectors. Phosphinothricin resistant plants from individual transformation events were obtained and PCR checking confirmed the integration of foreign genes.

P500. Isolation and culture of soybean microspores and pollen grains

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In the last three decades, research on soybean androgenesis was limited to anther culture, which presents several limitations, such as the small number of microspores with an androgenic response and the morphogenic potential of cells of the connective tissue, middle layers and epidermis. Therefore, a sequence of studies was performed, to establish appropriate conditions for the isolation and culture of soybean microspore and pollen grains, as an alternative to anther culture. The lack of studies published using this technique in soybean was the main limitation to doing so. First of all an isolation technique was developed, using floral buds from four cultivars (Bragg, IAS-5, MG/BR-46 Conquista and BRSMT Uirapuru). This technique made it possible to establish cultures with satisfactory density and characteristics to study androgenesis in isolated microspores. Next the following were tested: microspore viability in culture media with different constitutions and the response to incubation temperature regimes. Under the conditions tested, no incubation temperature regime triggered an androgenic response in proportions similar to those recorded in other plant species. Despite the fact that the B5 and MS media are recommended for androgenesis in soybean anther culture, the best results were obtained in PTA-15 modified medium, with the formation of 0.4% multicellular microspores in the BRSMT Uirapuru cultivar. The development of a more efficient microscopy technique to evaluate the microspores in culture will be the next step of this study.

P501. Histology of embryogenic responses in soybean anther culture

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Until now, it was assumed that, symmetrical, multinucleate and multicellular pollen grains might be the precursors of the embryo-like structures (ELS) obtained in soybean anther culture, since tissues of mature plant are known to be highly recalcitrant. Nevertheless, we recorded somatic embryogenesis in soybean anther culture. Thus, this study was undertaken to analyze the development of cultured anthers in order to elucidate the origin of the resultant ELS. Anthers of four soybean cultivars (Bragg, IAS-5, MG/BR-46 Conquista and BRS 133) were cultured under recommended conditions to trigger androgenic response. A histological study was performed with anthers *in vivo* and with approximately 100 explants sampled after 9, 12, 15, 18, 21, 30 and 45 days of culture. *In vitro* culture triggered the frequent accumulation of phenolic compounds on the locular and anther surfaces, and also caused the destruction of cells and tissues in complex structure such as the tapetum, microspores and early pollen grains. Somatic embryogenesis of unicellular origin was observed from the epidermis and the middle layer, and of multicellular origin from connective calluses. No androgenic response could be observed in the anthers of these four soybean genotypes, in the medium and conditions indicated. We point to the need of changing the approach of androgenesis study in soybean, either by using culture conditions unfavorable to the proliferation of somatic tissues, or by culturing isolated microspores.

P502. Application of simple sequence repeats to genetic diversity of soybean accessions

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It is very important to define genetic diversity of soybean(Glycin max(L.) Merr.) varieties, which is necessary to preserve and utilize those resources. Genetic diversity of soybean germplasm and resources should be further studied from DNA level with cultivars increased. A sample was obtained at random from primary core collection constructed by the soybean laboratory of the Institute of Crop Germplasm and Resources of CAAS. In the premise of 100 percent coincidence of quality traits and no significance in quantity traits at 0.05 level, 190 Chinese soybean land races were obtained as a standard sample. 606 alelles were found in 60 loci, with each locus having a mean of 10 alelles, and the mean of gene diversity scores was 0.83, with a range of 0.55^ÿ0.99. Stand error of similarity matrices were analyzed and the correlation among cophenetic matrices were examined using Mantel test. Genetic diversity was estimated by SSR markers and the proportion and ways in construction of soybean core collection were also studied. The results are displayed as following: First, it is possible to determine genetic relationships of Chinese soybean land races using SSR marker. The core SSR primers could be selected according to distribution of the loci in soybean genome and gene diversity scores. The truly genetic relationships of soybean land races could be reflected using over 570 alelles. Secondly, genetic relationships based on SSR data were not consistent with those evaluated by agronomic traits, and more genetic information would be obtained from SSR data associated with agronomic traits. Thirdly, Chinese soybean land races had three high genetic diversity of population, the first one was consisted of north spring-sown soybean, northeast spring-sown soybean and Huanghuai summer-sown soybean. The second was the population of south spring-sown soybean and south summer-sown soybean, and south autumn-sown soybean was another high genetic diversity population. Soybean land races might be several original places. Finally, alelles, Shannon indexes and the level of genetic diversity obtained from the proportion of 50%040%030%020%010% shared by total alelles were compared in the same sampling ways of variety classification-proportion. Those indexes originated from random sample, variety classification-proportion sample and cluster-proportion sample respectively were also compared. The results testified that the sampling ways of variety classification-proportion and 9% proportion were a better choice for constructing soybean core collection.

P503. Oxyradical levels in soybean seeds subjected to field weathering

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In view of their possible role in oxidative deterioration of seeds, oxyradicals were measured by electron spin resonance using N-t-Butyl-a-phenyl nitrone (PBN) as a spin trap in the unweathered and field weathered seeds of a susceptible (JS 71-05) and a tolerant (Punjab 1) soybean cultivar. The plants of these two cultivars were subjected to 1-4 weeks of field weathering. No signals of oxyradicals were recorded in the unweathered seeds harvested at physiological maturity (0 weeks of field weathering). However, a marked increase in the level of oxyradicals (778 x 10^{-10} a.u.) was observed after one week of field weathering in the seeds of JS 71-05. In Punjab 1, signals also first appeared in the seeds after one week of field weathering but reached a peak value (662 x 10^{-10} a.u.) in the seeds only after 2 weeks of field weathering. Hence, maximum value of these radicals was significantly low and their rate of accumulation was also delayed in tolerant as compared to susceptible cultivar. After the peak values of free oxyradicals, a progressive decline in the signals was observed in both the cultivars. Similar pattern was observed in malondialdehyde (MDA) content with maximum value of 0.098 and 0.086 mg/g dry weight of seeds recorded after one week and two weeks of field weathering in cultivars JS 71-05 and Punjab 1, respectively. There was a progressive increase in the electrical conductivity from 1 to 4 weeks of field weathering in the seed leachate of cultivar JS 71-05 (0.089 to 0.226 mS/g/50 ml) which was significantly higher than in Punjab 1 (0.046 to 0.162 mS/g/50 ml). In JS 71-05 percent germination declined from 100 (unweathered seeds) to 57 (after 4 weeks field weathering) and vigour from 92 to 38%. The reduction was lesser in Punjab 1 in which germination declined from 100 to 75 and vigour from 100 to 62%, respectively. The results clearly suggest that oxyradicals play an important role in lipid peroxidation, which in turn leads to damage in the cell membrane and loss of germination and vigour of soybean seeds. The duration of field weathering as well as genotypic variability influenced the rate of accumulation of oxyradicals, which explains the physiological reasons for variation in seed quality observed among the genotypes.

P504. Effect of temperature on protein and oil concentrations in soybean (*Glycine max* (L.) Merr.) in field conditions

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There is ample evidence in the literature that environmental conditions occurring during seed filling affects the final composition of soybean seeds. This variability in seed composition is problematic for the industry since the prescribed levels, for example, for protein concentration in the meal, are not always attained. The large variation in these levels in different years and locations commonly renders confusing information. Most literature reports that temperature is one of the major factors influencing protein and oil concentration in the soybean seed. The objective of this study was to determine, under field conditions, the effect of temperature on soybean protein and oil concentrations and to verify whether or not a geographic pattern exists to explain the variations of these levels. Protein and oil concentrations were evaluated in soybean seeds collected during two years in 10 different locations with variations in latitude, altitude and temperature. The largest variations in protein concentration within the same location were best explained by rain distribution during seed filling. Among locations the differences were larger. There was a trend that seed collected at locations with milder average temperatures (21°C to 23°C) and higher altitude (>650 m) present higher protein concentration than those collected in locations with higher temperatures (23°C to 27°C). When this trend was not observed, the rain distribution during the seed filling and seed yield, again best explained the results. The linear regression for oil and protein was performed aiming at selecting, among nine parameters related to temperature, the most relevant ones in explaining the oil and protein concentrations in the seeds. The regression for protein Concentration (r^2 = 0.75; P = 0.0482) showed that mean temperature for January, February and March was the most significant parameter: the lower the mean temperature the higher the protein concentration. On the other hand for oil (r^2 = 0.66; P = 0.0448), the temperature for January was the most significant parameter: the higher the temperature the higher the oil concentration. Due to the magnitude of the differences obtained among years and locations, and the importance of small difference in these parameters for the industrial sector, the geographic pattern based only on temperature variations was not sufficient to explain the variations on protein concentration, as expected. This may be the reason for confusing interpretations in relation to variations on oil and protein concentrations. The rain distribution during the seed filling period as well as the nitrogen availability to seeds during the same period, are the key factors to the best understanding of the variations in protein and oil concentrations in soybean seeds.

P505. Effects of salinity stress on soybean [*Glycine max* (L.) Merrill] seeds germination and seedlings growth

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Soil salinity is an unfavorable condition for germination, which consists in a limiting factor to the development of several crops. The objectives of this work were to evaluate the effects of sodium chloride (NaCl) on soybean seeds germination and seedlings growth. Seeds from BRS-133 cultivar were submitted to different concentrations of the salt: 0 (control), 50, 100, 150 and 200 mM. Sheets of germination paper were wetted with an amount of water or saline solution equivalent to three times their dry weight. Seeds were evaluated through standard germination test and speed of germination-index. Seedlings growth were evaluated through the measuring of root and shoot length and fresh and dry biomass. The assay consisted of a completely randomized design with four replications. The data were submitted to variance and regression analysis. The results showed that salinity stress reduced seed germination and seedlings growth. The germination percentage of the control group were 61% in average, while for the higher salt concentration (200 mM) the germination percentage was reduced to 5%. As salt concentration increased, root and shoot length and fresh and dry biomass decreased, but the roots growth was more affected than shoots. The increased salt concentration also reduced the development of secondary roots.

