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FRUIT

BUMPY FRUIT OF PAPAYA AS RELATED TO BORON DEFICIENCY

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Introduction

Externally deformed papaya fruits with "bumpy" skin surfaces (Figure 1) have been present in the papaya industry for many years. During the fall of 1986 and spring of 1987, this condition intensified, and individual farmers experienced significant economic loss due to distorted fruits being discarded in the packing process. In severe cases, farmers experienced losses of close to 100 percent due to this condition. Historically, "bumpy fruits" have been prevalent during dry months under thin soil conditions (pahoehoe), which usually disappeared with the onset of the wet season. This did not occur, however, during the spring of 1987, and the reason for the increased rate and persistence of bumpy fruit is not known.

A relationship between bumpy fruit and boron deficiency has been established in other studies (1, 3, 4, 6, 7). All of these studies were conducted under soil conditions with application methods and rates varying considerably. Studies relating to boron have not been reported under the "rocky" Hawaiian soil conditions.

The bumpy fruit condition is first noticed as extreme distortion on the mature fruit surface. In young fruits, the symptoms include a milky latex exudate from the fruit surface (Figure 2), which later turns brown. In older fruits, the skin becomes distorted and exhibits a bumpy surface.

Since studies on boron nutrition under Hawaiian soil conditions have not been reported, this study has two objectives. The first is to determine if there are differences in boron tissue levels between affected and unaffected trees under field conditions. The second is to determine the application rate of boron at which the milky exudate can be eliminated.

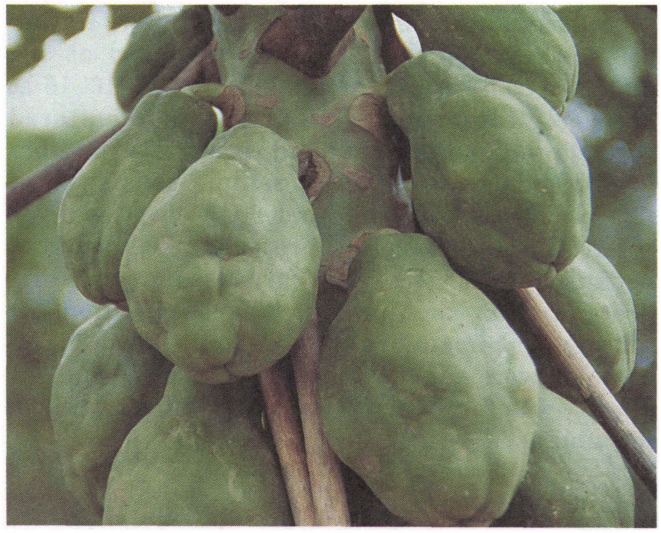

Figure 1. Mature papaya fruits with distorted, or "bumpy," surface.

Figure 2. Young papaya fruits with latex exudate, which has turned brown.

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Materials and Methods

The components of the study included a summary of samples collected over several years, to determine if a linkage could be established between boron levels and fruit condition. The second component included a field test using ground application of boron. The product selected for use in this test was a granular fertilizer from U. S. Borax (Borate 46—14.3 percent B). The treatments selected for this commercial test were three rates of elemental B (1.0, 3.5, and 4.5 lb B/ac) and a check plot.

The 10-acre test was installed on May 6, 1987; the site was selected because the entire field exhibited deformed fruits. The field was classified as Papai extremely stony muck, 3 percent to 25 percent slopes (rPAE), by the Hawaii soil survey (6). The field was fertilized at the standard commercial rate of 350 lb of 16–16–16 at six-week intervals. The test was monitored through field observation and tissue analysis on a biweekly basis, with each sample consisting of five petioles taken from under the most recently set fruit. This sampling procedure was selected because it is the standard tissue-sampling procedure for monitoring papaya nutrition for nitrogen, phosphorus, and potassium. The samples were sent to the Agricultural Diagnostic Service Center, University of Hawaii at Manoa, for analysis.

Results and Discussion

The previous tissue samples collected of normal and bumpy fruit trees are included in Table 1. The results show normal trees to have 25 percent higher levels of boron in the petiole than the trees with bumpy fruits.

Table 1. Tissue nutrient levels from previous samples.

	Petiole Concentration (Dry Weight Basis)					
	--------%--------				--ppm--	
	N	P	K	Ca	B	Zn
Normal	1.00	0.15	2.07	1.07	25	17
Bumpy	1.11	0.15	2.13	0.75	20	10

The tissue samples collected in the boron field test are summarized in Table 2. The results indicate that boron concentration in the petiole increased about four weeks after application as compared with that of the control trees. This coincides with field observations that reflect termination of milky secretion from young fruits.

Table 2. Field boron rates test.

Interval (Weeks)	----Boron Rates (lb B/ac)----			
	Control	1.0	3.5	4.5
0	16	16	16	16
2	14	17	18	17
4	12	27	24	30
6	10	26	40	34
8	10	32	30	40
10	11	30	32	36
12	6	18	16	20
14	9	20	22	28
16	9	24	24	31

Boron concentration in the petiole peaks about eight weeks after application and trails off to the 16-week sampling. Correlation of tissue results with field observations indicate that tissue readings in the range of 25 ppm to 30 ppm boron in the petiole may be necessary to ensure correction of this condition in the field. At the termination of this field demonstration test, the check plots that had not received any boron still exhibited mature bumpy fruits and milky secretion from young fruits. All of the treatments included in the test were successful in correcting the distortion of the papaya fruit surface. None of the boron treatments exhibited boron toxicity symptoms of wilting leaves and exudate on young petioles. Observation of the site a year after the entire field was treated with boron showed it to be free of this condition.

Implications

Although additional replicated work should be done, this test gives preliminary results that are presently used for papaya production in the rocky Puna area. One application per year of the special commercial papaya fertilizer mix (14–14–14 plus 0.30 percent B) includes 1 lb of elemental boron when applied at a rate of 350 lb fertilizer per acre. Areas within the field that do not respond to the application should receive additional boron on an individual tree basis.

Additional replicated testing should be done to establish the critical level of boron in the petiole. Consideration should also be given to evaluating

the most sensitive tissue, which would best reflect the boron content of the plant. Work should also be done on liquid sources of boron to determine plant response and optimum application rates.

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