Nutrient Deficiencies in Cotton

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Be Your Own Cotton Doctor

Healthy plants yield more than Sick plants

- Identify problems in the field
- Diagnose the problems
- Treat the problems
- Prevent future problems

IPNI International Plant Nutrition Institute
Identify Problems in the Field

GET OUT AND LOOK!

- Stunting
- Wilting
- Discoloration
- Misshapen Plants
Make a Preliminary Diagnosis

- Discoloration
- Nutrient deficiencies
- Diseases
- Herbicide or salt injury

<table>
<thead>
<tr>
<th>Mineral Nutrient</th>
<th>Nutrient mobility within plant</th>
<th>Plant organ where deficiency symptoms usually appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>N, P, K, Mg</td>
<td>High</td>
<td>old leaves</td>
</tr>
<tr>
<td>S</td>
<td>Low</td>
<td>Young leaves</td>
</tr>
<tr>
<td>Fe, Zn, Cu, Mo</td>
<td>very low</td>
<td>Young leaves</td>
</tr>
<tr>
<td>B, Cu</td>
<td>extremely low</td>
<td>Young leaves and terminal</td>
</tr>
</tbody>
</table>
N Deficiency Symptoms

• Stunted growth
• Leaves become light green or yellowish with the older, lower leaves yellowing first
• Nitrogen deficiency reduces seed per boll, increases aborted bolls and decreases boll size and length of lint
• Excess N can extend vegetative growth and negatively affect fiber quality
P Deficiency Symptoms

• Symptoms not as clearly defined as other nutrients

• Stunted but normally have good, dark green color; can have delayed fruiting

• May include a purplish reddening

• Root system is reduced, smaller leaves, spindly stalks and few secondary branches which result in fewer bolls and lower yields

• Phosphorus deficiency causes late maturity which allows more insect infestation and inferior quality of staple
K Deficiency Symptoms

- Marginal chlorosis and bronzing of lower leaves
- The leaf becomes brittle with buckling and crinkling between veins and cupping under of the leaf lobes
- Eventually necrotic areas occur around the margins and between the veins
- Late-season deficiency can also occur with symptoms appearing first on the younger leaves in the upper third of the canopy and can ultimately result in premature leaf shedding, early cut-out, poorly formed bolls, inferior lint quality, and reduced yield
Mg Deficiency Symptoms

• Fairly common in parts of the South
• Magnesium deficiency appears first on the lower leaves as a purplish red color with green veins
• Leaves fall off causing reduced photosynthetic activity which lowers yields of both fiber and seed

Ca deficiencies in U.S. cotton are rare when adequate pH is maintained
S Deficiency Symptoms

- Yellowing of uppermost leaves
- Most common on deep, sandy soils
- Waterlogged soils can result in temporary symptoms
Micronutrient Deficiency Symptoms

• Most common micronutrient deficiency in cotton
• Distorted, abnormal uppermost leaves
• Aborted flowers and boll shedding
• Dark rings on the petiole
Micronutrient Deficiency Symptoms

• Interverinal chlorosis in younger leaves
• Zn deficiency can result in leathery, upturned leaves and bronzing
Micronutrient Deficiency Symptoms

- General chlorosis or bleaching of the younger leaves or yellowing between the veins with the veins staying green
- Usually associated with calcareous, high pH soils in the Southwest U.S.
- Cu, Mo, and Cl deficiencies are rare in U.S. cotton
Confirm the Diagnosis

- **Plant Nutrient Analysis**
  - Leaf or petiole testing
  - In-season evaluation of nutrient sufficiency

<table>
<thead>
<tr>
<th>N</th>
<th>P</th>
<th>K</th>
<th>S</th>
<th>Ca</th>
<th>Mg</th>
<th>Fe</th>
<th>Mn</th>
<th>Zn</th>
<th>Cu</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>ppm</td>
<td>ppm</td>
<td>ppm</td>
<td>ppm</td>
<td>ppm</td>
</tr>
<tr>
<td>3.5 to 4.5</td>
<td>0.3 to 0.64</td>
<td>0.9 to 2.0</td>
<td>0.3 to 0.75</td>
<td>1.9 to 3.5</td>
<td>0.3 to 0.75</td>
<td>30 to 300</td>
<td>30 to 300</td>
<td>20 to 100</td>
<td>5 to 25</td>
<td>20 to 60</td>
</tr>
</tbody>
</table>
Treat the Problem

Foliar Fertilizer Applications
Factors Affecting Foliar Fertilizers

**Environmental Factors**
- Light and Temperature
  - Light favors uptake
  - Temperature effects are variable

**Solution Factors**
- Concentration
- Solution pH
- Surfactants

Responses are **Highly Variable!**
- Humidity
  - High humidity swells cuticle
  - Reduces droplet drying
    - Low humidity increase concentration gradient
  - Uptake more affected by crystallization

**Plant Factors**
- Species and Variety
- Leaf Surface and Age
- Plant Developmental Stage
- Nutritional Status

Wojcik, 2004
Prevent Future Problems

- Soil Test Regularly
  - Every 2-3 yrs
  - Annually for N where justified by research
  - Apply recommended rates

<table>
<thead>
<tr>
<th>Crop</th>
<th>Unit</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>lb/bu</td>
<td>.75</td>
<td>.44</td>
<td>.29</td>
</tr>
<tr>
<td>Soybean</td>
<td>lb/bu</td>
<td>4.00</td>
<td>.80</td>
<td>1.40</td>
</tr>
<tr>
<td>Cotton</td>
<td>lb/bale</td>
<td>32.00</td>
<td>14.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Grain sorghum</td>
<td>lb/cwt</td>
<td>1.50</td>
<td>.75</td>
<td>.38</td>
</tr>
<tr>
<td>Wheat</td>
<td>lb/bu</td>
<td>1.15</td>
<td>.55</td>
<td>.34</td>
</tr>
<tr>
<td>Rice</td>
<td>lb/bu</td>
<td>.55</td>
<td>.29</td>
<td>.18</td>
</tr>
</tbody>
</table>
## Probable Response to Soil Test Recommendations

<table>
<thead>
<tr>
<th>Soil Test Category</th>
<th>Probability of Response to Fertilizer</th>
<th>Expected Yield Attainable Without Fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL</td>
<td>&gt;80%</td>
<td>50%</td>
</tr>
<tr>
<td>L</td>
<td>60-80%</td>
<td>50-75%</td>
</tr>
<tr>
<td>M</td>
<td>40-60%</td>
<td>75-100%</td>
</tr>
<tr>
<td>H</td>
<td>20-40%</td>
<td>90-100%</td>
</tr>
<tr>
<td>VH</td>
<td>&lt;20%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Conclusions

- To produce high-yielding, good-quality cotton, **Be Your Own Cotton Doctor**
  - Identify problems in the field
  - Diagnose the problems
  - Treat the problems
  - Prevent the problems from occurring again

- Manage fertilizer efficiently
  - Apply the **Right Source** at the **Right Rate**
    - at the **Right Time** and in the **Right Place**

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