P506. Temporal and positional effects of photoperiod and radiation on pod number and seed growth in indeterminate soybeans

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Exposure to long photoperiods after the R3 stage has been found to increase grain number per unit area in

indeterminate soybeans. As photoperiod sensitivity can be genetically manipulated, these effects are meaningful to increase yield in soybean. However the physiological basis of the increase in seed number in response to long photoperiod remains unclear. In this work we examined the dynamics of pod addition and seed growth in plants subjected to different photoperiod regimes and levels of radiation during the reproductive period. Indeterminate A5409RG (Maturity Group V) soybean was grown in field plots at Buenos Aires (34°35' S, 58°29' W). Mainstem nodes whose flowers opened at R1 and R3 stages were tagged to follow in detail pod addition and seed growth dynamics. Form the R3 stage onwards, a factorial combination of two photoperiods (natural and extended) and radiation levels (natural and shading) was applied, with three replicates per treatment. Photoperiod was lengthened with a combination of incandescent and fluorescent lamps of low intensity, which were automatically turned on before sunset and turned off 2 hours after civil twilight ended. Shading was imposed by means of a black mesh reducing radiation by a 60%. Young (< 2 cm long) and full-length pods were counted once a week on three plants per plot and twice a week in tagged nodes. Independent samples of grains were taken from tagged nodes and seed dry weight was obtained. At maturity the number of pods was counted at every nodal position and the number of seeds per unit area were obtained from a 1 m^2 sample. Young pods were formed during a longer period under extended than under natural photoperiod. Despite that full-length pods were established at a lower rate, final number of pods at maturity increased with daylength. Low radiation reduced the number of both young and full-length pods during most of the reproductive period without significant photoperiod by radiation interaction. Photoperiod effects on duration and rate of pod addition were more pronounced in the nodes whose flowers opened at R3. In these nodes the final number of pods increased respect to those corresponding to plants grown under natural photoperiod, while it remained unchanged in R1-flowering nodes. Seed growth rate was reduced by extended photoperiod in both positions while the beginning of active growth of the seed was hardly delayed in R3-flowering nodes. Differences in photoperiod effects between positions modified the distribution of pods within the mainstem, increasing the number of pods per node in the upper nodes. Shading reduced node fertility throughout the mainstem and branches but photoperiod improvement of upper nodes fertility remained evident. The number of seeds per unit area was related to the accumulated radiation during the critical period for seed number determination, in a relationship that closely agrees with previous experiments. It is proposed that long photoperiods reduce source limitations to late appeared pods by reducing instantaneous sink demand due to the negative relationship between rate of development and daylength.

P507. Characterization of the climatic risks for soybean cropping in Brazil

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Increments in yield and reductions in costs and risks of failure became basic requirements for competitiveness in the current globalized agribusiness world. Increased efficiency in the use of resources and inputs, improved quality of farm products and environmental conservation are some challenges of modern agriculture. Tools to help the decision making process are essential to tackle these challenges and succeed in obtaining competitive and environmentally sustainable products. Water availability is one of the main factors responsible for soybean yield variability in time and space. In a collaborative project involving several institutions (MAPA, EMBRAPA, ANEEL, INMET, IAPAR), areas with lower risks for soybean cropping were delimited in the states of PR, GO, TO, MS, MT, MG, MA and BA. Using soybean crop water balance simulation models, geographical information systems and geostatistics, areas with different probabilities of water deficit occurrence during the most critical phase of the crop development were defined and characterized as favorable, intermediate and unfavorable, based on: different sowing dates, water availability in each region, water consumption in the different stages of development of the soybean crop, soil type and cultivar. For each State, 54 to 72 maps were generated as a result of the combination of 9 or 12 sowing dates, 3 soil types and 2 cultivars. Each map portrays a combination of a level of each one of the factors listed above, representing the drought risk classification of different areas of the State for a given sowing date, as a function of the soil type and cultivar.

P508. Intercepted radiation and pod number in soybean canopies

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Crop yield in soybean is closely associated with pod and seed number. Both components have been correlated with the crop growth rate, which is a function of the intercepted radiation. Vertical distribution of pods,

however, changes with canopy structure. The objective of this work was to assess if the radiation intercepted by a given canopy stratum, during the pod setting period, was related with the pod number established at that stratum. The experiment was carried out at EEA Oliveros, INTA (Lat. 32° 33´ S). Design was a randomized complete block in a split plot arrangement, with four replications. Main plots were row spacing (RS, 52 or 76 cm) and sub-plots were genotypes (G, DM4800, María 55, A5634, and A6445). The plant canopies were divided into five to six (depending on G) horizontal strata of 20 cm height each, and named stratum S1, S2, S3, and so on, from the bottom to the top of canopy. Between R1 and R5.5 growth stages, radiation was measured, starting at soil level, every 20 cm, to the top of canopy. Radiation received above the canopy, Rda, was also measured. Radiation received at a given canopy level (i) was measured several times during the studied period to calculate the average radiation received at that level and named Rd1 (soil level), Rd2, Rd3, and so on. The Rdi times the length of the R1-R5.5 period was used to calculate the accumulated received radiation at each level (ARdi). Intercepted radiation at i level, IRdi, was calculated as percentage of ARdi divided accumulated Rda, ARda. Intercepted radiation accumulated by a particular stratum, IARdSi, was then calculated as the average ARd at the base and the top of that stratum. At maturity, plants from 1 m^2 were harvested and separated into 20 cm long sections. Each plant section corresponded to a particular stratum. Node number, pod number and reproductive node number were measured for each plant section. Pod per reproductive node was calculated. Differences in IRd were detected at Rd1, $p<0.0001$; Rd2, $p<0.0001$), for G; at Rd4, $p=0.074$, for RS; and at Rd3, $p=0.0157$, Rd5, $p=0.0576$, and Rd6, $p=0.0083$, for G x RS. Pod number variations were obtained at S1, $p=0.026$ (G x RS), S3, $p=0.006$ (G), S5, $p=0.0736$ (G). Radiation distribution in soybean canopies showed a marked decrease with level, and most of it was captured in the upper two strata (67.4 – 83.3 %). Distribution of pod number was, however, similar for all genotypes, with most pods (59.8 - 71.6 %) localized in the two middle strata (S2, S3). For these strata pod number correlated with reproductive node number ($r = 0.50$, $p=0.017$ and $r = 0.56$, $p = 0.007$, for S2 and S3, respectively), and with pod per reproductive node ($r = 0.58$, $p = 0.005$ for S3). Correlations between pod number per stratum and IARdS showed no association ($R^2=0.059$). Results suggest that other/s factor/s, besides IARdS, could be involved in pod number determination in soybean canopies.

P509. Effect of stem termination (Nipping) on soybean yield

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Effect of stem termination in crops like Gram have been studied, however this practice is rare in soybean. An experiment was conducted to study the effect of stem termination (Nipping) on yield of soybean. Two varieties of soybean, one tall (MACS 58) and one short (MACS 450) was used with four different levels of plant geometries along with nipping at 30 days after sowing (DAS) and 45 DAS. Stem termination at 30 DAS was found to increase yield to the tune of 9.8% compared to no nipping, in case of MACS 450, while in case of MACS 58 nipping at 45 DAS gave similar results. The interaction of other characters like planting geometries, number of branches, number of pods on main and side branches, etc, with stem termination is presented in the poster.

P510. Response of a photomixotrophic soybean suspension (SB-M) culture to different conditions of light

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Higher plants possess sophisticated photosensory signal transduction systems to monitor the direction, quantity and quality of light signal and to adjust their growth and development through regulated gene expression at every stage of their life cycle. An alternative to the genetic approach for yielding information about the signal transduction pathways in plants is the biochemical approach. A homogenous and well-characterized cell line is an invaluable tool in the elucidation of the molecular basis of light signal transduction pathway. It overcomes the problems associated with the use of whole plants for biochemical studies. Use of photomixotrophic soybean suspension (SB-M) culture for biochemical studies is easier since it obviates the need for CO_2 in gas phase compared to photoautotrophic culture. The SB-M cells were grown in SB medium as described by Horn *et al.*, 1983. The SB-M cells were agitated at 130rpm on a Multitron orbital incubator under continuous light (110-130μ mol photons $m^{-2}s^{-1}$) for 14 d; dark for 14 d and dark for 8 d followed by light until 14 d. Measurements of fresh weight, dry weight and chlorophyll content were done on alternate days to characterize the growth of SB-M cells. In light-grown culture, a linear increase in fresh and dry weight with no apparent stationary phase was observed. Exposure of dark-grown culture to light resulted in a similar pattern of increase in fresh weight

as the light-grown culture. However, the increase in dry weight was higher in the culture grown in continuous light. Lack of significant difference in the cell-growth pattern between light and dark indicated that the carbon source (sucrose) in the SB medium is sufficient for the growth of cells for 14 d. Decline in growth after 14 d indicated ideal subculture interval of 14 d. Measurement of chlorophyll a/b and total chlorophyll were done as described by Arnon (1949). In the light-grown culture, the total chlorophyll content declined between 4 d and 8 d and continuous chlorophyll accumulation was observed after that. In the dark-grown culture, the chlorophyll content decreased continuously between 2 d and 14 d indicating lack of photosynthesis in the absence of light. An increase in chlorophyll content on exposure of dark-grown culture to light provided evidence for the light induced photosynthesis in the dark-grown culture. The ratio of chlorophyll a: b ~ 2 for light- as well as dark-grown culture was in accordance with the ratio found in leaves. This concludes that the soybean suspension culture is similar to the mesophyll cells by physiological (photoautotrophy) as well as the morphological (round, chlorophyllous cells, no severe aggregation) criteria and can be used for the investigation of signal transduction pathway from the chloroplast to the nucleus.

