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Sugar Beets

The Effects of Micronutrients on Yield and Quality in Southwestern Idaho

Charles G. Painter

The use of zinc fertilizer in production of sugar beets has become a standard practice by many sugar beet growers in southwestern Idaho. The use of other micronutrients such as iron, manganese, copper and boron is practiced by some growers. Little research is available to show the need for these micronutrients in sugar beet production. To obtain more information on the value of these micronutrients in sugar beet production, experiments were conducted with sugar beet growers at eight locations over the 1964-69 period.

Procedure

Locations were selected with three considerations in mind: (1) micronutrients were being used quite extensively in the location in production of sweet corn seed, onions and other zinc sensitive crops; (2) soil type and (3) interest and cooperation shown by sugar beet growers. This study was in cooperation with the Amalgamated Sugar Co., Nyssa, Oregon. The company assisted in selection of growers, harvest of sugar beets and analyzed the beets for percent sugar.

Locations and field data

Sugar beet grower	Soil type	Crop rotations
1. George Smit 10 mi. N. of Parma	Silty clay	Sugar beets following pasture
2. Kay Hara 1 mi. E. of Parma	Silty clay	Sugar beets following grain
3. Jim Kubosumi 3 mi. W. & 2.5 mi. N. of Homedale	Silt loam	Sugar beets following corn
4. Lloyd Floyd 1 mi. W. Lake Lowell	Silty clay	Sugar beets following grain
5. Marion Bennett 1 mi. S. Roswell	Silt loam	Scraped area in leveled field
6. Ken Nelson 6 mi. N. of Parma	Silty clay	Unknown
7. Lawrence Gray N. Nampa	Silt loam	Scraped area in leveled field
8. Twining Farms S. E. Wilder	Silt loam	Sugar beets following grain

The micronutrients, rates, method and time of applications were as follows: ten pounds per acre of zinc and manganese were side dressed on May 27-30; five pounds copper side dressed on May 27-30; two pounds zinc and manganese were sprayed June 4-7 and June 18-20; and 0.66 pounds copper sprayed June 4-7 and June 18-20. Sulfate was the source.

Three pounds of solubor boron were side dressed May 27-30 and 0.66 pounds sprayed June 4-7 and June 18-20.

Five pounds chelate iron (sequestrene 138) were side dressed May 27-30 and one pound sprayed June 4-7 and June 18-20.

Zinc, manganese and copper in the form of Rayplex (polyflavonoid) were also applied. Ten pounds of each were side dressed May 27-30 and five pounds of each sprayed June 4-7 and June 18-20.

Micronutrients and sources used were not the same at all locations. At locations 1, 2, 3 and 4, sources of micronutrients used were the sulfates of zinc, manganese and copper; Rayplex, zinc, manganese, iron and copper; solubor boron and iron chelate. Both soil and spray applications were used. Soil application was by banding the micronutrients with 40 pounds nitrogen as ammonium sulfate per acre about 6 inches deep and 4 to 6 inches to side of row at about thinning time. Sprays were applied in water on about a 30 gallon per acre equivalent at two application dates. The first spray was applied when beet leaves were 4-6 inches in length and the second when leaves approached 100 percent ground cover.

At locations 5 and 6, sources of micronutrients used were the sulfate of zinc and manganese, iron chelate and solubor boron. Soil applications only were used and banded as described. At locations 7 and 8, sources of micronutrients used were the sulfates of zinc and manganese and solubor boron. Micronutrients were mixed with sand, broadcasted to soil in fall, disked and plowed under.

Rates of nitrogen, phosphorus and potassium fertilizers were those applied by sugar beet growers to fields where experiments were located.

Treatments varied between locations and are described in Table 1.

At locations 1 through 6, soil and plant samples were collected for nutrient analysis. Petioles of the most recently matured leaves, usually the 8th or 9th from the top, were collected during the first two weeks in July when beets were 2-3 inches in diameter and tops were 16-24 inches high. Soil samples were at the 0-8 inch depth.

