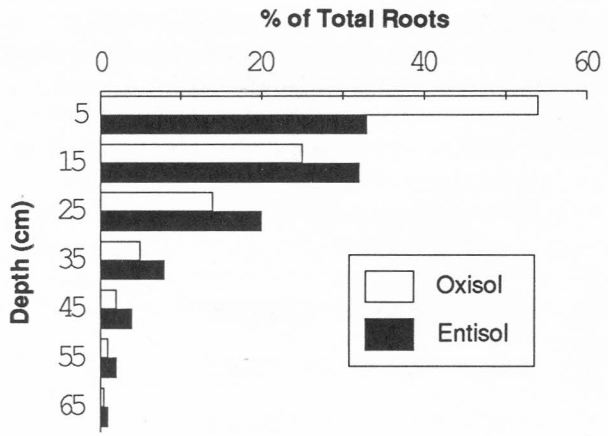

Figure 7. Corn root distribution as a function of soil depth in an Entisol and Oxisol during the 1987 crop.

Timing and Distribution of Fertilizer N Placement for Corn in a Central Amazon Oxisol: M-910B

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Oxisols in the Central Amazon have a high permeability and a low water-holding capacity. The potential for N movement into the acid subsoil below the rooting zone is high under such conditions. Fertilizer N availability and recovery may be improved by distributing N in several applications when crop needs are high.

Objectives

The objectives of this study were 1) to determine the optimum rate and method of N application for corn and 2) to estimate the effect and efficiency of the different N rates and application treatments on corn growth, N uptake, and grain yield.

Procedures

Two consecutive corn crops were grown during the 1986 and 1987 wet seasons in the clayey Oxisol in Manaus. Experimental design was a randomized complete block with four replications. Treatments consisted of a factorial arrangement of three urea-N levels (40, 80, and 120 kg N/ha) split-applied in five methods. A control with no N applied was included as an additional treatment. Nitrogen was applied either by single application or by splitting rates into two or three equal parts. Single-application treatments occurred 1) at planting in the seed bed (1-0-0) and 2) at 25 days after planting (DAP) (0-1-0). Treatments with two equal split applications occurred either 3) at planting and 25 DAP (1/2-1/2-0) or 4) at 25 DAP and silking (55 DAP) (0-1/2-1/2). The fifth method consisted of three equal split applications made at planting and at 25 and 55 DAP (1/3-1/3-1/3). All N applications were banded and incorporated soon thereafter with a manual hoe. Phosphorus, K, micronutrients, and lime were applied uniformly to all treatments before planting the first corn crop.

Since there were no significant crop-by-treatment interactions, the effects of N rates, the timing of the applications, and the distribution of fertilizer N on measured plant variables are presented using the means of treatments across both crops. The absence of interactions between N rates and methods of N application also indicates that the effects of timing and distribution of fertilizer N on corn growth were similar across all fertilizer N rates evaluated. The primary difference between crops was a reduction in maximum grain yield (3.4 vs 1.8 t/ha) for the second crop, a reduction associated with a

lower plant population density (9.4 vs 5.7 plants/m²). There was a linear increase in grain yield, N uptake, and total dry matter to N rates when averaged across methods of N application (Figure 1). There was no yield advantage to distributing fertilizer N in multiple applications (Figure 2). However, yields among treatments with single N applications were improved when fertilizer N was delayed from planting (1-0-0) to 25 DAP (0-1-0). Among the five methods of N application, there was a trend for increasing yields as a greater proportion of applied N was concentrated in the two final application times.

Aboveground corn dry matter at silking represented an average of 57 and 78% of the total dry matter accumulated at harvest in the first and second crops, respectively. Nitrogen fertilization decreased the proportion of total dry matter at harvest which had accumulated in plants by the silking stage (Table 1). The highest proportions of total dry matter at harvest accumulated by silking stage were obtained with treatments receiving all fertilizer N between planting and 25 DAP. This suggested that dry matter accumulation was delayed to post-silking stages when fertilizer N was concentrated in applications at 25 DAP and at silking. The absence of a fertilizer N timing and distribution effect on measured dry-matter accumulation at either 25 DAP or at silking also supports this observation.

Nitrogen uptake at harvest in treatments without applied N decreased from 28 kg/ha in the first crop to 15 kg/ha in the second crop. Despite the lower contribution of native soil N to the second crop, apparent fertilizer N recovery was higher for the initial crop (46% in crop one vs 35% in crop two). Apparent N recovery decreased with increasing rates of applied N. When averaged across all application methods and crops, recoveries were 48, 36, and 36% for rates of 40, 80, and 120 kg N/ha, respectively. Single applications of N at 25 DAP gave higher apparent N recovery levels than single applications at planting (Figure 3). Maximum apparent recovery was 70% with the application of 40 kg N/ha at 25 DAP in the first crop. A mean of 46% N recovery was obtained with a single application of N at 25 DAP averaged across all N rates. Apparent N recovery decreased with both split applications and treatments having a greater proportion of N applied at planting. The lowest mean value of 30% apparent N recovery was obtained for treatments that received all N at planting.

Even the highest N recoveries for corn in this study are lower than the values achieved at equivalent N rates in the Brazilian Cerrados region, where corn-grain yields are approximately 6 to 8 t/ha. However, observed apparent N recoveries, grain yields, and recommended N rates are similar to values reported for corn in the high rainfall regions of Africa.