P511. Evolution and current status of soybean production in northwestern Argentina

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The provinces of Tucumán, Salta, Jujuy, west of Santiago del Estero and southeast of Catamarca are part of the region known as northwestern Argentina (NWA), located between the 22° and 29° Latitude South and the 63° and 68° Longitude West. In this area, the soybean crop occupies around 700.000 ha. Tucumán stands out due to its active participation in the research, development, and diffusion of this crop in the region. At first, soybean was planted in cattle areas or with scrubland non-capable for the development of the traditional crops. Later it displaced these crops of marginal areas for them, and finally, the use of an advanced technological package, allowed it to settle down in marginal areas. The growth of soybean production in NWA is a consequence of the increase in planting areas and yields, resulting from research work. Currently, average yields and total soybean production in NWA are around 2.500 kg/ha and 1.750.000 t, respectively. In spite of representing only 5% of the national production, the crop is very important for the regional economy. The distribution of maturity groups in cultivars available in the 1980s was stable, using mainly group VIII (70%) and IX (30%). The available materials, had been selected or generated locally by public institutions. The last decade was marked by a continuous replacement of soybean cultivars and changes in the distribution of maturity group, caused by different factors such as disease problems, environment changes, new tillage practices, and the appearance of transgenic soybean. During the 2002/2003 growing season, the distribution by groups of maturity was the following: group VIII: 80%, groups IV and V (indeterminate): 3.5%, group VI and VII: 16% and group IX: 0.5%. The decreasing structural stability of the soil and the monoculture of soybean in NWA caused degradation of soils during the 1970s and 1980s. Currently, more than 95% of the area with soybean is under a no-tillage and 40% is fertilized with phosphorous. No-tillage and the use of short groups, changed the row spacing to 0.52 m with increments in the population density. An average of 1.5 treatments of glyphosate per ha are carried out for weed management in transgenic soybean and the mixture of this herbicide with diclosulam applied in early post-emergency is used for the control of different species of genus *Ipomoea*. The most important pests are: a complex of curculionids (*Sternechus pingui* and *Promecops carinicollis*), cutting worms, caterpillars (*Anticarsia gemmatallis* and *Rachiplusia nu*), and a complex of bugs (*Nezara viridula* and *Piezodorus guildinii*). At present, the main diseases in the region are sudden death syndrome (*Fusarium solani* f.sp. *glycines*), frogeye leaf spot (*Cercospora sojina*), charcoal rot (*Macrophomina phaseolina*), and the late season fungal complex (*Septoria glycines*, *Cercospora kikuchii*, *Corynespora cassiicola*, *Phomopsis* spp., *Alternaria* spp., and *Colletotrichum* spp.). Sclerotinia stem rot (*S. sclerotiorum*) and other root rots (*Fusarium* spp.) appear occasionally and are not widespread in NWA.

P512. Effects of water availability, temperature and solar radiation on industrial quality and production in soybean cultivars from different maturity groups, in San Luis, Argentine

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With the objective to analyze the variation of oil and protein content and the oil and protein production in soybean cultivars of different maturity groups (MG), an industrial quality research was carried out in Villa Mercedes, San Luis during 1998/99 and 1999/00 crop years, considering the water availability (WA) and the relationships with daily mean temperature (DMT) and incident solar radiation (IncR) during the R5-R7 period. The designs were split plots sown on the 15th of

November, with six cultivars from MG III to VII, with three replications, being WA the main plot and cultivar the sub-plot. Two WA levels were determined: irrigated and none-irrigated. Yield (Y), oil content (OC), protein content (PC) were measured and oil production (OP) and protein production (PP) were determined. Y, OC, PC, OP and PP were analyzed using ANOVA and Multiple Regression (Stepwise). Means differences were compared through Tukey test ($a=0.05$). OC showed differences ($P<0.01$) for year, WA and cultivar with year-cultivar interaction ($P<0.05$). The mean value for OC was 21.4%. In rainfed, a highest OC was obtained (21.6% vs. 21.1%). OC had a negative correlation (-0.25) with protein content (PC) and a positive correlation with Y (0.64), IncR (0.74) and duration of R5-R7 period (0.61). The combined ANOVA for OP showed differences ($P<0.01$) for year and cultivar, with an average value of 709 kgxha^{-1}. There were differences ($P<0.05$) for WA only in 1998/99 crop year. Under irrigation, an average of 5.3% more was obtained for OP. The ANOVA test for PC showed differences ($P<0.01$) in cultivar and year-cultivar interaction. It also showed differences ($P<0.05$) for WA and WA-year interaction. The average PC was 40.5%. Under irrigation, a highest PC (40.7% vs. 40.2%) was obtained. PC showed a negative but not significant correlation with DMT and IncR. The ANOVA test for PP showed differences ($P<0.01$) for cultivar and year, and differences ($P<0.05$) for WA, with an average value of 1326 kgxha^{-1}. Under irrigation, an average of 10% more of PP was obtained. The short cycle cultivars (MG III and IV) under good WA conditions had the highest values for OC, OP and PP. The IncR during R5-R7 (with a high correlation with DMT) was the environmental variable that best defined the variations of OC, OP and PP.

P513. Industrial quality and production of soybean cultivars from maturity groups II to VII, according to planting date, in San Luis, Argentine

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With the objective to evaluating the variation in oil and protein content and production of soybean cultivars from different maturity groups (MG), as a function of planting date (PD) an industrial quality research was carried out, at Villa Mercedes (San Luis-Argentine), during 2000/01 crop year. Twelve cultivars from MG II to VII were sown under irrigation and fertilization in three PDs (Oct 23, Nov 22 and Dec 9) in split plots design, with three replications. Oil content (OC) and protein content (PC) were measured as percentage of dry matter. Oil production (OP) and protein production (PP) were determined as yield per unit area. The variables were analyzed using ANOVA and Regression (Stepwise). The means differences were compared using the Tukey test ($a=0.05$). The duration of the soybean grain filling period (R5-R7) was determined. During this period, the daily mean temperature (DMT) and incident solar radiation (IncR) were analyzed. OC and PC showed differences ($P<0.01$) for PD, cultivar and *PDxcultivar* interaction. OC decreased linearly with an average reduction of 0.99% each 30 days of the PD delay. PC responds inversely to OC, increasing linearly in 0.14% for the same delay of the PD. The extent of such variations was greatest in the cultivars of MG V-short and V-long. OP and PP had a quadratic response with the PD delay. The mean values for OP were 796, 810, and 670 kgxha^{-1} for the 1st, 2nd and 3rd PD respectively. The mean values for PP were 1429, 1475, and 1317 kgxha^{-1} for the 1st, 2nd and 3rd PD respectively. The Stepwise procedure showed that the DMT was the most important environmental variable, with an R^2 of 0.81.

P514. The effects of soil organic matter on seedling emergence in soybean

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It is hardly possible to reach a maximum seed yield without successful seedling establishment. Poor seedling emergence results in yield reductions in crops. Seed quality and seedbed conditions affect the seedling emergence. Seedbed condition is affected by soil content, especially soil organic matter. In the recent years, insufficient seed germination and seedling emergence in soybean production areas is a major problem especially plus insufficient climatic conditions. Therefore, objective of this study was to determine effects of soil organic matter on germination and seedling emergence of three soybean cultivars (Mitchell, Ataem 1and Ataem 2). This research was conducted in 2000 and 2001 in field and glasshouse conditions. Perlite and 20 soils with different organic matter contents were used as seedbed conditions. As the results, organic matter content in the soil had a significant effect on seedling emergence of the three soybean cultivars. The decreasing soil organic matter content resulted in decrease of seedling emergence. This effect was clearer in adverse environmental conditions. Especially in the soils with less than 2 % organic matter, it was found to be difficult to obtain or target optimum plant density for maximum seed yield. Seedling emergence rates in the field chanced between 13.92% and 95.58%; 4.42% and 93.17% for 2000

and 2001, respectively while it was between 84.83% and 97.75% in the glasshouse. This study addresses that organic matter decrease in soil, as a result of mistakes in cultivation such as tillage, crop rotation as well as erosion may cause problems in seed germination and seedling emergence. Therefore, organic matter content in poor soils should be ameliorated for not only obtaining well seedling emergence but also optimum plant growth at later stages.

P515. Influence of growing locations on the variation of seed quality associated with processing suitability in soybean

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The properties of soybean seed sometimes show a great variation with the difference in growing locations. Such a lack of uniformity in seed quality leads to the deterioration in processing suitability for soy foods. The objectives of our study were to evaluate the actual variation of soybean seed quality associated with processing suitability and to determine the influence of growing locations on the variation. Seed size and seed coat cracking as properties in seed appearance and the contents of protein and oil as major seed components were measured on 5 cultivars grown in 2000, 2001 and 2002. They were cultivated at 3 to 15 locations in western region of Japan, where environment conditions were different, respectively. Seed size of each cultivar varied greatly with growing locations, especially "Sachiyutaka" showed the difference of 10g in 100 seed weight between the maximum and the minimum in 2000. There were locality differences in incidence of seed coat cracking with each cultivar, except for "Touzan 193" which consistently showed low incidence at all locations. Large variation among growing locations was observed for protein and oil contents as well. For example, variation within 11 locations for protein and oil contents of "Tamahomare" ranged from 35.4% to 43.7% and 17.9% to 22.0%, respectively in 2000. These results indicated that the variation of seed quality was considerably large and might actually reduce the processing suitability on a large scale soy food production. There was a significant correlation for protein content between cultivation years, which suggested that some cultivation sites could be expected to produce soybeans with high protein content consistently.

P516. Soil management and boron in the physiological quality of soy seeds (*Glycine max* L. Merrill)

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This research work was carried out with the objective to evaluate the effect of different systems of crop management and boron applied to the soil on the germination and on the vigor of soy seeds, Vencedora cultivar originated from a research work conducted in the 2001/2002 agricultural year in the city of Itumbiara, Goias State. The statistical analysis was done by the use of a randomized complete block design in split-plot with four replications. In the plots were evaluated different systems of soil management: 1-system of conventional cropping management with incorporated lime + gypsum with heavy harrow; 2- system of management of the conventional cropping with lime incorporated by a heavy harrow; 3- system of management with absence of tillage and lime + gypsum applied to the soil surface (without incorporation); 4- system of management in minimum tillage with lime partially incorporated with a chisel plough; 5- system of management in minimum tillage with lime + gypsum partially incorporated with a chisel plough; 6- system of management with tillage absence and lime applied to the soil surface (without incorporation); 7- system of management in no-tillage with lime + gypsum incorporated with harrow in the first agricultural year and also with the presence and absence of boron studied in the subplots. The referring determination to the physiological quality was made 17 months after the storage in a cold chamber at 12 °C which evaluated the weight of 1000 seeds, the germination (%), first counting of the germination test and accelerated aging. It was concluded that for all types of management evaluated there was no significant difference while the boron effect was significant for the tests of vigor (first counting and accelerated aging) and weight of 1000 seeds.

