N and P fertilizers and growth and yield of sweet pepper

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ABSTRACT

An experiment to determine the effect of fertilizer N and P on the growth and yield of sweet pepper grown on a Coto soil,a Tropeptic Haplorthox, was conducted at Isabela in northwestern Puerto Rico. The experiment consisted of 12 treatments, with five replications distributed in a complete randomized block design. Treatments included N fertilizer levels of 0, 75, 150, 225, 300 and 375 kg/ha; and P levels of 0, 33, 65, 98, 131 and 164 kg/ha. All plots received 150 kg/ha of K, except for the non-fertilized control. Pepper responded significantly to the application of 300 and 375 kg/ha of N when compared to 0 N application. However, there were no significant differences among N levels. There was no response to the application of P. Treatments had no significant effect on the time interval between transplanting and flowering. The N levels in the leaf were correlated with yield, whereas P levels were not.

INTRODUCTION

Sweet pepper production in Puerto Rico in 1980-81 was 2592 metric tons with a farm value of $1,470,000 (3). For the same year, imported fresh pepper from the U. S. and the Dominican Republic totalled 2028 and 1989 metric tons, respectively. Therefore, approximately 61% of the fresh pepper used in Puerto Rico is imported.

The pepper is a nutritious vegetable that can be utilized in various forms. Its most important components are vitamins C and A (2) with average contents of 128 and 126 mg per 100 g, respectively.

Serrano Pérez (13) showed that cultivars Blanco del País and Puerto Rico Wonder outyielded Yolo Wonder and Cubanelle under Isabela conditions. When planted in June the yields of Blanco del País and Puerto Rico Wonder were 36.8 and 23.4 metric tons, respectively.

Keng et al. (6) showed that when N and K were injected through drip irrigation and P banded, yields were higher than when all the fertilizers were broadcast. Mangual Crespo (8), Jordán Molero and Cruz Pérez (5) and Abrams et al. (1) found a higher response to N fertilizer and no response to K.

TABLE 1.—*Soil chemical analysis of the experimental plot*

pH	P	K	Ca	Mg	Al_1	O.M.	E.B.[1]	T.N
		P/M			*Meq/100g*	*%*	*Meq/100g*	*%*
6.01	27	178	1150	163	N.D.[2]	3.41	10	.21

[1] Exchangeable bases.

[2] Not detectable.

Investigations in Florida (10, 11, 12) showed that applications of P higher than 115 kg/ha had no effect on pepper yields and that 342 kg/ha of N and K produced maximum yields. Thomas and Heilman (14) observed that P leaf tissue content correlated slightly with yield but that leaf N content showed a better correlation with yields.

MATERIALS AND METHODS

In June 1982 an experiment was established at the Isabela Research and Development Center in northwestern Puerto Rico. The typical soil of this region is a Coto clay (tropeptic, haplorthox, clayey, kaolinitic, isohyperthermic; (7)). This soil is deep with good drainage, slightly acidic and moderately permeable. Mean rainfall during the months of the experiment (June-Dec.) was 140 mm, the average maximum temperature was 30° C and, the average minimum temperature 20° C.

Table 1 gives data on the chemical analysis of the soil. The P was analyzed by the Bray I method. A randomized complete block design with 12 treatments and five replications was used. The treatments included fertilizer N levels of 0, 75, 150, 225, 300 and 375 kg/ha and P levels of 0, 33, 65, 98, 131, and 164 kg/ha. All plots received 150 kg/ha of K, except for the nonfertilized control. N and K were applied twice at 10 and 40 days after transplanting. All the P was applied 10 days after transplanting the pepper seedlings to the field.

Fertilizer sources used were ammonium sulfate (20.5% N), concentrated superphosphate (46% P_2O_5) and potassium chloride (60.5% K_2O). Fertilizers were applied in double bands on both sides of the plants.

The experimental plots were 5.5 m long by 3.7 m wide. Four rows of plants were planted/plot. Rows were 91 cm wide, and plants within the rows were spaced at 45 cm. Necessary control measures were taken to keep the plots free from weeds, insects and disease. The *Anthonomus eugenii* weevil was controlled by application of oxamyl at the rate of 2.35 l/ha.

