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Lime and Gypsum Applications

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Farmers in the Manaus region prefer concentrated fertilizer sources to minimize the high transportation costs from southern Brazil. Ordinary superphosphate, therefore, has seldom been used on these acid Oxisols, despite indications that the gypsum in this P source effectively reduced subsoil acidity and promoted deeper root growth in strong ustic soil moisture regimes. An ongoing study in the Typic Acrothox has compared the acid-ameliorating effects of lime and gypsum for corn, cowpea and soybean for three consecutive years.

Procedures

At the study's inception, locally available calcitic lime (32% Ca and 0.8% Mg) was applied at the rates of 0, 0.5, 1, 2 and 4 t/ha. One t/ha of gypsum was applied in combination with lime rates of 0, 1 and 2 t/ha. An equivalent amount of gypsum was reapplied before planting corn in 1986.

During the last two years, plots were subdivided and two cowpea varieties were compared. IPEAN V-69 originated from locally collected germ plasm, whereas Vita-3 was introduced from IITA.

Results

Individual crop yields are shown in Table 1. Increased corn yield responses to lime, with successive years of cultivation, are in agreement with a progressive increase in soil Al saturation. On a relative-yield basis, all corn crops exhibited similar relationships to Al saturation (Figure 1). Relationships for both corn and soybean suggested a critical Al saturation level of 30%. Predicted lime recommendations by the Acid 3B Expert System, developed by the University of Hawaii's TropSoils program, corresponded to the observed quantities required to reach this Al saturation level. After the second gypsum application, soil-profile sampling data indicated that subsoil Al saturation was effectively reduced by the combination of lime and gypsum (Figure 2); however, no significant differences were observed between lime rates of 1 and 2 t/ha. Comparisons of soil Ca levels between cropping years suggested that gypsum effects may be short-lived in this high-rainfall regime when no lime was applied.

In keeping with its known tolerance to acidity,

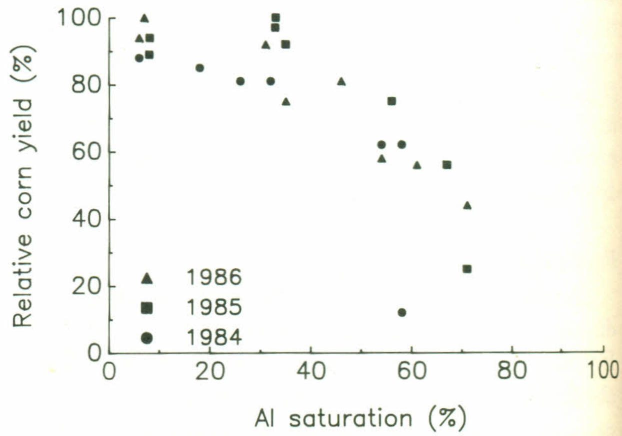

Figure 1. Effect of soil Al saturation on relative corn yield. Manaus, 1984-1986.

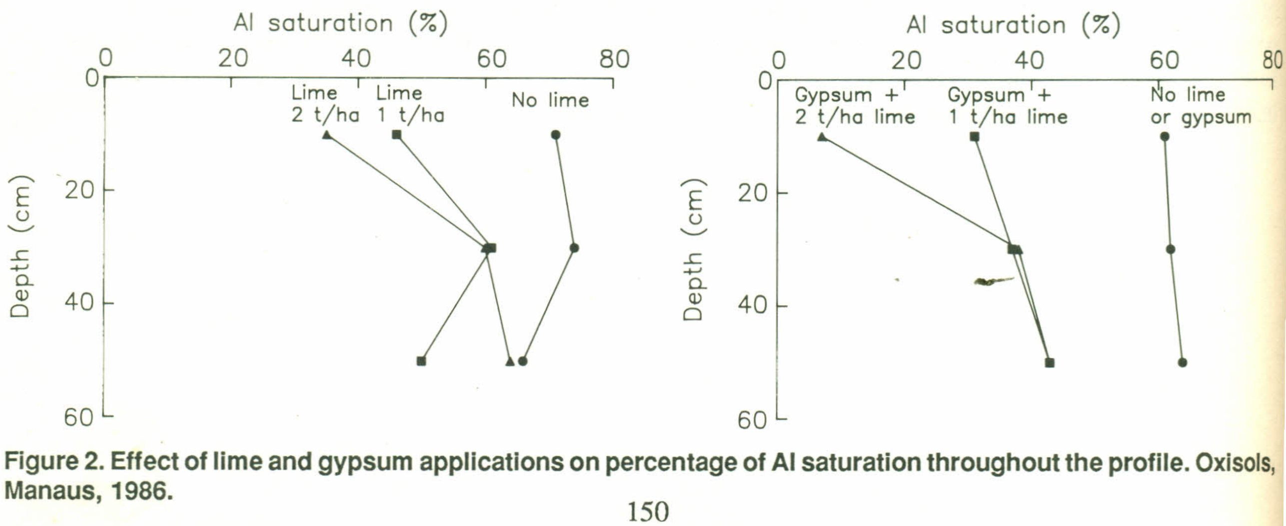

Figure 2. Effect of lime and gypsum applications on percentage of Al saturation throughout the profile. Oxisols, Manaus, 1986.

Table 1. Effect of calcitic lime and gypsum applications to a Manaus Oxisol on corn, cowpea and soybean yields. Lime and gypsum were initially applied before planting corn in 1984. Gypsum was reapplied before planting corn in 1986.

Applied		Grain yields								
		Corn			Cowpea					Soybean
					'84	'85		'86		
Lime	Gypsum	'84	'85	'86	IPEAN	IPEAN	Vita-3	IPEAN	Vita-3	'85
		t/ha								
0	0	0.3	0.9	1.6	1.1	0.6	0.5	0.7	0.7	1.0
0.5	0	1.6	2.7	2.1	1.0	0.7	0.7	0.7	0.7	0.9
1	0	2.1	3.5	2.9	1.4	0.7	0.9	0.8	0.8	1.9
2	0	2.2	3.3	2.7	1.3	0.7	0.8	0.8	0.8	1.8
4	0	2.3	3.4	3.4	1.4	0.8	0.9	0.9	0.9	2.2
0	1	1.6	2.0	2.0	1.2	0.7	0.8	0.6	0.8	1.4
1	1	2.1	3.6	3.3	1.4	0.7	0.7	0.8	0.9	1.8
2	1	2.6	3.2	3.6	1.5	0.9	0.9	0.8	1.0	2.1
$LSD_{0.05}$										
Lime		0.8	0.8	0.8	ns	ns		0.1		0.8
Variety						0.1		0.1		
Lime xVariety						ns		ns		

owpea has not shown a marked yield response to ither lime or gypsum application. In both years, owever, the Vita-3 variety tended to respond lightly to liming. Increased cowpea yields were ssociated with significant increases in leaf Ca levels t the mid-flowering stage. In 1985, for example, leaf Ca levels between the lime treatments of 0 and 4 t/ha increased from 1.03 to 2.51% for Vita-3 and from 1.21 to 2.27% for IPEAN V-69. Increases in leaf concentrations by gypsum alone corresponded to the levels achieved with 2 t of lime/ha in both varieties.

The Acid 3B liming model developed by the University of Hawaii's TropSoils program was successfully validated with Manaus liming data.