

FERTILIZATION OF PLANTAIN IN HIGH DENSITIES

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Introduction

Experimental work conducted in several sites located at the main plantain producing areas in Colombia has confirmed the yield benefit of the high plant density approach of plantain

cultivation. Nutrient management studies to obtain basic data to design fertilizer recommendations in this cropping approach were conducted in the main soil groups where plantain is cultivated in Colombia.

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

----- Fertilizer treatments, kg/ha -----					----- Fruit yield, t/ha -----			
N	P ₂ O ₅	K ₂ O	MgO	CaO	Population 1*		Population 2**	
					1996	1997	1996	1997
0	0	0	0	0	23.40	12.77	28.87	14.78
0	20	210	0	0	34.31	17.44	34.94	19.85
50	20	210	0	0	35.54	18.18	42.07	20.66
100	20	210	0	0	33.55	12.79	40.05	14.33
150	20	210	0	0	34.11	18.50	41.86	21.69
200	20	210	0	0	31.41	17.60	42.43	21.30
150	0	210	0	0	30.67	17.21	39.73	22.08
150	20	210	0	0	34.11	18.50	41.86	16.63
150	40	210	0	0	33.88	15.95	40.14	20.44
150	20	0	0	0	25.89	12.63	27.65	14.74
150	20	70	0	0	32.45	11.42	35.32	17.54
150	20	140	0	0	32.76	14.85	40.89	20.64
150	20	210	0	0	34.11	18.50	41.86	21.69
150	20	280	0	0	34.40	18.61	42.91	17.95
150	20	350	0	0	34.07	19.99	41.27	24.59
150	20	210	0	0	34.48	18.50	41.86	16.63
150	20	210	30	0	33.01	18.45	42.46	21.69
150	20	210	60	0	34.11	18.50	38.52	19.16
150	20	210	90	0	35.12	17.06	37.12	19.72
150	20	210	0	0	34.11	18.50	41.86	21.69
150	20	210	0	150	33.71	20.40	40.68	21.33
150	20	210	0	300	34.79	16.10	40.09	22.80

Population 1 = 2666 plants/ha (plants at 2.5 x 1.5 m, 1 seed per site)

Population 2 = 3333 plants/ha (plants at 3.0 x 2.0 m, 2 seeds per site)

Initial soil test: P = 80 ppm (Bray II); K = 0.14; Ca = 3.31; Mg = 0.48 meq/100 g, respectively (Ammonium acetate).

Plantain response to fertilizer application

Several field experiments were conducted in Colombia during the period of 1995 to 1998. Data from the most relevant experiments will be presented here. Two individual factorial experiments with different plant densities were conducted for two consecutive crop cycles in soils of the Piedmont of the Eastern planes of Colombia. These are alluvial soils of coarse to medium texture, representative of an important plantain producing zone of Colombia, are characterized by low content of potassium (K), calcium (Ca) and magnesium (Mg). Table 1 presents yield response to fertilizer application at this site. The marked general yield difference between 1996 and 1997 is due to the climate effect of El Niño in the plantain stand in

1997. Soil at the site were flooded intermittently and water saturation has significant effect on fruit yield in plantain. However, yield trends are the same in both cycles particularly in the response to N and K (photos 1 and 2).

Table 2 presents the results obtained in a detailed factorial experiment testing the effect nutrients rates and their interactions on the yield of high density plantain. This study was conducted during 1998, in an Inceptisol of Santa Marta, Colombia. The soil of this site is representative of the plantain growing area located at Caribbean coast of Colombia. These soils are characterized for having medium to low K and S content and this condition reflects in the response of the crop to the application of these nutrients.

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

----- Fertilizer treatments, kg/ha -----			--- Fruit yield, t/ha ---
N	K ₂ O	S	
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	0	0	29.25
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	0	33.08
150	210	30	33.33
150	210	60	38.58
150	210	90	44.66

All treatments received a uniform application of 40 kg P₂O₅/ha

Population = 3333 plants/ha (plants at 2.0 x 1.5 m, 1 seed per site)

Initial soil test: P = 18 ppm (Bray II); K = 0.12 meq/100 g (Ammonium acetate); S = 6 ppm (Calcium monophosphate)

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

----- Treatments -----				Bunch yield	Total income	Cost of fertilizer	Cost of other inputs	Cost of hand labor	Net income
N	P ₂ O ₅	K ₂ O	S						
----- kg/ha -----				t/ha	----- US \$ -----				
0	0	0	0	18.3	1283	0	403	391	489
150	40	210	0	27.1	1896	167	403	391	935
200	40	210	0	35.0	2450	199	403	391	1457
150	40	350	0	39.6	2770	207	403	391	1769
150	40	210	60	44.6	3126	197	403	391	2135

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

Nutrient	----- Soil level -----		
	Low	Medium	High
Phosphorus* (mg/kg)	<8	9-15	>15
kg P ₂ O ₅ /ha/year	40	20	0
Potassium** (cmol(+)/kg)	<0.2	0.2-0.3	>0.3
kg K ₂ O/ha/year	280	210	140
Calcium (cmol(+)/kg)	<3	3-6	>6
kg CaO/ha/year	300	150	0
Magnesium (cmol(+)/kg)	<1	1-3	>3
kg MgO/ha/year	80	40	0
Nitrogen	Variable		
kg N/ha/año	200-250		

* P extracted with Bray II

** Bases extracted with ammonium acetate

Response to K is high but a balanced nutrition with N, K and S allows top fruit yields. A simple economical analysis was conducted in selected treatments of the study (Table 3). The data indicates an excellent response to nutrient application and a profitable balance when inputs and outputs are computed.

