AGRONOMIC ALERT

Technology Development by MONSANTO

IRON DEFICIENCY CHLOROSIS IN SOYBEAN

Inquiries occasionally occur about symptoms associated with Iron (Fe) deficiency in soybeans. This article discusses causes, symptoms, and a few management practices if the problem is severe.

The availability of a specific micronutrient, such as iron (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.

Figure 1. Iron deficiency symptoms in susceptible soybean varieties.

Severe yield reductions have been reported from IDC throughout the North-Central U.S. Loss is estimated to be around $120 million annually[1].

Soybean IDC symptoms typically occurs 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 a complex interactions among many factors including soil chemistry, environmental conditions, and soybean physiology and genetics.

Soil types and conditions

Some calcareous soils with pH more than 7.4, 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), manganese (Mn), and zinc (Zn). High of 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

(Continued on page 2)

AGRONOMIC ALERT

Technology Development by MONSANTO

IRON DEFICIENCY CHLOROSIS IN SOYBEAN

(Continued from page 1)

and soluble salts can cause severe IDC (Table 1). Sandy soils with low organic matter also may exhibit IDC symptoms.

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 deficiency but it can be managed by a combination of several practices including selection of tolerant varieties, improving soil drainage in heavier soils, maintaining high levels of P, using Fe - chelate as a seed treatment, and applying foliar Fe sprays.

Resistant variety

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. Resistant 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.

Seed treatment can limit yield reduction due to IDC on calcareous soils. A study evaluating Fe - chelate as a seed treatment on soybeans with varying levels of resistance to IDC showed that seed treatment produced significantly higher yields for the more resistant genotypes than for the susceptible genotypes[2].

Iron fertilizer applications

Since the option of soil applications of Fe-containing materials is not economically effective, foliar sprays or manure applications are recommended to correct an IDC problem. Keep in mind the rate of Fe applied should be based on soil testing and/or tissue analysis.

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:

[1]The Mysteries Of Yellow Soybeans. 2007. Corn & Soybean. http://cornandsoybeandigest.com (Viewed 4/12/10)

[2]Karkosh, A. et al. 1988. Seed treatment for control of IDC of soybean. Crop Sci. 28:369-370, (Viewed 5/18/10)

Corn & Soybean Field Guide. 2007 Edition. Purdue Pest Management Program. Purdue Univ., (Viewed 4/4/10)

Diaz, D. 2008. Nutrient deficiency symptoms. Agronomy e-Updates, K-State Extension

Common nutrient deficiency symptoms, soybeans. 2007. http://plantsci.sdstate.edu, (Viewed 4/4/10)

Sawyer, J. 2007. Integrated Pest Management Nutrient Deficiencies and Application Injuries in Field Crops. Department of Agronomy, http://extension.agron.iastate.edu, (Viewed 4/4/10)

Advance agronomic guide 2009-2010, growing knowledge, Monsanto CO.

Pedersen, P. 2007. Soybean Nutrient Requirements. Iowa State University Ext. http://extension.agron.iastate.edu., (Viewed 4/4/10)

Soybean production handbook. 1997. Kansas State Univ., C-449.

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

Carbonate level (%)	Soluble salts (mmhose/cm)	Risk of iron chlorosis
0 – 2.5	< 0.5	Low
0 – 2.5	0.51 — 1.0	Moderate
0 – 2.5	> 1.0	High
2.6 — 5.0	0 — 0.25	Low
2.6 — 5.0	0.26 — 0.50	Moderate
2.6 — 5.0	0.51 — 1.0	High
2.6 — 5.0	> 1.0	Very high
> 5.0	0 — 0.25	Moderate
> 5.0	0.26 — 0.50	High
> 5.0	0.51 — 1.0	Very high
> 5.0	> 1.0	Extreme

Source: Iron Chlorosis: Soybeans. Agvise Laboratories, http://www.agvise.com (4/29/2010)