P517. Soybean yield determination in relay- and double-cropping in the Argentine southern pampas

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The most reliable option for cropping intensification in the Argentine southern pampas is the adoption of wheat-soybean double crop (DC), in which soybean

can be sown after wheat harvest (sequential, DD_{seq}) or into standing grain-filling wheat (relay intercropped, DC_{int}). During two growing seasons, experiments were conducted at Balcarce (37.5° S; 58.2° W; 130 m.a.s.l.) in order to evaluate growth, yield and seed quality of double cropped soybean, both sequential and intercropped, compared with monocropped controls sown at optimum dates (SC) or at dates coincident with those of double crops (SC_{int} and SC_{seq}). Early sown sole soybean crops (SC and SC_{int}) outlyielded double crops (DC_{seq}, DC_{int}) and SC_{seq} in the two seasons; yield was linearly and positively related to both seed mass ($p<0.0001$) and seed number ($p<0.0001$). Biomass at R7 accounted for 84-71% of variation in seed yield and harvest index accounted for 47-40%. Sole crop yields were reduced with delayed sowing at a rate of about 1.3% per day after 1 December, whereas in double crops the rate only was about 0.5%. Yields of DC ranged 74-77% of their respective control, by contrast yield of sequential cropped soybean ranged 86-110%. 'Lost time to growth', here defined as time (in days) to reach 80% of canopy full cover, was highest in relay intercropped soybean in both seasons; moreover pooling all treatments and seasons intercepted solar radiation from emergence to R1, and from emergence to R7 was negatively related to 'lost time to growth' ($R^2=0.60$, $p<0,009$ and $R^2=0.46$, $p<0,04$, respectively). Radiation use efficiency (RUE) computed from emergence to R7 was not significantly different among treatments. Therefore total biomass production was strongly related with radiation interception ($p<0.0002$) and unrelated with RUE ($p>0.4$). Seed yield was weakly related to crop growth rate (CGR) from R1 to R5 ($p<0.01$) but strongly related to CGR from R5 to R7 ($p<0.006$). Protein content did no differ significantly among treatments in any season whereas oil content differed only in season 2, where temperature during seed filling accounted ($p<0.002$) for 58% of oil content variation rather than any crop growth variable. In summary, biomass accumulation at the onset of reproductive period and temperature during seed filling were key issues related to seed yield and quality, respectively.

P518. Long-term effect of winter and summer/autumn cover crops in the grain cropping system over no-till in Brazil

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This research was carried out from april 2001 to may 2003, on a red latosol (Haplorthox) within a system conducted 11 years over no-till, at Cruz Alta, State of Rio Grande do Sul, Brazil. Analysis of soil (0-10 cm) showed clay 550 g kg^{-1}; pH H_2O 5.1; pH SMP 5.5; O.M. 38 g kg^{-1}; P 17.2 mg L^{-1}; K 161 mg L^{-1}; Ca 5.0 $cmol_c$ L^{-1}; Mg 2.0 $cmol_c$ L^{-1} and Al 0.7 $cmol_c$ L^{-1}. The treatments consisted by cover crops and grain crops, in several combinations in the sequence: winter cover crop, corn, summer/autumn cover crop or grain crops, wheat, soybeans. The winter cover crops were black oat (*Avena strigosa*), common vetch (*Vicia sativa*), black oat + common vetch (in consortium), blue lupin (*Lupinus angustifolius*), oil radish (*Raphanus raphanistrum* var. *oleiformis*), all cultivated unfertilized, and a control with common vetch chemical fertilized [500 kg ha^{-1} 00-20-20 (N-P-K)]. The summer/autumn cover crops were oil radish (*Raphanus raphanistrum* var. *oleiformis*), and sunnhemp (*Crotalaria juncea* L.) and the summer/autumn grain crops were soybeans (*Glycine max* (L.) Merril) and black bean (*Phaseolus vulgaris* L.). The experimental design consisted by randomized block in split-plots with four replications. In the main plots was located the winter cover crops, and in the sub-plot the summer/autumn cover crop or grain crops. Was evaluated the dry-matter and nutrient accumulation in the aerial parts of all cover crops, and the yield of black bean, corn, soybeans and wheat. The results were analyzed with ANOVA and submitted to Duncan test. The common vetch and lupin produced big dry-matter production and nutrient accumulation, with rapid decomposition and providing beneficial effects on the corn yield. The sunnhemp cultivated in the autumn, after summer corn, showed great dry-mass production and its residues decomposed more slowly than oil radish residues. The wheat production was increased when this crop was cultivated after oil radish in the autumn (planted after the summer corn), proceeded by sunnhemp after the summer corn. The lower wheat yield was obtained after soybeans and black beans cultivated in autumn, after the summer corn. Using oil radish as autumn cover crop after the summer corn, there was a increase in its dry-matter when was cultivated a leguminous (vetch or lupin) in the winter before the corn, and decreased if the winter cover crop was black oats or the oil radish. The residues of the winter cover crops planted before corn of don't affected the soybean yield cultivated in the next summer, planted 18 months later. However, there was a positive effect of sunnhemp cultivated in the autumn, after summer corn, in the soybean yield cultivated after nine months. Probably this sunnhemp effect in soybeans occur because its great dry-matter and consequent nutrient accumulation. The results indicate that the cover crops proposed beneficial effects in the grain crops in such way that the fertilized plots don't differed significantly to unfertilized plots in a same rotation's scheme. This effect can to be because the nutrient recycled by cover crops associated at the high soil fertility.

P519. Effect of dose and time of cobalt and molybdenum application in the productivity of the soy crop established in no-tillage system

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Increases in the production of grains have generated losts in the soil fertility by the inadequate replacement of nutrients to the soil. Amongst the observed nutricional deficiencies of the soy crop in soils with intensive cropping were distinguished the deficiencies in cobalto (Co) and molybdenum(Mo) (Hungria et al., 2001). The experiment was installed in the Floresta do Lobo Farm/ Pinusplan in the city of Uberlândia, MG in a Acric RED LATOSSOL (LVw) with clayed texture. It consisted of two summer harvests of the soy crop in the 2001/2002 agricultural year (first year) with the sowing of the Vencedora variety and the Conquista variety was sowed in the 2002/2003 agricultural year (second year). The area of the first agricultural year was already under no-tillage cropping for eight years and the second one was in phase of implantation of the no-tillage system for two years. The present research work had as main objective to evaluate the productivity increase of the soy crop under field conditions by providing to the plant Co and Mo as a seed treatment and also as a foliar spray application. The doses of fertilizers used in the first year were control, Cof P-171, 186 and 200 in the dosage of 26, 28 and 30 mL as seed treatment, 18 mL of Cof P-120 as foliar spray application, 26 mL and 15 mL of Cof P-171 and 100 as seed treatment and as foliar spray application, respectively. The foliar application occurred when the soy crop had reached the vegetative stage V7. The used dosages of the product for the second year were control, 12, 15 and 17 mL of Cof P-100, 120 and 140 as a seed treatment and 15 mL of Cof P-120 as foliar spray application in the vegetative stage V6. The greatest increments of productivity in the first year of this study were observed when the product was applied to the seeds, distinguishing the dose of 30 mL of the product which allowed the crop to reach the average productivity of 3.997 Kg ha^{-1}. For the second agricultural year the productivity obtained for the seed treatments were also superior when compared with the foliar spray applications. The most distinguished dose among the tested ones was 15 mL of the product which allowed the soy to reach the average productivity of 3.351 kg ha^{-1}. The greatest increment in the productivity of the soy crop in the first year of evaluation may have occurred in result of the greatest dosage of the product, supplying, therefore, greater concentrations of Co and Mo for the soy crop. This results are corroborating with the data of Hungria et al. (2001) that obtained great increments in the soy yield by the suplementation of these nutrients to the soil.

P520. Residual effect and methods of limestone reapplication in the culture of the soybean (*Glycine max* (L.) Merrill) in no tillage system

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The present work was developed in the experimental area of FE/UNESP - Campus of Ilha Solteira, located in county-MS, Brazil (20°22'S, 51°22'W and 335m of altitude). In the agricultural year of 1990/00 was initiated an experiment which has been accomplished annually. In this experiment, it was used 4 methods of limestone application (incorporated (CI), on surface, immediately after the installation of the covering cultures (CS), on surface, before the handling of the covering cultures (CM), and without limestone application (SC)), and 2 cultures of soil covering and straw production (millet and black oat). The covering cultures, millet and oat, were just cultivated in the first two agricultural years (1999/00 and 2000/01), during the period from August to October. In the treatments with limestone application, a dose of 1235 kg ha^{-1} with PRNT of 91% was used. In the agricultural year of 2002/03, the covering cultures have not been used as treatment. Related to the methods of limestone application (CI, CS and SC), it was applied or not a new limestone dose. When the limestone was applied, incorporated with chisel plow (CICI, CSCI and SCCI) or without incorporation (CICS, CSCS and SCCS) and in the portions in which the application has not been accomplished, there was also chisel plowed (CISCI, CSSCI and SCSCI) or not (CISC, CSSC and SCSC). The new limestone dose applied (769 kg ha^{-1}) was calculated by the method of elevation of the saturation by bases using the average value of the results of the analysis of a new soil sampling, accomplished from 0 to 10 cm of depth, aiming to increase the saturation by bases to 70%. In the CM treatment, it has been applied 0.5, 1.5, 2.0, and 2.5 times the dose calculated to the other treatments on surface, resulting in 384.5, 1153.5, 1538 and 1922.5 kg ha^{-1} of limestone applied on surface, respectively, with the objective of comparing, along with the treatments CSCS (D 1.0) and CSSC (D 0), levels of limestone applied on surface after the implantation of the direct planting system. The millet was used as culture of soil covering. The evaluations accomplished were: agronomic characteristics (final stand, plant and insertion of the first beans height, number of beans per plant and number of grains per bean), production, and weight of 1000 grains. The reapplication of the limestone as well the operation chisel plow have not given significant results to the characteristics evaluated in the culture of the soybean, which has presented an average of grain production of 3969 kg ha^{-1}, therefore they are unnecessary activities, in the presented conditions, after

4 agricultural years of implantation of the direct planting system; levels of up to 2.5 times of that to increase the saturation by bases to 70%, with limestone application on surface, does not modify the production of the culture in soil with V% above 50, in the no tillage system.

P521. Inclusion of soybean in systems of cultivations: the balance of nutritious

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In the mixed systems of the south region of Buenos Aires province (Argentina), a tendency has taken place to prolong the agricultural cycles with regard to the period of use with cattle and to incorporate pasture ground lands to the agricultural activity. In general all the cultivations are fertilized with Phosporus and only the gramineous species with Nitrogen, since in the oleaginous ones they have not been observed until the moment economic answers to this nutrient. To represent this situation 6 sequences of cultivations were evaluated during a 10 year-old period on a representative soil of the region (typical Argiudol). Half-high considered fertilization levels were applied for the region. The incorporation in the sequences of summer cultivations (sunflower, corn and soybean) in rotation with wheat, and the increments in the yields caused high indexes of extraction of nutritious, mainly nitrogen. The balance of this nutrient was negative especially for the cultivation of soybean, that which was explained by the high percentage of protein of its grain and the small contribution of nitrogenous fertilizer received. This notorious nitrogen deficiency for the soybean was still given considering a biological fixation of nitrogen estimated in 30% of that exported by the cultivation. The scarce quantity and low relationship Carbon/ Nitrogen of the stubble of soybean didn't compensate the carbon mineralized by the cultivation, causing marked decrease of the organic matter of the soil when a cultivation as the soybean repeated on oneself lot during several years in rotation with wheat. We concludes that the inclusion of the soybean would be interesting for its contribution to the diversification of the systems of production of the region, but it would be negative that the agricultural outlines concentrate in the oleaginous one for its impact on the decrease of the values of the organic matter of the soil.

