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Effect of Fertilization with Phosphorus, Sulphur and Micronutrients on Yields of Peppers Growing on an Alkaline Soil[1,2]

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ABSTRACT

Two sweet pepper cultivars growing on an alkaline (pH 8.0) Santa Isabel clay (Udic Pellusterts) did not respond in yield to three levels of phosphorus fertilization, to foliar or soil applications of minor elements, or to three rates of sulphur applied to the soil, which decreased pH to as low as 5.5. Soil samples taken in the root zone of the pepper plants 6 months after planting showed that the commonly used acid-residue fertilizers had decreased pH to 7.4.

INTRODUCTION

Low availability of phosphorus and micronutrients is of major concern when crops are grown on soils with high pH values such as occur over large areas of the south coast of Puerto Rico, where a modern vegetable production program has been established.

There is little information on the fertilization of vegetables grown under these conditions in Puerto Rico. Landrau and Samuels[4] found that field corn growing without irrigation on a Santa Isabel clay (Udic Pellusterts) did not respond in yield to single applications of B, Mn, Mg, Cu, S, and Zn. Alers and Orengo[5] found that the "Blanco del País" cultivar of sweet peppers growing on a San Antón clay (Cumulic Haplustolls) with a pH of 7.4 did not respond in yield to applications of up to 196 kg/ha of P. Pérez-Escolar and Lugo-López[6] showed that mixing powdered S

[1] Manuscript submitted to Editorial Board November 22, 1982.

[2] This paper covers work carried out cooperatively between the Agricultural Research Service, USDA, and the Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P.R.

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[4] Landrau, P. and Samuels, G., 1956. Results of lime and minor element fertilizer research in Puerto Rico, 1949–50, J. Agric. Univ. P.R., 40 (4):224–34.

[5] Alers-Alers, S. and Orengo-Santiago, E., 1977. Lack of response of sweet peppers to P levels, P placement and timing of N application in southern Puerto Rico, J. Agric. Univ. P.R., 61 (3):389–91.

[6] Pérez-Escolar, R. and Lugo-López, M. A., 1969. Sulfur transformation in a saline sodic soil of the Lajas valley, J. Agric. Univ. P.R. 53 (2):118–23.

with a Fé clay soil (Paleustollic Chromusterts) under greenhouse conditions decreased pH from 7.9 to 7.4.

The present study was undertaken to determine whether the low yields of peppers obtained by some farmers on soils with a high pH on the south coast of Puerto Rico were caused by nutritional problems related to phosphorus or micronutrients.

MATERIALS AND METHODS

Two experiments with sweet peppers (*Capsicum annuum*) were conducted near Santa Isabel starting in September and November 1979. The

TABLE 1.—*Effect of phosphorus and micronutrient applications on yields of marketable sweet peppers growing on an alkaline soil fertilized with an acid residue fertilizer*[1]

Treatments (All received 100 kg/ha of N and K applied in the rows)	Yields of marketable peppers
	kg/ha
0 P, 0 micronutrients	33,145
0 P, all micronutrients	28,490
50 kg of P/ha + all micronutrients (as foliar spray)	30,850
100 kg of P/ha + all micronutrients (as foliar spray)	29,235
100 kg of P/ha + all micronutrients—Cu (as foliar spray)	30,570
100 kg of P/ha + all micronutrients—B (as foliar spray)	29,495
100 kg of P/ha + all micronutrients—Fe (as foliar spray)	27,475
100 kg of P/ha + all micronutrients—Zn (as foliar spray)	27,010
100 kg of P/ha + all micronutrients—Mn (as foliar spray)	26,630
100 kg of P/ha + 110 kg/ha of fritted micronutrients (applied to soil)	32,170
100 kg of P/ha + 220 kg/ha of fritted micronutrients (applied to soil)	28,590
100 kg of P/ha + 440 kg/ha of fritted micronutrients (applied to soil)	28,370
	N.S.

[1] Initial soil pH was 8.0; 6 months later pH of the soil under the pepper plants was 7.4.

soil is a Santa Isabel clay (Udic Pellusterts) with an initial pH of 8.0, and containing 31 p/m of available P (Olsen method), 0.6 meq of exchangeable K, 18.8 meq of exchangeable Ca, and 8.2 meq of exchangeable Mg/100 g of soil in the upper 25 cm.

The field was plowed and harrowed twice and subdivided into 4 m^2 plots. The treatments were arranged in a partially-balanced imcomplete block design with 6 replications.

