Annual / Year 3 – September 2018

Cafés de Rondônia

Aroma, flavor and origin

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AVALIAÇÃO SENSOR
NOTA 82,67 PONTOS
LEVE SABOR DE DOCE DE LEI
TOQUES ADOCICADOS DE CANA
MELADO, AÇÚCAR MASCAVO
GARAPA E NOTAS DE AMÊNDOAS
E FRUTAS VERMELHAS
LEMBRANDO O VINHO.
250g
Café
na Amazônia
Alda Barroso

Amazon Robustas: differentiate to achieve recognition

Technology, tradition, and sustainability bring new aromas and flavors from the forest. Many coffee producers in Rondônia have already become aware of this. Among them are populations of the Rio Branco Indigenous Lands, who believe in production of fine robusta coffees as a window of opportunity to improve their quality of life, and in this crop season, they prepared their first micro-lot of specialty coffees. This is the theme of the special report of the third issue of **Cafés de Rondônia** magazine, which portrays the transformation of coffee growing in the state.

Various players in the coffee production chain seek differentiation in this process and in quality for recognition of origin and appreciation of the Amazon biome as a coffee production area. Amazon Robustas have all that is required to take part in the "third wave of coffee", with their hitherto unrecognized or disconsidered aromas and flavors coming under a new perspective of sensory evaluation. All this potential was perceived by diverse visitors (with domestic and international experience in this area), who were in Rondônia in 2018 to debate and enhance the efforts that are being undertaken. These specialists' impressions are recorded in texts and videos, a new feature that we make available in QR code in this issue.

So let's take a quick trip to the past. Many believe that coffee growing in Rondônia is recent history. Yet reports suggest that the state had a pioneering role in coffee growing in Brazil. Could it be? This issue of the magazine carries an article with different versions about when the first coffees appeared in the Amazon. Furthermore, regarding the past, discover how research worked in service of coffee growing and how that is related to the new clones that are now in crop fields. And, speaking of what's new, Embrapa Rondônia is preparing the release of cultivars of individual hybrid clones for 2019 as part of the strategy of a technological package for development and viability of coffee growing in line with new demands and challenges. These are new options for producers that need to stand out in a market with ever greater demands regarding quality and sustainability in the production process.

Coffee is a complex fruit in which each step of the production process is of significant importance. Therefore, the magazine discusses the effects of new spatial arrangements of crop fields, integrated management of the coffee berry borer, and the challenge of performing post-harvest procedures well. Another text highlights the potential for land use in the southwestern Amazon, and how wide variability of soils may determine success or failure in coffee growing.

What about the future? Among the highlights of this issue is a forecast of climate trends in Rondônia for the next 15 years. This can assist long-term planning of water resource management for the crop and its sustainability.

For this issue, specialists have prepared recipes whose main ingredient is an Amazon Robusta to make your mouth water. A flavor that goes beyond the cup!

It has been quite a journey to gather all these professionals, spur reflection, and promote knowledge on what is happening in the world of coffee in Rondônia. We hope the content of this publication is as pleasurable and exciting as good coffee. Good reading!

The editors.

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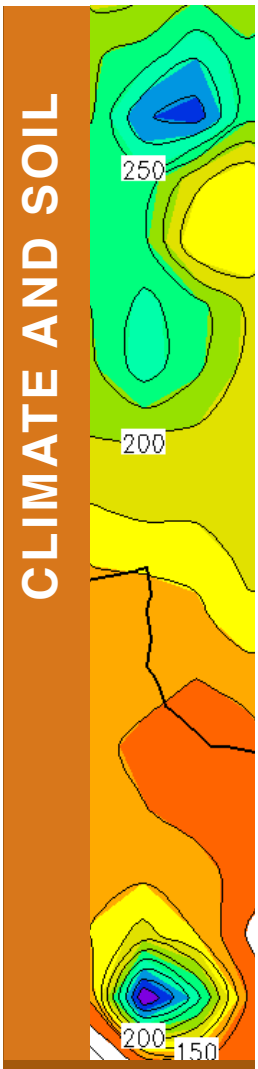

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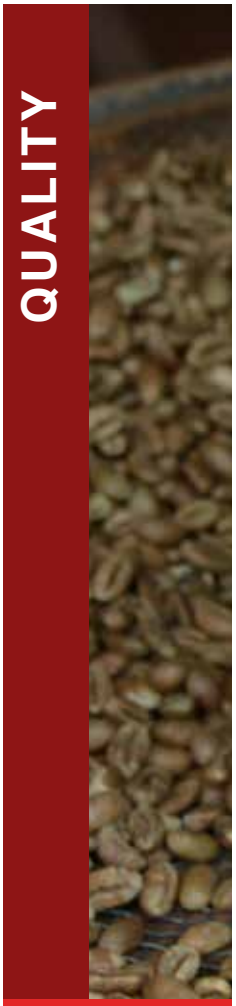

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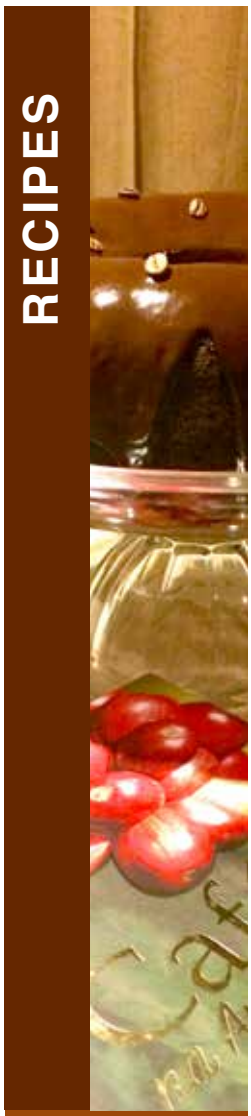

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Cafés de Rondônia

Coffees of Rondônia Magazine
(Revista Cafés de Rondônia)
Flavor and quality from the Amazon

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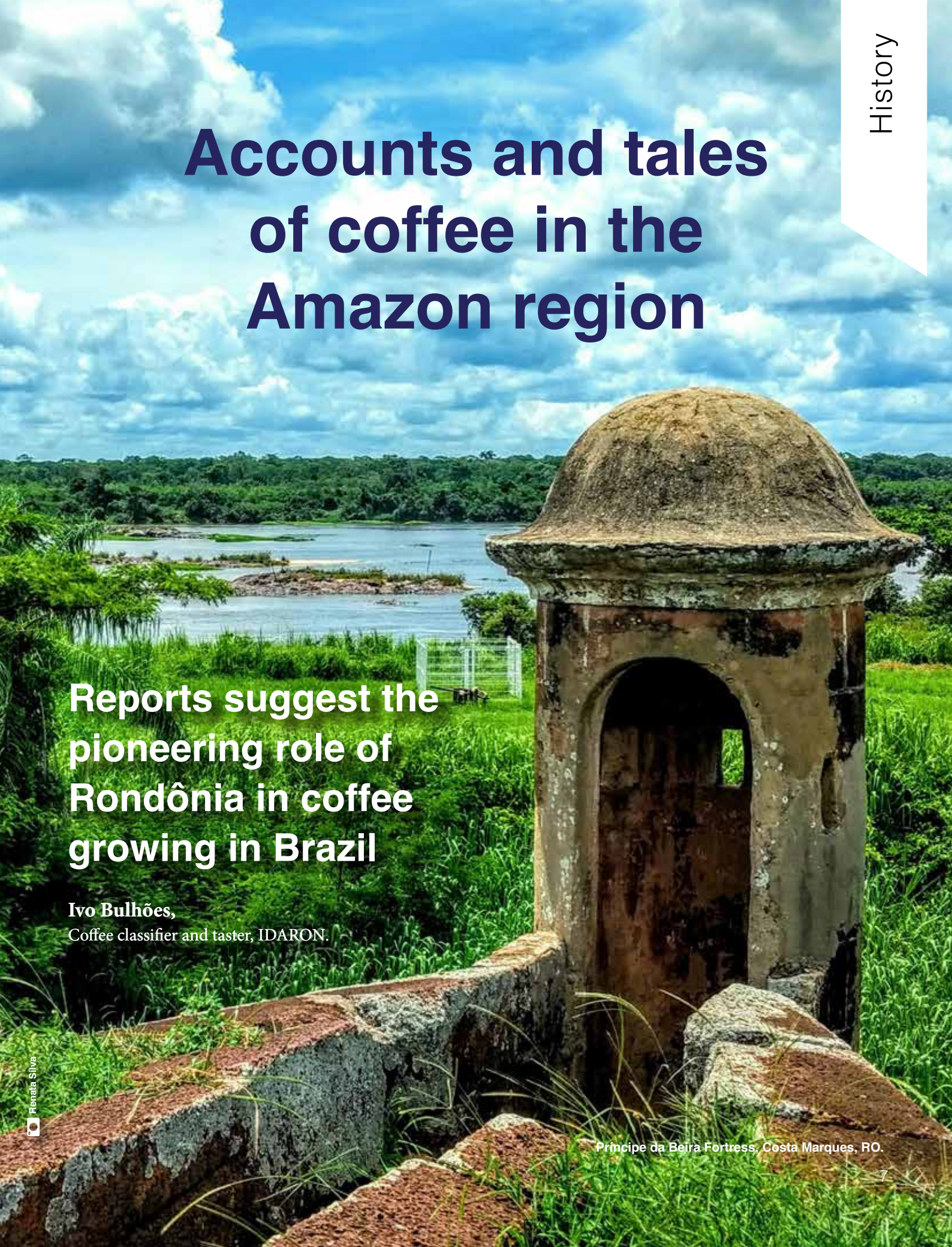
Accounts and tales of coffee in the Amazon region

Reports suggest the pioneering role of Rondônia in coffee growing in Brazil

Ivo Bulhões,
Coffee classifier and taster, IDARON.



Renata Silva

Príncipe da Beira Fortress, Costa Marques, RO.

So, when did the first coffee fields appear in the Amazon? Is it truly as told in the official story? Did coffee emerge among us as a successful act of biopiracy? There are many versions of the story. One of them is that the coffee trade escaped from Arab control in 1616 when the Botanical Gardens of Amsterdam received the first plants. They were then grown in experimental fashion in the Dutch colonies of Java (1658), Sumatra, Timor, and other colonies in Indonesia (1699).

King Louis XIV of France received a coffee plant as a present from the Dutch in 1714, which was carefully planted in the royal greenhouse in Paris. After that, the first French experiences of commercial growing occurred when the coffee was transplanted from the garden of Plantes, in Paris, to Bourbon Island, a French colony in the Indian Ocean, in 1715.

With acclimatization of coffee in Asia, the French also entered the coffee market. Around 1720, coffee trade originating from the Asian colonies totaled ninety tons, spurring French efforts to develop new plantations in their colonies. Coffee growing was introduced in Dutch Guiana (1718) and from there expanded to tropical regions of South America.

Another version is that of the arrival of coffee in the Antilles in 1723 when an official of the French navy, Gabriel-Mathieu d'Erchigny de Clieu, supposedly jumped over the wall of the royal greenhouses to steal coffee seedlings. This occurred after the mission of Sergeant Major Francisco de Melo Palheta going up the Madeira River (1722), the main tributary of the Amazon River, and shortly before the epic narrated in history books regarding the arrival of coffee in Brazil (1727). This officially recognized historic fact occurred in the Amazon region, which would later come to be known as Rondônia, nearly 300 years ago.

There are reports of the presence of Palheta in the Guaporé River valley in 1719 when gold had been discovered at the headwaters of the river. One of the aims of Palheta, in addition to gold and silver, was to find the "drugs of the backcountry". On this trip, he was said to have received word of coffee, a coveted plant already acclimatized, in lands formerly of Spain (up to the Treaty of Madrid, 1750). This is corroborated by the testimony of Elvis Pessoa, leader of the quilombo community composed of descendants of African slaves that worked in building the Principe da Beira Royal Fort in the municipality of Costa Marques, Rondônia, and who live in its surroundings still today.

Elvis Pessoa, who performs research on the presence of Africans in the region, furthermore states that when the old residents of Conceição, in the Guaporé valley, went to live there in 1889, they already found cacao and coffee plants that were grown by indigenous peoples instructed by the Spanish Jesuits. These Indians later came to serve as a labor force for the Portuguese crown. He also makes mention of a place called *"Sítio Labirinto"* ["Labyrinth Farm Place"], near Costa Marques, where abandoned coffee and cacao plants can be found, which were for many years maintained by African slaves who learned from the Indians.

Jean Carlos Chianca dos Santos, a coffee grower from Costa Marques and great grandson of one of the trailblazers of the region of the Guaporé River, reports to have heard stories of trading of cacao and coffee grown in the region of the Principe da Beira Royal Fort and that remained from plantings made by African slaves during construction of the fort. These products would have been shipped from the Costa Marques port. These stories are told by people in

Renata Silva

the region. It should be stressed that investigation of these informal reports under a scientific method would be fitting.

More reports precede the arrival of coffee in the Amazon

The controversy as to when coffee arrived continues. The historian Renato Venâncio reveals to us that one of the most outstanding Portuguese political thinkers of the seventeenth century, Duarte Ribeiro de Macedo, already mentioned the existence of coffee plantings in Amazon regions (1673). In letters exchanged between Father Antônio Vieira and Duarte Ribeiro de Macedo, the Jesuit complained about the prohibitions on Brazil imposed by the French and Dutch monarchies on planting these Asiatic species, as coffee was considered up to that time. The first account that coffee had already arrived in Brazil well before 1727, the date most accepted by historians, is owing to these letters.

The hypothesis of the official arrival of coffee in the lands of Rondônia and in Brazil is linked to the military incursions of Francisco de Mello Palheta from Pará. The Sergeant Major is said to have suggested to the governor of French Guiana, d'Orvilliers, that he sell some coffee seedlings, who, according to express orders from the King of France, did not approve the request. Palheta then sought to draw near the governor's wife, who did not long resist the enticements of the young military officer. When Palheta returned to Brazil, Madame d'Orvilliers sent him a bunch of flowers, where, hidden by the leaves, coffee seedlings were to be found. Nevertheless, dedicated to fulfilling his mission, Palheta had already filled the lining of his uniform with seeds of the coveted plant. He made the first planting on his lands in the municipality of Vigia, Pará, where he came to grow more than one thousand plants, for which he requested one hundred slave couples from the government.

In contrast, historians such as Artur César F. Reis attribute a pioneering role in introducing coffee in Brazil to Francisco Xavier Botero, a member of Palheta's delegation. Most importantly, it is said that already at the beginning of the eighteenth century, small lots of coffee from the North of Brazil began to arrive in Portugal.

On January 25, 1731, the "Gazeta" of Lisbon published the following report: "In the ships most recently arrived from Maranhão, some coffee came that had been discovered in the backcountry of that state of even better quality than that of the Levant, and it is said that on the farm from which it was harvested there was enough to load twenty ships." Three years later (1734), three thousand arrobas (an arroba is 15 kg) sent by the *Companhia Geral* do Maranhão e Grão-Pará [Maranhão and Grão-Pará Trading Company] entered the port of Lisbon at a time in which coffee consumption was still limited in Portugal.

At any rate, approximately 240 years after the first plants arrived in the Amazon region, planting of Coffea arabica resumed in the 1960s, and in the 1970s, *Coffea canephora* (conilon and robusta) was introduced. *Coffea congensis* (Congolese coffee) was later introduced in the settlements of the land reform and settlement agency, the Instituto Nacional de Colonização e Reforma Agrária - Incra, which promoted wide expansion of coffee growing, especially in the state of Rondônia, with the same strategic military intent of more than two centuries ago: consolidation of Amazon settlement. But that is another story.

Research in service of coffee growing

More than 40 years of challenges and generation of technologies for the Amazon

André Ramalho and Rodrigo Rocha,
Embrapa Rondônia

Photo Archive / Embrapa

Coffee field day at Embrapa, 1988.

Some striking fragments over four decades help tell the story of coffee growing in Rondônia. The agrarian reform and settlement model implemented by the *Instituto Nacional de Colonização e Reforma Agrária* – Incra [National Institute for Land Settlement and Agrarian Reform] favored farm family entrepreneurial activity in Rondônia. Numerous difficulties have been overcome by "fearless pioneers" in settlement and establishment of one of the most expressive coffee growing areas of Brazil. Over time, they have learned to become aware of "the will of the land", to grow good coffee, and to live with the climate variations of the Amazon. They have gotten the knack of growing the unpolished and productive conilon and of promoting the eccentric flavors of the promising Amazon Robustas. Now, young and old coffee growers can adopt advances in regional coffee genetics and innovate with technologies for management and improvement of the coffee growing environment.

"They have gotten the knack of growing the unpolished and productive conilon and of promoting the eccentric flavors of the promising Amazon Robustas."

Genesis and evolution in coffee growing in Rondônia

The first demonstration crop of the arabica coffee plant, using the 'Mundo Novo' cultivar, was likely established by a private land settlement company in the Federal Territory of Rondônia in the middle of the 1960s in an area around Vila de Rondônia, currently in the urban area of the municipality of Ji-Paraná.

In the initial phase of expansion of the coffee growing area of Rondônia, from 1970 to 1980, mainly arabica coffee cultivars were planted. Then conilon coffee began to gain ground. Conilon seeds of unknown genetic origin were used that came from commercial production fields from municipalities in the northern region of the state of Espírito Santo, where many migrants had family. In the following decades, local demand came to be met by seeds collected from the best coffee fields spread throughout Rondônia.

However, sources of genetic variability of C. canephora were lacking for breeding efforts to correct "genetic defects" in conilon. Therefore, assistance was obtained in the state of São Paulo from the Instituto Agronômico de Campinas (IAC) through selection of 18 seed varieties of conilon and robusta from its Active Germplasm Bank (AGB). That work benefitted from the consulting services and direct participation of the IAC breeder and geneticist Dr. Alcides Carvalho.

The pilot experiment of the new germplasm was set up in March 1981 in the experimental area of Embrapa in Ouro Preto do Oeste, RO, and conducted until 1998. That work resulted in selection and recommendation of seven varieties for Rondônia, with mean yield of 28 bags of hulled coffee/hectare. At that time, the coffee yields obtained from the new varieties greatly exceeded the state average. In the 1980s, Embrapa Rondônia facilitated the use of small volumes of seeds of the best lines and cultivars in testing arabica, conilon, and robusta.