Soil testing as a tool for fertilizer recommendations in plantain

Nutrition experiments in plantain at high densities, as those presented above, conducted in different soil types located in the main plantain producing areas of

Colombia have demonstrated that there is a good response to N, K and S application. However, the response is not uniform in all soils indicating that the response depends on the initial content of nutrients in the soil. For this reason is not convenient to use one general fertilizer recommendation to obtain high plantain yields as is generally done in the traditional plantain production. An efficient and profitable way of recommending fertilizer rate applications is based on calibrated soil analysis. High density plantain systems have been proven profitable and the use of soil analysis is a best management practices that fits well in the system.

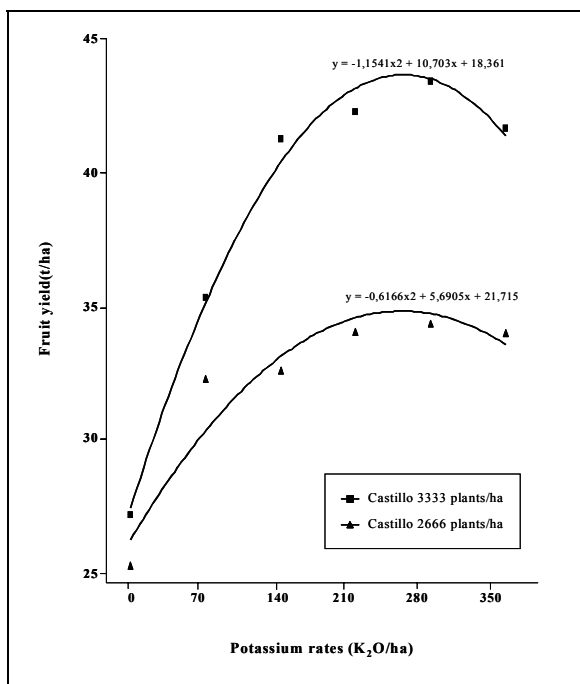


Figure 1. Plantain response to K rates at two plant densities in Colombia.

The series of experiments conducted at different sites in Colombia were designed to calibrate yield response with nutrient application and soil test. Since the magnitude of yield response is different in different sites due to climatic conditions, management and soil type it is better to use the concept of relative yield in the process of calibration to define nutrient yield response to certain nutrient content in the soil. The K response data obtained in two different plant densities in the same crop cycle at El Castillo (Table 1) illustrates the point. The magnitude of the response was controlled by plant population but the trend of response was the same providing a closely similar critical level (Figure 1).

Potassium calibration for high density plantain using data of all experimental sites is presented in Figure 2. Calibrated critical level is 0.29 meq K/ 100 g of soil with a soil test that uses ammonium acetate as K extractant. The calibrated yield data from all experiments were used to develop the a table of fertilizer recommendations for the use of extensionists and farmers (Table 4).

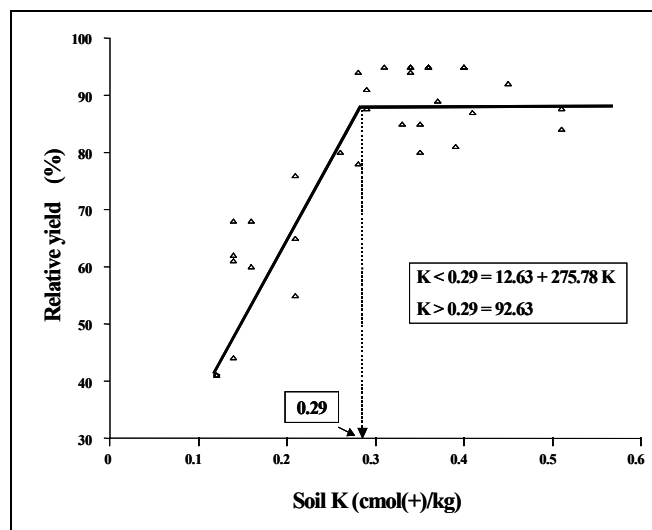


Figure 2. Calibrated K critical level for plantain in Colombian soils.

Conclusions

Plantain at high densities produces profitable yields, however, this system of production requires certain degree of management to be successful. The system requires a good seed management, good control of the population and adequate nutrition. Data of several experiments conducted in the plantain growing areas of Colombia have demonstrated high response to N, K and S. Soil analysis is a best management practice need in a successful high density plantain system. Experimental work provided the basis to develop a fertilizer recommendation table that can be used extensive in plantain production.

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