g N/kg, which approaches the internal requirement recommended by Stanford and Legg.

Since climatic factors impose a limit to obtaining higher biomass in annual crops, breeding programs should emphasize both N-use efficiency and harvest index to improve cereal productivity. The harvest index is an easy field determination, and it provides a quick estimate of the relative photosynthate partitioning potential among genotypes. Selecting efficient genotypes for N use would also contribute to a higher productivity on low-N environments or higher fertilizer-use efficiency.

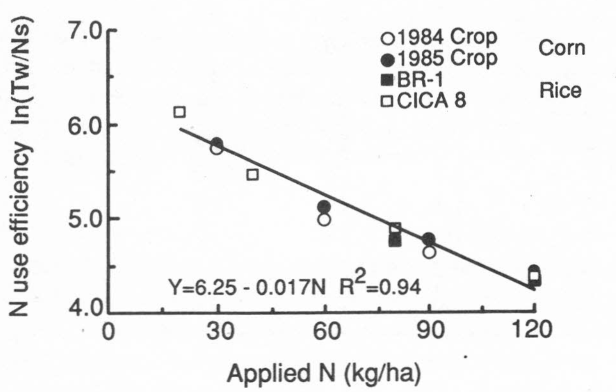

Figure 3. Effect of applied N on N-use efficiency for dry-matter production. Tw/Ns indicates total dry weight per unit of soil N.

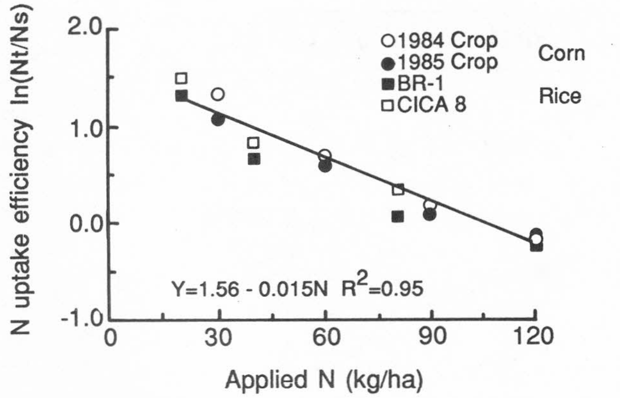

Figure 4. Effect of applied N on N-uptake efficiency for dry-matter production. Nt/Ns indicates the proportion of soil N taken up by the plant.

Lime and P Requirements for Peanut in a Clayey Oxisol: M-905

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Although there is little tradition of peanut production in the Central Amazon, data from Yurimaguas suggest that it would be a suitable crop for continuous production systems in these ustic or near-ustic soil-moisture regimes. Because of potential harvest problems in these clayey Oxisols, preliminary peanut trials compared different land preparation methods (plant beds, hilling vs. no-hilling). Results showed little seed loss when peanuts were planted toward the end of the rainy season for harvesting during the driest months (<100 mm) of the year. Planting on raised beds brought no yield advantage, but hilling near the pegging stage did.

Objective

The objective of this study was to assess soil Ca and P requirements for peanut production in these Oxisols through residual lime and P fertilization trials.

Procedures

The lime experiment contained five rates of calcitic lime (0, 0.5, 1, 2, and 4 t/ha; 83% $CaCO_3$ equivalency) applied once in 1983. Three additional treatments with 0, 1, and 2 t lime/ha also received 1 t gypsum/ha in 1983 and 1986. There were four replications arranged in a randomized complete-block design. Two peanut varieties were compared in both 1987 and 1988 in subplots of the eight lime treatments. Varieties were *Blanco Tarapoto*, selected from trials in the Yurimaguas Ultisols, and *Tatu Vermelho*, which is used in Southern Brazil. In both crops, gypsum was applied at planting to the three designated treatments, as in previous years of this study. Blanket applications were also made of P and K fertilizers.

Results

Chemical properties of the surface soil layer (0 to 15 cm) were measured at the flowering stage of both peanut crops (Table 1). Between the two years, exchangeable bases decreased and acidity increased in all plots. Aluminum saturation ranged from 17 to 79% in 1987 and from 83 to 32% in 1988. Gypsum applications caused significant increases in exchangeable Ca and small reductions in exchangeable Al. The net result was to decrease Al saturation by as much as 25% relative to comparable lime rates without gypsum.