Analysis of a period of eight crop years (1995 to 2002) of seed production by the Embrapa Coffee Breeding Program in Rondônia shows that around 7.5 tons of seeds were distributed and sold, 95% of which were absorbed by the market in Rondônia (Table 1). The remaining volume was sold to city governments and

nurseries of the states of Amazonas, Pará, Mato Grosso, and Acre. It is noteworthy that the demand for arabica coffee seeds was low, 2% of the total volume, denoting little interest from producers, announcing the end of the "pioneering period of the arabicas" in the state.

Reduction in donations and sales in the last two years of the period (2001 and 2002) shows the direct and indirect effects of a sharp decline in coffee price in the international and regional market. This period constituted one of the biggest crises of C. *canephora* in the last 15 years, a situation that led many producers to abandon or reduce investment in coffee growing.

Table 1. Account of seed production of C. *canephora* (conilon and robusta) and diverse cultivars of C. *arabica* in the period of 1995-2002. Source: Embrapa Rondônia, 2018.

Year	Seed production (Kg)	Conilon and Robusta	Arabica
1995	260	260	0
1996	0	0	0
1997	200	200	0
1998	370	370	0
1999	1.689	1.675	14
2000	4.243	3.953	290
2001	832	735	97
2002	89,5	85	4,5
Total	7.683,5	7.278,0	405,5

To encourage partial renewal of declining or aging coffee fields in the face of constant scarcity of seeds, the state government launched the "Plant Coffee" campaign in 1997, coordinated by the *Secretaria de Estado de Agricultura e Reforma Agrária* – Seagri-RO [State Department of Agriculture and Agrarian Reform]. As the main goal was production of conilon seeds, technical assistance was requested from Embrapa Rondônia. The researcher Wilson Veneziano and the agricultural technician Milton Messias, both of Embrapa, had made a pilot field survey to have knowledge of the best conilon populations grown in the Cacoal and Rolim de Moura regions, and so Embrapa was prepared to support this governmental demand. Forty tons of coffee seeds were produced and distributed to producers in the state by Seagri-RO from July to September 1998.

In the final years of the 1990s, "coffee clone fever" began and spread in some specific regions of the state. Thousands of conilon clonal plantlets that were not certified and of unknown genetic origin coming from Espírito Santo were sold in Rondônia. In short order, just as fast as the adoption of this new technology, came the disappointment and financial loss of those who first adopted it. Nearly always, the problem was not the technical quality of the plantlets, but rather the limited genetic base of the clones from Espírito Santo that were sold, and the consequent lack of adaptability to the climate and soil conditions of the Amazon.

From the 1997/1998 to 2000/2001 crop years, Embrapa made various expeditions for pre-selections in the

productive stage and for clonings in the post-harvest period of coffee plants phenotypically selected from the best commercial crop fields of Rondônia. A total of 1158 parent plants were selected and cloned, which were placed under different environments, management practices, crop treatments, and other factors. A total of 644 promising clones resulted from the germplasm, and they composed three preliminary clone competition trials (*ensaios preliminares de competição clonal* - EPCC-Conilon).

Wilson Veneziano (left) and Milton Messias (right), 1988.

These expeditions constituted a broad and representative sampling of the genetic diversity and potential of the coffee plants grown in the state. After various natural selection cycles among producers over the 1970s to the end of the 1990s, a true bank of genetic variability sources was formed for development of new commercial cultivars for clonal coffee growing.

One of the cultivars, the multiclonal conilon 'BRS Ouro Preto', released by Embrapa Rondônia in 2013, was the first commercial product certified and registered and made available to coffee growers in the western Amazon and Mato Grosso (North and Southwest regions), originating from the genetic collection expedition of 1997/1998.

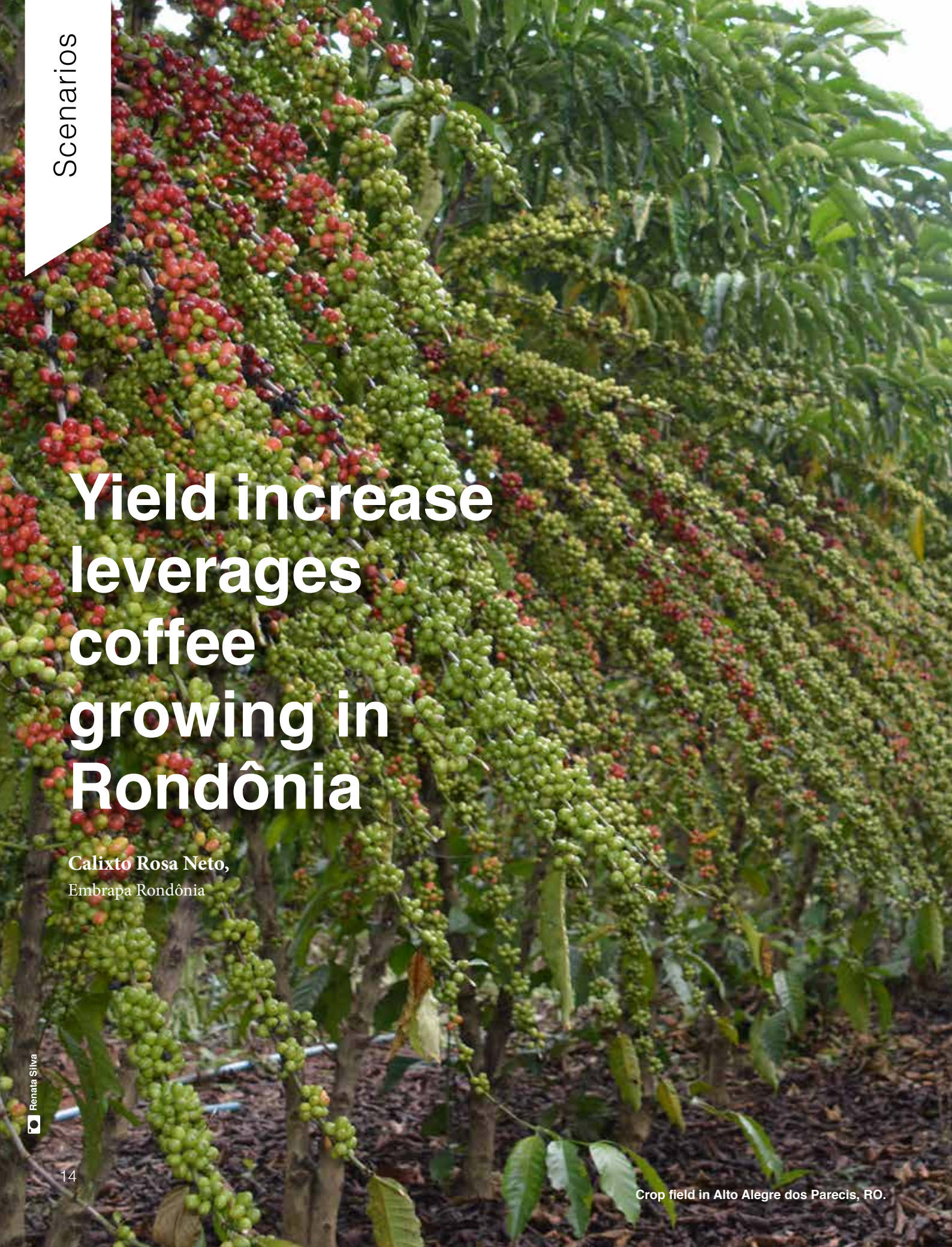
In the short and medium term, the ambitious objectives of Embrapa Rondônia are development of new clonal hybrid cultivars (resulting from intervarietal crosses of conilon and robusta) and development of previously unknown cultivars of fine beverage Amazon Robustas.

May these new releases be "bridges" to transfer technological innovations of agronomic processes toward economic feasibility and sustainability of coffee growing, regional self-sufficiency of coffee and derivatives, and the well-being of the entrepreneur and farm family.

Photo Archive / Embrapa

Yield increase leverages coffee growing in Rondônia

Calixto Rosa Neto,
Embrapa Rondônia



Renata Silva

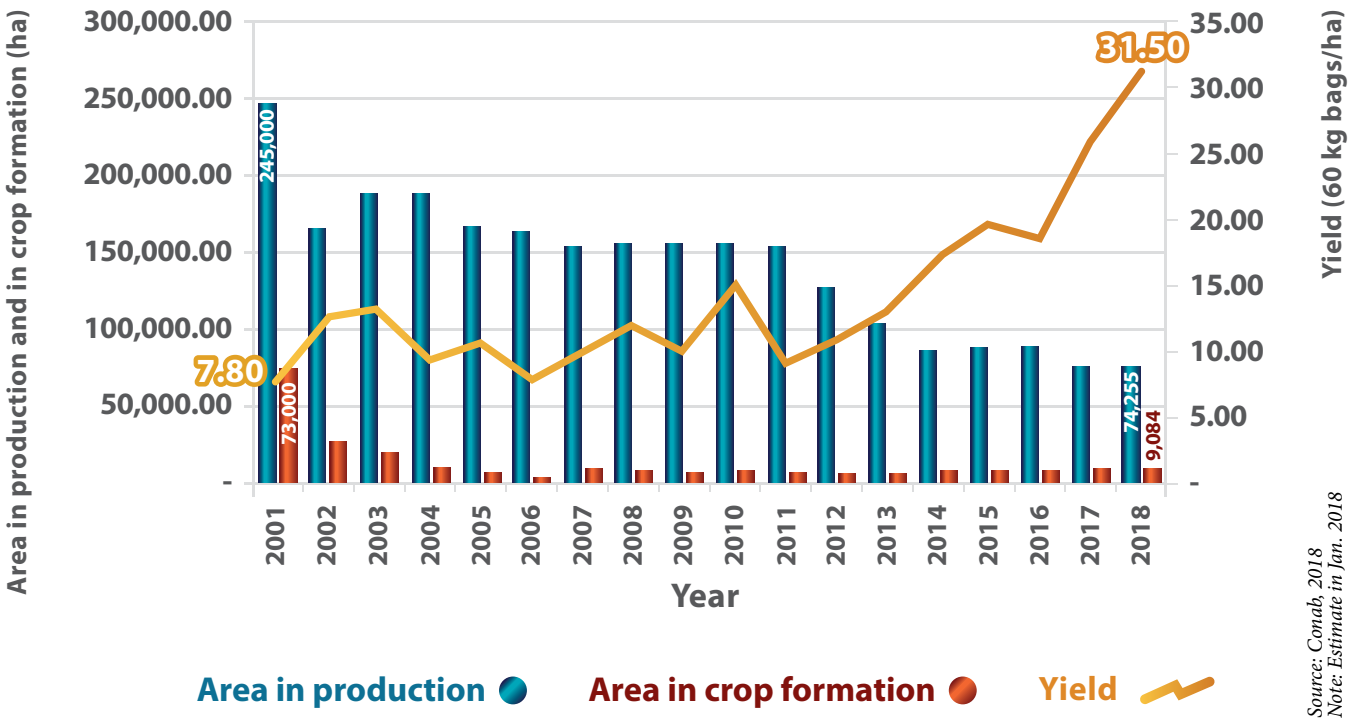
Crop field in Alto Alegre dos Parecis, RO.

According to data from the *Companhia Nacional de Abastecimento* – Conab [Brazilian Food Supply Agency], coffee growing in Rondônia reached its peak in planted area in 2001, when it totaled 318,000 ha. Of that total, 245,000 ha of coffee were in production, resulting in 1.9 million bags of hulled coffee, or a mean yield of 7.8 bags/ha.

It should be noted that already in the year 2000, the price of the product began to fall, with a mean value of R$80.74 paid to the producer per bag of hulled coffee (Emater-RO). This was 23% below what had been paid in the previous crop season. This tendency of declining prices became more pronounced in the next two years: in 2002, the mean price in current monetary values was R$52.12, in other words, 35.4% lower than the price paid in 2000.

Due to the low prices paid for the product, most notably in the 2001 and 2003 crop seasons, there was a sharp decline in planted area, and prices have oscillated from 2001 to 2018. Though area planted to coffee has declined nearly 74% in the last 18 years, yield has increased by 292%.

Evolution of areas in production and in crop formation and of coffee yield in Rondônia from 2001 to 2018



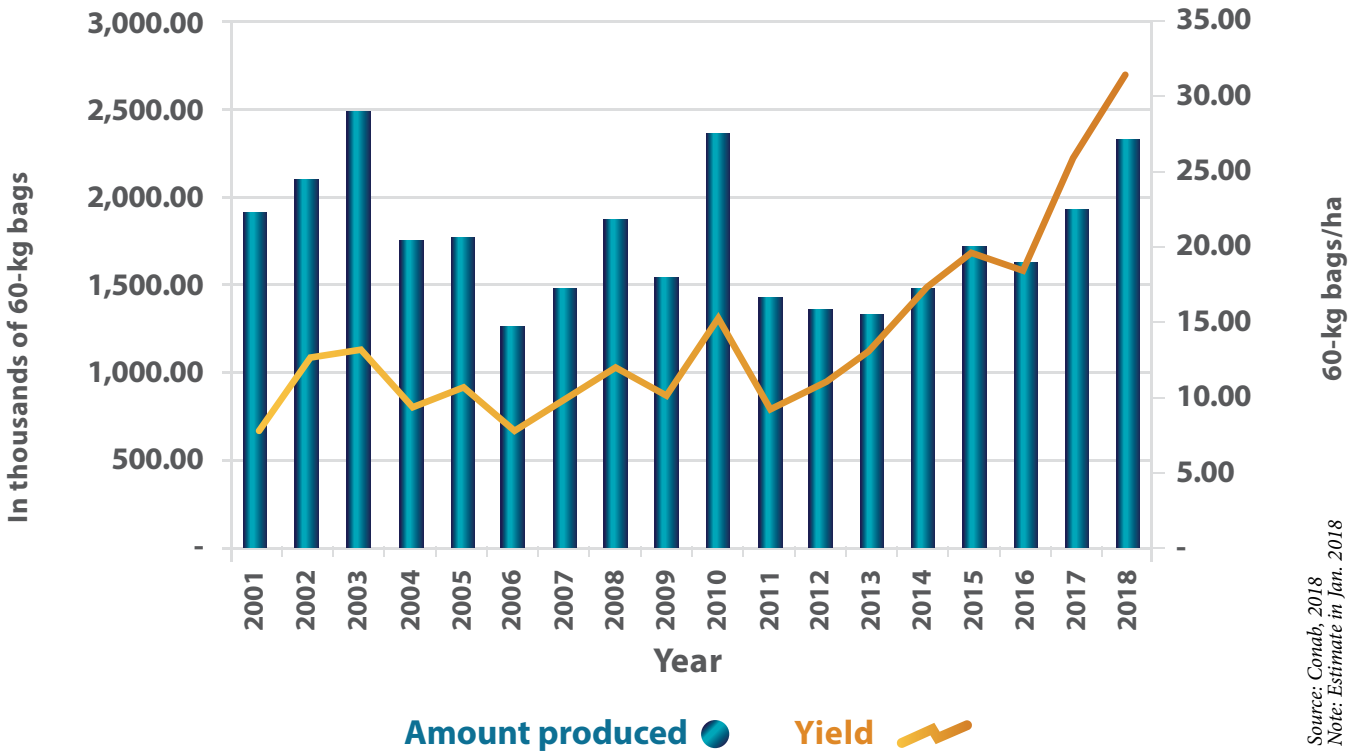
Source: Conab, 2018
Note: Estimate in Jan. 2018

A gradual reduction in the area planted to coffee can be seen beginning in 2011. This reflects eradication of old areas planted for seed propagation, which have now been replaced, though on a smaller scale, by planting of higher yielding clonal varieties. A diagnosis of the coffee production chain made in 2011 by Embrapa found that around 4% of the area planted to coffee in the state consisted of clonal varieties. Estimates are that this has now reached 37% in the 2016/2017 crop season (IBGE, 2017).

There has been a significant reduction in planted area. Total production, which in 2010 was 2.37 million 60-kg bags of hulled coffee, likewise decreased until 2013, when 1.36 million bags were harvested. After that, total production began to recover, and estimates are that around 2.19 million bags will be harvested in this crop year.

> **“in 2018, the third largest crop in the last 18 years will likely be harvested, only smaller than 2003 and 2010, but in a 61.9% and 53.7% smaller production area, respectively.”**

Evolution of the amount of coffee produced and of yield in Rondônia from 2001 to 2018



Source: Conab, 2018
Note: Estimate in Jan. 2018

Data indicate that the current increase in production can be attributed to gains in yield, which have mainly come from adoption of a more technologically advanced production system, with the use of clonal varieties, irrigation, fertilization, and adequate crop management techniques. In spite of express reduction in planted area over the period examined, in 2018, the third largest crop in the last 18 years will likely be harvested, only smaller than 2003 and 2010, but in a 61.9% and 53.7% smaller production area, respectively.

Therefore, yield is the main factor that explains the transformation in coffee growing in Rondônia.

Specialty coffees and differentiated flavors

Renata Silva and Enrique Alves,
Embrapa Rondônia

Josiana Bernardes was born in Viçosa, Minas Gerais, and has been in Spain for 25 years. Her academic training was in Food Technology, Nutrition, Marketing, and Commercial Distribution, and she has worked with dairy products, water, wine, and chocolate. Beginning in 2012, she has plunged into the world of coffee. Currently, she works in training and consulting in specialty coffees and it is the owner of IDCoffeelab in Madrid, Spain. She works exclusively with coffee in various producer countries and in her quality control laboratories. In addition, she is a volunteer in the organization International Women's Coffee Alliance (IWCA). In this conversation for Coffees of Rondônia (CR) magazine, Josiana Bernardes tells a bit of her story with coffee.

Marcio Erli

CR – Tell how coffee became part of your story.

