Research Notes

EFFECT OF BORON AND ZINC APPLICATIONS ON YIELDS OF INTENSIVELY MANAGED PLANTAINS GROWING ON A STEEP ULTISOL[1,2]

Plantains are a staple in the diet of millions of people throughout the Humid Tropics. About 260 million plantains with a farm value of over $15 million are produced yearly on about 15,000 acres in the humid mountain region of Puerto Rico.

Despite their importance, little research has been carried out on the nutrient requirements of plantains. In Puerto Rico, Vicente-Chandler and Figarella[3] found that plantains growing on Catalina clay (an Oxisol) responded strongly to applications of 200 pounds of nitrogen and 200 of phosphoric acid per acre. Caro, Abruña, and Vicente-Chandler[4] found that strip cultivated plantains growing on steep Humatas clay (an Oxisol) responded strongly to applications of 200 pounds of nitrogen, 200 of phosphoric acid, 400 of potassium, and 100 of magnesium per acre when all other nutrients were present in abundance. Hernández and Lugo-López[5] found that plantains growing on Lares (Corozal) clay (an Ultisol) responded to applications of magnesium and of a complete minor element complex to the soil. They also found that omitting zinc from a minor element mixture sprayed on the leaves reduced yields and that omitting boron reduced the number of fruits produced per acre.

The present study determined the response of otherwise well fertilized, intensively managed plantains growing on a typical Ultisol (Humatas clay) in the humid mountains of Puerto Rico to applications of boron and zinc to the soil.

The experiment was carried out near Aguas Buenas at an elevation of about 1,400 feet with annual rainfall of about 70 inches fairly well dis-

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[2] This paper covers work carried out cooperatively by the Agricultural Research Service, U.S. Department of Agriculture and the Agricultural Experiment Station, Mayagüez Campus, University of Puerto Rico, Río Piedras, P.R.

[3] Vicente-Chandler, J., and Figarella, J., Experiments on Plantain Production with Conservation in the Mountain Region of Puerto Rico, J. Agr. Univ. P.R. 46 (3): 226–36, 1962.

[4] Caro, R., Abruña, F., and Vicente-Chandler, J., Response to Fertilization of Strip Cultivated Plantains Growing on a Steep Latosol in the Humid Mountain Region of Puerto Rico, J. Agr., Univ. P.R. 48 (4): 312–17, 1964.

[5] Hernández-Medina, E., and Lugo-López, M. A., Effect of Minor Nutrient Elements and Magnesium Upon Growth Development and Yields of Plantains, J. Agr. Univ. P.R. 53 (1): 33–40, 1969.

tributed throughout the year. The soil, a deep, red, Humatas clay on a 40-percent slope had 3.5 percent of organic matter, a pH of 4.8 and 12 meq. of exchange capacity with 5 meq. of exchangeable bases per 100 g of soil.

The vegetation was killed or subdued by applying 6 pounds of Dalapon and 1½ pints of Paraquat per acre. Unselected seed of the Maricongo variety were planted in holes dug 5 feet apart in rows 10 feet apart (860 plants/acre) in the unplowed soil. Four tons of ground limestone were applied per acre to the soil surface and fertilizer containing a total of 200 pounds of nitrogen, 100 of phosphoric acid, 300 of potash and 60 of magnesium were applied per acre in three equal applications over a 1-year period. In addition, all plants in the boron experiment received 1 ounce of zinc sulphate and all plants in the zinc experiment received 1 ounce of borax.

TABLE 1.—*Effect of borax applications on yields of intensively managed plantains growing on an Ultisol (Humatas) in the mountain region of Puerto Rico*

Borax applied[1]		Yield of plantains per acre		Foliar composition				
Per plant	Per acre[2]			P	K	Ca	Mg	B
Ounces	*Pounds*	*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*P.p.m.*
0	0	25,700	17,990	0.32	2.08	1.18	0.34	16
1	55	29,840	20,900	.31	2.23	1.00	.30	25
2	110	28,200	19,700	.34	2.17	1.18	.31	38
4	220	28,100	19,600	.33	2.27	.98	.31	61
LSD_{05}		4,040	2,830					

[1] Contains 11 percent of boron.
[2] 860 plants/acre.

The plantain seeds were peeled and immersed in a solution of 2 pints of Nemagon (DBCP) in 50 gallons of water for 4 minutes to kill nematodes and insects. Two ounces of Dasanit (Terracur P) were applied under the canopy of each plant 6 months after planting to control nematodes and soil insects. The plants were sprayed every 21 days with 1½ gallons of orchard oil per acre starting 6 months after planting to control leaf spot. Weeds were controlled by hand-weeding or by the application of contact herbicides.

Treatments (applied 4 months after planting):

Boron experiment = 0, 1, 2, and 4 ounces per plant of borax containing 11 percent boron.

Zinc experiment = 0 and 1 ounce per plant of zinc sulphate.

Treatments were replicated six times in a completely randomized design with six plants per plot in a row and two plants as buffers between plots.

Nine months after planting, the third leaf from the top of four plants in each plot was cut off, the midribs removed, and the leaf blades washed with

distilled water, dried and analyzed for phosphorus, potassium, calcium, magnesium and boron.

The plantains were planted in November 1971 and harvested when mature-green during February–April 1973. Weight and number of plantains produced were determined.

The following tabulation shows that the plantains did not respond to applications of zinc.

	No zinc applied	*One ounce of zinc sulphate applied per plant*
Plantains per acre (number)	25,800	25,100
Plantains per acre (pounds)	18,060	17,600

Table 1 shows that the plantains responded to the application of 1 ounce of borax per plant but did not respond to heavier applications of this nutrient.

The application of 1 ounce of borax per plant, equivalent to 55 pounds of borax per acre, increased yields by an average of 4,140 plantains. In economic terms, $5 worth of borax increased value output by over $200 at current farm prices. Caro[6] found that closer spacing (5 feet × 6 feet or 1,430 plants per acre) increased yields of plantains without affecting bunch or fruit size. If this spacing had been used in this experiment, 90 pounds of borax would have been applied per acre and could have increased yields by 7,200 plantains. In this case $8 worth of borax would have produced an increase worth over $350 per acre. There is little danger that borax applied at the rate of 1 ounce per plant could be toxic to plantains growing on the deep porous soils (Ultisols) of the mountain region with 70 or more inches of annual rainfall.

Table 1 also shows that borax applications increased the boron content of the plantain leaves roughly in proportion to the amount of borax applied. A boron content of about 25 ppm in the leaves was apparently sufficient to produce maximum yields of plantains. This table also shows that boron applications did not affect the phosphorus, potassium, calcium or magnesium contents of the plaintain leaves.

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[6] Caro, R., Effect of Plant Population and Distribution on Yields of Plantains, J. Agr. Univ. P.R. 52 (3): 256–9, 1968.