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SUGARCANE MICRONUTRIENT PROBLEMS ALONG THE HILO COAST

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On a slightly-to-moderately sloped terrain, spanning 20 miles due north of Hilo and stretching 3 miles from the coast on the slopes of Mauna Kea mountain, lies our two large sugarcane plantations consisting of 18,000 acres of administration cane land and 8,000 acres of growers cane land. Sugarcane is grown from 50 feet above sea level to 1,800 feet. Annual rainfall at the lowland averages 125 inches while at the top of the cane land, averages 250 inches. The soil is volcanic in origin, geologically young but highly leached, acid, contains moderate amount of organic materials, and in an advance state of plant nutrient depletion. The soil is unique in that it can hold a large quantity of water before it is irreversibly dried, but once it is dried irreversible, it loses virtually all of its moisture holding capacity. Another critical and unique property of this soil is its low sheer strength. As a result, heavy field equipment constantly destroy the granular soil structures and cause extensive and frequent puddling. Deep plowing and irreversible drying of this soil are effectively countering this soil puddling problem.

Within this environmental parameter, Mauna Kea Sugar Company and Pepeekeo Sugar Company grow and harvest 12,000 acres of sugarcane annually producing about 130,000 tons of raw sugar. Our job in the agricultural research and crop control department at these two sugar plantations is to constantly find ways and means to improve sugar yields profitably so that our findings can be disseminated and implemented commercially to maintain these two sugar plantations as highly viable and profitable agri-business entities.

In our quest to improve our yields, numerous and diverse yield determinants are studied. Among these are the nutritional problems which constitute one of the major research projects and require much of our research funds and efforts. In solving our sugarcane nutritional problems, we have been improving the following controllable yield determinants that influence nutrient uptake by:

1. Constantly developing (in cooperation with HSPA) and planting high yielding varieties such as our current champion variety, 59-3775.

2. Keeping cane pests at a very low level---such pests as weeds, rodents, cane borer, chlorotic streak disease, and pineapple disease.

3. Improving our soil quality, specifically, increasing soil pH, drainage and aeration.

4. Improving our fertilization programs.

Of course, in addition to these controllable factors, there are the ever-present uncontrollable weather elements such as rain, temperature, and solar radiation which affect nutrient uptake, growth and sugar production.

During our nutritional studies of the '60s, we learned that magnesium, zinc and calcium deficiencies can be corrected by applying magox and zinc sulfate along with our standard N-P-K crop starter fertilizer mix and by broadcasting ground coral and incorporating it into the soil.

Improvement of sugar yields from the application of magnesium, zinc and calcium materials has been gratifying. Analysis of Pepeekeo Sugar Company's 1970 crop yields indicate over 5% yield increases attributable to magnesium and zinc applications. Commercial crop yield increases relating to calcium nutritional effect alone is difficult to isolate, since it serves a dual purpose of improving soil pH and correcting calcium nutritional deficiency. However, since intensification of the calcium application program in 1968, annual sugar yields at Pepeekeo increased by 10% to-date, following its soil pH-yield trend curve closely. Should the yield increases continue to follow the soil pH-yield regression curve, another 10% yield increase should be realized when enough calcium carbonate has been added to elevate the soil pH level to 5.8.

During the early part of 1968, extensive foliar chlorosis resembling classic zinc deficiency symptoms of corn appeared extensively in our very young (1½-3 months old) plant crop fields. Pot and field tests quickly revealed these symptoms can be corrected by applying 10 to 20 lb/ac of zinc. These levels of zinc were evaluated in a replicated field test (Expt. 175) with two commercial varieties. Foliar color, growth, and tillering responses to zinc application were substantial. For example, tillering improved by 15% over the check. At harvest, sugar yields were 10% higher in both zinc treatments over the check. In this experiment, we also observed yield increases of similar magnitude from 4 lb/ac of copper and from 6 lb/ac of boron. Follow-up field tests with copper and boron are in effect currently.

We were fortunate that zinc deficiency symptoms were strikingly apparent, and similarly, their disappearance in response to zinc sulfate application was rapid and dramatic. Other micronutrients such as copper and boron have not manifested these bovious symptoms at Pepeekeo. Similarly, we have not seen any visual responses to copper and boron applications to-date. Consequently, our only reliable guideline to establish the requirement of sugarcane to these micronutrients at present is the cane and sugar yields at harvest.

In the case of magensium, we have been successful in securing excellent field test results and even commercial crop results relating magnesium applications to tissue magnesium levels and sugar yields. Where the magnesium cane sheath levels were below .08%, we obtained highly significant linear correlation between sugar yields and sheath magnesium levels.

Evaluation of various plant nutrients, some of which were discussed in this report, indicate some sugarcane varieties differ widely in their ability to take-up various essential plant nutrients. These varietal differences indicate we should breed and select varieties that are efficient in extracting nutrients from the soils.

Also, in our studies we learned that observation of nutritional symptoms cannot be hastily related to nutrient excesses or deficiencies in the soil. Rather, the total environment in which the sugarcane is growing must be examined closely.

Finally, these micronutrients studies revealed the difficulty of developing simple and precise tissue nutrient parameters. No doubt complex nutrient interactions are involved here, making interpretation of single micronutrient determinations difficult or impractical in some cases. Much research work, requiring team work efforts of the plantation research department, agency technical staff, HSPA, University of Hawaii, and government research agencies, is needed to unravel the mysteries of these micronutrient problems, particularly in developing practical and precise micronutrient evaluation guidelines.

In retrospect, at Pepeekeo, we have been rather fortunate in solving some of our interim micronutritional problems rapidly and effectively. As we continue to use high purity fertilizers and grow high sugarcane tonnages which in turn deplete micronutrients from our low fertility soil, we can expect more micronutrient problems in the future. To cope with these potential and current micronutrient problems we need practical and effective guidelines to monitor all of them. To accomplish these objectives we solicit the aid of the various research agencies mentioned above.