Guarana Fertilization

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Guarana (*Paullinia cupana*) is a major permanent cash crop for small farms in the state of Amazonas. Commercial production is stimulated by strong demand for a national soft drink produced from the ground seed and by a growing export market. The plant (Figure 1) is a bushy shrub with a spreading, irregular growth habit. To date, research on guarana has centered on the selection of high-yielding cultivars. However, nutritional problems may become a future limitation, as seed yields on some of the most promising clones would represent an annual removal of 68 kg/ha of N, 4 kg/ha of P, 14 kg/ha of K, and 3 kg/ha of Mg.

Short-term studies have demonstrated yield responses by guarana to applications of fixed quantities of fertilizers. However, the absence of data on yield response curves for guarana to fertilizers has restricted the development of fertilizer recommendations for this crop. Long-term field studies with guarana fertilization recently became possible with the development of vegetative-propagation techniques.

The objectives of this study were 1) to characterize the yield response curves of guarana to rates of N, P, K, and Mg fertilization, and 2) to establish soil-test and tissue-analysis calibration data on guarana for these nutrients.

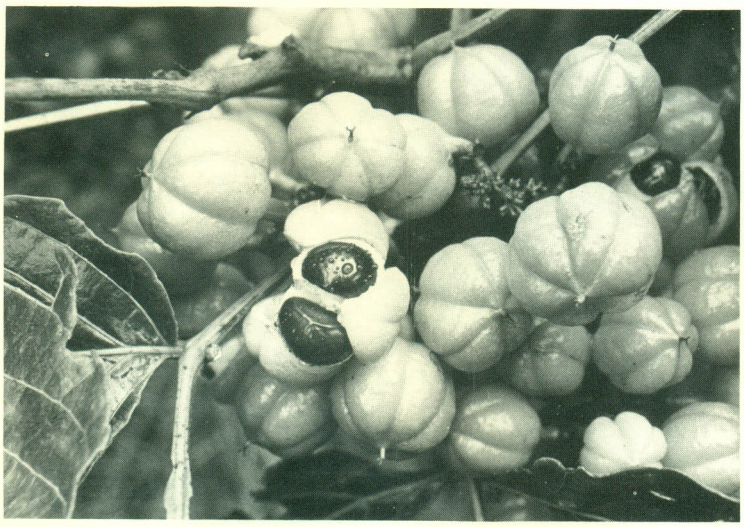

Figure 1. Guarana (*Paullinia cupana*).

The field experiment was initiated in February, 1983. Rates of N, P, K, and Mg fertilizers tested are shown in Table 1. Individual response curves were established with four annual rates of each nutrient, while maintaining the remaining nutrients constant at the highest rate. The experiment contained three replications with fertilizer treatments as main plots and three guarana clones as subplots.

Initial plans were to split annual fertilization rates, excluding P, into two equal applications during the vegetative growth phase, which extends from January to July in the Manaus region. In 1984, this fertilization scheme was changed to three split applications when symptoms of N deficiency were observed before the second fertilization. Planned measurements included determinations on propagation of branches, yield and nutrient analyses of soils, leaves, and fruits. A prolonged dry season immediately after planting the guarana resulted in a high mortality rate for the three clones. Over 50% of the original plants were replanted. Destructive plant measurements were, therefore, delayed until plant flowering in October, 1985.

Growth Response to Nutrients

Preliminary growth measurements have been affected by the large number of plants replanted in the study. Consistency of results was improved when average increases in the number of branches were determined between the last two sampling dates (Table 1). Maximum increases in branching, among the fertilized treatments, occurred with the treatment containing the highest rate of all nutrients. For lower rates of individual nutrients, the largest reduction in branching occurred in the absence of P, followed by K, Mg, and N, respectively. Plant growth as a function of rates of N, P and K, is further exemplified with individual clones in Figure 2 for the initial 24 months of this study. Differences in number of branches per plant were evident at 12 months after planting and increased during subsequent growth. Plant yields are considered to be partially related to the number of branches produced during the previous year. These data will be compared with yields for the first harvest of this study, in January, 1986.

Soil Nutrients

Because fertilizers were applied in 0.3 m wide strips corresponding to the circumference of the plant canopy, variability was great in soil-chemical analyses. Nevertheless, soil-test P values increased significantly with P fertilization. No differences were observed in

soil test levels of K and Mg among rates of these elements. In general, levels of exchangeable bases, Al and Mehlich 1 extractable micronutrients were similar to those observed for the unfertilized plots of the adjacent nutrient-dynamics study at a similar time after burning the primary-forest vegetation.

Implications

The UEPAE/Manaus station is responsible for coordinating all the guarana research conducted by the EMBRAPA network. As one of the few long-term guarana fertilization field trials, this study will be useful in delineating specific lines of future research and in providing initial guidelines for fertilizer recommendations on this permanent crop. The study will also provide a means of comparing soil-nutrient dynamics in the guarana experiment with those in the adjacent experiments with annual crops.

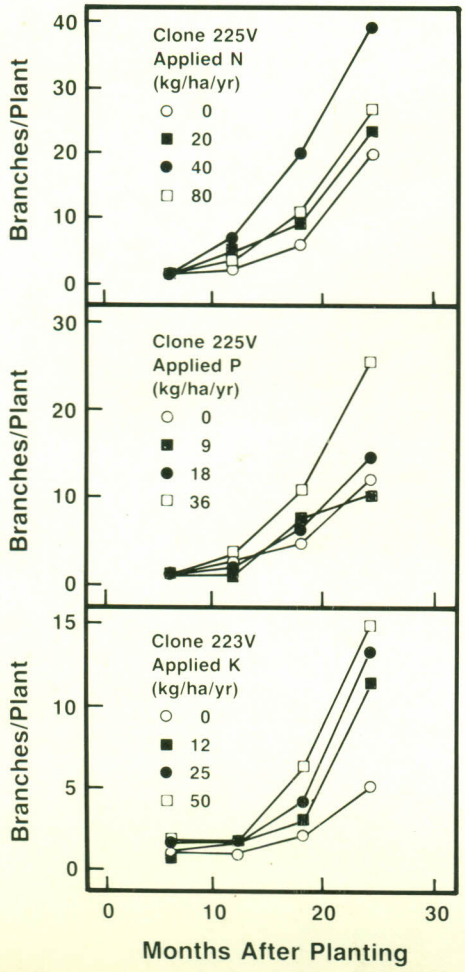

Figure 2. Guarana growth as a function of N, P and K.

Table 1. Effects of fertilizer treatments on increases in the number of guarana branches/plant between August, 1984 and February, 1985.

Treatment	Rates Applied				Average Increase of Branches
	N	P	K	Mg	
	kg/ha/year				number/plant
Check	0	0	0	0	8.3
N0P3K3Mg3	**0**	36	50	20	8.5
N1P3K3Mg3	**20**	36	50	20	8.7
N2P3K3Mg3	**40**	36	50	20	8.8
N3P0K3Mg3	80	**0**	50	20	4.5
N3P1K3Mg3	80	**9**	50	20	4.4
N3P2K3Mg3	80	**18**	50	20	5.0
N3P3K0Mg3	80	36	**0**	20	4.8
N3P3K1Mg3	80	36	**12**	20	5.7
N3P3K2Mg3	80	36	**25**	20	6.9
N3P3K3Mg0	80	36	50	**0**	5.9
N3P3K3Mg1	80	36	50	**5**	5.7
N3P3K3Mg2	80	36	50	**10**	7.3
N3P3K3Mg3	80	36	50	20	9.1
N2P2K2Mg2	40	18	25	10	7.0