Values for total micronutrients in petioles and

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Table 1 treatments used at each location.

Locations	
1, 2, 3 and 4	5 and 6
1. zinc	1. zinc
2. zinc + iron	2. iron
3. zinc + iron + manganese	3. manganese
4. Zn + Fe + Mn + copper	4. Zn + Fe
5. Zn + Fe + Mn + Cu + boron	5. Zn + Fe + Mn
6. Control	6. Zn + Fe + Mn + boron
	7. Control

7 and 8
1. zinc + Mn
2. zinc + boron
3. Mn + boron
4. Zn + Mn + boron
5. Control

the DTPA-TEA method of extracting micronutrients in soil are given.

Total yield and percent sugar were obtained at all locations except number 4.

Results

Source and method of application and micronutrients used did not affect nutrients in plant petioles, total yield or percent sugar at the five percent level of significance at the eight locations studied. Consequently, only the means for variables measured at each location are shown in table 2.

Summary

The yield of sugar beets and percent sugar were not increased by the application of micronutrients in bands with ammonium sulfate or by broadcasting and plowing under or by spraying on the sugar beet leaves. Apparently sugar beets are excellent foragers for plant nutrients and the existing levels in the soil at the test sites were sufficient to produce the tons of beets obtained.

The variation in yield and sugar produced appears to be related to factors other than micronutrients. The lowest yield of beets, 20.3 tons per acre at location 5, was on a scraped area that resulted from land leveling for irrigation. This location also shows the lowest zinc level in soil and plant petioles which is what you would expect with the surface soil removed. The high concentrations of other nutrients shown in petioles at this location tends to indicate that zinc would be limiting production if other production factors were not so critical. It was evident from soil and field observations at location 5 that soil aeration, water penetration and nitrogen deficiency were more of the factors limiting production than was deficiency of micronutrients.

Since yield and percent sugar were not significantly affected by micronutrients applied, we have no criteria to develop critical levels of micronutrients in soil and plant petioles that would restrict production. At location 6, where 36.8 tons beets per acre were grown, the levels of micronutrients shown in soil and plant should be sufficient to produce maximum tonnage. However, it is interesting to note that plant petioles collected at location 6 on July 11 showed one of the lower levels of zinc of 12.0 ppm. This is lower than critical levels established for most other crops such as potatoes, for example, which is about 20 ppm.

Table 2. Sugar beet yield, percent sugar, total sugar, plant and soil nutrients obtained at eight locations.

	Locations							
	1	2	3	4	5	6	7	8
Yield and quality								
Tons per acre	25.6	27.6	31.1	----	20.3	36.8	21.0	22.8
Percent sugar	15.2	14.2	15.1	----	16.7	15.3	17.2	16.8
Tons sugar per acre	3.9	3.9	4.7	----	3.4	5.6	3.6	3.8
Plant nutrients								
zinc, ppm	30.5	31.7	25.8	26.4	7.4	12.0	----	----
iron, ppm	83.0	95.4	57.7	30.1	91.9	94.0	----	----
manganese, ppm	23.0	85.8	16.7	25.8	60.8	46.2	----	----
copper, ppm	6.7	6.8	8.3	8.0	4.3	6.0	----	----
boron, ppm	20.0	11.0	15.0	12.0	33.0	21.0	----	----
Soil nutrients								
zinc, ppm	1.8	2.2	1.7	1.1	0.6	2.7	----	----
iron, ppm	10.5	51.7	4.8	15.8	20.0	47.0	----	----
manganese, ppm	5.2	46.4	6.3	12.3	2.3	8.0	----	----
copper, ppm	1.2	2.0	1.0	1.3	1.8	1.7	----	----
boron, ppm	0.20	0.29	0.49	0.30	0.44	0.67	----	----

ABOUT THE AUTHOR: Charles G. Painter is associate research professor of soils, headquartered at the University of Idaho Branch Experiment Station near Parma.

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James E. Kraus, *Director*