P522. Influence of nutrient management practices on the below ground bio-diversity of soybean cropping system

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Neglecting of biological fertility of the soil with the modern cultivation practices led to the loss of abundance and diversity of soil fauna. Interaction between soil fauna and plant control pattern and rates of organic matter decomposition, nutrient immobilization and nutrient uptake by plants, together with abiotic factors of the soil environment regulate soil fertility. With this background, an experiment was carried out to know the effect of eco-friendly nutrient management practices on the abundance and diversity of soil fauna (meso and macro animals, microbes) and soil organic carbon in soybean cropping system. An experiment was carried out with 10 treatments replicated thrice in red sandy loam soil under rain fed situation. The treatments included were recommended FYM (10 t ha^{-1}) + Rec. Fertilizer (25:60:25 Kg NPK ha^{-1}.) + Phorate 10G @1 kg a.i./ha + seed treatment with fungicide (Thiram + Bavistin – 2g each kg^{-1}) + Herbicide (Lasso 10G @ 2 kg a.i. ha^{-1}) (T_1); Rec. FYM + 25% Rec. FYM + 75% Rec. Fertilizer (T_2); Rec. FYM + 50% Rec. FYM + 50% Rec. Fertilizer (T_3); Rec. FYM + 75% Rec. FYM + 25% Rec. Fertilizer (T_4); Rec. FYM + Rec. FYM (T_5); Rec. FYM alone (T_6); Rec. FYM (partially decomposed) (T_7) ; Rec. FYM + Mulching (Glyricidia) (T_8) ; Rec. Fertilizer alone (T_9) ; 50 % Rec. FYM alone (T_{10}). FYM was incorporated in the plots a fortnight before sowing. Other chemicals were added to the soil before sowing operation. Soybean (variety Hardee) crop was raised during rainy season of 2001 and 2002. All the treatments were incorporated in the respective plots during second year also. Two hand weedings and one intercultivation were followed. Soil samples (0-10 cm depth) were drawn in each treatment at fortnightly interval to extract soil fauna, microbial biomass and to analyse soil organic carbon during cropping and non-cropping season. Maximum soil faunal abundance and Rizobium nodule dry weight were recorded in partially decomposed FYM treatment. Higher diversity of soil fauna was noticed in T_4. Significantly higher soil organic carbon content was registered in T_5, which also provided shelter for maximum microbial biomass compared to rec. fertilizer alone and recommended cultivation practices for soybean crop. Higher plant biomass and grain yield was noticed in T_1 but no statistical difference was noticed among the treatments. The results of the 2 years observation indicated that the altered eco-friendly treatments enhanced the soil faunal abundance and diversity, microbial biomass and organic carbon content of the soil in addition to on par in grain yield.

P523. **Effects of plant growth regulators (auxin, gibberelin and citokinin) on soybean culture yield (*Glycine max* L. Merril cv. 'IAC-18')**

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The soybean culture in Brazil is the most important grain production and hight exportation with more then 30 millions of ton, cultured in extensive areas in South and middle-west following by southest regions of Brazil. The yield of soybean culture is coming in each year, in fuction of new technologies, and one of these sources is the application of Plant Growth Regulators that was very discussed in many cultures and have showed positive results, specially by application of auxin, gibberellin and citokinin, that act directly on gene expression excited the plant metabolism, increasing your development by cell division and cell elongation that promote increase in plant growth, foliar area, lateral shoot number and flowering, that results in higher yield of soybean culture. Then, the present experiment had objective to evaluate the effects of auxins, gibberellins and citokinins, by application of Stimulate (commercial mixture of these plant growth regulators) by foliar and seeds treatment before sowing, on the development of soybean plants, without problems for the plants. The application of Stimulate (IBA - 50 $mg.L^{-1}$ + GA_3 – 50 $ml.L^{-1}$ + cinetin – 80 $mg.L^{-1}$) was realized on seeds before sowing and foliar application 30 days after germination (V6-V8). The treatments was: T1-Control (water); T2- 4 ml/Kg seeds; T3- 6ml/Kg seeds; T4- 250ml/ 120 L water (foliar application); T5- 500ml/ 120 L water (foliar application); T6- 750 ml/ 120 L water (foliar application); T7- 250ml/ 120 L water (foliar application) + 4ml/Kg seeds; T8- 250ml/ 120 L water (foliar application) + 6ml/Kg seeds; T9- 500ml/ 120 L water (foliar application) + 4ml/Kg seeds; T10- 500ml/ 120 L water (foliar application) + 6ml/Kg seeds; T11- 750ml/ 120 L water (foliar application) + 4ml/Kg seeds; T12- 750ml/ 120 L water (foliar application) + 6ml/Kg seeds. The results showed that Stimulate improved leaf number, by the foliar application and seed treatment on the T-10 and T-12.The higher number of lateral shoots occurred on T-5, T-10, T-11 and T-12, besides had more foliar area in T-12. The soybean yield was increased generally when Stimulate was applied in higher concentrations in association of different kind of application (foliar plus seed treatment). Its possible to conclude that these plant growth regulators is important treatment to improve yield in soybean culture.

P524. **Effects of 2,3,5-triiodobenzoic acid (TIBA) on yield of soybean (*Glycine max* (L.) Merrill)**

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The 2,3,5-triiodobenzoic acid, an auxin transport inhibitor, when applied on leaves, can reduce the vegetative growth, promoting higher flux of photoassimilates for the reproduction, increasing the number of pods per plant, grain yield and, also, protein and oil content (Pankaj-Kumar, 2001, Annals of Agricultural Research 22:2, 221-224). One of the problems faced by soybean producers is lodging of the plants in the field due to excessive vegetative growth caused by some factors like indeterminate growth habit of some cultivars, excessive nitrogen fertilization and high plant density. Trying to suggest a solution for this problem, an experiment was carried out in the greenhouse of the Department of Biological Sciences at ESALQ/USP to evaluate the effects of TIBA over soybean yield (*Glycine max* (L.) Merrill cv. Pintado). Using potted-plants, TIBA was sprayed on the leaves of soybean plants at 30, 40 and 50mgL^{-1}, 26 or 43 days after germination (DAG). Measurements of plant height were accomplished weekly. The crop yield was established determining the number and mass of pods per plant and 100-grain mass. The experimental design was completely randomized with seven treatments and six replications. The results were analyzed comparing means through Duncan Test (5%). Plants treated with TIBA at 30, 40 and 50mgL^{-1}, 26 or 43 DAG, showed a significantly reduction on height. Number and mass of pods and 100-grain mass did not show significant responses to TIBA application. According to these results the conclusion achieved at this study is that TIBA is effective in reducing plant height, avoiding this way lodging in the field, without affecting the crop yield negatively (Supported by Stoller of Brazil).

P525. **Agronomic efficiency of Penergetic in the soybean culture**

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The sustainable environment development depends of more production and less application of agricultural chemical products. A rational being of use and exploration of the natural resources is also necessary. The objective of this work was to evaluate the

agronomic efficiency and the beneficial effect of silicon and other elements of the natural fertilizer Penergetic ("Penergetic k" and "Penergetic p") in the soybean no-tillage culture. The experiment was conducted under Brazilian Savannah, in the Minas Gerais State, with the BRSMG Robusta Brazilian cultivar. The treatments were: T1) standard technology (ST) - with fertilizers and fungicides; T2) ST + Penergetic, with reduction of 20% in the ST products; T3) ST with reduction of 20% in the ST products; T4) ST + Penergetic; T5) ST without K in side-dressing; T6) Check without fertilizers, but with Penergetic + standard fungicides; and T7) Reduction of 20% in the ST and Penergetic quantity. It was used a complete randomized block design, with five replications. Before planting, 300g/ha of "Penergetic k" was applied with the herbicide. In the V_4 and R_3 development stages of soybean, 150g/ha of "Penergetic p" were applied on the leafs in each stage. Penergetic was sprayed at 150L/ha. The check without fertilizer, but with Penergetic (T6), produced 3300kg/ha, showing a high level of soil fertility. So, the grain yield, and pod insertion and plant height, were not affected by anyone treatment. Only for the 100 grains weight, the application of Penergetic, with 20% of reduction in fertilizers and fungicides (T2), differed in relation to the check without fertilizers, but with Penergetic + standard fungicides (T6).

P526. Decision support system for soybean and other crops fertilizer recommendations

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Sophisticated decision support systems are being increasingly applied in the calculation of fertilizer recommendations for soybean and other crops. A presented model calculates the fertilizer requirement using a range of input data, such as: the amount of available nutrients in the soil, nutrient removal with target yield, soil organic matter decomposition (according to the amount and type of harvest residues, C:N:P: ratio, application of organic fertilizers, soil humus content, soil pH value, climatic conditions), soil texture, field slope and exposition, soil water properties and management, field production level, etc. It also contains the possibility of analytical model selection considering the available phosphorus and potassium content in the soil (Olsen, Bray, CAL, DL, AL, $CaCl_2$). A plant nutrient requirement is calculated from the soil analyses data, by the particular score functions generated by field trials and incorporated in related subroutines. Soybean as a preceding crop is valued according to the achieved yield. Beside of N, P_2O_5 and K_2O dosage per hectare, this calculator estimates the eventual lime requirement and gives advices related to the economy of production, fertilizer distribution and application, instruct about the limiting factors and soil suitability for soybean. The calculator is written in JavaScript and automatically connected with input data base, while all results and recommendations are stored in output data base. Presented decision support system was calibrated by large number of field trials and is currently in usage by Croatian Extension service, under patronage of Ministry of agriculture and forestry in Republic of Croatia. Simplified version is available at http://www.pfos.hr/~vladimir/ for free.

