PROCEEDINGS OF THE CARIBBEAN FOOD CROPS SOCIETY

SIXTH ANNUAL MEETING
ST. AUGUSTINE, TRINIDAD
JULY 7-13, 1968

VOLUME VI

THE INFLUENCE OF FERTILIZERS ON THE YIELDS OF TANNIA

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INTRODUCTION

Tannias (Xanthosoma) are among the most important basic root crops eaten in Puerto Rico. Farm values for this crop in 1965 amounted to $1,714,000 (2). Despite such a high value for this crop, not very much is known concerning its agronomic requirements in Puerto Rico except for a few investigations conducted by Barrett (3) and Abruna *et. al.* (1).

Recent research by Cross and Wilson (4) in Trinidad revealed no significant fertilizer response to tannias over a five-year period, 1962–66. Spence and Ahmad (8) demonstrated nutrient deficiencies in tannias using a sand-culture technique. They found that treatments lacking nitrogen, sulfur, and phosphorus produced a smaller root system, but better size corms than in the control plants. Abruna *et. al.* (1) obtained responses up to 100 pounds of nitrogen per acre, a limited response to phosphates at 40 pounds P_2O_5 per acre and potash at 200 pounds K_2O per acre.

It is the purpose of this paper to present the results of an experiment with varying levels of nitrogen, phosphorus and potassium, as well as sources of nitrogen, phosphorus and lime on the production of tannias in Puerto Rico.

MATERIALS AND METHODS

The experiment was conducted at the Corozal Substation, Agricultural Experiment Station, University of Puerto Rico. The soil used was a Lares clay, an acid (pH 4.6) lateritic soil of the humid mountain terraces in the interior of Puerto Rico.

The experimental design was a triple lattice with 16 treatments replicated 4 times. The plot consisted of 5 rows, 3 feet apart and 15 feet long with a 5-foot path between plots. The distance between plants in the row was 1½ feet. The rows were mounded up and the seed material was planted in the hole. Prior to planting, fertilizer was added to each hole. Where liming materials were used, they were applied at the rate of two tons per acre. The material was applied on the soil surface, worked into the upper 6 to 8 inches of the soil with hoes, and then the rows mounded up. Mother corm slices of the tannia variety, Morada, were used.

The fertilizer and lime treatments used are given in table 1. All treatments, except where indicated, received 50 pounds of nitrogen (N), 100 pounds each of phosphorus (P_2O_5) and potassium (K_2O) per acre. The experiment was planted on June 26, 1967 and harvested 9 months later on April 15, 1968. Leaf samples were taken at 4, 5, 6 and 8 months. At time of harvest, only the inner 3 rows were weighed to avoid border effects. Twenty corms were taken at random from each plot for determination of the average weight per corm. Five plants at random were also weighed for determination of plant weight.

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RESULTS AND DISCUSSION

Nitrogen Rates

There was an increase in yields of tannia corms amounting to 14.2 hundredweights per acre when 50 pounds of nitrogen was applied per acre as compared to no nitrogen but with phosphate and potash present (table 1). This difference was not significant at the 5-per cent level. However, when nitrogen was increased to 100 pounds per acre yields of corms decreased 17.5 hundredweights to a production level below that of the no-nitrogen treatment (*see* table 1). Increasing the nitrogen rate to 200 pounds per acre depressed yields further to 21.9 hundredweights less than when only 50 pounds of nitrogen was applied.

Abruna *et. al.* (1) obtained significant yield increases with 100 pounds of nitrogen per acre over no nitrogen, but yields decreased when 200 pounds of nitrogen per acre was used.

Although there were no significant differences between treatments, the individual weight per corm followed rather closely the yields per acre except that the 200 pounds per acre nitrogen did not decrease individual weight as compared to 100 pounds (table 1).

The increase in production of top weight in relation to tubers has been reported by Samuels (6) for sweet potatoes. In this tannia experiment the ratio of tops (leaves and petioles) to corm production decreased from 0.52 for no nitrogen to 0.33 for 200 pounds of nitrogen per acre. In terms of weight, 100 pounds of tannia tops will produce 52 pounds of edible corms for a no-nitrogen application, and it decreases to 33 pounds of corms per 100 pounds of tops where 200 pounds of nitrogen was applied. The use of high nitrogen rates for tannias when soil supplies are adequate will increase production of leafy material at the expense of corm production.

Nitrogen Sources

Ammonium sulfate, the most commonly used nitrogenous fertilizer in Puerto Rico, gave higher yields of tannias than did urea or calcium ammonium nitrate at the same rate of 50 pounds of nitrogen per acre (table 1). At the higher rate of 100 pounds of nitrogen per acre, calcium ammonium nitrate depressed yields when compared to the 50 pound nitrogen treatment noted for ammonium sulfate. Abruna *et. al.* (1) found no significant response to nitrogen sources such as ammonium nitrate, and ammonium-nitrate-lime except for a detrimental effect from sodium nitrate. These results were obtained under conditions of severe drought.

