Fertilizer Trials with Tomatoes and Cucumbers in Puerto Rico

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INTRODUCTION

During the past 5 years the domestic market for salad vegetables, such as tomatoes and cucumbers, has expanded rapidly. The increased income of the Puerto Rican worker and better marketing facilities have helped bring about a demand for more fresh tomatoes and cucumbers here. Many farmers are beginning to grow vegetables to meet this expanding market. In addition to the farmers normally engaged in growing salad vegetables farmers in other areas are beginning to grow this profitable cash crop. Areas where vegetable growing shows great promise are in the Lajas Valley.

There is no information available for these new areas as to the fertilizer requirements of tomatoes and cucumbers. Even in the established tomato-growing area of Jayuya no reliable research data are available as to the response of tomatoes to various fertilizer treatments. This Agricultural Experiment Station realized that, if such profitable crops as tomatoes and cucumbers were to be recommended to farmers in new areas, knowledge was needed of the response of these salad vegetables to fertilizers. This paper reports the results of fertilizer trials with tomatoes and cucumbers in the southwestern portion of Puerto Rico.

PROCEDURE

Experiments were conducted at the Lajas Substation and in the area of Jayuya to study the influence of fertilizers on the yield of tomatoes.

The Lajas Substation experiment was planted on a Santa Isabel clay, an alkaline (pH 7.5), granular, heavy, black, plastic clay. The experiment was planted on December 7, 1959, fertilized 14 days later, and harvested from February 4 to April 8, 1960, in 11 pickings. The plot size was 12 by 15 feet, or about $\frac{1}{242}$ of an acre in area. A total of 20 plants per plot was planted in rows 3 feet apart, with a distance of 3 feet between plants. The field design was a triple lattice with nine treatments replicated three times.

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The tomato variety used was Rutgers. Weekly sprays of insecticides and fungicides were used and irrigations were applied when necessary.

The Jayuya experiment was located at the Pablo Vázquez farm, Barrio Saliente. The experiment was established on a Jayuya silty clay loam, a brown, slightly plastic, acid (pH 5.2), silty clay-loam containing some gritty material. The available soil nutrients were tested at 8 p.p.m. of phosphorus and 154 p.p.m. of potassium.

The plot size for the Jayuya experiments was 12 by 12½ feet, or about 1/290 of an acre. A total of 20 plants per plot was planted in rows 3 feet apart with a distance of 2½ feet between plants in the row. The experiment was planted March 29, 1961, and pickings occurred June 1 and 21, 1961. There were nine fertilizer treatments replicated three times in a triple-lattice field design.

The cucumber experiment at the Lajas Substation was conducted on a Santa Isabel clay adjacent to the site of the tomato experiment. The plot size was 12 by 15 feet with 2 rows 6 feet apart, and plants 1 foot apart in the row, giving 30 plants per plot. The planting date was July 3, 1959, fertilizer was applied 3 weeks after, and the experiment was harvested from August 8 to October 2, 1959, in 10 pickings. The variety used was P.R. 39.

The Fortuna Substation cucumber experiment was planted on a Paso Seco silty clay-loam, a brown, granular, alkaline, fairly friable soil. The plot size was 12 by 15 feet with 2 rows 6 feet apart and plants 1½ feet apart in the row, giving 20 plants per plot. The variety used was Ashley. The experiment was planted and fertilized on April 22, 1960, and harvested from June 1 to July 29, 1960, in eight pickings.

RESULTS

TOMATOES

The results of the tomato experiments are given in table 1.

Jayuya Experiment

There was a significant yield response to 50 pounds of nitrogen per acre in the Jayuya experiment. The use of 100 pounds of nitrogen per acre as compared with 50 pounds did not increase yields.

One hundred pounds of P_2O_5 per acre produced significant yield increases as compared to the no-phosphate treatment; however, 50 pounds of P_2O_5 per acre failed to increase yields significantly. In the Jayuya silty clay loam, the first 50 pounds of P_2O_5 per acre may have failed to augment yields because of the phosphate fixation present in this acid clay.

An application of 100 pounds of K_2O per acre gave a significant increase

over the no-potash treatment. The use of 50 pounds of K_2O per acre did not give a significant increase when compared with the no-potash treatment.

The use of 1,000 pounds of lime per acre failed to increase yields of tomatoes as compared to no liming. When no fertilizer nor lime was used

TABLE 1.—*Influence of fertilizers on yields (hundredweights) of marketable tomatoes at Jayuya and at the Lajas Substation*

Treatment (pounds per acre)			Yield of marketable tomatoes per acre at—	
N	P_2O_5	K_2O	Jayuya	Lajas Substation
		Nitrogen (N)		
0	100	100	57.2	150
50	100	100	76.5	131
100	100	100	74.0	136
		Phosphorus (P_2O_5)		
50	0	100	56.5	124
50	50	100	57.9	137
50	100	100	76.5	131
		Potassium (K_2O)		
50	100	0	58.4	136
50	100	50	65.2	137
50	100	100	76.5	131
		Other		
50	100	100	70.5[1]	125[2]
0	0	0	34.8	101
Least significant differences needed between treatments at:				
5-percent level			15.7	28.4
1-percent level			21.7	—

[1] Limed at 1,000 lb. $CaCO_3$ per acre.

[2] 100 lb. of Es-Min-El per acre; see text.

yields of tomatoes were drastically reduced. If we use the 50-100-100 fertilizer treatment as our best, the increase in yield over the no-fertilizer treatment was 41.7 hundredweights of tomatoes, or 120 percent.

For the acid Jayuya silty clay-loam the use of 50 pounds of nitrogen and 100 pounds each of P_2O_5 and K_2O (1,000 pounds of a 5-10-10 mixed fertilizer) may be used to secure high yields of tomatoes.