Fifty mature leaves (midrib and petiole) were taken to determine percentage of P and N in leaves. The samples were taken during flowering.

RESULTS AND DISCUSSION

Table 2 shows the response of pepper to different levels of N and P. The application of 300 and 375 kg/ha of N in the presence of optimum levels of P and K had a significant effect on the marketable yield of pepper compared with that of the control plots and plots receiving no N fertilizer. The effect is reflected in both the number of fruits and the yield per hectare. Applications of 300 and 375 kg/ha N increased yields by 12.52 and 11.86 metric tons, respectively, over control plots receiving no fertilizer. N applications also produced significant increases of 9.7 and 8.01

TABLE 2.—*Marketable yields of pepper on fruits/Ha and MT/Ha with different levels of N and P at Isabela, P. R.*

Fertilizer Treatment N-P-K kg/ha	Marketable Fruits/Ha	Marketable Fruits MT/Ha
0- 0-0	388,168 b[1]	12.43 b
0-98-150	453,508 b	15.25 b
75-98-150	671,308 ab	22.91 ab
150-98-150	699,622 ab	21.90 ab
225-98-150	579,832 ab	18.01 ab
300-98-150	789,162 a	24.45 a
375-98-150	762,784 a	23.29 a
	Phosphorus	
0- 0-0	388,168 b	12.43 b
225- 0-150	574,750 ab	18.30 ab
225-33-150	583,462 ab	18.44 ab
225-65-150	722,854 a	23.97 a
225-98-150	579,832 ab	18.01 ab
225-131-150	683,166 a	20.73 ab
225-165-150	558,052 ab	18.07 ab

[1]Means followed by the same letter are not significantly different at the 1% level.

mt/ha, respectively, over yields of plots with no N fertilizer. The yields obtained with the application of 300 and 375 kg N/ha were not significantly different from the yields obtained with the application of 75, 150, and 225 kg N/h. Over all, peppers will probably respond to application of 75 kg/ha of N.

Table 2 also shows that peppers did not respond significantly to fertilizer P applications in this soil. This finding could be related to the relatively high P content of the soil of the experimental plots. The soil is very high in Fe sesquioxides which fix large amounts of P that is slowly released later. Residual fertilizer may be another source of this nutrient. Unfortunately, the previous history of the experimental field is not known. It was probaly enriched by other crops for many years.

The maximum yield obtained with the fertilizer P application was 23.92 mt/ha (with the 65 kg P/ha treatment). This yield was not significantly different from the yield of 18.30 mt/ha obtained from plots receiving no P.

The maximum number of marketable fruits/plant was obtained with the application of 300 kg/ha of N (Table 3). Thirty-three fruits per plant were collected but this was not significantly different from that obtained from the application of 75, 150, 225 and 375 kg N/ha. Neither did different levels of P significantly affect the number of marketable fruits/plant.

The different levels of N and P had no significant effect on the number of days from tansplanting to flowering (table 3). Plants took an average of 31.8 to 46.4 days from transplanting to flowering.

Figures 1 and 2 show graphically the correlation between the foliar content of N and P and the yields of marketable pepper. This correlation

TABLE 3.—*Effect of different levels of N and P on the number of Marketable fruits per plant and days from transplanting to flowering*

Fertilizer Treatment N-P-K (kg/ha)	Marketable Fruits/Plants	Days to Flowering
0-0-0	16 b[1]	46.4[2]
0-48-150	19 b	38
75-98-150	28 ab	42.2
150-98-150	29 ab	34.8
225-98-150	24 ab	35.4
300-98-150	33 a	36.2
375-98-150	31 a	31.8
	Phosphorus	
0- 0-0	16 b	46.4
225- 0-150	24 ab	46.2
225-33-150	24 ab	39.6
225-65-150	30 a	38
225-98-150	24 ab	35.4
225-131-150	28 a	32.6
225-164-150	23 ab	46.2

[1]Means followed by the same letter are not significantly different at the 1% level.
[2]Means without letter are not significantly different at the 1% level.

was determined by the linear regression method. The correlation coefficient between foliar N and yield was 0.72 with an r value (determination coefficient) of 0.52. The F value obtained in the variance analysis of regression was 11.07 for N. This value is highly significant and indicates that there is a linear relationship between foliar N at flowering and yield of peppers. This relation was reported previously by Thomas and Heilman (14). For P the correlation coefficient was of 0.28 with an r value of 0.08. The F value of the variance analysis of regression was 0.87. This value was not significant, indicating no relationship between pepper yield and foliar P content.