Josiana Bernardes – Coffee is in my soul, it's a passion, I'm rooted in it. I have worked with various products, but I already had an intuition that the next would be coffee. But I hadn't imagined that I would plunge so deeply into this world. I was drawn through the sense of smell, the aroma of my childhood. The first cupping I took part in was filled with aromas that carried me back home to when I was a child. Because on my paternal grandfather's farm, where I spent my vacation time in Minas Gerais, there was coffee in the drying yard in July, and they roasted their own coffee. So I had a great emotional attachment to all those aromas that I sensed once more. Since I live outside of Brazil, in Europe, coffee reconnected me with my roots and truly captured me. I'm used to saying I belong to two worlds: the world of the coffee producer and coffee consumer. Half of my life I spent in a producer country and the other half in a consumer country, and I try to be this bridge in all I do, acting in a very collaborative way. I began to work exclusively with coffee in 2012 as a course coordinator of the Specialty Coffee Association – SCA, with education and consulting services in specialty coffees.

CR – You are a member of the IWCA; what is your role in this association and what do women represent in the coffee production chain?

Josiana Bernardes – Work in the IWCA is on a volunteer basis, donating one's efforts, in which connections and a network of information, education, and global support are created. It is very gratifying to be part of this network and talk about it around the world. In my travels through various producer countries, I saw an army of women in the field. I was moved by this situation and began to work in collaboration on behalf of women in coffee through the IWCA. One of the endeavors is granting scholarships to daughters of producers to attend certification courses in coffee, an opportunity to get to know the consumer market and final product and obtain important information to be able to act. In addition, we arrange space for the coffee they produce, with global visibility. Women can have entrepreneurial skills without becoming men, without fierce competitiveness, with sensitivity. Women like to be up-to-date, pursue education, and end up innovating the sector. When women feel they are part of the process, they can contribute even more. We talk about providing visibility, including, adding, because then we all gain. In a short time, the IWCA has become an example, removing women from anonymity, and they felt part and joined together, achieving miracles. All of this never fails to move me; I feel part of this value chain.

CR – In your work, you have the opportunity to get to know the most diverse production regions. Which of the coffees from these locations impressed you most and why?

Josiana Bernardes – Each country was fascinating because of its singularity, because coffee is culture and an emigrant product by nature. But it is different in each country, region, and farm, and from lots within each plot of land. That's fantastic! Discovering new flavors and meeting people involved in this product. Ethiopia never fails to impress because 90% of the coffee is still wild, pure, born in the forest. It was a trip to the heritage of humanity, of intact agriculture. They buy green coffee in the fruit and vegetable market and roast it at home. This makes you think of the Brazilian market, the biggest producer worldwide, and most people have never seen a green coffee bean, unroasted. Regarding Brazil, I see that there is great potential for mountain coffees, produced by small families, who are getting a return in terms of quality and recognition and can continue to live in the country. The work in Rondônia really drew my attention. It has great potential

to be prominent and occupy its place as origin. I carry out an awareness raising activity in my courses by presenting clean cup robustas and conilon (without defects) and specialty coffee, to appreciate special coffee. I enjoy seeing how students are surprised in experiencing a quality canephora. They immediately ask me where they can get it.

CR – Are there big differences among the coffees consumed in the American, European, and Asian markets? How do you see it?

Josiana Bernardes – Within the specialty coffee market, I notice a difference in the sense of variety of origins. Europeans are privileged regarding diversity of origins. I believe that the United States and Canada consume more coffees from Brazil and Central America. The specialty coffee market demands quality and diversity. Europe is the world's second largest market; it is more stable and is still underestimated by Brazilians, who look more toward the United States. I find that roasting is a process that still leaves much to be desired in many markets. Just as it is wrong to say that an espresso machine makes good coffee, it is also wrong to say that a machine is going to roast your coffee well. Education and training is fundamental, both for the producer and for the service and consumer market.

CR – What does a coffee need to have to be considered special?

Josiana Bernardes – A clean cup, that is, free from primary defects, those that modify the flavor. It needs to have a differentiated flavor profile, which raises its score. Origin, related to the regions of the coffee fields, which can determine quality characteristics that are inherent to the region where the plant is grown. Higher than 80 points by the Specialty

Marcio Erli

Coffee Association (SCA) is considered special, based on counting defects and profile differential in testing. Above 85 points are the most desired coffees that get the best price in the specialty market.

CR – Which producer markets do you consider as having potential in becoming a reference in fine coffees (arabicas and/or robustas)?

Josiana Bernardes – Brazil has potential not only as a producer but also as a consumer of the specialty coffees it produces. Producing specialty coffees requires effort from the producer, but it is worth it because the consumer market for good coffees is awakening and growing in Brazil. I was pleased to visit micro-roasters that are in direct contact with producers. We no longer need to consume what is left over from exports. Brazilians can have more pride than ever in their market potential and in producing excellent micro-lots. Information is the only way. When we try real coffee, well roasted and well served, there's no turning back.

CR – We know that your contact with fine robusta coffees is recent. Was that a change of paradigm for you?

Josiana Bernardes – It was a total surprise. As soon as I tried a pure robusta, well processed, with an exotic profile, I immediately began to make robustas known and included trying these coffees in my courses, breaking taboos.

CR – What way do you think the market will absorb the new robustas? Can Brazil be a big player/competitor?

Josiana Bernardes – Brazil can be a big player/competitor in quality, but we have to be realistic. Labor is expensive in agriculture, and it is difficult to compete on price with countries that still have cheap or even slave labor. We have to show our plus in quality and sustainability to the buyer. A country that moves forward with labor laws and recognizes the rural worker will have problems in competing on price. I go back to placing my sights on the domestic market as an interesting site for greater investment.

> "When we try real coffee, well roasted and well served, there's no turning back."

CR – In recent years, coffee growing has gone through revolutions in which quality is as important if not more important than production. What will the next wave be?

Josiana Bernardes – That of internal domestic consumption; and producers that go through training will begin to roast their own coffee. This is what is "brand new" - consuming and appreciating the local product. Through training and more information to the consumer.

CR – The state of Rondônia is predominantly a producer of *Coffea canephora* (conilon and robusta) and is also going through a big evolution in the production sector, with use of technologies and improvement in quality. So much so that the state is now one of the largest producers of this type of coffee and has been gaining attention through good results achieved in recent years. Do you think that Amazon Robustas have potential for winning over markets beyond the traditional commodity markets?

Josiana Bernardes – I believe in this new era of canephora and I spread the word. Because we have to respect the culture of coffee consumption, and various countries only attain coffee perfect for them through blends of arabica and robusta, making for a cup of coffee that is strong and oleaginous. No arabica is able to impart the oleaginous features and

intense body of robusta. And a good robusta can be consumed straight. The robustas on the market of some producer countries denigrate this variety because the market has only known very poor quality canephora. But I think this is going to change.

CR – You visited Rondônia recently; what did you think?

Josiana Bernardes – I was invited to participate in the Amazon Robusta Days (Jornada dos Robustas Amazônicos) event in Rondônia in May of this year, and I was able to get to know a little of coffee growing in the state. I was surprised and struck by the human factor and technological development involved with coffee growing in Rondônia, by the work of Embrapa and the support of the state government and other institutions united on behalf of coffee. I had the opportunity of trying Amazon Robustas on the coffee plant and I noted that the flavor of the fruit is different for each clone; that is something new and an incredible potential. I have a desire to closely follow the process so that all these flavors I observed in the fresh fruit get to the cup for the consumer. They are raw diamonds in the field that now need to be polished. That can be done by implementing good drying processes adapted to the hot and humid climate, avoiding contamination by fungi and very high temperatures that affect quality. And roasting that is well performed and controlled concludes this process.

CR – What kind of coffee do you prefer and why?

Josiana Bernardes – Disciplining our senses is a scientific process and involves the psychology and sociology of how we perceive flavor in foods. The tendency is to like what we have known from the time of our childhood and surroundings, our habitat. I always consider tastes with a great deal of respect in regard to the culture and origin of the individual. My personal taste is for natural processes, which brings me this complexity in the cup and much more information from the terroir of origin, with pure and unique characteristics.

> “The robustas on the market of some producer countries denigrate this variety because the market has only known very poor quality canephora. But I think this is going to change.”

CR – As a specialist, what tips do you give to *Coffea canephora* producers in Brazil and in Rondônia?

Josiana Bernardes – More investment in training, planning, and pursuing ecological and social sustainability. It is also necessary to prioritize cultivation based on plant nutrition. Providing training and passing on information to neighbors, spreading knowledge. Cooperating, collaborating with each other - in the end the family, society, and region gain from this. Parity is important, equality and recognizing the important activity of women throughout the process. Brazil is the only country I’ve visited that has a federal institution like Embrapa and other state institutions that provide support and work with the producer. This support should be appreciated. Coffee growers need to pay more attention to adequate drying and roasting processes to conserve all the flavors we are able to identify in the crop field.

Marcio Erli

Enrique Alves

Indigenous child in the midst of the coffee field, Alta Floresta D'Oeste, RO.

Indigenous coffee growers!

Technology, tradition, and sustainability yield new aromas and flavors from the forest

Enrique Alves,
Embrapa Rondônia

There is no general concept that serves to classify indigenous populations, unless, of course, classification as human beings. As human beings, their cultures, traditions, and levels of relationship with the environment are very broad and differentiated. Improvement in the quality of life of these populations, as well as social inclusion, is a question of public policy and a long-standing demand of this array of ethnic groups that still remain in Brazil.

Sustainable agriculture may help to promote this balance between obtaining financial resources, improving life in indigenous villages, and preserving the forest. In this context, coffee growing may be an excellent choice. Coffee adapts to cultivation both in full sun and under tree shade and has high profitability per area, resulting in less dependence on large crop fields to constitute a viable production module.

The indigenous are not limited to extraction activities; they have always collected and conserved seeds and fruit. Their tradition includes care for and love of the land and the environment. They have simple forms of agriculture and are extremely selective at the time of harvest. This actually seems to be the description of family-based producers specialized in quality coffees. They are the main characteristics that make the indigenous peoples potential producers of fine coffees.

This potential is being enhanced through efforts of guidance and support in producing quality sustainable coffees. This work is being developed by Embrapa Rondônia and the Secretaria Municipal de Agricultura de Alta Floresta d' Oeste - Semagri [Municipal Agricultural Service of Alta Floresta d' Oeste] on the Rio Branco Indigenous Lands, among the Aruá and Tupari ethnic groups.

These institutions were invited by one of the indigenous leaders, Dalton Tupari, at the end of 2017 during an event that dealt with coffee production in Rondônia. Amid statements from technicians, researchers, and politicians, the indigenous leader felt motivated. He wanted to be part of this movement of transformation of coffee growing in Rondônia of which all spoke with pride. He sought support to change the reality of common coffee producers by investing in production with quality.

The agriculture of these ethnic groups is diversified,

Enrique Alves

Indigenous child playing with coffee fruit.

with little application of technology. They plant subsistence crops like cassava, maize, and some fruit-bearing plants. The main source of income is collecting Brazil nuts, which is already done in quite an organized manner. Coffee growing likewise is not new; it has been part of the agriculture of these villages for 15 years. Small areas are planted and cultivated mostly in glades in the midst of the forest, mixing fruit trees, nut trees, and some traditional crops.

Crop treatments are quite rudimentary and already dabble in the use of clonal plantlets and herbicides. Post harvest, until that time, was performed in quite an ill-conceived manner. Drying occurred on a dirt yard or was outsourced. In the latter case, the drying process occurred under high temperatures after delays in the crop area and in the lines of the coffee dryers. The result was considerable loss in quality, and the coffees were sold in the common mass of commodity coffees.

To transform this scenario, the indigenous communities began to receive the first technical visits and specific training sessions regarding coffee growing at the beginning of 2018. The initial focus was on post harvest, one of the main bottlenecks of coffee growing in Rondônia and in Brazil. Solar dryers, raised drying screens, were built with an emphasis on sustainability, and the indigenous began to practice concepts already familiar to them: collecting ripe fruit and selecting that which is healthiest and most well formed.

Indigenous producers of Fine Amazon Robustas

Contrary to what one may imagine, when these indigenous producers began to work with production of specialty coffees, they renewed their concern for the environment and reinforced a desire to be sustainable and organic. They do indeed want technology and evolution in their agriculture, however, with respect for their tradition, preserving and interacting with the forest. What's more, they have given up the practicality of herbicide use in favor of mechanical weeding and are thinking of protecting the soil with green manure crops between rows.

The initial effort has already begun to bear good fruit. The indigenous of the Rio Branco Lands of the Aruá and Tupari ethnic groups will produce their first micro-lot of Fine Amazon Robustas. The result of sensory analyses of the first samples of the coffee beans is highly encouraging and there are buyers already willing to pay more for this delicacy. The specialist in specialty coffees, Josiana Bernardes, indicated the great potential of these coffees, which have unique sweetness, aromas, and flavors and a striking aftertaste.

Indigenous producer Valdir Aruá in manual selection of coffee.

Enrique Alves

Impressions of a specialist

Sample analyzed:
Rio Branco Indigenous Land

Green coffee bean:
aromatic, intense,
molasses, ripe red berries.

Trial roast

Fragrance:
toasted cereal grain,
caramelized butter,
chocolate, and dark
caramel.

Aroma:
caramel, Toflle, malt.

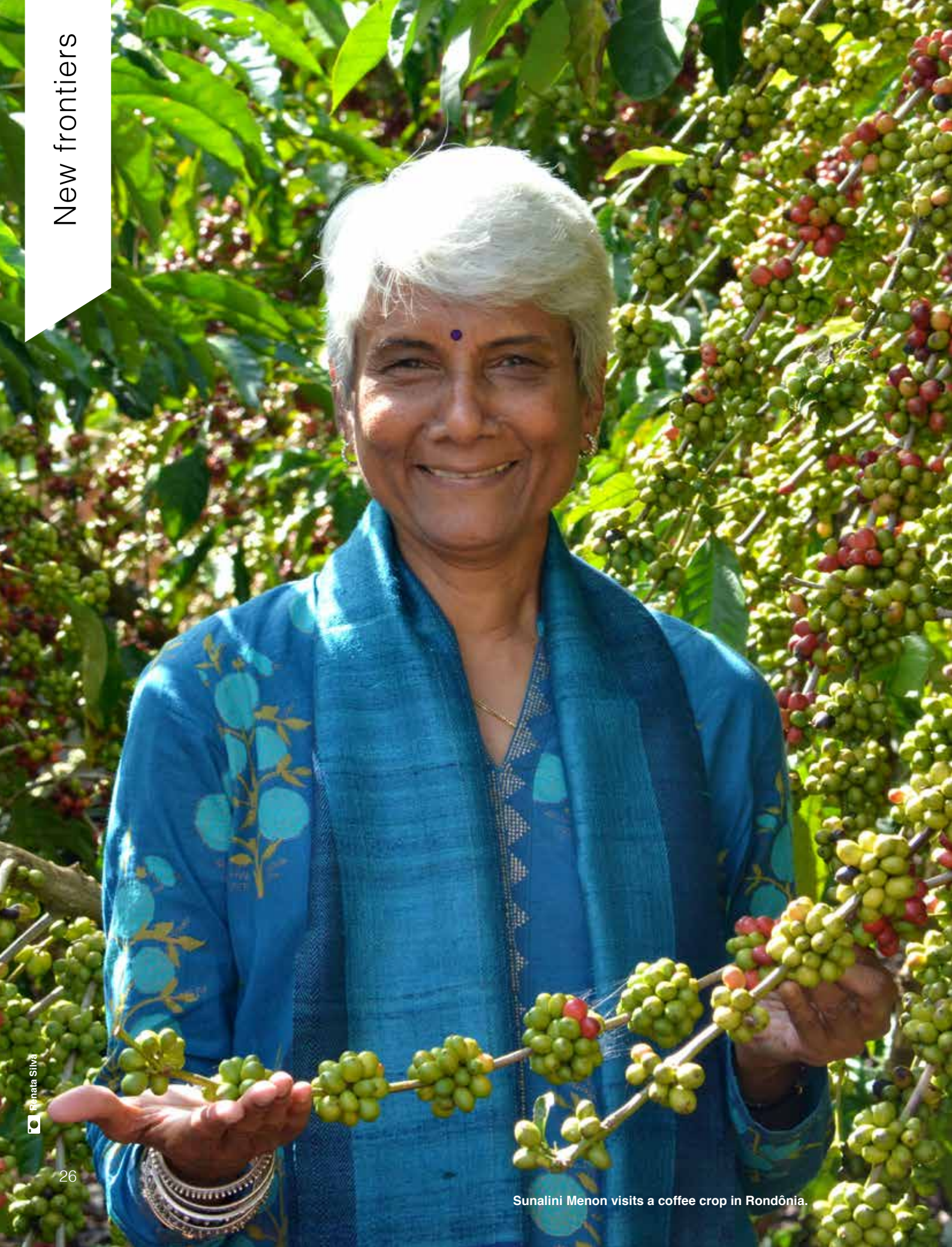
Flavor:
oats, nuts, and malt

Dalton Tupari provides a coffee sample to Josiana Bernardes.

Body:
medium intensity, balanced, and smooth.
Clean cup with sweet and uniform aftertaste.

Description:
the coffee remains stable throughout cupping at different temperatures. It is not bitter and excels through its sweetness from the first sip to the last. According to my experience in India, this is an excellent coffee, worthy of entering a competition. It is the best robusta I have tried!

Renata Silva



Renata Silva

Sunalini Menon visits a coffee crop in Rondônia.

The world of coffee in Rondônia

Potential of Amazon Robustas attracts the attention of Brazilian and world specialists

Renata Silva,
Embrapa Rondônia

Positive transformations occurring in coffee growing in Rondônia have made the state prominent on the Brazilian and international production scene. Although planted area has declined by 54% in the last 10 years, yield has grown nearly 154%. In addition, there is considerable potential of the Amazon region for production of fine robustas, specialty coffees with exotic and differentiated aromas and flavors - a diversity as yet little explored and little known.

According to the specialist in specialty coffees, Josiana Bernardes, an infinity of flavors and sensations in Amazon Robustas are waiting to be known and recognized by the world of coffee. "Each plant has specific features in the flavor of its fruit that evoke different sensations in us. After a well-conducted post-harvest and roasting process, the consumer will be able to sense this distinctiveness in the beverage. This is incredible potential for the whole world," Bernardes emphasizes.

She was in Rondônia in May 2018 during the Amazon Robusta Days (Jornada dos Robustas Amazônicos) event, which gathered renowned specialists with experience in Brazil and abroad to debate and improve the work being done in coffee growing in Rondônia. In the five days of activities, issues from production to marketing were dealt with, touching on quality, storage, public sector management, and gender equality in the field, as well as technical visits to coffee fields within the state.

