Iron Deficiency Chlorosis in Soybean

Inquiries occasionally occur about symptoms associated with iron (Fe) deficiency in soybeans. While effective in-season management options for Fe deficiency are few for this season, variety selection and use of an Fe chelate product at planting are effective practices for next season in areas affected by iron deficiency chlorosis (IDC).

The availability of a specific micronutrient, such as Fe, is often related to soil characteristics. Soil pH has a major impact on the availability of Fe. Iron deficiency has been a common, serious, and yield limiting problem for soybean production in some parts of the United States.

Iron is one of the necessary micronutrients for soybean plant growth and development.
- Needed for the development of chlorophyll, the green pigment in the plant.
- Involved in energy transfer, plant respiration, and plant metabolism.
- Is a constituent of certain enzymes and proteins in the plant.
- Necessary for soybean root nodule formation and has a role in N-fixation; thus, low levels of Fe can lead to reduction in N-fixation.

Iron Deficiency Chlorosis (IDC) Symptoms
When Fe is limited, chlorosis can be expressed in soybean plants (Figure 1). The most common IDC symptom is interveinal chlorosis in which leaf tissue of newly developed soybean leaves turn yellow, while the veins remain green. The leaves may develop necrotic spots that eventually coalesce and fall off the plant. Iron deficiency symptoms are similar to that of manganese (Mn); therefore, only soil and tissue analysis can confirm the deficiency.

Severe yield reductions have been reported from IDC throughout north central United States. Loss is estimated to be around $120 million annually.

Soybean IDC symptoms typically occur between the first and third trifoliate stage. Depending on the severity of the problem, symptoms might improve later in the season. Severe stress can stunt soybean plants causing 50% or more yield reduction and may even kill the plants.

Favorable Conditions for IDC Development
IDC in soybean is the result of complex interactions among many factors including soil chemistry, environmental conditions, and soybean physiology and genetics.

Soil types and conditions
Some calcareous soils with a pH more than 7.4 and heavy, poorly drained, and compacted soils may exhibit IDC symptoms, due to insufficient Fe uptake. However, soil pH is not a good indicator and does not correlate very well with IDC. Symptoms are highly variable between years and varieties and depend on other soil factors and weather conditions.

There is a direct relationship between IDC and high concentration of calcium carbonate and soluble salts. Iron uptake is adversely impacted by high concentrations of phosphorus (P), Mn, and zinc (Zn). High calcium (Ca) levels in the soil cause Fe molecules to bind tightly to the soil particles and become unavailable for uptake.

It is important to measure the percentage of calcium carbonate and soluble salts in the soil. Some combinations of percentage of free calcium carbonate and soluble salts can cause severe IDC (Table 1). Sandy soils with low organic matter also may exhibit IDC symptoms.

Figure 1. Iron deficiency symptoms in susceptible soybean varieties.

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Environmental conditions
Weather also plays a role in IDC symptoms. Cool soil temperatures and wet weather, combined with soils that have marginal levels of available Fe can increase IDC symptoms.

Management Considerations
It is difficult to correct IDC, but it can be managed by a combination of several practices including selection of tolerant varieties, application of in-furrow Fe-chelate, improving soil drainage in heavier soils, and maintaining high levels of P. Inconsistent yield benefits have been observed when using Fe-chelate as a seed treatment and applying foliar Fe sprays.

Variety Selection
Careful selection of soybean varieties with a degree of tolerance to IDC is one of the best and most recommended options to protect yield potential against IDC. This option is especially recommended for fields with a history of Fe chlorosis or soil with high levels of salts and carbonate. Tolerant varieties can provide protection to the newly developed leaves and to the growing point, which can help reduce plant death and improve chances for recovery.

Iron Chelate Products
Iron chelating products can help improve the availability of iron to soybeans. Products such as Soygreen® may be applied in-furrow at the time of planting. University of Minnesota research has supported the yield benefits of Soygreen when used at planting.

Always consult the product label for rates and application information. Please contact your local Agronomist for help in selecting the right soybean variety for your area.

Sources:

Additional references used in the development of this publication:


Table 1. Combination of calcium carbonate and soluble salt levels in the soil that can cause IDC.

<table>
<thead>
<tr>
<th>Carbonate level (%)</th>
<th>Soluble salts (mnhose/cm)</th>
<th>Risk of iron chlorosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 2.5</td>
<td>&lt; 0.5</td>
<td>Low</td>
</tr>
<tr>
<td>0 – 2.5</td>
<td>0.51 – 1.0</td>
<td>Moderate</td>
</tr>
<tr>
<td>0 – 2.5</td>
<td>&gt; 1.0</td>
<td>High</td>
</tr>
<tr>
<td>2.6 – 5.0</td>
<td>0 – 0.25</td>
<td>Low</td>
</tr>
<tr>
<td>2.6 – 5.0</td>
<td>0.26 – 0.50</td>
<td>Moderate</td>
</tr>
<tr>
<td>2.6 – 5.0</td>
<td>0.51 – 1.0</td>
<td>High</td>
</tr>
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<td>&gt; 1.0</td>
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</tbody>
</table>


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