RESUMEN

Abonos nitrogenados y fosfatados y el crecimiento y rendimiento del pimiento

Se hizo un experimento en un Oxisol (Tropeptic Haplorthox) de Isabela para medir el efecto del abonamiento con distintos niveles de nitrógeno (N) y fósforo (P) sobre el crecimiento y desarrollo del pimiento Blanco del País. El experimento consistió de 12 tratamientos y cinco replicaciones distribuidos en un diseño de bloques completos al azar. Los niveles de N probados fueron: 0, 75, 150, 225, 300 y 375 kg/ha; los P fueron 0, 33, 65, 98, 131, y 164 kg/ha. Las aplicaciones de potasio (K) se mantuvieron constantes a 150 kg/ha, excepto en el tratamiento control.

Los resultados demostraron que el pimiento responde significativamente a aplicaciones de 300 y 375 kg/ha de N en este suelo y que no responde a aplicaciones de P. Los distintos niveles de N y P no afectaron sig-

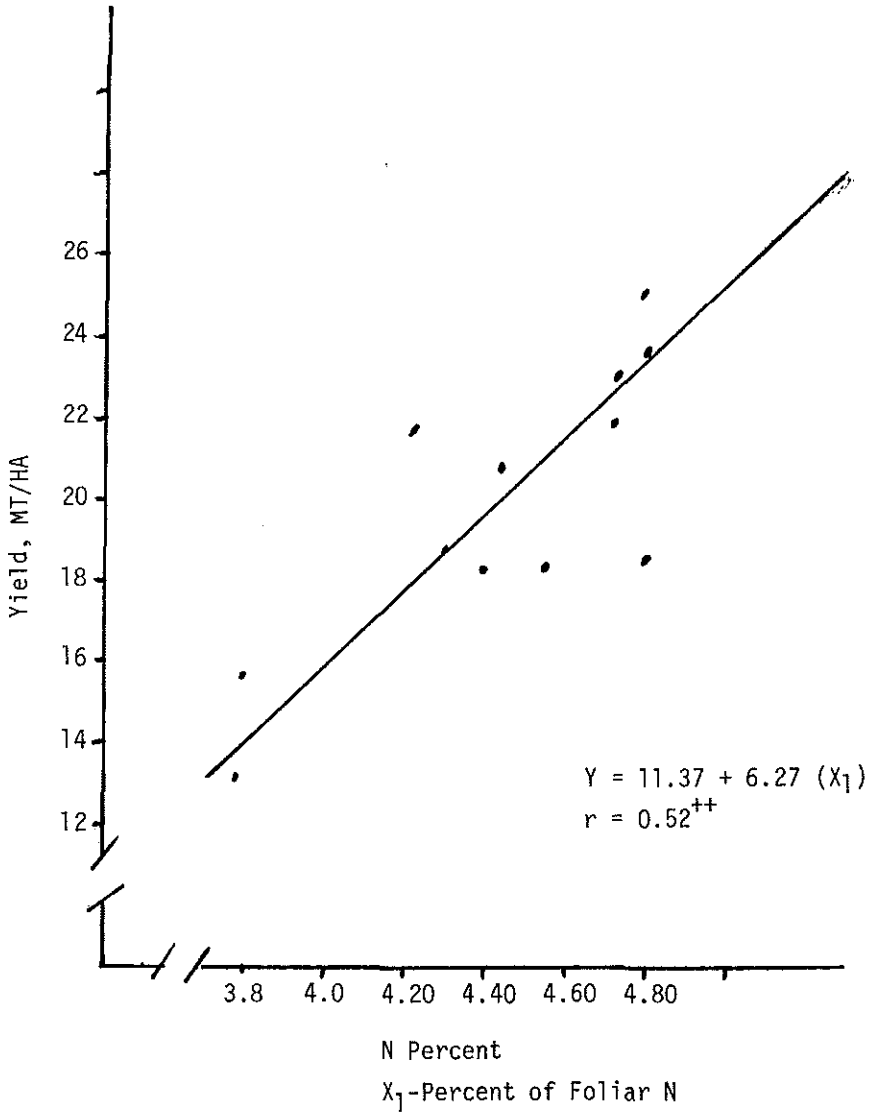

FIG. 1.—Relationship between foliar N content and the marketable yield of pepper.