The coffee ambassador in Asia, Sunalini Menon

from India, also attended this event and was enthused with what she saw and tried in the fields she visited. Like Josiana, she identified different flavor profiles when trying the fruit still on the plant and highlighted that each clone had distinct characteristics, with flavors that brought to mind mango, combinations of peppers, and, her favorite, a clone whose fruit had the sweetness of red apples. "People think that only arabica has this diversity of flavors. But I have worked with coffee for 40 years and fine robustas also have complex and distinct flavors," explains Sunalini Menon, who is considered the highest representative of the work performed in Asia with fine robustas. It is fitting to emphasize that India has a place of prominence in the world in production of quality coffee beans.

In addition to these two international specialists, Rondônia received other opinion leaders of coffee growing in the world in 2018, and they were able to obtain first-hand knowledge of the transformations in progress in the state. Groups of coffee growers who were champions in a quality competition in Ecuador and a delegation of representatives of the Corporación Colombiana de Investigación Agropecuaria – Agrosavia [Columbian Crop and Livestock Investigation Corporation] were welcomed. They got to know technologies for production of robusta coffees and the potential for implementing them in their regions. The Kenyan ambassador, Isaac Oshink, also visited the state and was impressed by coffee production and the process of valuing the producer and beverage quality. He now wishes to form partnerships that can promote coffee growing in his country.

"People think that only arabica has this diversity of flavors. But I have worked with coffee for 40 years and fine robustas also have complex and distinct flavors"

Representatives of the main coffee-producing states in Brazil - Minas Gerais, Espírito Santo, Bahia, São Paulo, and Rio de Janeiro - were also in Rondônia. Noteworthy among them were members of the Grupo Técnico de Especialistas em Café – GTEC Conilon [Coffee Specialist Technical Group], an important forum for debates on Brazilian coffee growing. The delegation that was in Rondônia for the Amazon Robusta Trade Mission (Missão dos Robustas Amazônicos) was composed of 26 coffee specialists – producers, business owners, consultants, analysts, and researchers – who are among the most prominent in production of canephora coffee (conilon and robusta) in Brazil.

According to the Embrapa Rondônia researcher, Enrique Alves, the state is beginning to reap the fruit of a constant modernization process, resulting from the efforts of producers, the support of research institutions, rural extension, and governmental action. "These technical visits have the potential for creating a critical mass in agriculture in the Amazon region and sustainable development. It was a time of sharing experiences and mutual learning. These kinds of activities plant the seed of a new era of agricultural entrepreneurial activity in the state of Rondônia," Alves emphasizes.

Renata Silva

Amazon Robusta Trade Mission group visits a coffee farm.

Recognition of potential in the field

The members of the GTEC Conilon arrived with curiosity and high expectations because they had seen pictures through social networks and heard of the potential of Rondônia. "This visit proved to me that coffee growing in the state has changed and will have a big influence on the quality of canephoras in Brazil," highlights Luis Carlos Gomes, a coffee grower from Santa Tereza, ES. The agronomist Luiz Fernandes, who works in Espírito Santo with market technical development in the Syngenta company, complements, "All doubts were removed that one of the next coffee production centers of Brazil will be Rondônia."

The president of the group and a coffee producer in Espírito Santo, José Silvano Bizi, also emphasized that the clones seen in Rondônia stand out. "The visit exceeded our expectations in terms of technologies and the efforts of producers and research and extension agencies. We also found differentiated technology that we can take to our state, and we can bring more experiences to coffee growing in Rondônia, strengthening canephora coffee in Brazil," he states.

Renata Silva and Leonardo Araújo

1- Coffee grower Milton Lima.
2- Amazon Robusta Days visits a producer.
3- Checking yield in the crop field of the coffee grower Marcelo Braun.
4- Panoramic view of the coffee field, Amazon Robusta Trade Mission.

New status for canephora and coffee growing in the Amazon

Canephora coffees, until recently relegated to a supporting role in order to lower product price in blends with arabica, or otherwise used in the instant coffee industry, are little by little gaining status. For the researcher Enrique Alves, the new robustas and hybrids (robusta × conilon) from the Amazon have many nuances that should be seen from a new sensory perspective. "Rondônia and the Amazon region have a great deal of potential to 'ride this new wave', presenting quality coffee to the world and producing with sustainability," highlights Alves.

The director of Escritório Carvalhaes (a coffee brokerage company), Eduardo Carvalhaes Jr., who also is president of the Câmara Setorial do Café de São Paulo [São Paulo Coffee Sector Council] visited the state and declared that he is not surprised by the changes in coffee growing in Rondônia because he has followed its advances. Regarding the flavor of Amazon coffees, he recommends, "You shouldn't try robusta coffee trying to find arabica. It is not similar and won't be. They are two products with different flavors and each one will have its own market."

Arthur Fiorott, from Espírito Santo, a specialist who works in projects for improving coffee quality, highlights the favorable period for investing in canephora quality. "It is a singular moment for robustas and conilons in which we can access a greater market." According to him, in addition to big companies, the markets of micro-lots and small lots are recognizing the quality of robustas as coffees of origin. "It is important to take advantage of this moment and put this coffee on the market," Fiorott concludes.

Amazon Robusta Trade Mission (Missão Robustas Amazônicos)

This took place March 14 to 16 and, during the event, in addition to a technical meeting in Cacoal, producers and nurseries that stand out in coffee growing in the state were visited in the municipalities of Alto Alegre dos Parecis, Rolim de Moura, Nova Brasilândia, and Cacoal. The event was organized by GTEC Conilon, Embrapa Rondônia, and partners.

Amazon Robusta Days (Jornada dos Robustas Amazônicos)

This occurred May 21 to 25, with diverse activities directed to coffee in the capital city and within Rondônia in general, including technical visits to coffee fields in the municipality of Alto Alegre dos Parecis. The event was organized by Embrapa and the Government of Rondônia through SEDI (State Office of Economic Development) and partners.

Scan the QR CODE and watch the video.

Sunalini Menon

Climate variability in Rondônia over the next 15 years

Coffee growers should use suitable cultivation techniques to minimize impacts

Luiz Carlos Molion,
Physicist and PhD in Meteorology

Much has been said of global climate changes, or global warming, attributing such changes to human activities. Human beings, with their activities of modification of land use (deforestation and agriculture) and modification of the chemical composition of the atmosphere (increase in greenhouse gases – GHG), are held to be responsible for climate changes that are supposedly in progress on the planet and that will be catastrophic for society in the near future.

Statements are made in the media that deforestation of the Amazon and of the Atlantic Forest were responsible for the drought in the Southeast of Brazil in 2014. Such statements are not based on science and do not stand up to simple analyses of long time series of rainfall amounts. The very nature of climate is variable; drought and severe flooding are repetitive and have already been registered in the distant past when human interference in the environment was insignificant.

A climate diagnosis of rainfall in the state of Rondônia was elaborated using the technique of similarity to suggest possible climate trends in the state for the next 15 years. The purpose is to plan long-term management of water resources, aiming at social and economic development. The difficulty of making a diagnosis of rainfall distribution for Rondônia is the lack of availability of observed data. Data collected from Hidroweb and the *Agência Nacional de Águas - ANA* [National Water Agency] were used. Data available on grid points by the Global Precipitation Climatology Center (GPCC), Germany, available at the Earth System Research Lab, National Oceanic and Atmospheric Administration (ESRL/PSD/NOAA) of the U.S. were also used.

There are basically two techniques for making "projections" of future climate on the time scale of months to decades. One is use of Global Climate Models (GCM) and the other is by similarity. The GCM are mathematical models, or computer codes, that seek to simulate the future state of the climate using supercomputers to solve equations that represent the physical processes inherent to a given model.

Unfortunately, global climate is very complex and the models are rudimentary and do not adequately simulate the physical processes and feedback processes that control global climate. In addition, future scenarios of GHG used in the simulations are fictitious, created by the human mind, and therefore uncertain. If the GCM are rudimentary and the scenarios used are fictitious, obviously the results of these simulations are also fictitious.

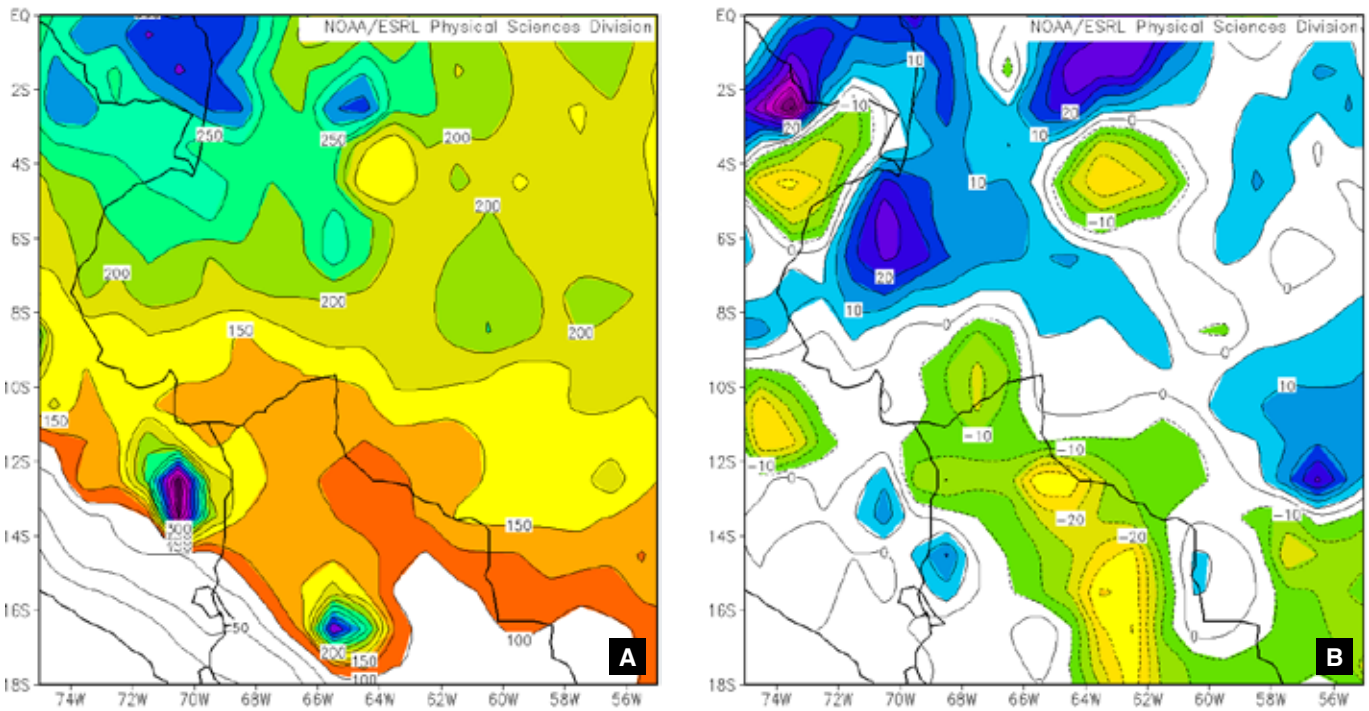
In this regard, it is important to leave no doubt that the Intergovernmental Panel on Climate Change (IPCC) – which is the body of the United Nations that vehemently spreads the idea of global warming – and its followers, including the *Painel Brasileiro de Mudanças Climáticas* – PBMC [Brazilian Climate Change Panel], do not make "forecasts" of climate, but rather "projections", which do not serve for planning human activities. This can be seen in the article of E. Assad and coauthors in which, using results from the GCM, they affirm that air temperatures in the Amazon during the winter will increase 1.5°C from 2011-2040, 3.5°C from 2041-70, and 6°C from 2071-2100. In these periods, annual rainfall totals will decline 10%, 30%, and 45%, respectively. The drought stress resulting from these climate conditions, for example, would eradicate coffee growing in the state. Well, if the GCM are deficient and are not even able to reproduce the current climate, how reliable are their "forecasts" 30, 70, or 100 years from now?

In contrast, the technique of forecasting by similarity is based on the climate configurations that occurred in the past and on what appear to be (temporal) cycles of the main climate control factors. Based on the past, it uses these cycles to project a tendency of future climate, which is more qualitative than quantitative. The climate in Rondônia is determined by the global climate, and it, in turn, by the long-term variability of phenomena both external and internal to the terrestrial climate system. For example, the sun is the main source of energy for the biogeophysical processes that occur on the planet. It is the most obvious example of external influence on the climate.

Climate over the next 15 years in Rondônia

Air temperature is not a limiting factor in Rondônia, which registered a minimum temperature of 7.4°C in July 1975. The difficulty of studying the variability of its rainfall is the lack of long time-series of this variable. The data that is available indicates that Rondônia has one of the lowest coefficients of variation of annual rainfall in Brazil, at around 10%, and even the worst year (2015) of the time-series used here had an annual total of 1310 mm, higher than necessary for growing coffee. The rainy period occurs from October to May, with 85% of the annual total, and January and February are the rainiest. The dry period extends from June to August, with 5% of the annual total.

Mean global temperatures have remained remarkably stable, between ±0.4°C, over the last 150 years, as if the climate system made use of a thermostat activated by physical control mechanisms (negative feedback)



Precipitation over the next 15 years: a) annual average total (mm / month) and b) average annual deviations (mm / month) with respect to normal 1981-2010.

that act to reestablish climate equilibrium when it is disturbed by some other mechanism. Therefore, it is highly unlikely that the increase in GHG can come to cause an adverse climate in the next 100 years.

For Rondônia, rainfall totals for 2018 and 2019 are expected to remain near the mean (±10%). In the following years (2020-2032), it is expected that mean annual rainfall will be around 1740 ± 230 mm/year, a not very expressive reduction in relation to the normal time period of 1981-2010, highlighting January, with a reduction of around 9%, and October, with an increase of 10%. Although there is not a strong correlation between the indices of El Niño –Southern Oscillation (ENSO) and rainfall totals, strong El Niño events

tend to reduce rainfall totals. The worst case in the 70 years of records was 2015, with a 26% reduction compared to the mean annual total. An event of this kind, however, has the statistical probability of repeating once every 45 years.

Paradoxically, the rainiest year of this rainfall series was 1978, which was also a year with a weak El Niño, at 28% greater than the mean. There is the chance of occurrence of three to four El Niño events, from weak to moderate, at a spacing of three to four years. With the occurrence of La Niña events, in general, rainfall totals remained near or a little above the mean. The next critical period, similar to 2010-2017, may occur from 2027-2034.

Severe events, such as droughts and excessive rains, high temperatures and frost, are time events and not climate events. They have always taken place and will continue to take place in the future, regardless of whether the climate heats or cools. Whenever the alert of an El Niño event is given, administrators should prepare for a possible dry period.

However, the main impact on agriculture is caused by reduction in rainfall for several consecutive weeks within the rainy months, such as the reduction that occurred in January 1998 (-52%) and in December 2015 (-54%). The big concern in the tropics is prolonged, pluriannual droughts, such as occurred from 2014-2016.

Therefore, producers should use suitable cultivation techniques to minimize these impacts. As, in general, tropical rains are torrential and infiltration in the soil has decreased over time because of compaction, techniques of storing rainwater on the surface (dams) and in the soil (organic matter, earth mounds), conserving water through crop practices (drip irrigation), and soil protection against erosion are highly recommended.

“The worst case in the 70 years of records was 2015, with a 26% reduction compared to the mean annual total. An event of this kind, however, has the statistical probability of repeating once every 45 years.”

Luiz Carlos Baldicero Molion has a bachelor’s degree in Physics from USP, Brazil (1969), a PhD in Meteorology from the University of Wisconsin, USA (1975), and post-doctoral studies in Forest Hydrology from the Institute of Hydrology, England (1983). He has been scholar of the Institute for Advanced Study of Berlin (Wissenschaftskolleg), Germany, since 1989. He is a retired researcher of the Instituto de Pesquisas Espaciais (INPE/MCT), where he was director of Space and Atmospheric Sciences, retired professor of the Universidade Federal de Alagoas, and collaborating professor of Graduate Studies in Climate and Environment of the Universidade de Évora, Portugal. He was a representative of South America in the Climatology Commission of the WMO from 1997-2010 and, among other awards, received the Júlio Redecker Medal in 2013 from CINDRA of the Federal House of Representatives for services rendered to Brazil. Currently, he devotes himself to consulting work and lectures.

Lands for growing coffee in the southwestern Amazon require particular technological solutions

Wide variability of soils may determine success or failure in regional coffee growing.

Elaine Almeida Delarmelinda Honoré,
Universidade Federal de Rondônia

Paulo Guilherme Salvador Wadt,
Embrapa Rondônia

Ângelo Mansur Mendes
Embrapa Territorial

Sérgio Shimidzu

The states of the southwestern Amazon, including Rondônia, Acre, and the southern part of Amazonas, have lands with different potentials and limitations for growing coffee. The wide variability of soils and agricultural potential of the land requires that different technological solutions be adopted in each situation as a means of overcoming these limitations and providing adequate conditions for development of coffee growing.

Lands appropriate for growing coffee include those with deep, well-drained soils with good water storage capacity that are situated on landscapes with low to medium slope, easing adoption of mechanization. The main limitations of most of these lands are related to susceptibility to erosion in more rolling landscapes and to the low natural fertility of these soils.

Both limitations can be overcome by the introduction of techniques for controlling erosion, by neutralization of soil acidity, and by fertilization. Other lands in the region, such as those with rocky soils or under poor drainage conditions, even those soils with high natural fertility, restrict establishment of crops.

In general, the best suited lands are associated with soils in the orders of *Argissolos Vermelho Amarelos* (PVA) and *Latossolos Vermelhos Amarelos* (LVA). Outstanding soils for coffee growing in Rondônia include *Argissolos Vermelho Amarelos* of Ouro Preto do Oeste or *Nitossolos Vermelhos* associated with *Argissolos* of Alta Floresta d´Oeste.

A characteristic that differentiates lands with *Latossolos* and *Argissolos* is that those with *Argissolos* have greater susceptibility to erosion through having a soil surface layer that is sandier than the underground layer. They therefore require greater attention in relation to surface cover to avoid soil losses at the time of rain or irrigation.

“the best suited lands are associated with soils in the orders of *Argissolos Vermelho Amarelos* (PVA) and *Latossolos Vermelhos Amarelos* (LVA).”

