Fertilization of Plantain in High Densities

By José Espinosa and Sylvio Belalcázar

Research in the main plantain producing areas in Colombia has confirmed that plant density cultivation produces greater yields than traditional plant populations. However, nutrient management information under these high-density systems is lacking. Data are presented for field experiments conducted from 1995 to 1998, which refine fertilizer recommendations for high-density plantain cultivation.

Factorial experiments with different plant densities were conducted for two consecutive crop cycles in Piedmont soils of the eastern plains of Colombia. These soils are alluvial, coarse to medium textured, and are representative of the primary plantain-producing zone. They are characterized by having low potassium (K), calcium (Ca), and magnesium (Mg) contents.

Table 1. Plantain response to plant population and fertilization at El Castillo, Meta, Colombia.

Application rate, kg/ha			Fruit yield, t/ha			
			1996		1997	
			Plant density		Plant density	
K_2O	CaO	MgO	High[1]	Low[2]	High	Low
0	0	0	27.65	25.89	14.74	12.63
70	0	0	35.32	32.45	17.54	11.42
140	0	0	40.89	32.76	20.64	14.85
210	0	0	41.86	34.11	21.69	18.50
280	0	0	42.91	34.40	17.95	18.61
350	0	0	41.27	34.07	24.59	19.99
210	150	0	40.68	33.71	21.33	20.40
210	300	0	40.09	34.79	22.80	16.10
210	0	30	42.46	33.01	21.69	18.45
210	0	60	38.52	34.11	19.16	18.50
210	0	90	37.12	35.12	19.72	17.06

[1]High plant density = 3,333 plants/ha (plants at 3.0 x 2.0 m, 2 seeds per site).
[2]Low plant density = 2,666 plants/ha (plants at 2.5 x 1.5 m, 1 seed per site).
Initial soil tests for K, Ca and Mg = 0.14, 3.31 and 0.48 cmol (+)/kg, respectively.
150 kg N/ha and 20 kg P_2O_5/ha were applied to all treatments.

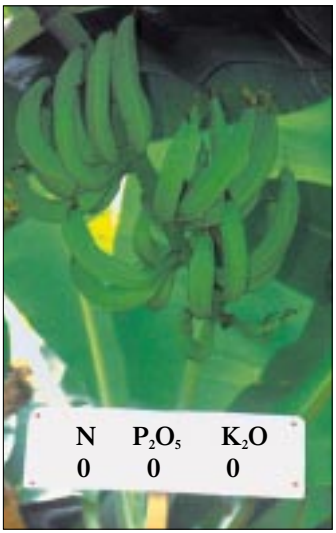
Plantain Response to Fertilization

Yield responses to K, Ca and Mg fertilizer application at El Castillo are presented in **Table 1**. Response to nitrogen (N) and phosphorus (P) at this site was minimal. The marked yield difference between 1996 and 1997 was due to the climatic effect of El Niño in 1997. Soils at the site were flooded intermittently and water saturation had a significant effect on fruit yield.

Results from a factorial experiment testing the effect of N, K and sulfur (S) on the yield of high-density plantain grown on an Inceptisol at Caribia, Colombia, are shown (**Table 2**). Soils in this region are

characterized by having medium to low K and S contents. They are representative of the plantain growing area located on the Caribbean coast of Colombia. This trial showed a positive response to K, but highest fruit yields occurred only when N, K and S were applied together.

A simple economical analysis was conducted in selected treatments of the Caribia study (**Table 3**). The data indicate an excellent response to nutrient application and a profitable balance when inputs and outputs are computed.



Response of plantain to fertilization has not been uniform. Soil analysis and calibrated response curves are more efficient management tools for developing recommendations.

Soil Testing as a Tool for Fertilizer Recommendations in Plantain

These studies in high-density plantain have demonstrated a good response to N, K, and S fertilization in the main plantain growing areas of Colombia. However, response was not uniform in all soils due to the initial nutrient content of the soil. One general fertilizer recommendation has traditionally been used for low-density plantain production systems, but this practice is not the most effective approach to nutrient management. Fertilizer recommendations based on soil analysis and calibrated response curves are more efficient and profitable. High-density plantain systems have been proven profitable, and the use of soil analysis is a best management practice (BMP) that fits well in the system.