P527. Soybean productivity on savannas of Roraima, ameliorated with sources of phosphorus and with nitrogen and sulfur side dressing

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This work aimed to study the effects of soil application of phosphorus sources and of Nitrogen and Sulfur side dressing in a medium textured yellow latosol from the savannas of Roraima, over soybean (BRS Tracajá and BRS Sambaíba) productivity, considering first and second cultivation. The experiment took place at Embrapa Roraima, beginning in May, 2002. As corrective fertilization 100 kg.ha^{-1} of P_2O_5 were used (sources as Super phosphate, Triple phosphate, partially acidulated phosphate and reactive natural phosphate); a fifth stripe consisted on a row application of 120kg.ha^{-1} of P_2O_5. As side dressing fertilization 20 kg.ha^{-1} of N, 45kg.ha^{-1} of S and 20 + 45kg.ha^{-1} of N + S were applicated. The different treatments were distributed among randomized horizontal and vertical stripes on the field. The different P sources were attributed to the stripes (75x4,0m) in a direction and the N, N + S and S doses to stripes (25x20m) perpendicular to the former. The fertilization concerning to planting operation consisted on the application within the planting row of 80 kg.ha^{-1} of P_2O_5 (SS) and of 120 kg.ha^{-1} of K_2O (KCl, ½ during planting operation and ½ in side dressing 35 days after planting day). The seeds were treated with fungicides, inoculated and sowed. The analysis of productivity data, considering the first year of cultivation, showed effects both from P sources and from side dressing of elementar sulfur and of nitrogen + sulfur. BRS Tracajá showed greater yield than BRS Sambaiba and its highest productivity was obtained with fertilizer applicated in the row, while concerning BRS Sambaiba P source resulted in highest grain yield. In addition, considering the second year of cultivation, significant results were obtained as related either to P sources and also to side dressing with sulfur alone or among nitrogen, for both cultivars;

BRS Sambaiba presented higher yield than BRS Tracajá and with the application of all fertilizer in the row the smallest productivity was obtained. S side dressing increased soybean productivity in both years of cultivation.

P528. Anticipation of the soybean fertilization on the *Eleusine coracana* (L.) Gaertn., in a no- till system

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This research was to evaluate the effect of the anticipation of soybean fertilization on dry matter production and extraction of nutrients by finger millet (*Eleusine* coracana (L.) Gaertn.) and on dry matter accumulation and exportation of nutrients by soybean seed cultivated in sequence, in a no-till system. The experiment was carried out at the experimental fields of Escola Superior de Agricultura "Luiz de Queiroz" (USP/ESALQ), in Piracicaba-SP, during the growing season of 2001/2002, in an Oxisol. The cultivar used was BRS-133. The soybean fertilization, according to the official recommendation to the state of São Paulo, consisted in the application of 90 kg of P_2O_5 ha^{-1}, 50 kg of K_2O ha^{-1} and of micronutrients (Co, Cu, Fe, Mn, Mo and Zn). The treatments consisted of levels of anticipation of the soybean fertilization to the finger millet crop (T_1: 0%; T_2: 50% of P; T_3: 50% of K; T_4: 100% of P; T_5: 100% of K; T_6: 50% of P and K; T_7: 100% of P and 50% of K; T_8: 50% of P and 100 % of K; T_9: 100% of P and K; T_{10}: micronutrients; T_{11}: 100% of P and K + micronutrients; T_{12}: controle), totaling 12 treatments, designing a complete randomized blocks with three replications. The evaluated characteristics were: dry matter production, concentration and nutrients accumulation at biomass of finger millet; dry matter accumulation, nutrients concentration and accumulation in soybean seed. The main conclusions are: a) in reference to the dry matter production, *Eleusine coracana* (L.) Gaertn. is a recommended specie to obtain plant residues in no-till systems, since it is growing on medium to high fertility soils; b) considering the nutrients accumulation in dry matter, it is verified that *Eleusine coracana* (L.) Gaertn. presents the following sequence of nutrient absorption: K > N > Ca > Mg > S > P >> Mn > Fe > Zn > Cu; c) the anticipation of the soybean fertilization to the *Eleusine coracana* (L.) Gaertn. sowing do not decrease dry matter accumulation nether interferes with the nutrients exportation by soybean seed; d) dry matter production and phosphorus and calcium accumulation by *Eleusine coracana* (L.) Gaertn. increase in response of phosphorus anticipation from soybean fertilization.

P529. Effects of phosphorus and potassium fertilization on the growth and seed yields of soybean (*Glycine max* L.)

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A field study was conducted to investigate the influence of variable rates of P_2O_5 and K_2O on the growth and the seed and oil yields of soybean. Chemical composition and oil constants of soybean was studied under environmental conditions of the central region of Saudi Arabia during 1999 - 2000. Treatments included three broadcast rates of P (0, 45 and 90 kg P_2O_5/ha) and K (0, 30, 60 K_2O/ha), all the P and K were applied at sowing date. The responses of growth, seed yield and components of yield were consistent in both years. Increasing the rate of fertilizer application increased the leaf area index (LAI) relative to the control. The yield of grain yield significantly increased over control by fertilizer application. Phospate, in combination with potash was more effective than either of these nutrients applied alone. The grain yield increased from 2.32 t/ha in control to 2.77 t/ha as a result of adding 90 and 60 kg/ha of P_2O_5 and K_2O respectevely. Fertilizer application significantly increased the protein and oil whereas the oil constants were not affected by fertilizer treatments. The yields of protein and oil concentration were maximum with 90 kg P_2O_5 and 60 kg K_2O per hectare.

P530. Response of soybean (*Glycine max* L.) varieties to varying levels of plant densities in mollisols on North Indian Plains

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A field experiment was conducted at the Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar during rainy seasons of 2001 and 2002. The soil was silty clay loam with pH 7.5, O.C. 0.70%, available P_2O_5 and K_2O 43.0 and 239.0 kg ha^{-1}, respectively. Eight soybean varieties viz. Bragg (Jackson x D49-2491), Pusa-16 (CNS x Lee), PS-1042 (Bragg x PK 416), PK-1251 (PK-1039 x PK 327), PK-416 (UPS 534 x S 38), SL-517 (PK-564 x SL 112), SL-525 (PK 416 x PK 1023) and SL-528 (SL 96 x SL 269) in main plot treatment with 3 plant populations (0.3, 0.45 and 0.6 million plants ha^{-1}) as sub plot treatments were tested in split plot designs in 3 reaplications. A basal application of 100 kg DAP (N-18% and P-46%) was applied at sowing. Plant height increased with plant population and the maximum was observed in Pusa-

16. Plant dry matter increased up to 0.45 m. plants ha^{-1} thereafter it declined. Leaf area index (LAI) increased with increase in plant population and Bragg recorded in highest LAI. In general mean, NAR, CGR and RGR at stage one (30-45 DAS) were increased with crop growth and were maximum at 0.3 m plants ha^{-1}. Yield attributes viz. number of branches/plant and number of pods/plant were decreased significantlu with increase in plant population, while number of grain/pod and 1000 grain weigh were maximum at 0.45 m.plants ha^{-1}. Grain yield increased with increase in plant population, cv. PS-1042 significantly yielded (22.76 q ha^{-1}) highest followed by Bragg (22.31 q ha^{-1}) than rest of the varieties. Lowest grain yield (18.17 q ha^{-1}) was recorded in PK-1251. Grain yield was positively correlated with 1000- seed weight. Harvest index (HI) increased significantly with decrease in plant population.

P531. Effect of plant population, row spacing and cultivar type on yield, lodging, rust and soil moisture levels by soybeans

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Response of soybean [*Glysine max* (L.) Merr.] to changes in row spacing and seeding rate have been variable. Most researchers have reported higher grain yields with the use of narrow row spacing. During 1991 and 1992, three soybean cultivars were planted in 22.5, 45-, and 90-cm rows at seeding rates of 200 000, 300 000, 400 000 and 500 000 seeds/ha. The plots were split for soybean rust control. The 22.5-cm and 45-cm row spacing out yielded the 90-cm row spacing for all cultivars over both seasons. Increasing the seeding rate resulted in increased yields in 1991. However there was no significant response in yield to seeding rate in 1992. The 1991 yield response to seeding rate was due to the 22.5-cm row spacing. CRN5550 out yielded LS555 at the lower seeding rates of 200 000 and 300 000 in the 22.5-cm row spacing in 1991, whereas at the highest seeding rate of 500 000, LS555 out yielded CRN5550. In 1991 CRN5550 out yielded LS555 for all seeding rates at the 45-cm row spacing, but only for the low seeding rate (200 000) in the 90-cm row spacing. Lodging increased with an increase in row spacing and seeding rate. This lodging response to row spacing and seeding rate was most marked for the strongly branching cultivar, CRN5550. The average yield difference between sprayed and unsprayed yields for all treatments was 1.42 t/ha. This yield difference can be attributed to the effect of soybean rust. There was no relationship between yield loss and row spacing. Increasing the seeding rates above 300 000 resulted in increased yield differences between sprayed and unsprayed yields in the 22.5-cm row spacing only. Decreasing row spacing resulted in increasing soil moisture, especially at the 400mm depth. This trend was more marked after a major rain event.

P532. Effects of early and traditional normal sowing dates on soybean growth and yield in the south area of Santa Fe Province, Argentina

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Crop growth and development are affected in soybean cultivars at early sowing dates, during September and October as compared with normal sowing dates in November. This response is a consequence of the different sensitivity crop development has to photoperiod and temperature. The objective of this paper was to evaluate the effects of early sowing dates on several genotypes of maturity groups (MG) III to VII compared with normal sowing dates on crop growth and seed yield. Genotypes tested were A 3901 RG (MG III), ADM 4400 RR (MG IV), ADM 4800 RR (MG IV), A 5409 RG (MG V), A 5520 RG (MGV), A 6445 RG (MG VI) and A 7321 RG (MGVII) in the 2001/02 growing season, and the first five ones in the next year. Tests were carried out at EEA Oliveros INTA (32° 33' S; 60° 51' W), on a Maciel typical Argiudoll soil, class I. In the first season, sowing dates were 9/18 (1SD-01), 10/22 (2SD-01) and 11/14 (3SD-01) and 9/20 (1SD-02), 10/18 (2SD-02) and 11/28 (3SD-02) in the following season. Treatments were arranged in a split plot design with sowing dates being the main plots and cultivars the subplots. Phenology was recorded every other day and at harvest (R8) plant height, seed yield, node number.plant-1, seed weight and seed number.m-2 were determined. The lowest seed yields were obtained in the 1SD in both seasons. In this sowing date, cultivars with indeterminate growth habit of MG V and VII had the highest yields. However, cultivars with determined growth habit of GM V and VI had a low vegetative growth and low yields and showed a positive correlation with plant height and nodes.plant-1. In the 2SD, almost all cultivars had the highest seed yields, but there was no correlation with plant height or with nodes.plant-1. In the 3SD, MG III and IV had similar seed yield to those of the 2SD in both years; meanwhile MG V and VI genotypes had lower seed yields because of a water and/or light stress during the critical stage of seed number and/or seed weight definition. Our data points out the importance of genotype selection for obtaining higher seed yields under early sowing dates and that planting can be anticipated

by one month in relation to traditional normal sowing dates (November). In early sowing dates, cultivars with a high crop growth rate, high biomass accumulation at the beginning of R5, either without lodging or an extensive cycle, as it happens with indeterminate cultivars GM VII, should be chosen. Indeterminate MG IV and V genotypes have adequate plant growth with highest seed yields in early sowing dates.

