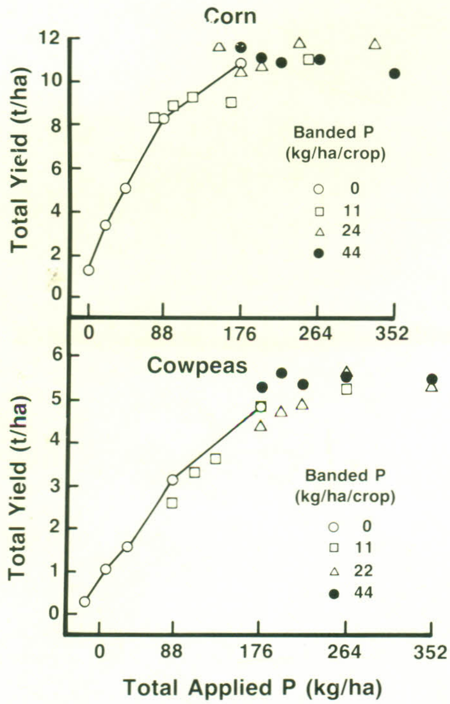

Figure 5. Cumulative corn and cowpea yields in relation to total applied P during four years in Manaus.

Implications

Results from this study have been used in the farmer-demonstration trials which UEPAE/Manuas has established as its participation in the State Rural Integration and Development Program. Soil-test critical levels for P have aided in the selection of appropriate sites for corn and cowpea trials. In P deficient areas, cowpea trials were established with and without 22 kg/ha of banded P.

Potassium Management In Humid Tropical Oxisols

Manoel S. Cravo, EMBRAPA
Thomas Jot Smyth, N.C. State University
Joaquim B. Bastos, EMBRAPA

Abundant rainfall in the Central Brazilian Amazon, and the naturally low cation exchange capacities of the regions's clayey Oxisols, promote the rapid leaching of potassium from the soils. Native soil K reserves can be expected to be small, since clay mineralogy is predominantly kaolinitic. These conditions suggest that crop production on these soils will require continual K fertilization, and that management systems should be considered to minimize K losses.

The objectives of this project were 1) to establish K response curves and soil-test calibration data for the main annual crops cultivated in the region, and 2) to determine whether split applications would improve the efficiency of K fertilization.

Yield Response to Broadcast K

The first phase of this project examined the yield response of a corn-cowpea rotation to annual broadcast rates of 0, 16.5, 33, 66, and 132 kg K/ha, applied at corn planting during two consecutive years. Although maximum corn yields were obtained in both years with 66 kg K/ha, yield differences between 33 and 66 kg K/ha were not significant. Cowpea yield responses to residual fertilizer K were not significant in either crop. Measurements at harvest of K uptake in all crops indicated that maximum fertilizer K utilization (39%) occurred with the application of 66 kg K/ha. Periodic soil K measurements to a 60 cm depth indicated significant increases in subsoil K only in the treatment with 132 kg K/ha.

Effects of Split Applications

A second K experiment was established in December, 1983 to evaluate whether split K applications might reduce fertilizer K requirements or improve the efficiency of K fertilization in a corn crop. Three methods of K application were combined with four K rates in a factorial design with four replications. Potassium rates were 0, 16.5, 33, and 49.5 kg K/ha. Methods of K application were 1) 100% broadcast at planting; 2) 50% broadcast at planting and 50% sidedressed at 55 days, and 3) divided equally among three broadcast applications—at planting, 25 days and 55 days. Times for side-dressed K applications were selected to coincide with N applications, in order to avoid additional labor inputs. Potassium was applied to corn in an annual rotation with cowpeas.

Yield data for four consecutive crops of the corn-cowpea rotation are shown in Tables 1 and 2. Foliar K levels are not shown but ranged from 1.13 to 2.05% in the 1984 corn crop, from .90 to 1.83% in the 1984 cowpea crop, and from .79 to 1.71 in the 1985 corn crop. Yields and leaf K levels in all crops increased significantly with rates of applied K, whereas mean effects of split applications were not significant. Corn yields in 1984 tended to increase with the number of split applications to the maximum K rate. Leaf K levels for this crop suggested luxury K consumption when 49.5 kg K/ha was parcelled into three applications. Foliar K levels for corn in 1985 were inferior to corn in 1984 for identical fertilizer K treatments. The native soil K supply may have declined by the second year of cultivation.

The 1984 cowpea crop showed a lower yield response to residual K fertilizer treatments, compared to the response in corn. In 1985, cowpea yields in general were decreased in the residual K fertilizer treatments. Plant and soil analyses for the latter crop have not been completed.

Soil and leaf analyses for corn in 1985 suggested that Mg was a potential constraint for this crop. Foliar Mg concentrations declined below the recommended sufficiency range with increasing rates of applied K (Figure 1). Soil Mg levels for all treatments were .1 me/100 ml and represented less than 5% of the effective CEC. Ratios of soil exchangeable Mg:K decreas-

Table 1. Yield response in 1984 of a corn-cowpea rotation to rates and methods of K application to the corn crop.

