THE INFLUENCE OF FERTILIZER AND CORM SIZE ON INITIAL PLANTAIN GOWTH

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INTRODUCTION

Plantain is an important agricultural crop in Puerto Rico. In 1973 - 74 it ranked seventh in value of production with a farm value of about $19 million. Bananas for the same fiscal period had a farm value of $6 million. Fertilizers amount to 10% of the total cost of production, and 50% of the costs for materials purchased for production for this crop in 1971 - 72.

When possible, the farmer may use large size seed pieces (corms) weighing from 3 to 4 pounds to ensure that good growth is obtained until he applies his first fertilizer application at from four to six weeks after planting. With shortages of planting material, the farmer must use smaller size corms. However, he still applies his fertilizer from four to six weeks after planting. Experiments were initiated to determine the relationships of corm size and fertilizer application on plantain growth up to six weeks after plantings. The results of the two initial experiments are given in this paper.

MATERIALS AND METHODS

The experiments were conducted in the greenhouse using the nutrient-sand culture technique to study the influence of fertilizers and size of corm on the growth of plantains. Quartz sand in 8-litre glazed pots was employed in this study rather than soil in order to obtain a clearer concept of the portion of the nutrients contributed by the corm in the early stages of growth. It was felt that a complete nutrient solution treatment throughout the first six weeks of growth would approximate an application of fertilizer to the soil at the time of planting. The no-fertilizer treatment would approximate the application of fertilizer at six weeks. It is realized that in actual field practice, the soil would supply some nutrients to the plant regardless of the time of fertilizer application. However, using a nutrient-sand culture technique provided a manner to determine the extreme limits of nutritional demands the plantain undergoes in the first six weeks without the complications of the variables of soil nutrient availability.

The first experiment dealt with the nutrient contributions of the corm using the following treatments: NPK, -N, -P, -K, and -NPK. All treatments received adequate supplies of Ca, Mg, S, Fe, Mn, Cu, and B. The -NPK treatment received additional Na to keep the osmotic concentrations similar to the other treatments. The nutrient solutions */ were applied every other day, with tap water applied on alternate days. The experiment was planted on November 11, 1974, and harvested 47 days later. The experimental design consisted of five treatments replicated five times in a randomized block design using one-corm per pot per replication. The average corm weight was 1080 ±40 g.

The second experiment dealt with six corm sizes: 454 g (1 lb), 681 g (1.5 lbs), 908 (2 lbs), 1135 g (2.5 lbs), 1362 g (3 lbs), and 1589 g (3.5 lbs). Within a given corm size treatment, the variation ranged ± 50 g of the stated size. Each corm size was given two fertilizer treatments: complete and none. The complete fertilizer treatment was similar to that in experiment 1 except that K was raised to 12 meq/litre. The no-fertilizer treatment received only tap water. The experiment was planted on March 26, 1975, and harvested 44 days later. The experimental design was a split-plot with six treatments at the whole-plot level and two treatments at the sub-plot level replicated three times.

At harvest, after washing the sand away each plant was divided into roots, corm, pseudostem, and leaves. Each was weighed and samples were oven-dried.

RESULTS AND DISCUSSION

The influence of fertilizer treatments on the growth of plantains for the first six weeks after planting is given in Table 1.

The various fertilizer treatments had no significant influence on the below soil surface parts of the plant, although variations in weight for root were greater than for the corm. However, the above-ground parts, leaf and pseudostem, showed significant differences in weight and plant height with fertilizer treatment.

The above-ground parts of the plant produced 88% more green weight when receiving a complete fertilizer as compared to no fertilizer. The increase in green weight was greatest for the leaf with 148%; the

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*/ Nutrient concentrations, expressed as meq/litre, were provided as follows: $N\text{-}NO_3$, 10; P, 6; K, 5; Ca, 3; Mg, 2; and S, 2. Micro-elements; expressed as ppm, were supplied as follows: B, 0.05; Cu, 0.02; Mn, 0.50; Zn, 0;05; Mo, 0.01; and Fe, 0.50.

pseudostem increase was 77%. The increase in weight using a complete fertilizer was also accompanied by significant increases in plant height when compared with the no-fertilizer treatment. The number of leaves was greater by one leaf for the complete fertilizer compared to the no-fertilizer treatment, but this difference was not significant.

The absence of N and P produced significant decreases in pseudostem and leaf green weight compared to the complete NPK treatment. This was not true for K.

In the absence of N, leaf weight was reduced 43% and pseudostem weight 25%. Visual symptoms of N deficiency became evident in the leaf at about four weeks after planting. Murray working with bananas in sand culture obtained reductions in leaf weight of 93% at 3½ months of age when severe N deficiency symptoms were evident. He stated that the plant may produce its first half dozen leaves with reserves from the corm of all nutrients except N.

Omitting P from the plant for six weeks reduced plant weight significantly. The leaf weight decreased 19% and pseudostem 20% compared to the complete treatment. Murray found a 58% reduction in above-ground parts of the banana plant after seven months under a -P treatment.

The absence of K from the nutrient treatment produced a non-significant 10% reduction in above-ground weight of the plant when compared to the NPK treatment (Table 1). Although there were visual symptoms of a mild K deficiency in the leaf at six weeks of age, no significant reductions in weight, height of plant, or number of leaves occurred. Similar results were obtained by Murray for bananas at eight months.