Corn-grain yield, total dry matter, N uptake, and apparent N recovery in this humid tropical environment were increased by delaying N applications from planting to 25 days after planting. There was no yield advantage to partitioning a single fertilizer N application at 25 days after planting into two or three equal split applications between the planting and silking stages. The higher yields

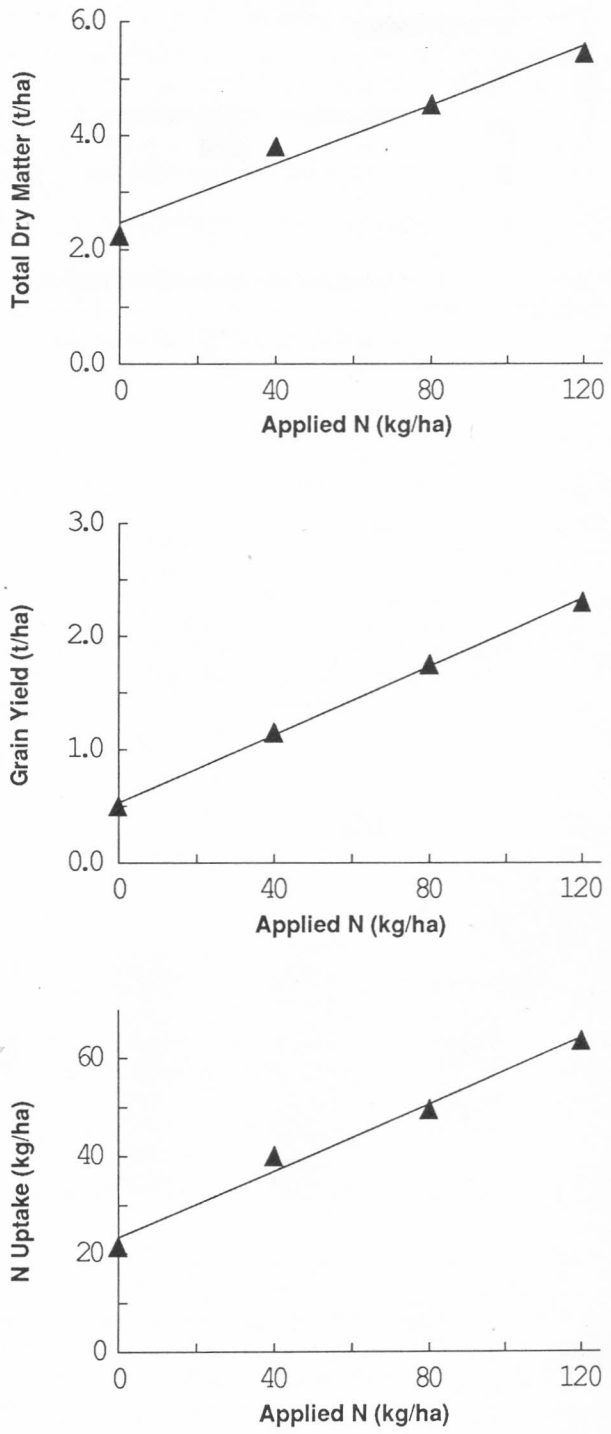

Figure 1. Total dry matter, grain yield, and N uptake at harvest as a function of applied N in a Central Amazon Oxisol.

obtained with N applications at 25 days after planting and silking, relative to planting, were associated with an increase in the proportion of total dry matter assimilated during post-silking growth.

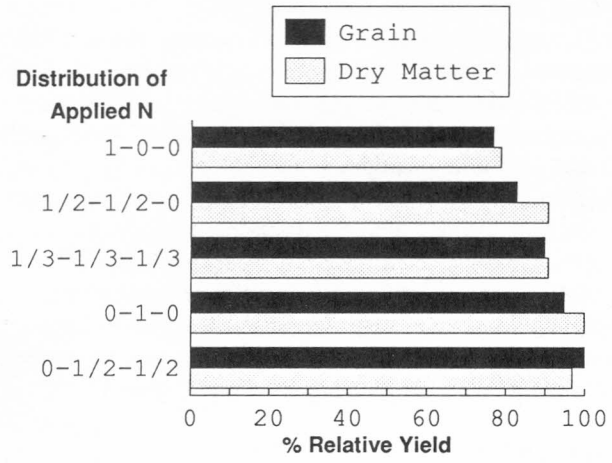

Figure 2. Relative corn-grain and total dry-matter yields as a function of fertilizer N timing and distribution methods in a Central Amazon Oxisol.

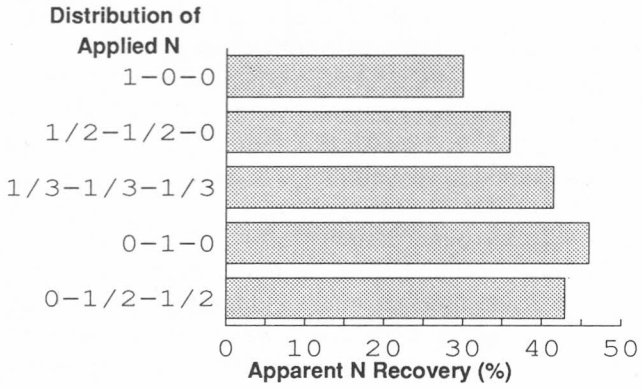

Figure 3. Apparent fertilizer N recovery by corn for different timing and distribution methods of applied N in a Central Amazon Oxisol.

Table 1. Effect of timing and distribution of fertilizer N on the ratio of total dry matter at harvest to the dry matter which had accumulated by silking stage in two consecutive corn crops in a Central Amazon Oxisol.

	Total dry matter at silking		
Treatments	**1986**	**1987**	**Mean**
N rates (kg/ha)	Dry matter at harvest (%)		
0	75	98	87
40	59	74	67
80	56	76	66
120	51	78	65
0–1–0	52	73	62
1–0–0	66	82	74
1/2–1/2–0	61	83	72
0–1/2–1/2	48	67	57
1/3–1/3–1/3	51	75	63
LSD:0.05			
N Rates	—	—	10
Timing	—	—	13
Rate x Timing	—	—	30