Corn Response to Micronutrients Across Minnesota

Fertilizer: Treatments
1) Control (Chk) - no fertilizer
2) Without Zinc (-Zn)
3) Without Manganese (-Mn)
4) Without Copper (-Cu)
5) Without Boron (-B)
6) All - 10 lb/ac Zn + 10 lb/ac Mn + 10 lb/ac Cu + 5 lb/ac B
Nitrogen, Phosphorus, and Potassium kept at non-limiting levels
Fertilizer was broadcast and incorporated before planting except for Delavan which was managed with no-till.

Weed Management: Glyphosate
Experimental Design: Randomized complete block design with 4 replications

Objective: The purpose of this study was to determine if there is a potential yield response in corn to selected micro-nutrients applied broadcast before planting.

Results: This study used a simple drop out design to study the effects of micronutrients by comparing plots with 4 micronutrients with plots where one of the particular nutrients are not applied. To test treatment effects, an analysis of variance procedure was used to determine whether any of the treatments were significantly different. When the analysis indicated significance, all treatments with a particular nutrient were averaged and compared to averages of treatments without. Initial soil test results are given in Table 1. Soil samples were taken at 0-6” soil depth from all locations. However, at the time of this report the samples from three of the locations are still being analyzed. Soil types varied by location. The soil at Oklee was a Northwood muck, Rochester was a Marshan silt loam, Staples was a Verndale sandy loam, and Westport was an Estherville loam. The Oklee site was selected because of the high amounts of organic matter (data not shown). This was to better evaluate response to copper since these types of soils typically are more responsive to copper (Cu) in small grains. Corn is somewhat sensitive to Cu deficiency according to many reports. However, most mineral soils contain plenty of copper to satisfy the needs of most crops. Typically zinc (Zn) is the most deficient micronutrient reported in corn.

Reports of lowered micronutrient uptake in glyphosate tolerant crops have spurred interest in Manganese (Mn), especially in soybean. However, no documented cases of Mn deficiency in corn have been reported outside of areas of the country that have

Table 1. Initial soil test data for 0-6” samples collected before treatment application for corn micronutrient studies.

<table>
<thead>
<tr>
<th>Location</th>
<th>County</th>
<th>P</th>
<th>K</th>
<th>Zn</th>
<th>Mn</th>
<th>B</th>
<th>OM</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oklee</td>
<td>Red Lake</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Rochester</td>
<td>Olmsted</td>
<td>66</td>
<td>185</td>
<td>1.9</td>
<td>53.7</td>
<td>0.4</td>
<td>3.2</td>
<td>6.1</td>
</tr>
<tr>
<td>Staples</td>
<td>Wadena</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Westport</td>
<td>Pope</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

P, Bray-P1 phosphorus; K, ammonium acetate potassium; Zn, DTPA zinc; Mn, DTPA manganese; B, hot water extracted boron; OM, organic matter loss on ignition; pH, 1:1 soil: water; na, data not available.

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soils historically low in Mn. The final micronutrient, Boron (B) was included since soil tests ran on sandy soils typically will show lower boron levels. However, corn is not as sensitive to B deficiency as crops such as alfalfa. Therefore, the current fertilizer suggestions for corn do not include any B applications to corn. Two of the locations included sandy soils or soils that have high leaching potentials (Staples and Westport). Borate is the form of B in the soil and is highly leachable. Typically soils low in B are sandy soils low in organic matter. Another major issue with B application is B toxicity which can be a significant problem in crops due to the over application of the nutrient.

Yield data is given in Table 2 (reported yields are adjusted to 15.5% moisture). Grain yields were high at all locations except for the peat/muck soil site at Oklee. This site was wet early in the year and had a hard frost before the corn reached physiological maturity. Consequently yield potentials were limited at this site and calculated grain moisture were very high (Table 3). There were no significant yield increases at Oklee, Rochester, or Westport. The only site that soil test data were available was the Rochester location which tested high in Zn and Mn was adequate according to data from states which have Mn guidelines for crops (from the Tri State fertilizer recommendations MI, OH, IN). Soils typically responsive to Mn in those areas are high in organic matter and also have high pH. The Oklee site would fit this description, but still yields were not affected. The only site where there was a significant yield increase was Staples. At this location plots receiving Zn and Cu both appeared to have yields 7 bu/ac higher than those without. Even though we cannot tell whether both did have an effect, it is likely that Zn increased yields due to the soil type at this location and the fact that Zn is the micro-nutrient most likely to be deficient. Soil test values from this location can help to confirm this result.

Grain moisture data is given in Table 3. Nutrient deficiencies can delay maturity thereby significantly influencing grain moisture levels at harvest. In this study there was no significant increase or decrease in grain moisture at harvest for any of the micronutrient treatments. At Oklee the grain harvest moisture were extremely high. This may have been due to extreme shrinkage of the kernel following the hard freeze and the plot not being fully mature. Harvest moisture were much lower at all other locations.

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