Response of Eggplant, to Various N, P, K Levels and Plant Densities on an Oxisol[1]

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ABSTRACT

At 90 × 60 cm planting distance eggplant showed a gradual response to N with each increment of 112 kg/ha up to 450 kg/ha (highest level studied). At 60 × 60 cm response was obtained with the application of 225 and 338 kg of N/ha; a slight decrease in yield was observed with the application of 450 kg/ha.

Limited response to P_2O_5 or K_2O was obtained. There were no differences in yield attributable to plant densities. The fertilizer yield equation indicated that 398 kg N, 200 kg P_2O_5 and 253 kg K_2O/ha are needed to obtain maximum eggplant yields under the conditions prevailing at the experimental site in Isabela.

INTRODUCTION

The response of various crops to different N, P, K levels on Oxisols is variable. Lugo-López, Badillo and Calduch (8) determined that about 180 kg/ha of N was required to complement native soil N to obtain maximum yields of dry beans.

Pigeon pea grown in a Coto clay, an Oxisol at Isabela, did not respond to different N, P, K levels as stated by Landrau and Samuels (7) and later confirmed by Badillo, Abrams and Pietri (2). Jordán (5) reported no response to K in cabbage grown in an Oxisol at Isabela. Abruña et al. (1) reported the K-supplying power of a Catalina clay, Tropic Haplorthox, planted to Pangola grass for 4 years as 481 kg/ha total "available" (exchangeable hot nitric acid soluble) and 461 kg/ha total extracted by the grass.

Planting distances for eggplant show a lot of variation from place to place. In the United States, Knott (6) recommends from 0.6–1.4 m between rows and 0.5 m within the row. In Trinidad, Campbell and Hartnett (3) stated that 0.5 m planting distance was the most profitable spacing.

This experiment deals with the study of 15 N, P and K levels and two planting densities on eggplant cv Rosita under the conditions of Isabela Substation, in northwestern Puerto Rico.

MATERIALS AND METHODS

An eggplant experiment was planted December 5, 1977 at the Isabela Agricultural Experiment Substation, at about 122 m above sea level.

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Mean annual maximum temperature at this location is 29.4° C and the mean annual minimum temperature is 18.9°C. Solar radiation ranges from an average of 300 langleys/day in the winter to 600 langleys/day in the summer. Mean annual rainfall is about 1658 mm. Evaporation from a class A pan is approximately 6 mm/day during the summer and 4 mm/day during the winter. The soil at the experimental site is Coto clay, a Tropeptic Haplorthox, clayey, kaolinitic, isohyperthermic soil (9). The chemical analyses from the upper 15 cm of the soil were as follows: K (available) 45 p/m; P (Bray), 4 p/m; CEC 6 meq. Organic matter is 2.44% and the pH 4.02. Calcium carbonate was applied at the rate of 7.5 tons/ha.

The experiment followed a split-plot design with 16 treatments replicated 4 times. The treatments consisted of two planting distances and quantities of 112, 225, 338 and 450 kg/ha of N, P_2O_5 and K_2O, respectively, while keeping the other two elements constant in 225 kg/ha.

The main plots were assigned to the fertilizer treatments and the subplots to the two planting distances (90 × 60 cm and 60 × 60 cm). Seed of the native variety Rosita was sown in jiffy pots placed in metal flats 54 cm × 39 cm × 10 cm November 8, 1977, and planted in the field December 5, 1977.

Plots at the 90 cm × 60 cm spacing consisted of three rows 60 cm apart and 5 m long. Plants were spaced at 90 cm in the row for a total of 18 plants/plot. The 60 × 60 cm spacing consisted of three rows 60 cm apart and 5 m long with plants spaced at 60 cm within the row for a total of 24 plants/plot.

The source of N was ammonium sulfate (20% N), of P, triple superphosphate (46% P_2O_5); and of K, potassium chloride (60% K_2O).

The mixed fertilizer salts were broadcast on top of the bed and worked into the upper 20 cm with a rotavator, prior to planting. A blank row was left between each bed to minimize the effect of fertilizer run off.

Insects and diseases were controlled by weekly preventive sprays of Dithane M-45[3] at the rate of 2243 gm/935 l of water/ha mixed with 1180 cm^3 of Lannate 24%.

The crop received 463 mm of rainfall during the growing season plus 291 mm of supplemental irrigation.

