PROCEEDINGS

OF THE

CARIBBEAN FOOD CROPS SOCIETY

SECOND ANNUAL MEETING

BRIDGETOWN, BARBADOS

OCTOBER 19-23, 1964

VOLUME II

MINERAL-DEFICIENCY SYMPTOMS OF BANANAS

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INTRODUCTION

Little published information appears to be available on the mineral nutrition of the banana. Murray (5) in Trinidad produced deficiency symptoms of nitrogen, phosphorus, potassium, calcium, and magnesium using a sand culture technique. He did not give any information on sulfur, iron, manganese, and boron; nor did he cite any chemical analyses of the plant tissues under this deficiency study. Martin-Prevel and Charpentier (6) working on the Ivory Coast in Africa produced deficiency symptoms on the "Poyo" or Robusta variety for nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. They showed that the "blew" of bananas found in the Ivory Coast area could be produced by a magnesium deficiency.

Chemical analyses of the various parts of the banana plant growing under normal conditions has been well done by Baillon et al. (1), however, their study does not include manganese and boron. C. W. Hewitt (4) in Jamaica showed the possibility of using plant analysis as an indicator of the nutritional status (N-P-K) of the banana. Bhangoo et al. (2) used Hewitt's technique in their study of Giant Cavendish banana nutrition in Honduras.

In Puerto Rico there appears to be no published information concerning the mineral nutrition of the banana. Recent efforts by the Puerto Rican Department of Agriculture has been directed to the promotion of larger acreages of bananas in mountainous areas formerly in coffee or sugarcane. It is the purpose of this paper to provide accurate pictures and written descriptions of the deficiency symptoms of bananas (Dwarf Cavendish) for use by farmers and agricultural technicians in determining these deficiencies under actual field conditions. Also presented are chemical analyses of various parts of the banana plant under deficiency and complete nutrient treatments for the benefit of the agronomist and research worker.

PROCEDURE

All deficiencies were developed on plants grown in sand culture. The fine quartz sand used was obtained from the Tortuguero area and is classified as a St. Lucie fine sand. It was placed in concrete pits 3 feet on each side and 1 1/2 feet deep each pit had an individual hole for draining out the excess nutrient solution.

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There were 10 treatments, each replicated 2 times. The composition of the different nutrient solutions used in this experiment are shown in table 1. Applications were made once a week at the rate of 2 1/2 gallons per pit. Once in a while the pits were flushed with distilled water only to wash out excess salts or to prevent salt accumulations.

RESULTS

VISUAL DEFICIENCY SYMPTOMS

The deficiency symptoms described herein for bananas were developed under experimental greenhouse conditions. It is to be expected, therefore, that differences in intensity of the symptoms will be found under field conditions. However, the pattern of the deficiency development will be the same, and thus the descriptions given should serve as a useful guide in identifying nutrient deficiencies in bananas.

Nitrogen

The effects of nitrogen deficiency were the first to appear. The leaves became lighter green in color in the earlier stages of the deficiency. The growth of the plant was stunted as a result of a reduction both in the rate of leaf production and in the size of leaf developed. The new leaves were progressively smaller and paler green in color, and there was also a gradual loss in color of the older leaves as nitrogen was translocated from them to the young leaves. All leaves became a pale yellow green and older leaves developed a necrosis along the margin of the leaves.

Phosphorus

A deficiency of phosphorus began on older leaves. The symptoms first appeared on the margin of the leaf as a necrosis which began at the tip and extended about two thirds of the way to the base. In the pale areas, purplish spots or flecks appeared which coalesced and work towards the midrib. The necrosis extended rapidly soon leaving premature senescent older leaves. Growth was reduced and the banana bunch was small with few hands.

Potassium

For a potassium deficiency, reduction in growth was noted before any marked leaf symptoms appear. The interval between the production of new leaves became longer and the leaves were progressively smaller. The production of a bunch was delayed as well as the maturing of the hands.

Leaf symptoms, when they developed, were seen on the older leaves, the younger leaves remaining green. The old leaves lost their color from the margin inwards and from the tip towards the base. The chlorosis and yellowing was followed by a marginal necrosis. The chlorosis spreads very rapidly so that in a few days the whole leaf became yellow; it then dried up and the petiole broke.