In both years, shelled peanut yields, shelling percentage, and leaf Ca content at flowering were increased significantly by lime treatments (Table 2). Mean yields for *Blanco Tarapoto* were significantly higher than for *Tatu*

Table 1. Surface soil (0 to 15 cm) chemical properties at flowering stage of both peanut crops in the clayey Oxisol of Manaus

Lime rate	Year	pH	Exchangeable Ca	Exchangeable Mg	Exchangeable K	Exchangeable Al	Al sat.	Avail. P
t/ha			cmol/L				%	mg/kg
0	1987	4.3	0.26	0.04	0.16	1.7	79	19
	1988	4.4	9.19	0.07	0.14	2.0	83	13
0.5	1987	4.4	0.37	0.10	0.18	1.4	68	24
	1988	4.4	0.28	0.09	0.13	1.8	78	14
1	1987	4.6	0.62	0.15	0.19	1.2	56	24
	1988	4.6	0.44	0.11	0.19	1.6	68	12
2	1987	4.6	0.71	0.16	0.21	1.0	48	20
	1988	4.6	0.55	0.11	0.13	1.5	66	10
4	1987	5.0	1.49	0.29	0.21	0.4	17	17
	1988	4.9	1.23	0.15	0.14	0.7	32	9
0 + G§	1987	4.2	0.71	0.02	0.16	1.4	61	24
	1988	4.3	0.61	0.06	0.10	1.8	70	19
1 + G	1987	4.3	1.13	0.13	0.19	1.1	43	22
	1988	4.5	0.86	0.09	0.12	1.3	55	12
2 + G	1987	4.6	1.60	0.19	0.17	0.6	23	22
	1988	4.5	1.08	0.09	0.10	1.3	51	12

§ G denotes the application of 1 t gypsum/ha to each crop.

Table 2. Seed yield, shelling percentage, and leaf Ca levels for two peanut varieties as a function of lime treatments during two crops in the Manaus Oxisol.

Lime rate	Year	*Blanco Tarapoto* Yield	*Blanco Tarapoto* Shelling	*Blanco Tarapoto* Leaf Ca	*Tatu Vermelho* Yield	*Tatu Vermelho* Shelling	*Tatu Vermelho* Leaf Ca
t/ha		t/ha	%		t/ha	%	
0	1987	0.8	27	0.58	1.3	64	0.68
	1988	0.1	34	0.67	0.2	56	0.50
0.5	1987	1.1	42	0.68	1.0	62	1.16
	1988	0.4	41	0.73	0.2	54	0.53
1	1987	2.1	56	0.88	1.5	69	1.10
	1988	0.7	52	1.03	0.7	68	1.00
2	1987	2.3	60	0.93	2.0	73	1.15
	1988	1.0	59	1.28	0.7	68	1.06
4	1987	3.0	71	1.16	2.1	73	1.36
	1988	1.5	69	1.46	1.0	74	1.58
0 + G§	1987	3.3	71	1.00	2.0	74	1.33
	1988	1.3	70	1.30	1.1	74	1.34
1 + G	1987	3.2	69	1.03	2.0	74	1.23
	1988	1.4	69	1.39	1.2	74	1.56
2 + G	1987	3.5	72	1.23	2.4	74	1.20
	1988	1.4	71	1.62	1.3	74	1.75

§ G denotes the application of 1 t gypsum/ha to each crop.

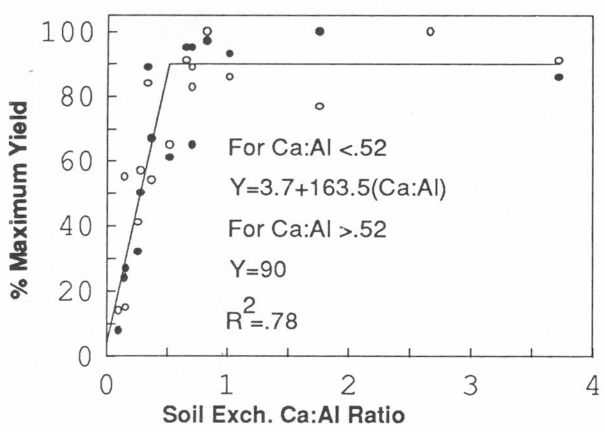

Figure 1. Relative yield of shelled peanut varieties *Blanco Tarapoto* (solid symbols) and *Tatu Vermelho* (open symbols) as a function of the exchangeable Ca:Al ratio in lime and lime plus gypsum treatments in a clayey Oxisol of the Brazilian Amazon.