It is important to highlight that lands with *Latossolos* or *Argissolos* with the presence of ferruginous concretions (petroplinthic), commonly known as *piçarra*, or of horizons (soil layers) of gray color might restrict development of the root system of coffee plants because of physical impediments or poor drainage of the soil profile.

Although other lands of Rondônia are also suitable for growing coffee, where *Latossolos Amarelos* (LA) in the region of Ariquemes and Machadinho d'Oeste occur, for example, they are restricted for greater use due to the association between low soil fertility and high concentrations of kaolinite type clay. This results in greater soil density and, therefore, greater difficulty for management and more restrictive conditions for crop development.

Other lands that seriously restrict crops are poorly drained lands, constituted by *Plintossolos* in general (FT, FX, or FF), or other soils of similar appearance that, at depth, have mixed coloring (composed of red, yellowish, or grayish tones), such as some *Cambissolos* (CX) from the region of Pimenta Bueno, RO, or from Humaitá, AM.

Furthermore, there are lands with predominance of very sandy soils, such as *Neossolos Quartzarênicos* (RX) of Rondônia, located between Pimenta Bueno and Vilhena, which are among those that most limit

coffee production because they have low water and nutrient retaining capacity, requiring more investment in irrigation and fertilization techniques to allow greater productive capacity for coffee fields.

In lands with very rocky soils, as in *Neossolos Litólicos* (RL), common in Rondônia, development of the coffee plant root system may be compromised, but, above all, more reasonable management is made difficult because of lower water storage capacity and limitations for operation of agricultural machines and equipment.

In some lands of the state of Acre, especially in soils known as having clay of the "tabatinga" (gleysol) type, limitations for coffee growing are associated with poor soil drainage. These soils are known as *Luvissolos Háplicos* (TX), but limitations also often occur in association with *Cambissolos*, *Vertissolos*, and, to a variable degree, some *Argissolos*. In these lands, in the rainy period, there may be oxygen deficiency in the soil because of excess of accumulated water. In the dry period, there may be water deficit due to low storage capacity of water in a manner available to the coffee plant.

In the south of Amazonas, in lowlands of the regional landscape, some soils may remain waterlogged for most of the rainy period and, as such, are not appropriate for coffee growing, as is the case for *Plintossolos Argilúvicos* (FT) and *Cambissolos Háplicos* (CX). In contrast, fields with higher elevation (normally associated with well-drained and clayey soils, flat to slightly rolling topography, and absence of rocky features) are more appropriate for coffee growing, as in *Argissolos Vermelho Amarelo* (PVA)

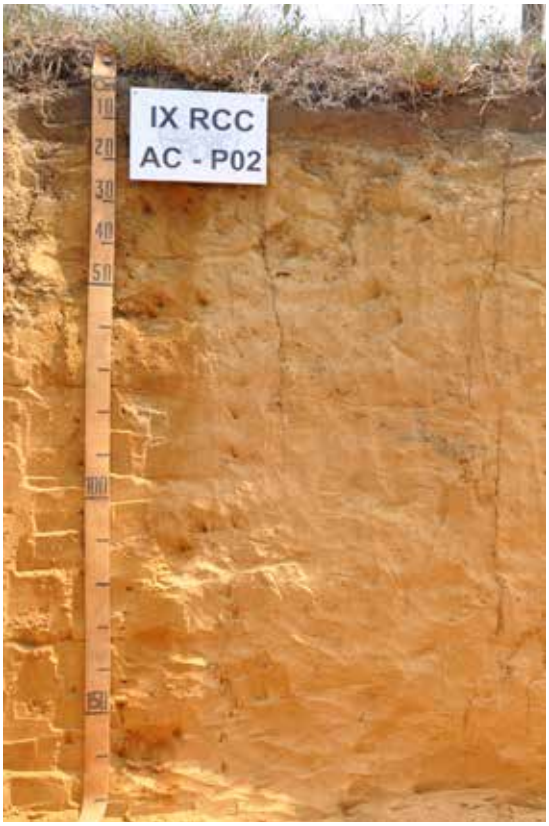


Figure 1. *Latossolo Amarelo.*
Mancio Lima, AC, Brazil.

Figure 2. *Latossolo Vermelho Amarelo.*
Ouro Preto d'Oeste, RO, Brazil.

Sérgio Shimidzu / IBGE

of Humaitá or in *Latossolos Vermelho Amarelos* (LVA) of Boca do Acre, AM.

Factors such as soil fertility, drainage conditions, susceptibility to erosion, and possible restrictions to use of mechanization and to water availability, based on frequency of rainfall and soil storage capacity, determine the economic viability of coffee growing.

Therefore, in spite of the advance of coffee in Rondônia and its expansion to other states of the southwestern Amazon, it should be noted that this region has wide variability in potential for use of its lands for agricultural production, and the wide variability of soils is one of the key factors in determining economic and environmental success or failure in regional coffee growing.

Figure 3. *Luvissolo Háplico*.
Tarauacá, AC, Brazil.

Figure 4. *Nitossolo Vermelho*. (IBGE).
Alta Floresta d'Oeste, RO, Brazil.

Figure 5. *Plintossolo*.
PortoVelho, RO, Brazil.

Something new in the field for canephora coffee

Release of cultivars in individual clones is a strategy for coffee growing

Alexsandro Teixeira,
Embrapa Rondônia

Renata Silva

Individual clones are the newest strategy of Embrapa Rondônia for growing *Coffea canephora*. This pioneering action recognizes that different producers have different production goals and realities that must be borne in mind. It is an effort to empower the coffee grower at the time of setting up or renewing the crop field. Embrapa will offer coffee growers a portfolio with all the options of combinations of compatibility and the agronomic characteristics of each cultivar released. In this model, each clone is considered a cultivar.

This means that, beginning now, producers will have more freedom of choice, and the result will be a final product of greater added value, associated with more sustainable agriculture with fewer agricultural chemicals and more efficient use of land.

tion and release of cultivars of individual clones was not possible because the compatibility group was not known. A mixture of many clones was always necessary to ensure pollination and fertilization of the flower. With the characterization of compatibility groups, release of the individual cultivar is feasible, emphasizing that the crop must necessarily be formed by clones of three groups; furthermore, the directive of a minimum number of six clones must be respected. This same technology can be adopted by other breeding programs of public and private institutions, further expanding the portfolio of cultivars for producers.

To arrive at this innovation, more than 10 years of research were necessary to characterize the compatibility groups. Up to now, all canephora coffee cul-

For example, if the aim is high yield, the crop will be set up using clones that best promote that trait. Those who have quality as a priority will be able to choose cultivars with greater potential for bearing large fruit and yielding fine beverages – with scores above 80 points in the Protocolo de Degustação de Robustas Finos – PDRF (Fine Robusta Cupping Protocol). If the producer's reality is cultivation in environments prone to water deficit and plant health problems, the option may be for clones less demanding in resources such as water, fertility, and temperature and more tolerant to pests and diseases.

To understand the innovative nature of this process, it is necessary to recognize that, up to now, registra-

tivars available in Brazil have from 9 to 23 clones. In traditional releases of canephora, producers who strictly follow all the technical recommendations are obliged to use a large number of clones in the crop field. In practice, this almost never happens. Coffee growers choose only those clones that have the characteristics that they judge will meet their needs.

The problem is that clones have always been chosen in an empirical, and sometimes random, way. This results in economic loss for many producers, especially when clones are chosen that individually are high yielding but in combined planting have results below expectations because of incompatibility between the groups chosen.

Renata Silva

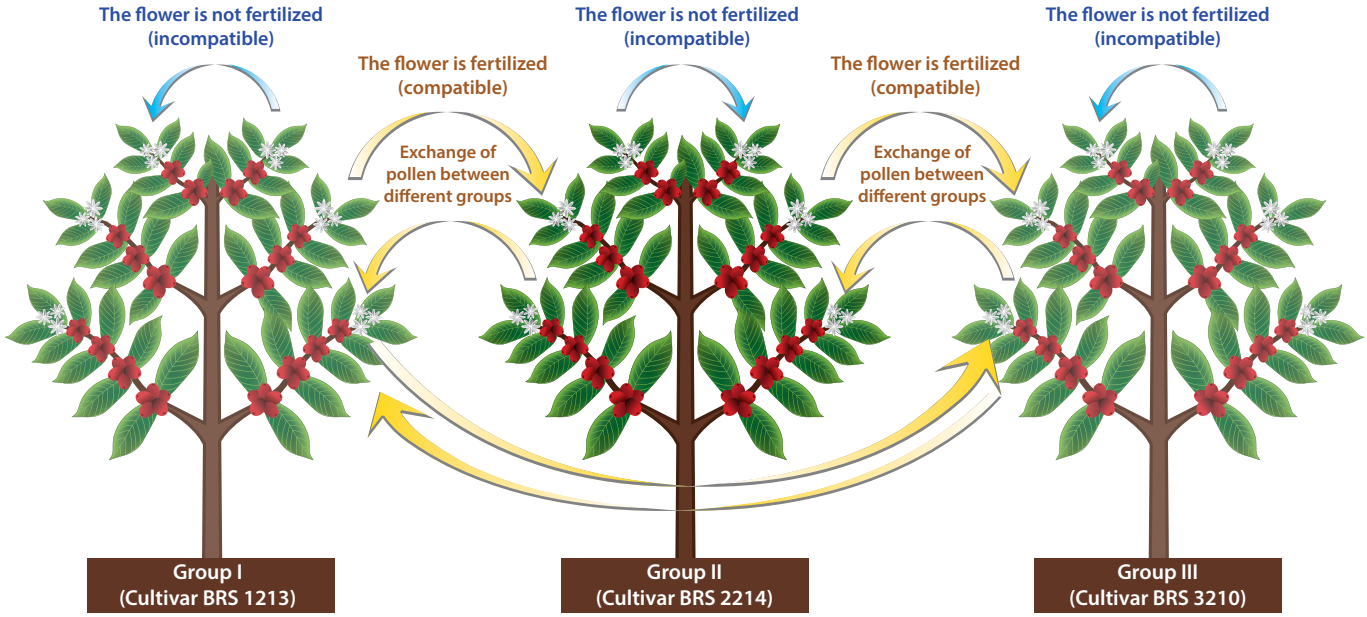


Figure 1. Unlike *Coffea arabica*, the self-incompatibility of *Coffea canephora* prevents its self-fertilization. Thus, during flowering of *Coffea canephora*, the flowers of cultivar BRS 1213 (Group I) must receive pollen from other cultivars of different groups (groups II or III), and vice versa. Only then will flower fertilization occur. This mechanism is called gametophytic self-incompatibility, controlled by an "S" gene consisting of three alleles (S1, S2 and S3).

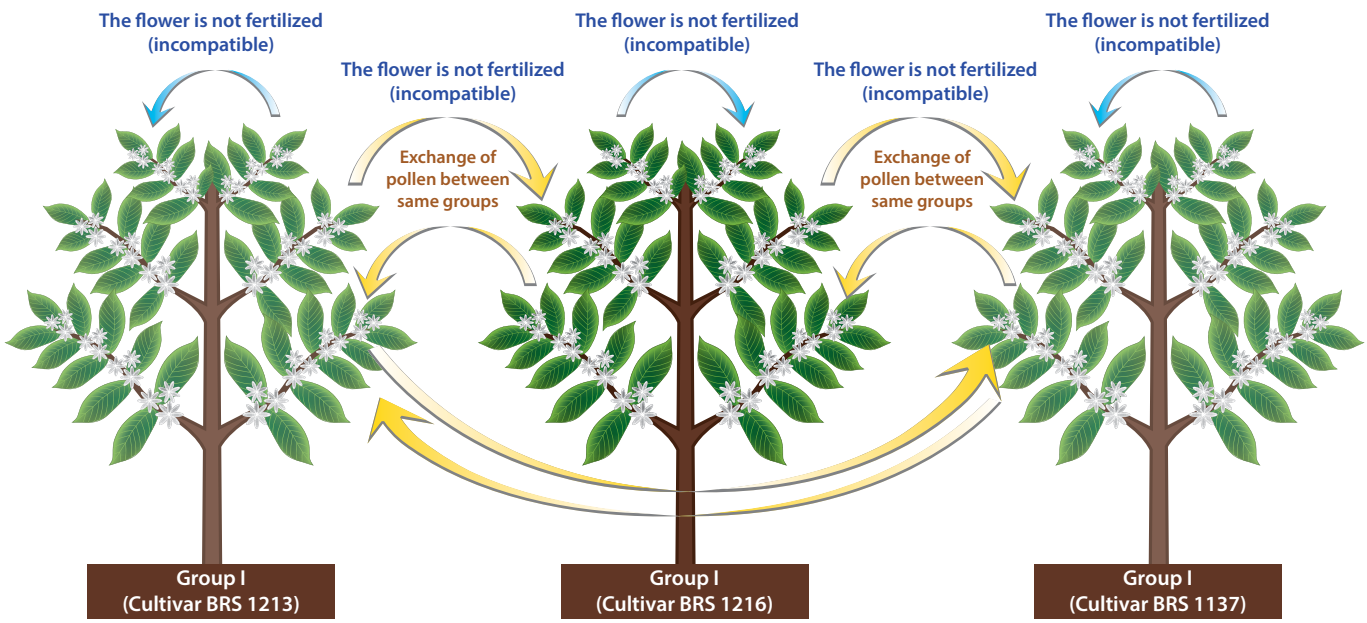


Figure 2. Illustration of self-incompatibility when all cultivars of cloned *Coffea canephora* are from the same group. Despite the occurrence of flowering and pollination, flower fertilization does not occur since all the clones are from the same group, and consequently, the plants do not produce fruits.

Researcher Alexsandro Teixeira, checks coffee flowering in an experimental area.

Renata Silva

Innovations arrive in the field in 2019

For 2019, Embrapa Rondônia prepares the release of ten cultivars of individual hybrid clones recommended for planting throughout the Amazon region, with description of all the agronomic characteristics and compatibility groups. These new clones were obtained from crosses between two distinct botanical groups, known as conilon and robusta. Through artificial hybridization, plant selection, and evaluation in different states of the region, the Embrapa Rondônia Breeding Program identified plants that have favorable characteristics from both groups, i.e., the drought tolerance of conilon associated with the high yield, beverage quality, and rust resistance of robusta. This "gene fusion" allowed selection of these hybrid clones with all the attributes necessary to add value and enable sustainable coffee growing in the Amazon.

The yield potential of these ten clones is greater than 100 bags/hectare through adoption of high technology, i.e., irrigation, fertilization, pruning, and pest and disease management. In these tests, some clones achieved yields of 80 bags/ha in low fertility soils without irrigation. Others exceeded 130 bags/ha in high fertility soils with use of irrigation. Thus, priority was placed on selection of stable clones, i.e., those that are able to maintain good yield in different environments. In addition, there are materials with early, intermediate, and late cycles, which further enables the producer to better plan and manage the crop fields, favoring selective harvest per clone.

These new cultivars have been established in 25 demonstration units (DUs) throughout the states of Rondônia, Acre, Mato Grosso, and Amazonas. After release of these materials, those who are interested will be able to visit these areas and get to know the materials firsthand and how they respond in each environment. In this process, Embrapa Rondônia will facilitate registration of nurseries interested in production and sale of these individual clonal cultivars so that, at the time of release, plantlets will already be available for sale to producers.

Evolution beyond clones

Evolution beyond clones
New genetic materials and spatial arrangements have raised coffee growing to new levels

Marcelo Curitiba Espindula,
Embrapa Rondônia

Enrique Alves

High-density crop in production.

The recent success of coffee growing in Rondônia has been associated with the use of clonal plantlets, which popularized the term clonal coffee growing. These new coffee fields have been established with hardy conilon and robusta hybrids that have high fruit yield and plant vigor. Indeed, clonal coffee growing has helped transform the coffee field.

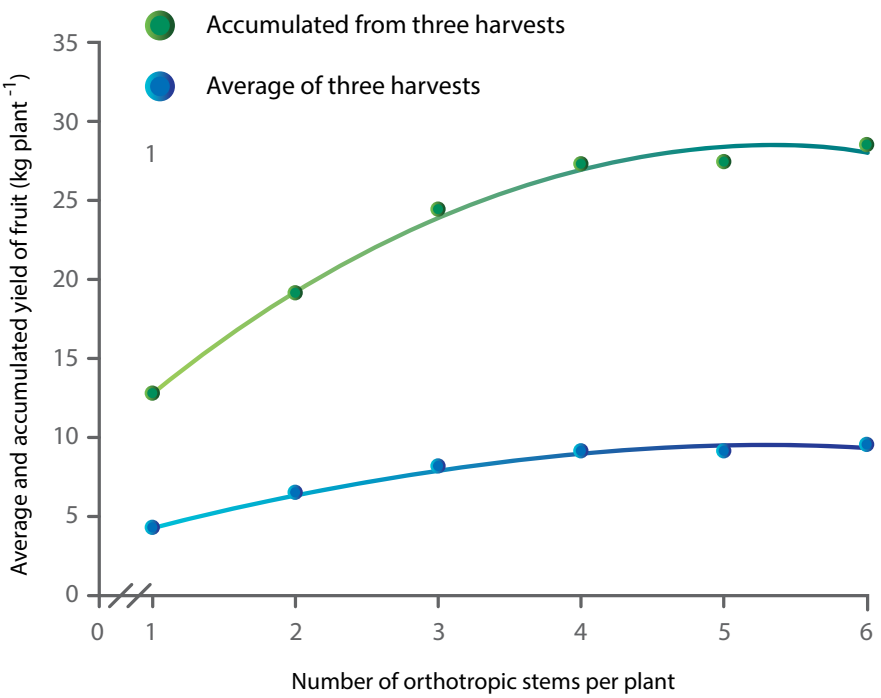
However, simply using clones instead of seeds does not ensure a productive crop. The crop must also be well managed, following all technical recommendations, so that plants express all their genetic potential.

One of the main management practices that have contributed to increased yield is optimizing the spatial arrangement of the crop, which is the distribution of plants in the crop area. In the case of conilon and robusta coffee plants, not only the spacing needs to be considered, but also the number of stems per plant and, consequently, per hectare.