Harvesting began February 13, 1978 (70 days after planting) and continued weekly until the last picking on April 10, 1978. In each picking all marketable and cull fruits were harvested from each plot (2m × 5m), counted and weighed.

[3] Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

The Capó fertilizer-yield equation (4) was fitted to the yield data:

$$Y = \frac{A}{1 + B(X - C)^2},$$

where

X is the quantity of the fertilizer applied to the soil, Y is the yield of the crop. Parameter A represents the maximum yield obtainable in the

TABLE 1.—*Number of fruits/ha and their weight and under different N, P and K levels and planted at 60 × 60 cm*[1] *spacing at Isabela, 1978*

N-P-K levels	Marketable fruits/ha	Marketable fruits	Average fruit weight
Kg/ha		*Kg/ha*	*G*
	Nitrogen		
0-0-0	45,428	11,792	259
0-225-225	62,464	16,968	272
113-225-225	75,016	20,744	277
225-225-225	104,306	27,482	259
338-225-225	138,676	38,283	272
450-225-225	134,790	37,943	281
	Phosphorus		
225-0-225	90,259	23,665	263
225-113-225	79,201	20,405	254
225-225-225	104,306	27,482	272
225-338-225	121,640	33,558	272
225-450-225	77,706	21,831	272
	Potassium		
225-225-0	74,718	21,206	286
225-225-113	80,695	20,459	245
225-225-225	104,306	27,482	259
225-225-338	87,868	23,882	263
225-225-450	114,168	31,952	277
		Mean	268

[1] 26,898 plants/ha.

given field with the optimum fertilizer application C, under the prevalent environmental conditions. B is assumed to be an index of the variability of the crop yield as the quantity of the respective fertilizer material applied differs from the optimum application, C.

RESULTS AND DISCUSSIONS

Data related to the effect of different N-P-K levels on eggplant yields planted in December are presented in tables 1 and 2 and figures 1, 2 and

3. They suggest, in general terms, that eggplant responded to N applications in a Coto clay at Isabela. Furthermore, eggplant did not respond to P or K applications, probably due to a high native content of these elements in this soil.

There was a gradual response to N application up to 398 kg/ha in both plant densities.

The application of P_2O_5 and K_2O at the rate of 225 kg/ha each and no N reduced the number of marketable eggplants at the 90 × 60 cm spacing

TABLE 2.—*Number of fruits/ha and their weight under different N, P and K levels and planted at 90 × 60 cm*[1] *spacing at Isabela, 1978*

N-P-K levels	Marketable fruits/ha	Marketable fruits	Average fruit weight
Kg/ha		*Kg/ha*	*G*
	Nitrogen		
0-0-0	75,913	19,033	250
0-225-225	52,900	13,897	241
113-225-225	75,614	19,630	259
225-225-225	115,962	31,150	268
338-225-225	99,225	26,898	272
450-225-22	129,411	36,897	286
	Phosphorus		
225-0-225	100,121	27,931	277
225-113-225	99,823	28,759	286
225-225-225	115,962	31,150	268
225-338-225	89,661	24,100	268
225-450-225	88,167	24,399	277
	Potassium		
225-225-0	103,110	27,523	268
225-225-113	92,949	23,869	254
225-225-225	115,962	31,150	268
225-225-338	99,823	26,518	263
225-225-450	93,546	26,613	286
		Mean	268

[1] 17,932 plants/ha.

from 75,913 to 52,900 fruits/ha. This could probably be attributed to a nutrient unbalance. However, the same pattern was not observed for the closer planting distance.

At 90 × 60 cm, the highest marketable yield of eggplants (36,897 kg/ha) was obtained with the application of 450 kg/ha of N and keeping a constant application of 225 kg/ha of P_2O_5 and K_2O, respectively. Reducing N, while maintaining P_2O_5 and K_2O levels constant at 225 kg/ha, apparently lowered the yield, but the reduction was not significant.