nificativamente la florecida del pimiento. Además se encontró que el porciento de N foliar está relacionado con la producción de pimiento, pero el porciento de P no lo está.

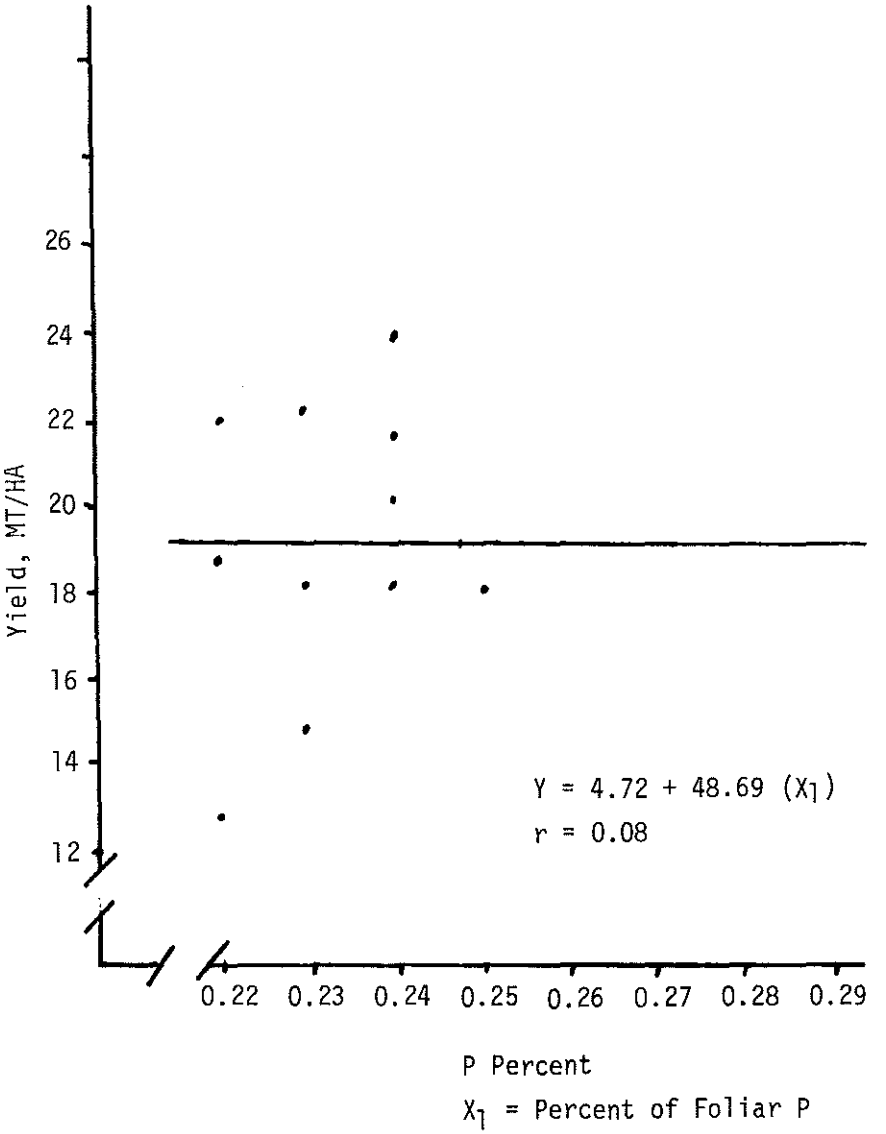

FIG. 2.—Relationship between foliar P content and marketable yield of pepper.

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