Weight per corm was reduced with nitrogen source. The reduction in corm size ranging from largest to smallest due to nitrogen source was: ammonium sulfate—urea—calcium ammonium nitrate.

Sources of Phosphate

The response to phosphate fertilizers, at the rate of 100 pounds P_2O_5 per acre, was not significant over the no-phosphate treatment (table 1). Diammonium phosphate (21–53–0) did not give any significant increase in corm yield over triple superphosphate (45% P_2O_5), the common phosphate source for Puerto Rico.

Potassium

There was no significant response to potash application at the rate of 100 pounds of K_2O per acre as compared to none (table 1). Cross and Wilson (4) in Trinidad did not obtain any significant field response to potash at 50 pounds K_2O per acre in their experiments. Abruna *et. al.* (1) in Puerto Rico obtained a limited response to 200 pounds but not 400 pounds K_2O per acre in only one of the three experiments.

It is interesting to note that leaf and petiole values at Corozal averaged 3.57 per cent and leaf values at 4 months valued 3.8 per cent as compared to 9.0 for a complete nutrient solution by Spence and Ahmad (8) and 1.35% for high yields by Abruna *et. al.* (1). No visual symptoms of potassium deficiency were noted in the field at the Corozal experiment.

Sources of Calcium

Liming acid soils is normally considered a good agronomic practice for most crops to increase yields. With this thought in mind, the acid (pH 4.6) Lares clay of the experiment was limed at the rate of two tons per acre using several liming materials to raise the pH to 5.5. The influence of liming on yields of corms was negative. Both yields per acre and weight per corm were markedly reduced by the use of liming materials. Limestone ($CaCO_3$) and calcium silicate (TVA basic slag) reduced yields more than 33 hundredweights per acre. Cement-flue dust, a by-product of the cement factory, lowered yields by 23 hundredweights per acre.

There is no apparent explanation for the cause of this decrease in production due to liming. Soil pH samples at time of harvest were as follows: no lime 4.6, limestone 5.1, calcium silicate 5.0, and cement-flue dust 5.0. None of the limed plots showed pH values above 7 which might indicate damage due to overliming. In the experiments of Abruna *et. al.* (1) tannias did not respond to lime on Cialitos or Alonso soils, but responded negatively to the application of 8 tons of limestone per acre on acid (pH 4.8) Los Guineos clay at Jayuya. The authors offer no explanation for these results.

Magnesium

The Lares clay soil at Corozal has shown response to magnesium fertilization for sugarcane (7) and plantains (5). Thus, a magnesium fertilizer application was applied using 50 pounds of MgO per acre as SulpoMag, a double salt of potassium and magnesium sulfate. Yield response was negative (*see* table 1) as compared to no magnesium, nor was weight of corm or production of tops affected.

Plant Yield (Tops) vs. Corm Production

It has been said by farmers that the production of tops (leaves and petioles) is not a good guide as to yields (corms and rhizomes) for tannias. The weight of tannia tops was compared to corm production per plant for the various treatments in the experiment. There was a significant positive correlation of production of tops and yields of tannias (corms) such that the heavier the top, the greater was the production of tannias. The only exception was the 200 pounds nitrogen per acre treatment which gave heavier top than tannia production.

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Table 1

The influence of Fertilizers on the Yields of Tannias

Treatment[1]	Material	Rate, pounds per acre	Tannias (Corms) Cwts. per acre	Tannias (Corms) Weight each, pounds
No Fertilizer	None	0	53.4	0.277
Nitrogen Rates	Ammonium sulfate	0 N	70.0	.303
		50 N	84.2	.352
		100 N	66.7	.267
		200 N	62.3	.273
Sources of Nitrogen	Ammonium sulfate	50 N	84.2	.352
	Urea	50 N	67.9	.318
	Calcium ammonium nitrate	50 N	64.4	.260
	Calcium ammonium nitrate	100 N	60.7	.254
Sources of Phosphate	None	0 P_2O_5	69.5	.320
	Triple superphosphate	100 P_2O_5	84.2	.352
	Diammonium phosphate	100 P_2O_5	65.6	.283
Sources of Calcium	None	0	84.2	.352
	Limestone	4,000	50.9	.263
	Calcium silicate [2]	4,000	49.9	.254
	Cement-flue dust	4,000	61.4	.290
Magnesium	None	0 MgO	84.2	.352
	Sulpomag [3]	50 MgO	72.6	.315
Potash	None	0 K_2O	66.7	.313
	Potassium chloride	100 K_2O	84.2	.352
	LSD	5%	21.6	0.099
		1%	30.2	.138

[1]Unless otherwise indicated N was applied at 50 pounds, P_2O_5 and K_2O at 100 pound per acre.
[2]TVA silicate basic slag.
[3]Potassium-magnesium sulfate.