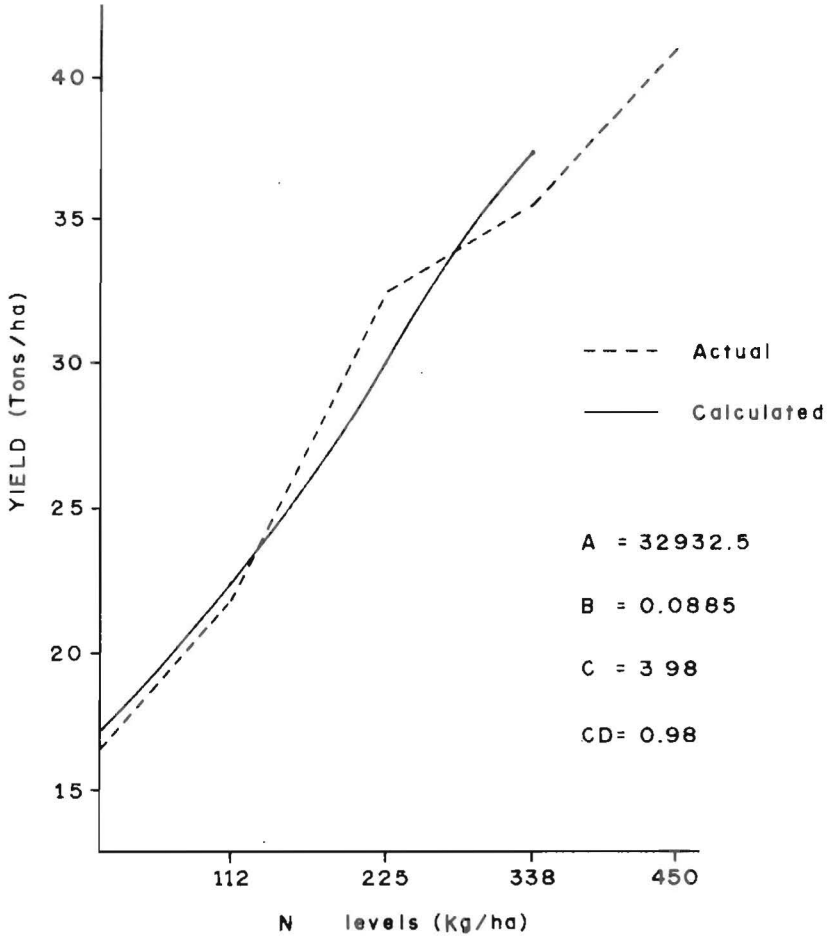

FIG. 1.—Marketable yield of eggplant under various N levels, 1977.

The highest marketable yields for P_2O_5 and K_2O treatments were obtained at 225 kg/ha, but yields were not statistically different at any levels for each of these nutrients.

At 60 × 60 cm, the highest marketable yield (38,283 kg/ha) was obtained with the application of 338 kg N/ha while keeping P_2O_5 and K_2O levels constant. Nitrogen levels under 338 kg/ha progressively reduced yields. Although the highest marketable yield was obtained with 225 kg P_2O_5 and K_2O/ha, the application of these nutrients was not a determining factor in increasing significantly the yield at any level.

Mean fruit weight was not affected by N, P, K treatments.

The fit of the curve obtained from the fertilizer-yield equation was a very close one for N, the equation indicating that 398 kg N/ha are needed to obtain maximum eggplant yield (fig. 1).

For P, the curve explained 58% of the variation in yield, indicating that 204 kg P_2O_5/ha would lead to maximum yield (fig. 2).

For K, only 25% of the variation is accounted for, the remainder being unknown. The equation indicated 253 kg of K_2O/ha as the optimum amount (fig. 3).