Up to the end of the last decade, most crop fields in Rondônia were planted at spacings that used from three to four meters between plant rows and two to three meters between plants. At these spacings, plant densities that ranged from 800 to 1600 plants per hectare were obtained. Considering that the number of stems used was from 6 to 12 per plant, this represented 9000 to 19,000 stems per hectare.

In these arrangements, in addition to underutilization of the area due to the large space between plants, there was competition among the stems of the same plant because of their excessive number. According to Embrapa research data, the ideal number of stems per plant to obtain maximum yield potential should be no more than four.

Average and accumulated yield of *C. canephora* plants with different numbers of stems, with plants grown at a spacing of 3 meters between rows and 2 meters between plants.



Source: Marcelo Curitiba Espindula

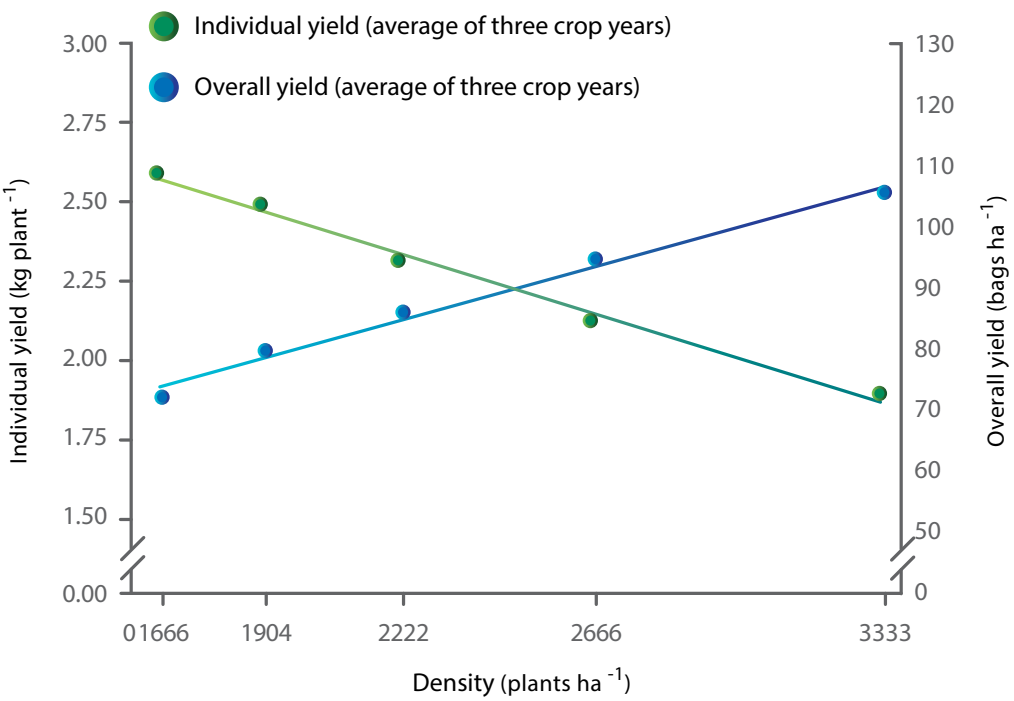
In new crop fields, established from 2010 on, the number of stems per plant was reduced to three or four, culminating in an increase in plant production efficiency. This reduction, associated with the use of production pruning, allowed the use of denser plant spacings, with predominance of three meters between rows and one meter between plants (3 x 1), for a total of 3,333 plants per hectare. This is more than double the plant density of the past, and although it results in reduction of yield per plant, it promotes higher production per area.

Evolution of spatial arrangement can be considered as one of many production factors, and yield gains obtained from this type of plant management alone can be estimated. In an experiment coordinated by Embrapa on one hectare of coffee planted with suitable technology at a spacing of 3 × 2 m, with a total of 1,666 plants, it was possible to obtain around 2.6 kilograms of hulled coffee beans per plant and a little more than 70 bags per hectare.

In this same experiment at reduced spacing, 3 × 1 m, with density of 3,333 plants per hectare, around 1.9 kilograms of hulled coffee beans per plant were obtained, and yield came to approximately 105 bags per hectare. In this case, yield increased by approximately 50%.

These numbers suggest potential for gain that can be obtained from efficient use of the growing area, and producers in the state have replicated these new spatial arrangements on their properties. This, in part, explains how the increase of 304% in coffee yield in Rondônia was obtained from 2001 to 2018 (Conab). It was the fruit of dedication of producers working with a combination of adequate management, new spatial arrangements, and elite clones. Studies in progress suggest that there is still a lot of opportunity to evolve.

Individual and overall yield of *Coffea canephora* plants grown at different densities in Alta Floresta d'Oeste, RO, Brazil



Source: Marcelo Curitiba Espindula. Data collected on the property of Ademar Schmidt

> “Results of research in progress indicate a future with plant spatial arrangements that are quite different from those used up to the most recent decade.”

Enrique Alves

Aerial view, high-density crop experiment in Rolim de Moura, RO.

Mechanization of the crop field requires new models of spatial arrangements

In spite of the advances obtained from denser spacings, new arrangements have been studied for adaptation of crop fields to mechanized management practices. With the aim of facilitating machine traffic in crop fields, arrangements use a smaller spacing between plants and a greater spacing between plant rows. One of the spacings most used is 3.30 meters between rows and 0.8 meters between plants. In these crop fields, the number of stems per plant has been limited to only two to avoid competition for water, light, and nutrient resources.

In this respect, Embrapa, in partnership with agricultural machine companies and rural producers, has studied new spatial arrangements and adaptation of coffee fields to semi-mechanized harvest, which is already used in Rondônia, and to the feasibility of use of very dense cropping systems for totally mechanized harvest.

In very dense cropping systems, the number of plants per hectare may go beyond 10 thousand, and the number of stems may be greater than 20 thousand. The main goal is implementation of what is called a “superharvest” system. In this system, years of high production alternate with years of no production. The main goal is full mechanization of harvest, reducing costs on labor for this operation. In addition, this system can bring other benefits, such as greater soil cover and efficiency in soil use and nutrient cycling.

Results of research in progress indicate a future with plant spatial arrangements that are quite different from those used up to the most recent decade. In other words, changes in spatial arrangements have been a determining factor in yield gains obtained up to now, but there is much room for advancement. It is likely that new spatial arrangements can contribute to increased yield, but, above all, to greater efficiency of crop areas, with a view toward sustainability of coffee growing in the Amazon.

José Nilton

Research and technology

Control of the coffee berry borer

Alternatives for coffee growers after prohibition of endosulfan

José Nilton Medeiros Costa,
Embrapa Rondônia

The coffee berry borer is one of the main pests of the coffee plant in Rondônia. It causes serious damage, such as rotting of seeds and falling of affected fruit, loss of weight and quality in hulled coffee, limitation of coffee seed yield, downgrading of the product in classification, and loss of the consumer market abroad.

In recent years, a dilemma has arisen in controlling this pest with insecticide. This dilemma arose from prohibition of the use of endosulfan, which is considered highly toxic to humans.

Of the insecticides registered for the coffee crop, endosulfan was the only active ingredient recognized as effective in control of the coffee berry borer, until it was prohibited in Rondônia. Besides endosulfan, only some products with the active ingredient chlorpyrifos, which is recognized as having only medium efficiency in the field, were registered.

Two insecticides for this pest were registered by the Ministry of Agriculture (Ministério da Agricultura, Pecuária e Abastecimento - MAPA) in 2016 alone: Benevia, which has the active ingredient cyantraniliprole, and Voliam Targo, formulated from the molecules chlorantraniliprole and abamectin. Besides these products, various others have been registered for coffee berry borer, as listed in Table 1.

It should be noted that the fact that a product is registered does not mean it has optimum efficiency against the target pest. The new products are relatively expensive in comparison to endosulfan and it has not yet been proven that they are efficient in all coffee-producing areas and regions, such as Rondônia. These new products are less toxic and harmful to the environment, especially those of classes IV and III described in Table 1.

Table 1. Products registered for coffee berry borer (*Hypothenemus hampei*)

Trade name	Active ingredient	Application rate mL.cp.ha*	Classification	
			Toxicity	Environ.
Alverde	Metaflimizona	1,5 – 2,0 L/ha	I	III
Azamax	Azadiractina	0,6 – 0,8 L/ha	III	IV
Benevia	Ciantraniliprole	1,5 L/ha	IV	III
Bio Broca	Etanol + Metanol	25 un/ha	*	IV
Bovemax EC	*Beauveria bassiana*	1,5 L/ha	IV	IV
Chlorsab 480 EC	Clorpirifós	1,5 L/ha	I	II
Clorpirifós Fersol 480 EC	Clorpirifós	1,5 L/ha	I	II
Clorpirifós Poland 480 EC	Clorpirifós	1,5 L/ha		
Clorpirifós Sabero 480 EC	Clorpirifós	1,5 L/ha	II	I
Curbix 200 SC	Etiprole	2,0 - 2,5 L/ha	I	II
Instivo	abamectina + clorantraniliprole	1,0 L/ha	II	II
Klorpan 480 EC	Clorpirifós	1,5 L/ha	I	II
Lorsban 480 BR	Clorpirifós	1,5 L/ha	I	II
Prez	Acetamiprido	160 a 200 g/ha	III	I
Pyrinex 480 EC	Clorpirifós	1,5 L/ha	I	II
Sperto	Acetamiprido	160 - 200 g/ha	III	I
Tracer	Espinosade	0,3 – 0,4 L/ha	III	III
Trebon 100 SC	Etofenproxi	1,25 L/ha	III	II
Verimark	Ciantraniliprole	0,5 L/ha	IV	III
Verismo	Metaflimizona	1,5 – 2,0 L/ha	I	III
Vexter	Clorpirifós	1,5 L/ha	II	II
Voliam Targo	Abamectina + Clorantraniliprole	0,4 – 0,6 L/ha	II	II

Source: Agrofit (2018).

How to control the borer

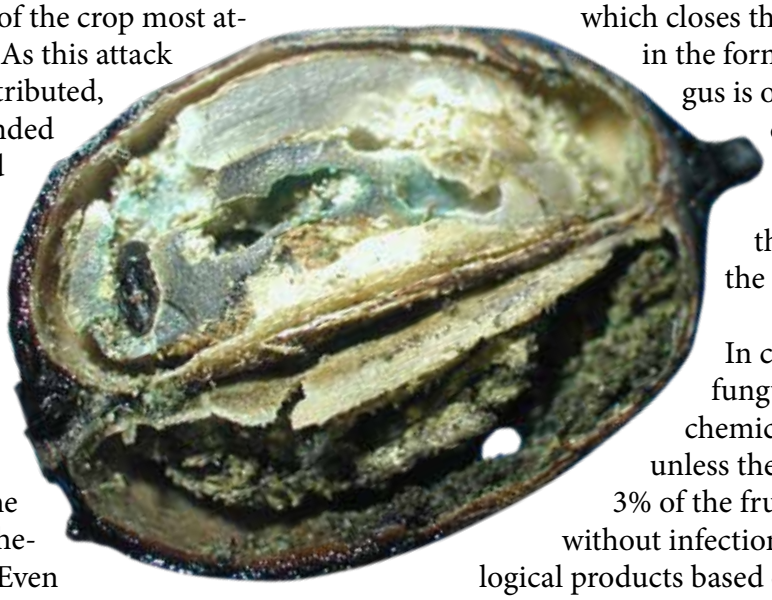
The most adequate manner to manage infestation of the borer and to undertake control measures at an opportune **time is to take monthly samples in the crop field**. This should begin when the fruit is in the unripe "chumbo" or "chumbão" phase, a period in which the seeds have already been formed within, the phase in which the borer perforates the fruit and can lay its eggs.

To take crop samples, the field should be crossed in a zig-zag pattern and 20 coffee berries (5 from each direction on the plant) should be taken from each of the plants that have been chosen at random. The number of plants to sample depends on the size of the field. For a field with 1000 plants, a minimum of 30 plants should be sampled; in a field with 1000 to 3000 plants, 50 plants should be sampled; in a field with 3000 to 5000 plants, 75 plants should be sampled; and in a field with more than 5000 plants, 1.5% of the plants should be sampled.

The fruit from each field will compose a single sample. The fruit with borer damage and the un-damaged fruit are then separated for determination of the percent of infestation. In practical terms, the result will be obtained by multiplying the number

of berries damaged by the borer by 100 and dividing this result by the total number of fruit samples.

Chemical control should be initiated when the percentage of borer-damaged fruit is greater than or equal to 3%. This chemical control should be performed in the parts of the crop most attacked by the borer. As this attack is not uniformly distributed, control is recommended only for the sampled areas in which infestation of the pest has already reached 3%. Proceeding that way, unnecessary expenditures on labor and insecticide are avoided, and impacts related to the use of agricultural chemicals are reduced. Even after these control measures, monitoring should continue, and if the infestation returns to reach the control level, a new application must be made, respecting the limits of the withdrawal period.



Borer attack can be reduced by a **well-performed** harvest, as well as **passing through the crop area again** to harvest remaining fruit, to keep the pest from surviving and passing on to the new fruit in the next harvest. Old and abandoned coffee fields should be destroyed, for the coffee berry borer finds a haven and freely multiplies. It is important to make neighbors aware so that the borer can be controlled, avoiding proliferation of points of infestation to other crop fields.

In crop fields of several municipalities of Rondônia, a fungus called *Beauveria bassiana* was observed naturally performing **biological control of the borer**. It is easy to perceive the presence of the fungus, which closes the hole made by the borer in the form of a white tuft. The fungus is often found surrounding a dead borer at the hole entrance, meaning that the borer died infected by the fungus before reaching the seed.

In crop fields where the fungus occurs, agricultural chemicals should not be applied, unless the borer infection exceeds 3% of the fruit with borer damage without infection from *B. bassiana*. Biological products based on this fungus have been registered. The use of biological components in the formulation of pesticides and fertilizers has grown considerably. This responds to a demand from society to restrict the use of chemical components and expand careful procedures in handling them, and reflects significant advances in research in the sector. The only commercial product registered for coffee berry borer based on *Beauveria bassiana* is *Bovemax* EC (Table 1).

To learn more about this and other coffee pests that occur in Rondônia, see the video produced by Embrapa on this subject:
www.youtube.com/watch?v=lT7UBRrwVik

Just as a reminder:

On August 9, 2010, Resolution RDC no. 28 suspended production, use, and sale of the active ingredient endosulfan in Rondônia, effective immediately, as well as in other states that constituted this group. This prohibition was differentiated for two groups of states of Brazil. For the other group, progressive removal of this active ingredient occurred over a period of three years, beginning on July 31, 2010.

José Nilton

> **“This is a unique opportunity for the state to establish itself as a region of origin of robustas differentiated by quality; it just needs to do it right.”**

Rodrigo Del Guerra

Coffees awaiting drying space in an outsourced structure using high temperature direct flame.

The challenge of doing it right

Perfect drying may be the key to competitiveness for coffees from Rondônia

Reymar Andrade,
Pinhalense

Coffee consumption has been increasing around the world, especially consumption of superior coffees. This has occurred due to the emergence of new markets. The demand is for coffee beans that not only have organoleptic quality of the beverage, but that also have origin, source, and sustainability and are rooted in an environmental and increasingly social context. This new wave of evolution generates new patterns of coffee consumption in traditional and emerging markets.

Coffee from Rondônia fits perfectly within this scenario because it is produced in a region of the Amazon biome with fertile soils and good topography, as well as rainfall amounts, temperature, and solar radiation suitable for plant development. Furthermore, it has an extremely partitioned, family-based, and social landholder model. This is the ideal context for meeting the requirements of this market eager for new and reputable origins.

For coffee, from production to consumption, quality is the focal point. Among all the factors inherent to coffee production, post-harvest is one of the most decisive. The process begins at the correct time for harvesting, passes through processing of the fruit (wet process and dry process), and then includes drying and hulling.

In spite of the importance of this post-harvest phase for beverage quality and for adding value, it is still overlooked by many coffee growers. Harvest is commonly performed with a high rate of unripe fruit or after a long wait of fruit in the field or in the line for drying. The drying process is inadequately performed. The use of high temperatures and direct flames result in coffee beans with a dark appearance, a high number of defects, the smell of smoke, and, consequently, lower added value.

However, this is changing, and more and more producers perceive how much the drying process done right can represent gains in dried coffee yield and product quality. Most drying techniques to maintain fruit and bean integrity after harvest are simple and effective. As part of the evolution the coffee production chain is passing through in Rondônia, coffee growers have begun to invest in technologies at all stages of production. This is a unique opportunity for the state to establish itself as a region of origin of robustas differentiated by quality; it just needs to do it right.

Drying structure with indirect flame and appropriate temperatures without smoke.

Rodrigo Del Guerra

Panorama and benefits of drying

Throughout the history of coffee growing in Rondônia, robusta and conilon (both canephora) seeds and clones have been included, resulting in "robust type" hybrids that confer a difference in the quality of the coffee beverage and the quantity of large beans in sieving. But Rondônia has even more advantages: these materials are part of the technological evolution that has occurred in the area planted to coffee. This has come about through the use of genetically superior clonal materials, fertilization practices, pruning practices, and irrigation. More efficient and productive coffee fields make Rondônia stand out in coffee production and yield.

The estimate of average yield of coffee crops in the state will exceed the unprecedented level of 30 bags per hectare for the 2018 crop year. This will also represent an increase in production, at more than 2 million bags. This positive situation generates demand because the need for logistics for hulling and drying of fruit and coffee beans grows at the same rate; yet the infrastructure for hulling and drying hasn't kept pace.

Currently, natural drying systems on drying yards or terraces, whether covered on not, are used in the state. However, they demand laborers to displace the coffee, which is critical at the time of harvest; the properties are family based and all family members are involved. In addition, it is a slow process that is quite dependent on climate conditions.

Another system used is mechanical drying, performed in associations or through service providers known as "machine operators". This system does not demand many workers, and the drying process

is fast. It does not expose fruit and coffee beans to the risk of rains that favor the fermentation process. Nevertheless, direct flame mechanical dryers are often used and at high temperatures, which leave coffee with the smell of smoke and cause uneven drying and physical and chemical damage to the beans.