P533. The impact of research and development of soybean production on tax revenues in Brazil

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The soybean-related agribusiness is one of the most important in Brazil. Research and development have played a key role in improving the soybean production system, allowing soybean production to increase as much as 71% in the last 20 years. In this work, the impacts of soybean research and development on Brazilian tax revenues were estimated. Data on soybean yields from the seasons of 1983/84 (1.650 kg/ha) and 2002/03 (2.818 kg/ha) were used. These yields were multiplied by area cultivated with soybean in the season of 2002/03 (18.5 million of hectares), to obtain the total soybean production for each season. These production values were then multiplied by the sale price of soybean in the year 2003, to obtain the gross value of each production season. Using these values, tax revenues from only 5 different tributes applied to the soybean production/industrialization complex were calculated: CPMF (temporary contribution on financial movements), CESSR (special contribution for the rural social security), ICMS (tax on the circulation of goods and services), PIS (program of the employee's social integration), and Cofins (financial contribution for the social security). To calculate ICMS, PIS and Cofins, only the amounts of soybean for industrialization in the internal market were considered. Only these amounts were used because these tributes are not applied to raw materials exported by individuals. In order to facilitate the calculation of these tributes in the industrial process, the gross values of production were considered; in other words, the effective prices practiced in the industry were not used. Thus, the values of tax revenues obtained were, in general, underestimated since the profit margins attributed by the industrial section were not considered. Tax revenues with the yields from seasons 1983/84 and 2002/03 were US$647 million and US$1.087 billion, respectively. Thus, tax revenues using the yield of 1983/84 were 40% smaller. The greater revenue in 2002/03 is mainly due to the development and use of improved technologies for soybean production, fruit of research, technical assistance and rural extension in Brazil. This tax surplus generated (US$440 million), however, has not been reinvested in research in the same proportion. This value is 80% higher than the current year's estimated budget for Embrapa (US$244 million).

P534. Business rationality and expansion of agricultural frontier: soybean crop in Mato Grosso, Brazil

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Soybeans are considered the great development enhancer of Brazil's new agricultural areas. The crop is more than a simple vector of economic growth. It expresses the rationality with which the brazilian agribusiness has been designed for the last three decades. In order to understand the expansion of soybeans in agricultural frontiers, it is necessary to consider how official policies are established, how the private initiative sees the crop, and how the different personalities of the production chain rationalize. The official policies reveal the changes in the State rationality, as well as the insertion of its economy in a globalized world. In the case of Brazil, the expansion of soybeans into the low latitiudes shows the possibility of altering the profile of the regional agriculture and its production hierarchy. The private initiative, represented by the *Soybean Chain*, uses the business rationality. The present study intends to understand how the farmer – soybean grower – sees the other *chain* members and the public sector. That involves establishing the social, economic, cultural and political profile of the farmer as a *chain* member. It also involves understanding how the farmer used the opportunities of economic growth which were made available in that scenario. In order to predict possible scenarios for the future of soybeans in Brazil, it is necessary to consider the role of new agents, like those involved with environmental policies in different levels – local, regional, national, and international. The informations and ideas of the present study were colected by interviewing farmers of the State of Mato Grosso, Brazil. The intent of the interview was to colect data to study the dinamics of soybeans in the forest and transition forest areas. The study also intended to learn how the farmer sees the environmental policies and what role the local scenario has in their regional, national and global view of environmental policies. The study shows that there is a tendency – in the soybean chain as a whole, and specially among growers – to discuss the culture inserted in the global context with a growing emphasis to the local influences/consequences with respect to the local/regional debates on the effects of the large scale grain production on the environment and local economy.

The study also showed a change in the farmers rationality – specially the introduction of new environmental concepts and concerns, which were formerly incompatible with their economic activity.

P535. Economic impacts of biotech soybeans in Brazil on agricultural markets

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Herbicide tolerant soybeans have been rapidly adopted by Brazilian farmers, yet their approval for commercialization has been on hold for the past five years. Despite the fact that its cultivation is forbidden, Brazilian producers in the southern state of Rio Grande do Sul, are planting genetically enhanced soybean seeds obtained from Argentina, where GM crops are legal -it is estimated that over 80 percent of soybean production in Rio Grande do Sul are transgenic soybeans. As is the case for the U.S., the primary reason Brazilian growers have adopted Roundup Ready weed control programs is for the simplicity of a weed control program that can rely on a single application of one herbicide to control a broad spectrum of both broadleaf and grass weeds without crop injury or crop rotation restrictions. To minimize losses by producers restricted from marketing the illegal crop, in March 2003, the Brazilian government approved the exports of 6 million tons of harvested biotech soybeans, equivalent to 12 percent of Brazil's 2002/03 harvest. The government issued a second provisional measure in September 2003 to permit biotech soybeans planting and marketing only for 2003/04. Monsanto estimates that if the Brazilian Congress approves permanently the use of Round Up Ready soybeans, by 2004/2005 close to 50 percent of the soybean area planted will be Roundup Ready soybeans with area continuing to increase within the next decade to 70 percent. By comparison, the United States reports 81 percent of U.S. soybean acres were planted with biotech soybeans in 2003. To understand why Brazilian farmers have embraced biotechnology and are likely to continue to do so (legally or not), this analysis seeks to estimate the realized and potential impacts of adoption of biotech soybeans in Brazil, including changes in yield, production costs, and pesticide use. To analyze the trade impacts of Brazil adopting biotech soybeans, we obtained detailed costs of production data for various soybean producing regions in Brazil. Preliminary results on the benefits of the introduction of Roundup Ready soybeans in Brazil indicate that adoption of biotech soybeans in Brazil will result in an increase of soybean yields by 3.1 percent, lower production costs by about 12 percent, and a reduction in chemicals use by two-thirds. However, producers will also have higher seed costs due to licensing (royalties payments have been estimated at $12/ha in Brazil). The economic advantage for Brazilian farmers who plant biotech soybeans is an estimated additional US$1 billion over ten years and include savings of $196 million annually in weed control costs and 9 million fewer soybean herbicide applications per year. An estimate of the impact that the adoption of these crops in Brazil will have on U.S. agriculture is also provided.

P536. The situation of soya in Iran and the World

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soya at first have seen in asia especially the (North,east) of china&japan which the original place of this plant. this seed has planted in china from 5000 years ago it has planted in america about 2th centuray.at first they plant this seed for soilage and after while they used it for human and the most resource of oil &protein. soya contain much more oil in thier core , it use just for their oil and ... it is very important for beast in added we can cheese and milk from soya.the original kind of this plant GLYCINE USSURINSIS and the next kind of this plant which we can have farme it is GLYCINE MAX. The spcies of glycine have various sub spices which they are crawling& maybe they are lived A year or more than a year. The spices of soya has found in Australia& (South East)of Asia and afica. The second world war was the most important reasone for Developing of this kind of plant. The economist pressure in the war make the farmer to product soya much more than last year in 1935_1945 the harvest index of soya were less than 5.6(mil/hec) and in 1980 it's decrese 28.5(mil/hec). In1980 it has Develope about 28.5(mil/hec). Althuogh the original land of soya is the east of asia but in the west it has much more and it can planted in all over the world . the market of seed ,oil and diary of these plant have many costumer .the oil which given from this plant is usefull for human like: MARGARINE, SOLID or LIQUID oil and it have competetion with the other oil. The other which isnot usefull in soya is one of the most resource of protein for about their feed. one of the biggest Exportter of this production is United state of America which they have exported about 80% in all over the world and Japan is one of the biggest consumer which used this kind of production. this seed is contain 12%_30% oil, 30%_40% protein which we can reforme it to another oil like margarine and ... in added we can produce milk,cheese or yogurt and the other thing. Also soya cotain Risobium Tumor they can symbiosis by another bactries so they can confirm Azot(N2) in the soil, However this plant is very usefull for the nature.

P537. Satellite images for soybean crop area and yield estimation in municipalities of Rio Grande do Sul State, Brazil

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Reliable information about soybean (*Glycine max* (L.) Merr.) planted area and grain yield is crucial to early import/export government decisions, as well as to traders and farmers. Therefore, there is a need for objective methods to estimate soybean crop production. LANDSAT satellite images acquired at specific growth stages can be used to identify and map soybean areas. In addition, MODIS satellite images can be used to monitor crop spectral behavior at local and regional scales and introduced in an agrometeorological-spectral model to improve yield estimation. The objective of this work was to estimate soybean crop area and grain yield using images acquired by LANDSAT and MODIS satellites, respectively, in municipalities of Rio Grande do Sul State, during the crop year of 2000/01. The study area comprises more than 90% of the State's soybean production. Twelve LANDSAT scenes were acquired at two critical growth stages during the crop season (early February and early March), in order to map soybean planted areas by using both digital and visual classification. Grain yield was estimated using MODIS 16-day composite images of optimum NDVI (Normalized Difference Vegetation Index) from November to March coupled in an agrometeorological-spectral model (AGROMET) interfaced in a Geographic Information System. Results were compared with the official statistics provided by the Brazilian Geography and Statistics Institute (IBGE). For the total estimated soybean crop area it was observed that IBGE data were overestimated by 11,3% (280.624 ha). Consequently, IBGE grain yield estimate needed to be adjusted in order to be compared with AGROMET results. In this case, the initially IBGE yield estimate increased from 2.358 $kg.ha^{-1}$ to 2.623 $kg.ha^{-1}$. Eventually, a very low difference between the AGROMET (2.624 $kg.ha^{-1}$) and the adjusted IBGE (2.623 $kg.ha^{-1}$) yield estimates was observed. Moreover, AGROMET proved to be a powerful tool to provide yield variation in both municipal and state level, as well as to monitor soybean crop throughout the growing season.