Chemical analyses of the various parts of the plant are given in Table 2. The leaf, the site of photosynthesis and carbohydrate production, did not display sharp reductions in % N and % K under their respective deficiency treatments with reductions of N of 10% and K 12% compared to the NPK treatment. However, the -P treatment had a reduction of 48% in leaf P.

The corm, with its potential reserve of nutrients, had used up 46% of its N, 50% P, and 23% K comparing the NPK treatment at 6 weeks after planting with the corm before planting (Table 2).

The effect of the size of the corm on the first six weeks of growth of plantains is given in Table 3. Significant increases in above-ground weight was obtained with increasing corm size with corms

weighing from 908 to 1362 g (2 to 3 lbs) appearing to be the optimum size. The fertilized corms produced significantly more above-ground weight than those receiving no fertilizer, the average for all corm sizes having 60% greater above-ground weight than the non-fertilized ones.

A 454 g (1 lb) corm fertilized for the first six weeks was able to make as good growth as a 908 g (2 lbs) non-fertilized corm. A 681 g (1.5 lbs) fertilized corm was better in above-ground weight production than a 1135 g (3.5 lbs). Providing fertilizer for small-sized corms (454 to 681 g) during its first six weeks after planting can give as good growth as using larger-size planting material.

The response to corm size, as measured by plant height, was not evident at four weeks after planting for either fertilized or non-fertilized corms, except for the 454 g corm which had a significantly smaller plant than the larger size planting material. At 6 weeks after planting, the unfertilized corms of size 1135 g or more were significantly taller than those having smaller corms. However, when fertilizer was applied, only the smallest corms, 454 g, gave lower plant heights.

Summerville in his work on the nutrition of the Dwarf Cavendish banana in Queensland concluded that the difference in plant size could be attributed to differences in nutrition in the early stages of growth particularly the first three months from planting; thereafter, relative growth rates for all plants become sensibly identical. Simmonds following the conclusions of Summerville states that it would seem advisable to ensure that fertilizer nutrients are abundantly available at the time of planting. Croucher and Mitchel made the same assumption.

The data from experiment 1 indicates that corms receiving NP for the first 6 weeks from planting produced significantly better growth than those receiving no fertilizer for the same period. The data from experiment 2 confirms the value of early fertilizing of the corm especially when corm sizes are small (454 to 681 g). Thus, early application of fertilizer at time of planting is better than waiting until six weeks from planting, especially in soils of low fertility and where seed size is small.

ACKNOWLEDGEMENT

The authors wish to thank Dr. Alex G. Alexander, Physiologist, of this Station for his excellent cooperation in planning and carrying out the two greenhouse sand culture experiments reported herein.

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TABLE 1. The influence of nutrient supply on green weight and growth of plantains for first six weeks after planting.

Treatment	Green weight of plant material, grams					Height cm	Number of leaves
	Root	Corm	Pseudostem	Leaf	Above ground parts		
NPK	140 a[1/]	928 a	428 a	109 a	537 a	40 a	3.8 a
-N	158 a	938 a	321 b	62 bc	383 b	34 b	2.4 a
-P	162 a	963 a	342 b	88 b	430 b	34 b	3.0 a
-K	187 a	907 a	363 ab	120 a	483 ab	38 ab	3.4 a
-NPK	125 a	945 a	242 c	44 c	286 c	27 c	2.8 a

1/ Treatment with different letters are significant at the 5-percent level.

TABLE 2. The nutrient content of various parts of the plantain plant, 6 weeks old, under differing nutrient treatments.

Treatment	Nutrient content on a dry weight basis		
	N%	P%	K%
	Corm		
NPK	1.90	0.15	6.14
-N	1.58	.15	5.96
-P	1.80	.08	6.14
-K	2.50	.13	5.78
-NPK	1.50	.08	5.16
	Pseudostem		
NPK	2.66	.57	3.54
-N	2.18	.59	3.66
-P	2.70	.27	3.86
-K	2.76	.60	8.50
-NPK	2.22	.30	8.90
	Leaf		
NPK	4.25	.46	6.18
-N	3.82	.58	6.92
-P	4.10	.24	6.26
-K	4.32	.50	5.42
-NPK	4.08	.27	5.74
Original Corm before planting	2.76	.16	6.73

TABLE 3. The influence of size of corm, with and without fertilizer, on growth of plantains for first 6 weeks after planting

Initial weight of corm, gm	Above ground green weight, cm		Height of plant, cm			
			4 weeks		6 weeks	
	0	Fertilizer	0	Fertilizer	0	Fertilizer
454 (1) [1]	125 a [2]	349 a	11 a	15 a	23	35 a
681 (1.5)	253 a	579 a	20 b	24 b	28	43 b
908 (2)	332 bc	616 ab	20 b	27 b	23	45 b
1135 (2.5)	356 bc	697 bc	23 b	26 b	37	49 b
1362 (3)	438 c	742 c	27 b	31 b	38	50 b
1589 (3.5)	424 c	796 c	28 b	28 b	38	54 b
Average	393	630	21	25	31	46

[1] Number in parenthesis refers to weight in pounds

[2] Treatments with different letters are significant at the 5 percent level