Although these are the means used for drying and hulling most of the coffees produced in the state, they do not meet current and growing demand. The infrastructure is incompatible with production in Rondônia. For that reason, coffee growers harvest the fruit and store it in bags in the crop fields themselves or on yards waiting for the time of transport and the drying process. Once more, the fruit is exposed to moisture, temperature, and the activity of fungi and bacteria that bring about undesirable fermentations, which, together with drying at high temperatures, reduce the yield of dried hulled coffee and increase the proportion of defects.

Drying at the right dimensions and performed at a suitable temperature with indirect flame preserves the quality and the yield of hulled coffee. Moreover, it prevents numerous defects and the smell of smoke. This is possible through a system that works with radiative heat and independent chambers.

In a comparison of the effect of drying time and direct and indirect flame systems on coffee yield in crushed coffee beans, the best results were obtained in a drying system that uses coffee mass temperatures up to 60°C and indirect flame. This confers greater yield and, consequently, lower cost per bag of hulled coffee. In this context, inadequate drying speed and temperature are hidden enemies of quality.

Table 1 – Comparison of the effect of drying temperature and direct and indirect flame systems on coffee yield.

Systems	Volume	Drying time	Renda
Direct flame at 200°C	15,000 liters	12 hours	39 60-kg bags of crushed coffee
Indirect flame at 60°C	15,000 liters	23 hours	45 60-kg bags of crushed coffee

Coffee growing in Rondônia, through the Concafé Quality Competition, attracts the attention of coffee tasters and coffee buyers. This is the result of a combination of genetics, environment, and good pre- and post-harvest management practices. Producers are gathering capital and investing on their properties. This is the time to do things right and invest in modern and efficient production systems so that coffee growing in the state achieves new levels. The challenge is in gaining recognition of Rondônia as a producer of volume and quality, with coffees that stand out beyond the quality competitions. It is in establishing its own market and exploring new frontiers.

The distinctiveness of coffee from Rondônia is gained through quality. Its geographic location generates distinctiveness in relation to Amazon origin, but, at the same time, leads to difficulties in logistics and increases cost. Coffee growing in Rondônia competes with coffees from other regions that are nearer to Brazilian roasting industries and the main ports for export. The challenge is doing things right and making the Amazon product attractive in an increasingly competitive market full of opportunities.

Enrique Alves

Beyond the cup

Amazon Robustas prepare to ride the third wave of coffee

Enrique Alves,
Embrapa Rondônia

Coffee is the most consumed beverage worldwide after water; it is among the main agricultural commodities in the world; and, in Brazil alone, it generates more than eight million jobs. Worldwide coffee consumption exceeds 150 million 60-Kg bags of hulled coffee per year. These are truly impressive numbers. But, between you and me, none of this is really important when you're drinking a cup of coffee.

Savoring a good cup of coffee is a moment of relaxation and surrender. We are initially taken in by its aroma; we experience the nuances of flavor; and we conclude with the body of the beverage, which leaves a sensation of well-being and of "I want more". In other words, everything ends with a striking and pleasant aftertaste.

The above words could very well be the definition of the sensations of insistent coffee consumers, those who have the beverage as a fundamental part of their daily activities. Up to that point, nothing new. But, upon holding a cup of coffee, have you ever imagined what could be so special about the process of production and extraction of a product that causes you so much well-being? If you have ever wondered about that, you're not alone; you're part of a change in consumption known as the "third wave of coffee".

That is a popular expression that identifies a moment of greater closeness and connection with the whole coffee production chain. It is the traceability of the entire production process, from the field to the cup. An environment in which all are connected by coffee. The customer states his or her preferences, the barista talks with the roasters, and they, in turn, prompt the producers. In the midst of all this interaction, new products, roasts, and means of extraction are created or reinvented.

In this environment, which is both chaotic and organized and which abounds in information, those who are able to decipher the codes issued by each one of the players in this coffee production chain take the lead. The rule is precisely not to be limited

to rules. These are times of reinterpretation, placing value on tradition without attachment to it. Times of emergence of new technologies and the use of science.

In the "third wave", there are no patterns. Craftwork shares space with high-tech, and the way of obtaining raw materials is as important as their intrinsic quality. For a coffee bean to be considered special, it cannot have defects and needs to have a minimum score. But this is just the beginning of the process. There are social, human, and environmental values that are just as important or even more important.

Customers of the "third wave" coffees are still looking for the perfect beverage, but it does not have the same value if it is obtained through exploitation of producers and through environmental damage. As the song goes, "It's not about getting to the top of the world and knowing that the victory is yours. It's about climbing and feeling that the way has made you strong." The process counts!

In this regard, Amazon Robustas have all it takes to pick up this new wave and go with it, with their nuances of unknown or unexplored aromas or flavors. All of this thanks to a new perspective of sensory evaluation and definition of specific and characteristic standards of canephora coffees, always based on the *Protocolo de Degustação de Robustas Finos* - PDRF [Fine Robusta Cupping Protocol], introduced in 2010 by the Coffee Quality Institute (CQI).

Each day that goes by, more specialists begin the process of recognition of robustas with potential for production of fine coffees. They understand that it is a unique and differentiated product, with orga-

Coffee grower Milton Lima places his bets on coffee quality and sustainability.

Enrique Alves

noleptic characteristics that can be complementary to fine arabica coffees or savored straight. It is the emergence of a new concept in fine coffees, with more body, texture, and striking notes. As happens in every change, this may generate bewilderment in traditional markets. But that will never be a problem for those who ride the "third wave". For them, that which is different, exotic, and unusual may be considered special and rare. This is the time of new sensations in the cup.

The coffee production chain in Rondônia, a reference in and main producer of Amazon Robustas, is very diversified and is distributed across more than 20 thousand family-based properties. In addition to this social importance, it has significant environmental relevance since it is a crop of high (financial) yield per area, which results in less pressure on native forests. Coffee growing is suited to sustainable production, and many producers in the state already practice this to varying degrees.

Without a doubt, Amazon Robustas have the potential to truly break the paradigm in the "third wave of coffee". They bear this differential in their name because they are produced in the Amazon terroir, which has characteristics that are not easily found in other regions of Brazil or of the world. There are innumerable profiles of indigenous, family, organic, and corporate producers in a rich and variable environment of climate and soil, in which coffee plants selected over decades bear fruit. This combination of unique aromas and flavors is awaiting new gastronomic trailblazers.

Amazon Robustas have the strength of its people, the flavor of ripe fruit, and the aroma of its forests.

Amazon Robustas: quality, sustainability, and recognition

Rondônia may have the first Geographic Indication for *Coffea canephora* in Brazil

Janderson Dalazen and Francis Raphael Cidade,
Emater-RO

Renata Silva

Robusta coffees produced in Rondônia have nuances like pleasant acidity, sweetness, aromas, and flavors that remind one of chocolate, nuts, and fruit. These were the attributions given to Amazon coffees in evaluations made by specialists at the last Rondônia Coffee Quality and Sustainability Contest – Concafé 2017.

In the same year, three coffees from Rondônia received awards in the Coffee of The Year contest, Conilon category, during International Coffee Week in Belo Horizonte, MG. This capped off the efforts of producers and diverse players in the production chain that have confirmed the potential of the North region of Brazil in becoming one of the main centers of reference in production of fine robusta coffees.

All this owing to a combination of climate, soil, adequate management practices, and genetic material with differentiated characteristics. Noteworthy among all these factors are robusta clones and hybrids (conilon and robusta), and they have been one of the driving forces of the evolution of coffee growing in Rondônia. They are productive genetic materials that are tolerant to pests and diseases and that have unique organoleptic characteristics.

Clones 41, 80, and 88 are officially quality champions in Rondônia, and it was in Concafé 2016 that this potential was revealed. This event was coordinated by Emater-RO in partnership with other institutions and can be considered a milestone in valuing Amazon Robustas for production of fine coffees.

All these clones originate from an empirical process of plant breeding performed by the coffee growers themselves. The quality champion clones were developed on the Kalk family farm in the muncipality of Cacoal, RO.

Quality champions, Tiago Novaes, André and Sergio Kalk.

Dhiony Costa e Silva

Concafé and sustainability

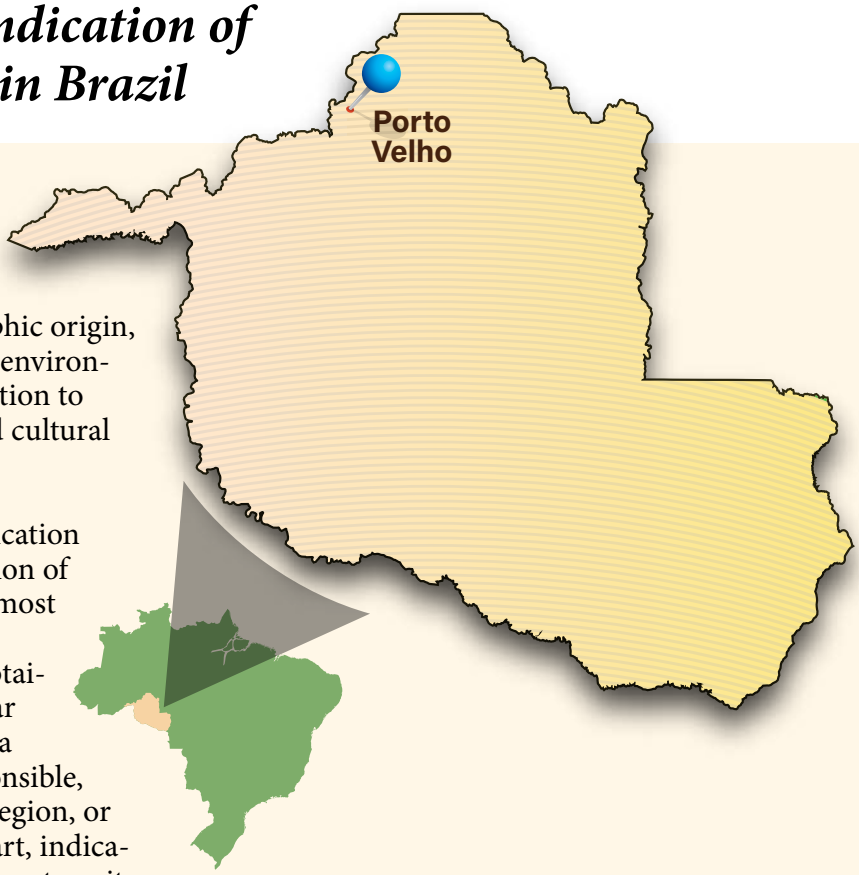
Concafé has proven to be a motivational tool and is responsible for the main advances in implementation of technologies related to coffee quality in Rondônia. In 2017, the second edition, 231 coffee growers from 30 municipalities signed up. They are family producers with an average area of 4.5 ha of coffee, and 68% of the crops are of clonal origin.

The adoption of good management practices during the harvest and post-harvest phases is becoming a habit among the coffee growers that wish to compete in the contest. Harvesting the fruit when ripe, separating the defective beans, and drying the coffee on raised drying screens or in covered drying areas have been the main practices implemented in recent years in the state.

Together with advances in quality, coffee growing in Rondônia is beginning to adopt practices of sustainability, which has resulted from partnership with the Global Coffee Platform. Implementation of these good practices has gradually been increasing in the state, but there is still much to be done.

Concafé also encourages adoption of sustainable practices and awards coffee growers that stand out in following the Coffee Sustainability Curriculum. In 2017, the Bento family, also from Cacoal, RO, was the champion in this category, with a property that serves as a reference. On this property, sustainable practices include providing for soil cover with grasses between the rows of the coffee field, creating an agricultural chemical deposit area, using Personal Protective Equipment (PPE), calculating the cost of production, and involving and valuing all members of the family in the production system.

The Amazon terroir: it may be the first Geographic Indication of Canephora coffee in Brazil



Geographic Indication (GI) serves to distinguish a product or service that has distinct characteristics that can be attributed to its geographic origin, constituting a reflection of the environment. That means that, in addition to natural conditions, human and cultural factors are important.

GI can be classified as IO (Indication of Origin) or DO (Denomination of Origin). In the case of IO, the most important aspect is possessing knowledge of the process of obtaining a product that has singular characteristics, and indicating a geographic region that is responsible, which may be a country, city, region, or specific location. DO, for its part, indicates the geographic name of a country, city, region, or specific location that designates a product or service whose qualities or characteristics are due exclusively to the geographic medium, including natural and human factors.

The state of Rondônia has diverse products with potential for receiving the seal of Geographic Identification. Among them, coffee is one that stands out through having its organoleptic diversity recognized and linked to the productive process, region (climate and soil), and genetic and crop characteristics. Since Rondônia still has a seed-based coffee plantation area, it also holds genetic richness and variability that is difficult to find in other regions of Brazil. These combinations can produce coffees with unique qualities, and recognition of this property can strengthen the production chain and transform the state into a world reference in production of fine Amazon Robustas.

Formal recognition of the GI in Brazil and geographic responsibility belongs to the *Instituto Nacional de Propriedade Intelectual* – INPI [National Institute of Intellectual Property], an autonomous agency of the federal government. By means of diagnoses and technical analyses performed in Rondônia by the *Rede Nacional de Inovação e Produtividade* – RENAPI [National Innovation and Productivity Network], a program connected with the *Agência Brasileira de Desenvolvimento Industrial* – ABDI [Brazilian Industrial Development Agency], the company AJLima Consultoria em Agronegócios was contracted for technical services of elaboration and application of a methodology for Geographic Indication of the coffee producing region in Rondônia, through contract no. 016/2018. This is a process that may take years, but the first steps have been taken.

Alda Barroso

Yes, robusta. Why not?!

Revealing flavors and aromas of Amazon coffees

Alda Barroso,
Barista and Coffee Consultant

In 2016, in the International Coffee Week (ICW) in Belo Horizonte, one stand drew my attention; it served 100% gourmet robusta grown in Rondônia: Amazon Coffee. I tried it and was surprised by the quality of the beverage, its characteristics, aromas, and specific flavors. I was given a sample as a gift and, at home, I made the suitable adjustments on the coffee machine and grinder, resulting in a beverage with extraordinary crema, beautiful color, velvety body, pleasant aroma, and surprising aftertaste.

As a barista since 2008, I had always heard that robusta coffee is bad, of low quality, with disagreeable aromas and the taste of medicine. My impression changed. I now have a new perception of robusta and conilon. They are coffees that go far beyond body and neutrality. Today I can say that robusta coffee is another variety with potential for a high quality beverage, with specific characteristics and flavors, and that consumers are interested in it. Just spread the word. What the market wants is high quality coffee in its establishments, at breakfast, in a business meeting, or at leisure time, regardless of the species.

With the consumer market ever more demanding regarding quality, it is necessary to pay attention to the processes involved in coffee growing, which directly affect the beverage the final consumer will enjoy. Consequently, any lapse can result in a low quality product. Coffee is a very complex fruit and each step in its production is of significant importance; roasting certainly cannot be disregarded. Roasting complements the quality and the type of the final beverage. If poorly done, it destroys all the work performed from planting to hulling in a few seconds. After all, coffee in the cup is the last link in this whole production chain.

The professional behind the cup

A barista is a person who is interested in everything that involves the coffee bean, from agricultural production to preparation of the most diverse coffee-based recipes. He/She is responsible for contact with the customer, before and after the order. The barista should assist in choosing the beverage and help in appreciating it in the best way, showing the variety of options, the origin of the beans, their qualities and characteristics. It is necessary to respect and understand that, behind each cup, there is a chain of people that work so that the product gets there. Thus, the importance of a professional in this last step.

The profession of barista has been achieving an international standard of quality and, that way, it requires constant training and refinement of those who want to provide an excellent service. I have a passion for this area and I am always investing in it. I seek to remain enchanted by what I do because, then, problems and challenges are overcome in a gratifying, pleasurable, and enjoyable way, and a great deal of learning is attained.

My story with coffee: from childhood to the best years of life

The smell and flavor of coffee have always been part of my life. I was born in Coluna, a small town in Minas Gerais, and from the time I was a child, I played under coffee plants on the farm where I lived. It was wonderful to try those little red berries with the flavor of honey...

In 2004, after I retired, I decided to study Business Administration with an emphasis on hotel management at Senac Minas. Then I studied for my MBA in Gastronomy at Senac BH, aiming to increasingly refine my knowledge in the gastronomic sector. In addition to expanding my marketing perspective and acquiring knowledge in the area, I was sure that with a great deal of persistence, I would be able to attain my professional goal.

In 2007, during my studies in Business Administration, I elaborated a business plan called "Feasibility of a Coffee Shop". During the research, I came across the activity of a barista. Since at that time a course was not available in Belo Horizonte, I attained qualification at Senac Francisco Matarazzo in São Paulo with professor Concetta Marcelino de Prizzio. At the time, I visited coffee farms, the Coffee Museum in Santos, and the best coffee shops in the capital of São Paulo. Upon returning to Belo Horizonte, already convinced that I would make coffee my profession, I continued to specialize in the diverse segments of the production chain. I participated in the selection process of the Coffee Team Barista and was then a sensory quality judge over five years in barista championships in Minas Gerais and Brazil. I achieved certification as a barista from the *Associação Brasileira de Café e Barista* - ACBB [Brazilian Coffee and Barista Association] and as an instructor from the Specialty Coffee Association - SCA. Currently, I provide consulting services and operational training in coffee shops and I give barista training courses.

Alda Barroso

New phase of coffees from Rondônia

Renata Silva and Enrique Alves,
Embrapa Rondônia

Eduardo Carvalhaes Júnior is a chemical engineer, businessperson, and market analyst. He is the director of Escritório Carvalhaes, which has worked for 100 years in the areas of brokerage, reports, approval of samples, and shipping, also providing services in the area of coffee exports. Eduardo is also president of the *Câmara Setorial do Café de São Paulo* [São Paulo Coffee Sector Council] and founder and first president of the Coffee Museum in the historic *Bolsa Oficial do Café* [Official Coffee Exchange]. The interview he granted to the team of Coffees of Rondônia magazine (CR) follows.

CR – You visited Rondônia for the first time in 2018. What were your first impressions on coffee growing in the state?