P538. Planted area and production estimate of soybean in Tucumán, Argentina, using satelital data and interviews to qualified informants

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Since 2002, because the cooperation agreement signed among the Estación Experimental Agroindustrial "Obispo Colombres" (EEAOC) and the Secretaría de Agricultura, Pesca y Alimentación de la Nación (SAGPyA), the EEAOC acts as organism operator of the Provincial Unit of the Integrated System of National Agricultural Information (UPSIIA). The UPSIIA in Tucumán is integrated by the Agricultural Economy (EA) and Remote Sensors and Geographical Information Systems (SR and SIG) sections of the EEAOC. The objective of the SIIA is to have a national net of agricultural information to the service of the public and private sector. About this topic the EEAOC comes working, from 1997, using satelite images in the sowed area determination of sugarcane, citrus, soybean, corn, wheat, drybean and tobacco. Using this method also carries out the estimation of the sugarcane production. The grains, citrus and tobacco production cannot be obtained using satelite images. For this reason the EEAOC is developing a consultation system to qualified informants. Soybean is the first sector on which one has worked. For the estimate of the soybean production the obtained yields of the consultations and the determination of sowed area, starting from images LandSat, carried out by the SR and SIG section are used. To obtain the primary information, the Province of Tucumán was divided in segments in those the qualified informants were selected. This segmentation was made taking like reference the Outline Agrológico of the Province of Tucumán (Zuccardi and Fadda, 1985) and the division of productive areas and estimates of sowed area made by the SR and SIG section. The general results for the soybean season 2002/03 were the following ones: the sowed area was estimated in 226.350 ha and the production in 400.840 t. In this season a production of 638.300 t was expected, considering the average yield of the last year (2,82 t/ha). If we compare this value with the production estimated in this work, the soybean production fell 37%. The factors that impacted negatively in the production and the used methodology will be detailed in the whole paper.

P539. Municipal Agriculture Program having as an instrument of education a contest of low losses in soybean harvest

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The losses that occur during soybean harvest phase are reported as an inadmissible waste, since they are

not related to the inherent risks of agricultural exploitation, but to the carelessness with some simple practices at the crop implantation and calibration of harvest machines. On the other side, in the process of habits modification just few growers are receptive and promptly follow the advice. A convincing demonstration is necessary for most of them. The community of Cambé-Pr (Brazil) has been developing over the last 10 years, in a systematic way, a contest of minimal losses during the soybean harvest, with the purpose of spread the technology adoption among the growers of this community. The work has been coordinated by the County and carried out by the agronomists, represented by 5 entities. During the contest period were trained, with rural extension methodology, 120 producers and 230 operators, which is the totality of harvest machines in the community. The main problems of harvest losses were discussed such as: soil management; internal and external mechanism tune of harvest machines; work speed and methods to evaluate the losses. The average of grain losses before the beginning of the contest (crop1991/92) was 144 kg/ha, corresponding 3.6 millions of kg or, approximately, 600,000 dollars. In the first year of the contest 62 harvest machines participated and the losses average was 96 kg/ha, 48 kg/ha less than the average of losses for the community. For the last crop (2002/03), involving 101 harvest machines (80.1 % of the machines of the community) the losses observed was between 99.6 kg/ha and 2.1 kg/ha, being the losses average 27.6 kg/ha. Among the participants of the contest just 6.9 % had losses over the acceptable average, which has been considered as 60 kg/ha. The losses in the state of Paraná were in this crop 73.2 kg/ha which permit to conclude that the contest is an important tool in education programs.

P540. Guidance of field sprayers by light bar using algorithm compared to the conventional system by foam marker guidance in straight-line and in curve

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The quality of ground application depends on a correct guidance. Equipments called light bar is replacing conventional guidance methods in parallel swathing operations, such as foam markers and disk markers. However, the use of theses conventional techniques bring the high possibility of overlaps or flaws on the parallel swathing ground applications. Overlaps mean an additional application cost, besides damages to the culture or environmental, while application flaws need to be avoided to guarantee the maximum efficiency of the correct agricultural input distribution or needed target control. The light bar is alternative guidance equipment to the conventional methods for parallel swathing operation. This equipment also had the function of decrease the overlap of parallel swathing application and increases the ergonomic conditions to the operator. When it was developed, the light bar was used just on straight-lines applications, but with the technology development some light bar models became capable of guidance the operator in curve. Nowadays practically all sprayer companies sell light bar as optional sprayer equipment, mainly for self-propelled sprayers. Some farmers are also using light bar for fertilizers and correctives applications. The accuracy of the alignment is extremely dependent of the operator ability, because the light bar just indicates the correct route. The purpose of this work was to evaluate the light bar guidance accuracy compared to the foam marker in straight-line and in curve. Two Trimble DGPS receivers was used, a model Ag 106 and a model Ag 110. Both models used the optimized algorithm developed by Trimble to correct the GPS errors. A Jacto self-propelled sprayer model Uniport 2000 was used as a vehicle. This equipment has an electronic spray controller that indicated the displacement speed during the test (15 km/h). The basic alignments were made by pickets positioned at every 10 m of the basic straight-line and at every 20 m of the basic curve line, took as reference. The basic reference of the curve test was made by two tangential semicircles forming a "S" format on the flat field. The results indicated that the accuracy of the light bar models was better than the accuracy of the foam marker to guidance parallel swathing applications. The average error of Ag 106 and Ag 110 models were statistically similar (0.22 m and 0.34 m, respectively) in straight-line operation, but this average error was different when compared to the foam marker error (0.99 m). The Ag 110 model is also capable to guide the operator in curve applications (average error 0.60m) and could substitute the foam marker (average error of 1.09 m).

P541. Controlled deterioration and other vigor tests on stored soybean seeds

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The objective of this research was to evaluate the controlled deterioration test and others vigor tests with

stored soybean seeds. This research evaluated the physiological quality of three soybean seed lots using the controlled deterioration test, germination and other vigor tests such as: speed of emergence index, electrical conductivity, accelerated ageing and field emergence, on stored soybean seeds. The germination and vigor of the seeds lots were analyzed before the storage and after three, six and nine months of storage in a cold and dry chamber (10°C and 50%RU). For the lots characterization was used the randomized design with 4 replications for every storage period (0, 3, 6 and 9 months), being the mean compared by the Tukey test at 5% probability. For the controlled deterioration test was used also a complete randomized with a factorial arrangement of treatments 3x3x3x4 [3 seed lots, 3 temperatures (41, 43 and 45°C), 3 seed moisture contents (15, 20 and 25%), and 4 storage periods (0, 3, 6 and 9 months)] being the mean compared by the Tukey test at 5% probability. Correlation coefficients (r) were made between standard germination and vigor versus controlled deterioration. According to the obtained results was verified that the germination and vigor tests, even controlled deterioration, were not efficient to differentiate the vigor of different seed lots. Few correlations between controlled deterioration and other tests were observed, and didn't show consistent.

P542. Drying soybean seed using ambient temperature at low relative humidity

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Under subtropical and tropical environments soybean seed (*Glycine max* (L.) Merrill) are harvested early to avoid deterioration from weathering. Careful after-harvest drying is required and is an important step in maintaining the physiological quality of the seed. Soybean seed should be harvested when their moisture content is in a range of 16-20%. Traditional drying utilizes a high temperature and high humidity air stream passed through the seed mass. The drying time is long because the system is inefficient and the high temperature increases the risk of thermal damage to the seed. New technology identified as heat pipe technology (HPT) is available and has the unique feature of removing the moisture out of the air stream before it is passed through the seed mass at the same environmental temperature. Two studies were conducted to evaluate the performance of HPT to dry soybean seed. In the first trial the seeds were dried from 17.5% to 11.1% in 2 hours and 29 minutes and in the second trial the seeds were dried from 22.56% to 11.88% in 16 hours and 32 minutes. This drying process caused no reduction in seed quality as measured by the standard germination, tetrazolium-viability, accelerated aging and seedling vigour classification tests. The only parameter that indicated a slight seed quality reduction was tetrazolium vigour in the second trial. It was concluded that the HPT system is a promising technology for drying soybean seed when efficiency and maintenance of physiological quality is desired.

P543. Increase of the competitiveness of the soy due to use of natural gas in the grain drying process

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Grains and seeds can be extremely durable, but when inadequately storage is provided. If they were harvested in good conditions, they are kept at low moisture contents and low temperature, their germination power and natural characteristics can be maintain for long periods. Drying process is normally done due to keep biological, chemical and physical characteristics of the seeds since even long storage periods. Two main factors affect the grain quality: high moisture and inadequate drying conditions. This work (report) intends to study the advantages in use natural gas to dry soybeans, evaluating its consumption and looking for operational conditions optimization without damaging grains. Methodology used was a bibliographical research concerning advantages and disadvantages of main fuels used for soy drying. Economic and technical aspects were analysed and compared considering implications of each fuel usage, for drying process, and the quality consequences in the dried grain. Natural gas furnaces are very efficient their flowing out air is free of smoke and impurities. By experiments, we'll be able to reach important parameters in order to optimize operational control and the whole system. Parameters tracked will be: natural gas consumption; energy consumption; drying time; moisture reduction per pass in the drier; drying air humidity (in/out) and grains quality (vigor tests). Rational use of energy at agricultural products drying can contribute for fuel economy and, obviously, for costs reduction. This way, natural gas also offers great quality to grains/seeds, leading to a product with high competitiveness in the market.

P544. Soy industry change of technology from plg to natural gas

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The grain industry is looking for alternatives to better position itself on the market, and among these alternatives we can mention the technological change which aims an improvement in quality and productivity added to a cost reduction. Regarding this scenario a research is presented and developed having as target the impact analysis of an technological change implemented in an agro-industry, which by its turn used plg fuel in its productive process and decided to install natural gas as an energy production source. This survey supports this theme's discussions regarding an aid to help clarify some on going arguments in relation to the effects of a new technology covering problems seen in the organizational social activities and the employee. The work is featured as a study case, and conducts an intensive analysis in one particular industry, considering the following levels: managerial, technical and operational. it utilizes many tools for research (interviews, standard questionnaires, direct observations in the work place and documents), having the purpose to understand the over all situation. For our analysis, the approach included the industry cultural aspects, labor qualification, work conditions, productivity and quality in its processes. The presented results are shown through statistic data covering the necessary adaptations in the process of organitional management, as well employees qualification employed by it. These results show aspects as, a new managerial posture, the necessary time for learing the tasks to be performed, the new physical and mental conditions at work and the new operational procedures. This survey also presents a skills improvement proposal for workers who work in agro industries that chose a change in technology.

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