TABLE I

A Comparison of the Various Parts of Nutrient-Deficient Banana Plants on a Dry-Weight Basis

Part of plant	Nutrient Content								
	N	P	K	Ca	Mg	S	Fe	Mn	B
	%	%	%	%	%	%	ppm	ppm	ppm
Main plant leaves									
deficiency	0.90	.01	.52	2.02	.31	.14	253	52	16
complete	2.04	.26	2.20	3.78	.84	.15	299	77	22
Main plant stem									
deficiency	1.21	.01	.22	--	.84	.33	200	55	--
complete	2.48	.37	3.21	4.77	2.12	.29	208	52	34
Sucker plant leaves									
deficiency	1.30	.02	1.14	1.31	.44	.25	149	19	20
Complete	1.34	.26	2.09	3.23	.57	.30	211	34	17

Calcium

A calcium deficiency was slow in appearing; and when it did, it began on the younger leaves. The leaf became yellow at the tip and along the leaf margin extending back from the tip. The yellowing became intense followed by a marginal necrosis. The necrosis tended to remain marginal until the leaf turned yellow and became senescent.

Magnesium

Deficiency symptoms for magnesium developed on the older leaves along the entire margin of the leaf as a chlorosis. This yellow banding of the leaf margin was quite distinctive. Following the chlorosis, was a marginal necrosis. Necrotic spots also developed in the internal part of the leaf.

Manganese

The leaf symptom began as an interveinal chlorosis alternating green vein tissue with yellow intervein tissue. As the deficiency progressed, the yellow chlorotic portion became severely necrotic leaving large black areas. The symptoms developed primarily on leaves about five or six back from the spear.

The fruit produced under a manganese deficiency had a yellow peel as if ripe, but the pulp was hard and not mature. Some fingers tended to become dry and black.

Iron

As for manganese, the iron deficiency begans as an interveinal chlorosis. However, for the iron deficiency, young leaves developed the chlorosis first. In severe stages of the deficiency on very young plants, the entire plant became almost a light green to white color. This symptom has been noted in the field on very acid soils (below pH 4).

Sulfur

Sulfur deficiency was slow in appearing. The leaves tended to turn yellow with a drying of the leaf beginning at the tip and progressing toward the base.

Boron

No especial deficiency symptoms were noted in the leaves which could said to be distinctive. However, fruit produced under a boron deficiency show a blackening of the center part of the pulp. This "black heart" of the banana fruit appears to be similar to that produced by boron deficiency in other fruits and vegetables.

PLANT ANALYSES

The results of the chemical analyses of the banana plant grown under various deficiency symptoms are given in table 1.

The level of the various elements under the deficiency treatments were all lower than those under the complete treatment for the leaves of the main banana plant (table 1). Thus it appears that most of the plants were under deficiency stresses. Some plants showed greater deficiency-level stress than others. The ranking of the intensity of the deficiency from severe to almost none are as follows:

PK, Mg N Ca Mn B Fe S Complete

Phosphorus, potassium, magnesium, and nitrogen levels under deficiency were all less than 50 percent of the complete treatment; whereas, sulfur had only 8 percent and iron 16 percent less under deficiency as compared to complete. It appears that the iron and sulfur deficiency symptoms produced were not too severe.

When we consider the main stem of the plant, we find that under the complete treatment there were higher values for all stem than in the main leaves. Phosphorus levels were extremely low under phosphorus deficiency for both leaves and stem.

The leaves of the banana suckers showed lower nutrient content under a complete treatment than did the stem or leaves of the main plant except for sulfur and phosphorus.

It is interesting to note that for the more mobile elements nitrogen, phosphorus, potassium, and magnesium, the leaves of the sucker plant under deficiency had a higher level them did the leaves of the main plant under similar treatment. Whereas, calcium and iron which are not considered mobile, physiologically speaking, had lower values in the sucker leaves than in the main plant (table 1).

SUMMARY

1- Bananas have been grown in sand culture in absence of nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, manganese, iron, and boron.

2- The deficiency symptoms produced were described and illustrated.

3- Chemical analyses of the various parts of the banana plant grown under deficiency symptoms were related to the level of the nutrient in the deficient treatment as compared to the complete.

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