The experiments reported above were designed to calibrate yield response with nutrient application and soil testing. Relative yields were used in the calibration since the magnitude of response was different in different sites due to climatic conditions, management, and soil type. This point is illustrated in the K response data obtained in two different plant densities in the same crop cycle at El Castillo (**Table 1**). Plant population controlled the magnitude of the response, but the trend was similar and provided a comparable critical level.

The K calibration for high-density plantain using data from all experimental sites is presented (**Figure 1**). The calibrated critical

Table 2. Plantain response to plant population and nutrient rates at Caribia, Magdalena, Colombia.

Fertilizer application rate, kg/ha			Fruit yield,
N	K_2O	S	t/ha
0	0	0	18.33
0	210	0	27.83
50	210	0	27.91
100	210	0	31.49
150	210	0	33.08
200	210	0	35.01
150	70	0	30.31
150	140	0	33.83
150	210	0	33.08
150	280	0	37.33
150	350	0	39.60
150	210	30	33.33
150	210	60	38.58
150	210	90	44.66

All treatments received a uniform application of 40 kg P_2O_5/ha. Population = 3,333 plants/ha (plants at 2.0 x 1.5 m, 1 seed per site). Initial soil test: P = 18 mg/kg, K = 0.12 cmol(+)/kg, S = 6 mg/kg.

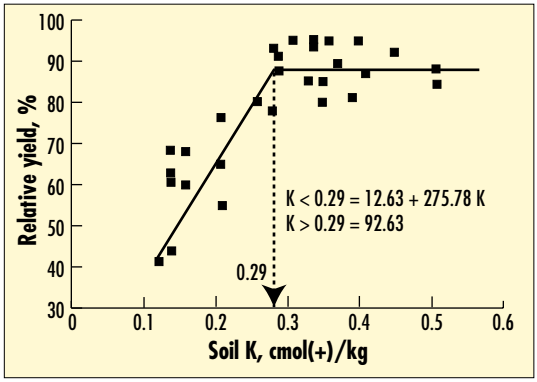


Figure 1. Calibrated K critical level for plantain in Colombian soils.

level is 0.29 cmol(+)/kg of soil with a soil test that uses ammonium acetate as the K extractant.

Calibrated yield data from all experiments were used to develop fertilizer recommendations for high-density plantain (**Table 4**).

Conclusions

Plantain at high densities produces profitable yields. However, this production system requires high management input to be successful. Use of good seed, establishment of high plant population, effective culling, and proper nutrition are essential. Data from several experiments conducted in the plantain growing areas of Colombia have demonstrated a high response to N, K and S. Soil analysis is a BMP needed in a successful high-density plantain system. This experimental work provides the basis for developing fertilizer recommendation that can be used in extensive plantain production. **BCI**

Table 3. Balanced nutrition effect on high-density plantain yield and income in an Inceptisol from Caribia, Magdalena, Colombia.

Fertilizer applied, kg/ha				Yield,	Gross income	Fertilizer cost	Other inputs	Hand labor	Net income
N	P_2O_5	K_2O	S	t/ha	US$/ha				
0	0	0	0	18.3	1,283	0	403	391	489
150	40	210	0	33.1	1,896	167	403	391	935
200	40	210	0	35.0	2,450	199	403	391	1,457
150	40	350	0	39.6	2,770	207	403	391	1,769
150	40	210	90	44.6	3,126	197	403	391	2,135

Table 4. Recommended fertilizer rates for plantain at high densities based on soil analysis, Colombia.

Soil nutrient rating	Soil test rating					Fertilizer recommendation				
	P	S	K	Ca	Mg	P_2O_5	S	K_2O	CaO	MgO
	mg/kg		cmol(+)/kg			kg/ha/yr				
Low	< 8	< 6	< 0.2	< 3	<1	40	90	280	300	80
Medium	9-15	6-12	0.2-0.3	3-6	1-3	20	45	210	150	40
High	> 15	>12	>0.3	>6	> 3	0	0	140	0	0

Nitrogen fertilizer application at a rate of 200 to 250 kg/ha/year in each situation.

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High-density plantain production requires more management, but increased yield and profit are possible.

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