Eduardo – Because of professional commitments, I stayed only one day in Porto Velho and I wasn't able to visit the coffee-producing regions of the state. I was surprised and quite impressed with what I heard in conversations with Embrapa technicians during the first day of the Amazon Robusta Days (*Jornada dos Robustas Amazônicos*) event in Rondônia. I returned convinced that coffee production in the state had greatly advanced, supported by technology and research; it has entered into a new phase, more organized, professional, with a well-defined focus. This new phase, that of Amazon Robustas, if consistently carried out with the readiness and political willingness that I felt, will bring coffee growing in the state to a new level, placing Rondônia in the select group of the main coffee-producing states of Brazil.

CR – What do you believe the coffee market will be like in the future? How can Rondônia secure its position?

Eduardo – Coffee production and consumption is in the best phase of its long life. Brazilian production has advanced a great deal in quality and yield. The image of coffee as an agreeable product beneficial to health grows each day and drives consumption throughout the world. Countries with the cultural habit of drinking tea are embracing coffee in new generations. This has already occurred in England and in Japan and it is happening now in South Korea and India; in recent years, it has begun to penetrate China. Also for coffee, the twenty-first century will be Asia's turn. Rondônia is well positioned to provide coffee to these new consumers.

CR – Rondônia is consolidating itself as a corridor of regional integration that includes Asian countries, the main logistical bet of agribusiness in Brazil. How might this affect the export potential of coffees from Rondônia?

Eduardo – The geographic position of the state, near an outlet to the Pacific, lends a competitive advantage to coffees of Rondônia. In addition, experience shows that in tea-consuming countries, instant coffee is the form in which their inhabitants begin to acquire the habit of drinking coffee. They don't need any special piece of equipment; just mix coffee in hot water, as they already do with tea. Because of its quantity of soluble solids, much greater than in arabica, robusta is the basis of instant coffee.

CR – The production of fine coffees has been a bet of some producers in the state that work with Amazon Robustas in a differentiated manner. How would you direct them so that they are successful in such a complex and volatile market?

Eduardo – Although it is a much smaller market than that of commodity coffees, the consumption of fine, differentiated coffees is growing at a higher rate. In addition to quality, these coffees have to have identity, personality, be differentiated. The name Amazon Robustas was very well chosen. It is strong and differentiates the coffee produced in the region. However, you can never get away from the cost of production, of marketing, and of the continual pursuit of more technology and improvement in quality.

CR – As a coffee and wine taster, what organoleptic characteristics of the Amazon Robustas do you think should be used to differentiate them in the market?

Eduardo – Tasting/cupping of conilon and robusta is recent compared to the long tradition of arabica. In this century, we began to speak more about beverage quality for these coffees and better define what a gourmet beverage is for them. The good news is that the number of young consumers throughout the world is large; they are eager for new things and are as yet without a formed taste and, therefore, open to new flavors. The organoleptic differentiation of Amazon Robustas in relation to other origins will have to be "constructed" in coming years. Preservation of the environment, of the local culture, and of the terroir should be included in the identity of the coffees produced in Rondônia.

CR – If you had the opportunity to define a public policy for coffee growing in the state, what would it be?

Eduardo – Eduardo – In my opinion, the directives adopted in this new phase of coffee production in Rondônia, that of Amazon Robustas, are correct. It is good to remember that development of coffee growing in the region will always depend on more research, technology, infrastructure, financing, and modern logistics, by means of waterways and an outlet to the Pacific. It must also be remembered that the image of coffee growing in Rondônia was that of low quality, low yield, and little technology. There were mixed varieties, low in type (many defects), and trade was not very organized. Now, the image is that of greater organization, with a focus on research and new varieties, the pursuit of yield and quality. Coffees produced in the region were joined and given an identity. This change in image toward modern productive coffee growing with quality needs to be consolidated. The renewal and technical transformation of coffee fields needs to continue, to be universalized. Increased yield and optimization of production costs must always be pursued. Research and the search for new varieties must not be neglected.

Recipes

Robusta in my way

Enrique Alves

"Suna's Coffee"

By Sunalini Narayan Menon

Ingredients:

- Brown or refined sugar - 10 g (dissolved in a small amount of hot water)
- Cold tonic water - 150 ml
- Fresh lime juice - 1 teaspoon
- Espresso - 2 doses
- Optional – two cubes of ice, whole or crushed

Directions:

Pour the dissolved sugar and lime juice in a large cappuccino cup. Add two doses of espresso. Mix well. Add 150 ml of cold tonic water and serve. Should you decide to use ice, place it at the bottom of the cup before adding the ingredients of the recipe.

You can substitute sparkling water for the tonic water. In that case, instead of using 10 g of sugar, use 15 g.

Alda Barroso

Robusta Coffee Cake with Chocolate

by Alda Barroso

Ingredients:

- 4 eggs
- ½ cup vegetable oil
- 1½ cup sugar
- 1 cup cocoa powder
- 1 cup coffee, 100% robusta, filtered coffee or "espresso" (without sugar), cold
- 2 cups sifted flour
- 1 pinch salt
- 1 pinch baking soda
- 1 tablespoon baking powder

Directions:

In a bowl, mix the flour with the cocoa powder, the pinch of salt, and the baking soda. Separate the egg whites and beat separately. When the egg whites are nearly firm, add ½ cup sugar and beat to the consistency of meringue and set aside. In another bowl, place 1 cup sugar and add the egg yolks one by one and beat until pale yellow and creamy. Then add the oil with the beater in action. Stop beating and stir in the flour and chocolate mixture little by little, interspersed with the cold coffee. Then lightly mix in the beaten egg whites until covered. Finally, stir in the baking powder. Pour into a greased tube cake pan dusted with chocolate and place in the oven at 180°C (350°F) for 45 to 50 minutes.

After cooling, remove from the cake pan. Make a chocolate sauce with 1 cup of coffee, 2 tablespoons of sugar, 4 tablespoons of cocoa powder, and 1 tablespoon of butter. Heat to desired thickness. Pour over the cake and decorate with coffee beans that most resemble gems.

It is hard to resist coffee cake with chocolate. A perfect combination. A great match with just-brewed coffee. The aim here is to experience the intense flavor of 100% robusta coffee, which, with higher caffeine content, provides this recipe with the distinctive flavor of this type of coffee.

Cake making for me is a repetitive exercise. Sometimes the first don't turn out so well. But don't despair. Over time, if you like what you're doing, good surprises arise, especially when you start to hear compliments from your guests.

Dhiony Costa e Silva

Chocolate brigadeiro (fudge balls) with robusta coffee prepared by Ruth Helena.

Foto: Dhiony Costa e Silva

Chocolate brigadeiro (fudge balls) with robusta coffee

By Rute Helena Assis da Silva

Robusta coffee is full-bodied and has intense flavor, a perfect combination with chocolate. So, we join two Brazilian favorites by adding coffee to our brigadeiro. With the special flavor of childhood, no one can stand to just look at a candy counter full of delicious brigadeiros. Remember your childhood, friends, birthday parties, grandma's house.

Ingredients:

1 can sweetened condensed milk
1 tablespoon butter
1 tablespoon 100% cocoa powder
1 short shot espresso

Directions:

In a pan, stir together the sweetened condensed milk, the butter, and the cocoa until well mixed. Place over low heat, stirring constantly. Add the coffee and continue stirring until you can begin to see the bottom of the pan. Then place in a buttered glass or porcelain container and cool. With the aid of a teaspoon, form the brigadeiro (bonbon) balls and roll in granulated chocolate or crushed peanuts. Enjoy.

Send your recipe with robusta coffee; it might appear in the next issue:
rondonia.imprensa@embrapa.br

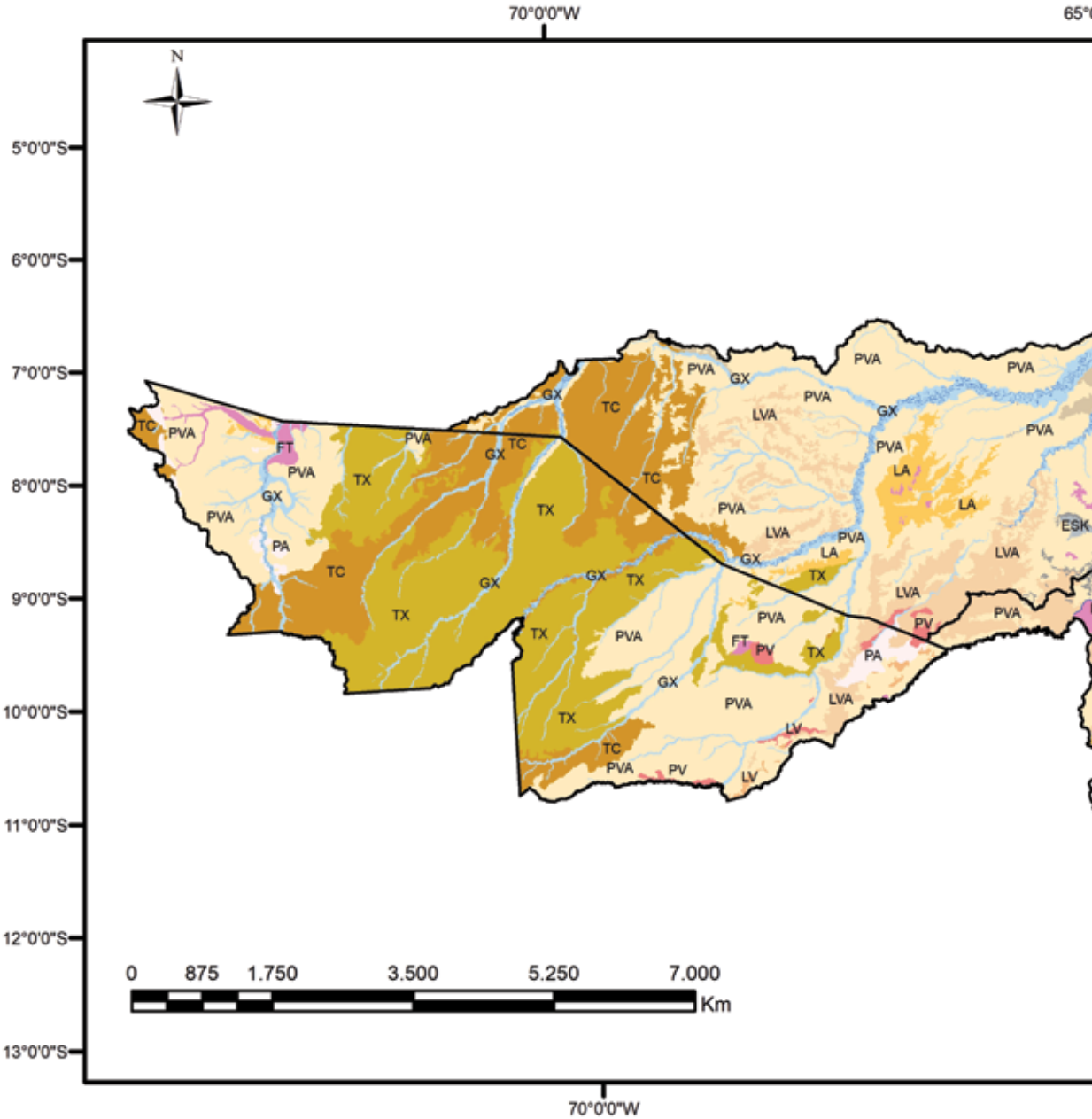
SOIL MAP
OF THE STATES

Acre, Rondônia,
and southern
Amazonas

Soil Classes	Municipalities*	Yield Potential		Limitations
		Dryland	Irrigated	
Argissolos Vermelho Amarelos	Ouro Preto do Oeste (RO), Plácido de Castro (AC), Acrelândia (AC), Assis Brasil (AC), Monte Negro (RO)	●●●●	●●●●●	Water deficit Lack of fertility Mechanization limits Susceptibility to erosion
Cambissolos	Pimenta Bueno (RO), Sena Madureira (AC), Humaitá (AM)	●●	●●●●●	Water deficit Oxygen deficiency Mechanization limits
Latossolos amarelos	Machadinho do Oeste (RO), Cruzeiro do Sul (AC)	●●●	●●●●	Lack of fertility
Latossolos or Argissolos associated with plinthites	Porto Velho (RO), Bujari (AC)	●●●	●●●●	Water deficit Lack of fertility Oxygen deficiency
Latossolos Vermelho Amarelos	Boca do Acre (AM), Xapuri (AC)	●●●●	●●●●●	Lack of fertility
Luvissolos Háplicos	Feijó (AC), Tarauacá (AC), Assis Brasil (AC)	●●●	●●●●●	Water deficit Oxygen deficiency Mechanization limits
Neossolos Litólicos	Ariquemes (RO) Buritis (RO), Jaru (RO)	●●●	●●●●	Water deficit Lack of fertility Mechanization limits Susceptibility to erosion
Neossolos Quartzarênicos	Pimenta Bueno (RO), Vilhena (RO)	●●	●●●	Water deficit Lack of fertility Susceptibility to erosion
Nitossolos Vermelhos	Alta Floresta do Oeste (RO)	●●●●●	●●●●●	Lack of fertility
Plintossolos Argilúvicos	Humaitá (AM), Canutama (AM)	●●	●●●	Water deficit Oxygen deficiency Lack of fertility
Vertissolos	Feijó (AC), Tarauacá (AC)	●●	●●●●	Water deficit Oxygen deficiency Mechanization limits

* The municipalities indicate only some of the locations of the occurrence of these soils and were cited due to the soil-landscape interaction as one of the factors that determine the degree of limitation.

SOIL MAP OF THE STATES OF ACRE, RO



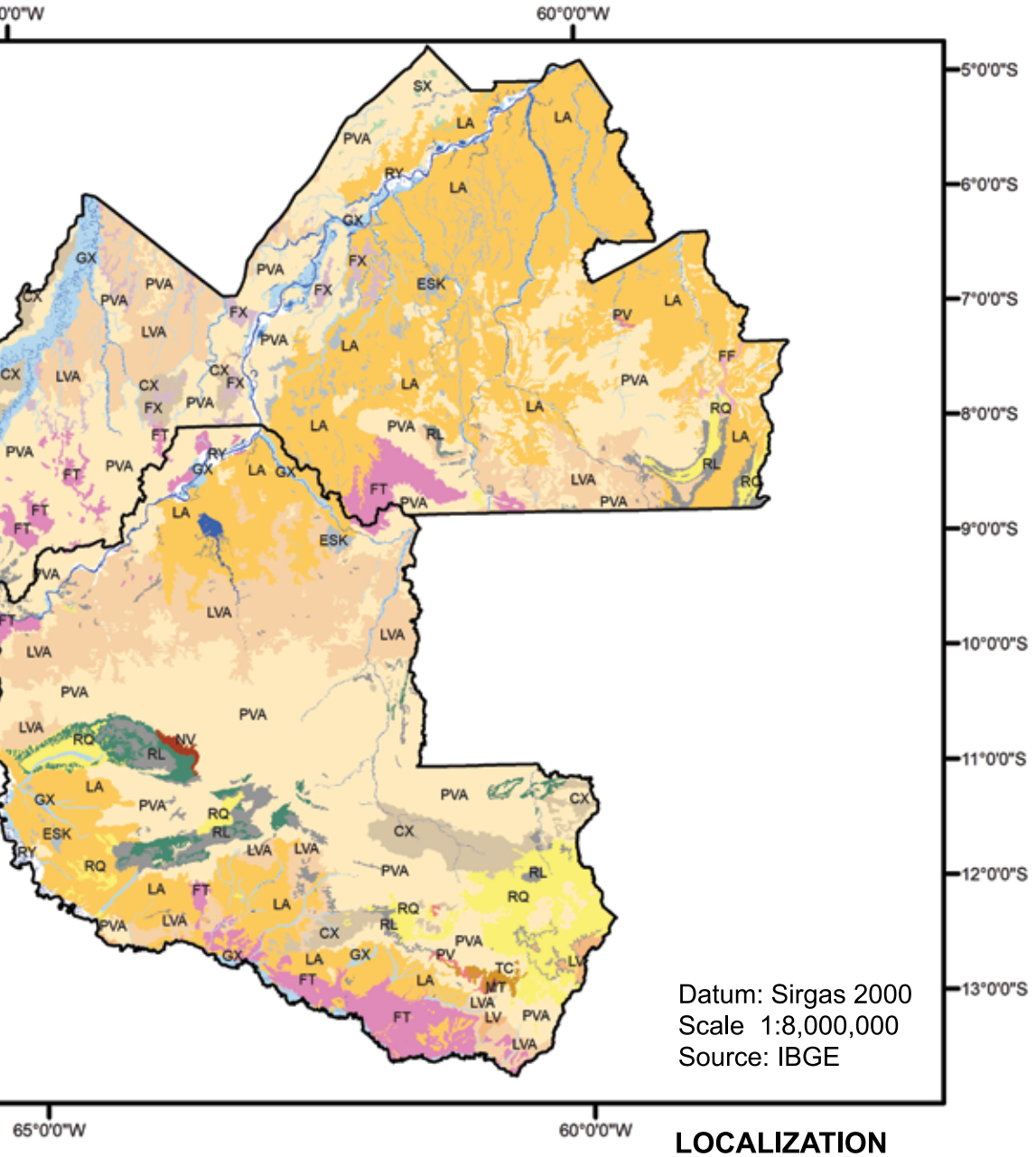
Legend

SOIL CLASSES

(Sistema Brasileiro de Classificação de Solos – SiBCS)

- PA- Argissolo Amarelo
- PV- Argissolo Vermelho
- PVA - Argissolo Vermelho-Amarelo
- CX- Cambissolo Háplico
- MT - Chernossolo Argilúvico
- ESK - Espodossolo Ferri-Humilúvico
- ES - Espodossolo Humilúvico
- GX - Gleissolo Háplico
- LA - Latossolo Amarelo
- LV - Latossolo Vermelho
- LVA - Latossolo Vermelho-Amarelo
- TC - Luvissolo Crômico
- TX - Luvissolo Hápli
- RY - Luvissolo Flúvi
- RL - Neossolo Litóli
- RQ - Neossolo Quar
- RR - Neossolo Rego
- NV - Nitossolo Verm
- OX - Organossolo H

NDÔNIA, AND SOUTHERN AMAZONAS



LOCALIZATION

- SX - Planossolo Háplico
- FT - Plintossolo Argilúvico
- FX - Plintossolo Háplico
- FF - Plintossolo Pétrico
- RIVERS AND LAKES
- ROCK OUTCROPPINGS
- **STATE BORDERS**

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