Experiment No. 1 determined the effect of 3 levels of P, 3 levels of fritted micronutrients applied to the soil, and 6 micronutrient sprays applied to the foliage (table 1) on yields of peppers of the "Blanco del País" cultivar.

Experiment No. 2 determined the effect of 3 levels of S (0, 900 and

1,800 kg/ha) broadcast and mixed with the soil and of a complete micronutrient spray on yields of peppers of the Cubanelle cultivar.

Seedlings were transplanted to the field at about 45 days and planted 30 cm apart in row 90 cm apart. Weeds, insects and diseases were controlled according to the recommendations of the Agricultural Experiment Station. Sprinkler irrigation was applied at the rate of 25 mm weekly.

All plots received 500 kg/ha of 10-0-10 fertilizer 3 and 12 weeks after transplanting. Where used, P was banded below the seedlings at transplanting, and fritted micronutrients were added to the fertilizer. Micronutrient sprays were applied 5 weeks after transplanting and biweekly thereafter for a total of eight applications.

TABLE 2.—*Effect of broadcast sulfur applications, and of micronutrient sprays on yields of marketable sweet peppers and pH of an alkaline soil receiving an acid-residue fertilizer*

Treatment	Yields of peppers	Soil pH at 01–15 cm depth[1]
	kg/ha	
Complete fertilizer (1,000 kg/ha of 10-10-10)	38,030	7.4 a[2]
Complete fertilizer + micronutrient spray	36,410	7.4 a
Complete fertilizer + micronutrient spray and 900 kg of S/ha	36,330	6.1 b
Complete fertilizer + micronutrient spray and 1,800 kg of S/ha	32,120	5.5 c
	N.S.	

[1] Initial soil pH = 8.0.

[2] Means followed by the same letter do not differ significantly at the P = 0.05 probability level (Duncan's multiple range test).

Nitrogen was applied as ammonium sulphate, P as simple superphosphate, K as potassium sulphate, and sulphur as a powdered commercial product containing about 90% elementary S. The fritted micronutrient mixture contained 8.0, 7.7, 7.0, 6.0, 4.8 and 2.5% of Zn, Mn, Fe, Mg, Cu and B, respectively. The foliar spray contained the following nutrients, expressed in p/m: Fe – 40, B – 10, Zn – 20, Mn – 40 and Cu – 2. All but B were in the form of chelates.

Yields of marketable fruits were determined by hand-picking at the mature-green stage.

The experiment was terminated about 6 months after planting. The soil in each plot was sampled in the main root zone of the pepper plants, and pH was determined.

RESULTS AND DISCUSSION

Yield of marketable peppers averaged about 30,000 kg/ha and were not significantly affected by phosphorus applications to the soil or micronutrient foliar sprays (table 1).

In Experiment 1, soil samples from the root zone 6 months after planting had an average pH of 7.4 compared with an initial pH of 8.0. Thus, it appears that the application of commonly used acid residue fertilizers in the rows of peppers decreased soil pH sufficiently so that the plants could effectively use both P and micronutrients.

Neither did the micronutrient sprays combined with S applications to the soil significantly affect yields (table 2), although the highest level of S (1,800 kg/ha) tended to decrease yields. Samples taken about 6 months after planting showed that soil pH had decreased with increasing S levels to 5.5 at the highest S level tested (table 2).

The data indicate that the use of acid residue fertilizers, such as ammonium sulphate, can reduce pH in the root zone of pepper plants growing on alkaline soils to levels at which the plants can obtain the P and micronutrients needed to produce high yields.

RESUMEN

Se evaluó el efecto de varios niveles de fósforo y azufre y aplicaciones foliares o al suelo de oligoelementos sobre el rendimiento de dos cultivares de pimiento sembradas en un suelo Santa Isabel arcilloso con un pH inicial de 8.0.

Ninguno de los tratamientos alteró significativamente la producción de pimientos. Las aplicaciones de azufre al suelo aumentaron la acidez del suelo señaladamente.

Las aplicaciones de fuentes de nitrógeno con efectos residuales ácidos usados en estos experimentos, y que son los más recomendables para suelos alcalinos, bajaron el pH del suelo en la zona de las raíces a 7.4. A este nivel de acidez los pimientos pudieron utilizar el fósforo y los oligoelementos.

Por lo tanto, si se usan abonos con residuos ácidos, la nutrición del pimiento y otras hortalizas con fósforo y oligoelementos en suelos como los utilizados en estos experimentos no debe constituir un problema.