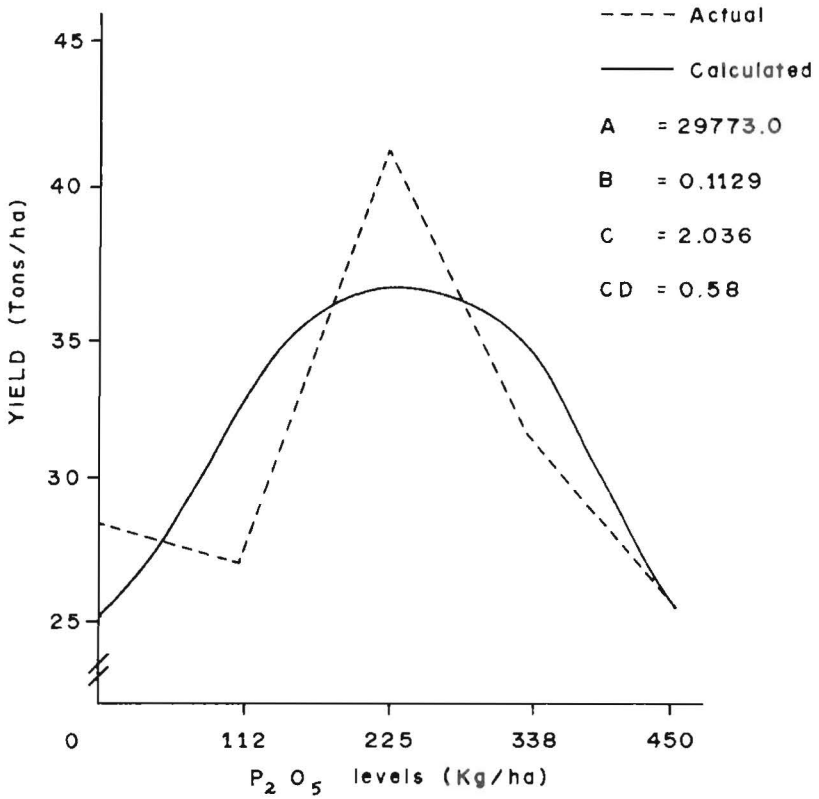

FIG. 2.—Marketable yield of eggplant under various P_2O_5 levels, 1977.

RESUMEN

Una siembra de berenjenas se estableció en la Subestación Experimental de Isabela para evaluar distintos niveles de N, P, K y dos densidades de siembra. Hubo respuesta a N, pero no así a P_2O_5 y K_2O. Los niveles de N sobre 225 kg/ha aumentaron los rendimientos, pero los aumentos no fueron significativos.

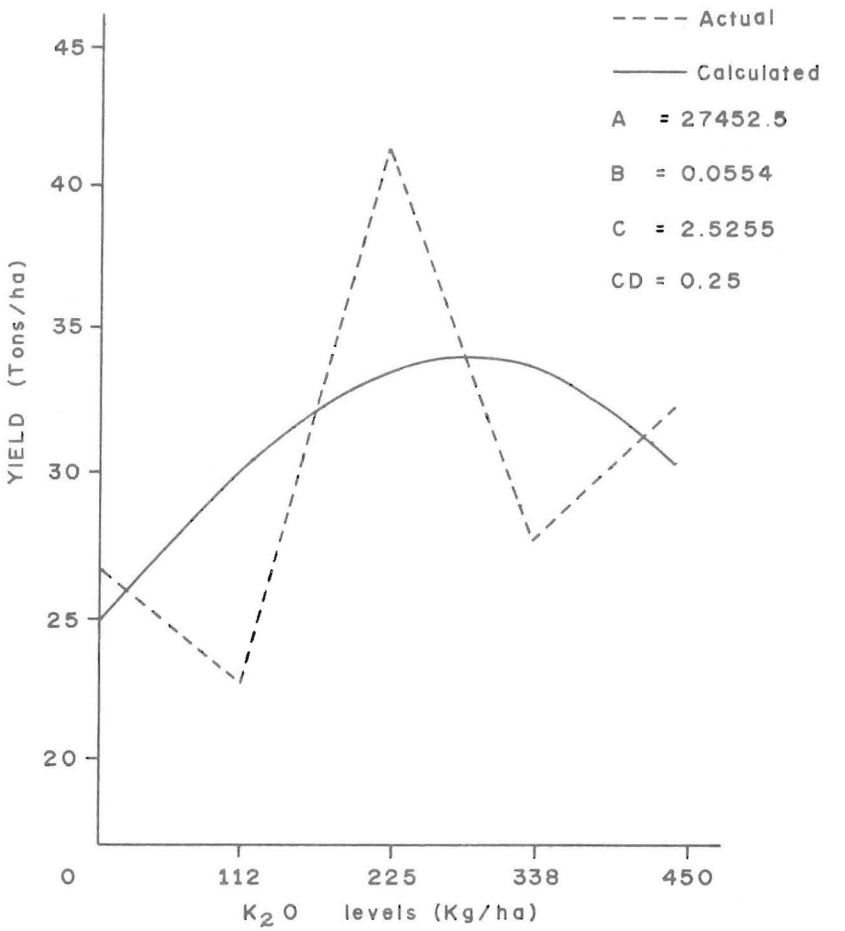

FIG. 3.—Marketable yield of eggplant under various K_2O levels, 1977.

No hubo diferencias significativas entre los rendimientos de ambas densidades de siembra.

Bajo las condiciones prevalecientes en Isabela 398, 204 y 253 kg/ha de N, P_2O_5 y K_2O, respectivamente, parecen ser necesarios para un rendimiento máximo de berenjenas.

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