Vermelho. Blanco Tarapoto also showed a greater response in both yield and shelling percentage to lime treatments than did *Tatu Vermelho.* At their maximum yields, both varieties had similar shelling percentages and leaf Ca contents. Among the chemical soil properties measured, the ratio between exchangeabl· Ca and Al gave the best agreement with relative peanut yields (Figure 1). There was a linear increase in yields up to an exchangeable Ca:Al ratio of 0.52. Above this value, there was no response in yield. There were no differences between varieties or years in this relationship. Similar relationships were also found with percentage Ca and Al saturation, with critical levels of 20 and 60%, respectively. The exchangeable Ca:Al ratio, however, accounted for more of the variability in yield among varieties and years than either of the cation-saturation indices. That finding is consistent with those treatments that attain maximum yields by using lime to reduce Al toxicity and gypsum to provide supplementary Ca (Table 2).

Soil P requirements for peanuts were assessed in 1987 by planting *Tatu Vermelho* in a long-term P fertilizer rates-and-placement study. The experiment consisted of a split-plot arrangement of broadcast and banded P placement with four replications in a randomized complete-block design. Main plots are broadcast P rates (0, 22, 44, 88, and 176 kg P/ha) applied once before planting the initial crop in 1981. Subplots are banded P rates (0, 11, 22, and 44 kg P/ha) applied with variable frequency to the 11 crops preceding peanuts. Whereas a rate of 11 kg P/ha was applied to all former crops, rates of 22 and 44 kg P/ha were band-applied only to the first eight and four crops, respectively. Total band-applied P in the previous crops was, therefore, 121, 176, and 176 kg/ha, respectively. The experiment was planted in an annual corn-cowpea rotation each year. Peanuts were planted in May 1987 after harvesting corn without additional P inputs.

The relationship between Mehlich 1 extractable soil P (1:10 soil to solution ratio, 5 minutes shaking) and relative yield of shelled peanut in all P treatments is shown in Figure 2. P fertilization increased yields from 0.5 t/ha without applied P to a maximum of 2.0 t/ha. The Mehlich 1 critical value of 9 mg/kg is superior to the levels of 6 and 8 mg/kg established for corn and cowpea, respectively, during preceding crops in this study. There were significant linear correlations between Mehlich 1 soil P and both the Bray 1 (r=0.96) and Modified Olsen (r=0.80) extractants. Based on linear relationships between extractants, the respective critical soil-P levels for corn, cowpea, and peanut were estimated to be 9, 13, and 15 mg/kg with the Bray 1 method and 8, 9, and 10 mg/kg with the Modified Olsen method. Higher soil P requirements for the legumes relative to corn were associated with a significant increase in foliar N concentration for cowpea and peanut with increasing P applications. These data suggested a higher soil-P requirement for plants, depending on symbiotic N_2 fixation as their primary source of N.

The soil test calibration data provide guidelines for managing acidity and P constraints for peanuts in mechanized continuous crop rotations on clayey Oxisols of the Central Amazon. Although the variety *Blanco Tarapoto* has a higher yield potential than *Tatu Vermelho*, the latter provided higher yields under extreme soil conditions of low Ca and high acidity.

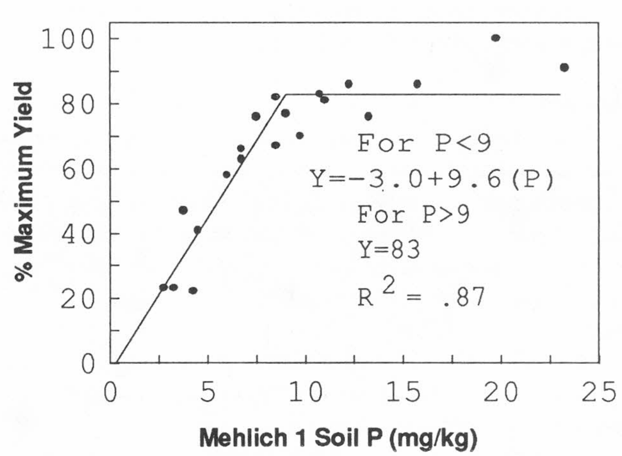

Figure 2. Relative peanut yields as a function of Mehilch 1 extractable soil P treatments containing variable rates of broadcast and/or banded P.