Applied K	Split Applications				Split Applications			
	1	2	3	Mean	1	2	3	Mean
kg/ha	corn yield (t/ha)				cowpea yield			
0	1.2	1.2	1.1	1.2	0.7	0.5	0.6	0.6
16.5	1.8	1.8	1.8	1.8	0.8	0.6	0.8	0.7
33	1.7	2.0	2.0	1.9	0.7	0.8	0.9	0.8
49.5	2.1	2.4	2.8	2.4	0.7	0.8	0.8	0.8
Mean	1.7	1.9	1.9	[illegible]	0.7	0.7	0.8	—
LSD .05								
K rate		.4				0.1		
Placement		ns				ns		
Rate X placement		ns				ns		

Table 2. Yield response in 1985 of a corn-cowpea rotation to rates and methods of K application to the corn crop.

Applied K	Split Applications				Split Applications			
	1	2	3	Mean	1	2	3	Mean
kg/ha	corn yield (t/ha)				cowpea yield			
0	1.6	1.5	1.5	1.5	0.8	0.8	0.8	0.8
16.5	2.3	2.0	1.8	2.0	0.7	0.6	0.4	0.6
33	2.3	2.3	2.4	2.3	0.6	0.7	0.7	0.6
49.5	2.7	2.9	2.1	2.6	0.7	0.9	0.6	0.7
Mean	2.2	2.2	1.9	—	0.7	0.7	0.6	—
LSD .05								
K rate		0.2				0.1		
Placement		ns				ns		
Rate X placement		0.4				ns		

Table 3. Total K uptake and fertilizer K utilization efficiency (UE) as a function of rates and placement of K fertilizer for corn.

Applied K	Split Applic.	K Uptake		1984 K Utilization Eff.			Corn 1985	
		Corn	Cowpea	Corn	Cowpea	Both	K Uptake	Utiliz. Eff.
kg/ha		kg/ha		%			kg/ha	%
0	1	19.7	10.1	—	—	—	10.7	—
	2	20.5	9.8	—	—	—	11.5	—
	3	19.5	8.8	—	—	—	11.5	—
16.5	1	26.6	16.8	41	44	84	20.9	59
	2	24.4	16.0	27	38	66	18.0	41
	3	26.0	11.8	37	13	50	19.3	49
33	1	24.9	16.2	15	20	35	21.3	30
	2	32.9	18.9	39	28	68	23.8	38
	3	30.3	17.6	32	24	58	25.2	42
49.5	1	32.2	16.7	25	14	39	25.2	28
	2	38.7	17.7	38	16	54	24.8	27
	3	39.7	19.4	40	20	60	23.2	24
LSD .05								
K rate		4.0	2.8				2.5	
Placement		ns	ns				ns	
Rate X placement		ns	ns				ns	

ed from 1.8 to 1.3 as K rates were increased from 0 to 49.5 kg/ha. Lower values of this ratio were not obtained due to the low levels of exchangeable K (21-30 ppm) maintained in the topsoil.

Total K uptake at harvest was determined for the three initial crops (Table 3). The efficiency of fertilizer K use was determined by comparing the amount of K applied each year to the amount detected in the crops at harvest. Native soil K uptake for each crop was assumed to be constant for all K treatments, and equivalent to the average of the treatments without K. For crops in 1984, the effects of split applications on fertilizer K utilization varied with the rates of K applied. Total K uptake and utilization of fertilizer K were increased by split applications as K rates increased. For corn in 1985, however, K uptake was lower with split applications at the rate of 49.5 kg K/ha.

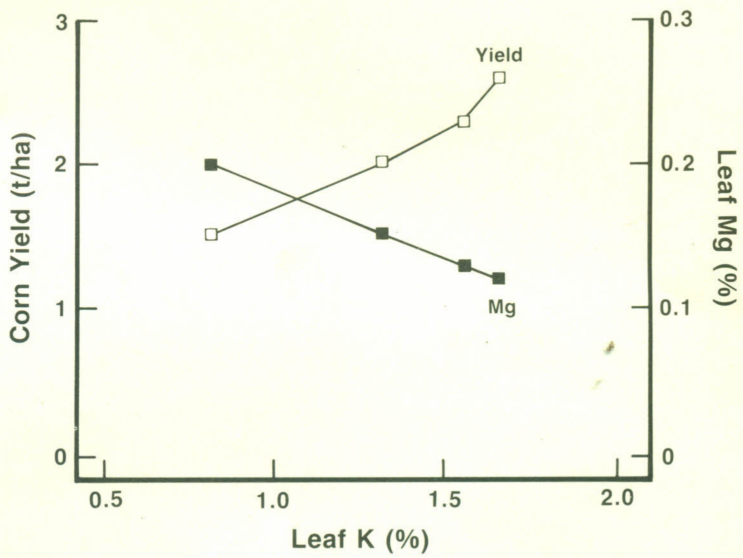

Figure 1. Relationship between K content in corn ear leaf, corn yields and Mg content in the leaf.

Observations

It is too early to draw firm conclusions from this study. Although current data have not indicated a clear yield advantage from split K applications, this practice may help reduce fertilizer K losses by maintaining a greater proportion of this element in crop residues.