Lajas Experiment

In the heavier and more fertile Santa Isabel clay of the Lajas Valley tomatoes grown under irrigation showed little to no response to fertilizer. Nitrogen decreased yields. The no-nitrogen treatment gave higher yields than those where 50 or 100 pounds of nitrogen per acre were applied (table 1).

Neither phosphate nor potash fertilizers increased the yields of the tomatoes significantly. There was a small increase of 13 hundredweights with the use of 50 pounds of P_2O_5 per acre, but the treatment with 100 pounds of P_2O_5 per acre failed to raise the yield to significance. There was no appreciable increase with potash for the two levels used.

Fertilizer plus minor elements applied as Es-Min-El[2] at 100 pounds per acre did not increase yields over the treatment with fertilizer alone. However, there was a significant yield decrease when no fertilizer was applied. The no-fertilizer treatment gave 101 hundredweights of tomatoes per acre as compared to 150 hundredweights when a 0-100-100 treatment was used.

For the fertile soils of the Lajas Valley, it appears that care must be used not to overfertilize tomatoes, especially as to nitrogen. The use of no nitrogen, and 50 pounds each of phosphate (P_2O_5) and potash (K_2O) per acre, appears to be adequate. If nitrogen is needed later, side-dressings may be applied.

CUCUMBERS

Fortuna Experiment

The use of 100 pounds of nitrogen per acre gave significant increases in yields of cucumbers of 61 hundredweights over the no-nitrogen treatment (table 2). The use of 50 pounds of nitrogen per acre failed to produce any significant increase in yield over the no-nitrogen treatment.

Fifty pounds of P_2O_5 per acre gave significant yields of 40 hundredweights per acre over the no-phosphate treatment, but 100 pounds per acre P_2O_5 failed to give any increases in yields over either of the previous treatments.

There were increases in yields with increasing increments of potash. However, the use of up to 100 pounds of K_2O per acre failed to give significant yield increases over the no-potash treatment.

The no-fertilizer treatment gave a yield of 557 hundredweights per acre, a yield which was increased only by the 100-pound-per-acre of nitrogen and the 50-pound-per-acre of phosphorus treatments. It appears from the

[2] The trade name for a soluble trace or minor mineral element mixture containing salts of manganese, copper, zinc, iron, magnesium, and boron. Such mention constitutes no endorsement.

results of this experiment that the Paso Seco silty clay loam is in need of nitrogen and phosphate primarily for cucumber production.

Lajas Experiment

The Santa Isabel clay of the Lajas Valley failed to respond to any of the fertilizers used (table 2). Similar results were obtained for tomatoes on the same soil (table 1). The no-fertilizer treatment gave the lowest yields, but none of the fertilizer treatments used gave sufficient yield increases to be significant over those from the use of no fertilizer. The experiment itself had a large variation due to factors other than the fertilizer treatments used, as evidenced by the high value of 55 hundredweights needed for significance at the 5-percent level.

The generally lower yields encountered in the Lajas as compared

TABLE 2.—*Yields (hundredweights) of marketable cucumbers from fertilizer experiments at the Fortuna and Lajas Substations*

Treatment (pounds per acre)			Yields of marketable cucumbers per acre at—	
N	P_2O_5	K_2O	Fortuna Substation	Lajas Substation
		Nitrogen (N)		
0	100	100	561	237
50	100	100	556	206
100	100	100	622	242
		Phosphorus (P_2O_5)		
50	0	100	552	220
50	50	100	592	218
50	100	100	556	206
		Potassium (K_2O)		
50	100	0	536	237
50	100	50	549	259
50	100	100	556	206
		Other		
0	0	0	557	203
Least significant difference needed between treatments:				
5-percent level			32.5	55
1-percent level			44.2	—

with the Fortuna experiment may be attributed to the time of planting rather than to soil fertility. The April planting of the Fortuna experiment is considered more favorable for yields of cucumbers than the July planting date of the Lajas experiment.

SUMMARY

Fertilizer trials were made with tomatoes, Rutgers variety, and cucumbers, P.R. 39 and Ashley varieties, in the Southwestern section of Puerto Rico with the following results:

1. For tomatoes at Jayuya, on a Jayuya silty clay loam, highest yields were obtained with 50 pounds of nitrogen and 100 pounds each of P_2O_5 and K_2O per acre. Liming at 1,000 pounds per acre did not increase yields significantly.

2. The more fertile Santa Isabel clay of the Lajas Valley failed to respond significantly to variations in nitrogen, phosphate, or potash for tomatoes or cucumbers.

3. Cucumbers grown on a Paso Seco silty clay loam at the Fortuna Substation showed significant yield responses to 100 pounds of nitrogen and 50 pounds of P_2O_5 per acre.

RESUMEN

En pruebas de abonamiento con tomates y pepinillos en la región sudoeste de Puerto Rico, se obtuvieron los siguientes resultados:

1. Se obtuvieron los más altos rendimientos de tomates sembrados en Jayuya, en un suelo del tipo Jayuya, limo-arcilloso lómico, aplicando 50 libras de nitrógeno, 100 libras de ácido fosfórico y 100 de potasa por cuerda. La aplicación de cal a razón de 1,000 libras por cuerda no aumentó los rendimientos significativamente.

2. En un suelo más fértil del tipo arcilla Santa Isabel del Valle de Lajas, la variación en la cantidad de nitrógeno, fosfato o potasa aplicada a los tomates o pepinillos no afectó los resultados significativamente.

3. Pepinillos sembrados en un suelo del tipo Paso Seco, limo-arcilloso lómico en la Subestación de Fortuna, respondieron significativamente a las aplicaciones de 100 libras de nitrógeno y 50 de ácido fosfórico por cuerda.