

Mid-Season Soybean Nutrient Deficiency

- Soybean leaf yellowing occurs primarily because of a nutrient deficiency.
- When soybean plants reach seed fill they require the greatest amount of all key nutrients.
- Any condition that restricts root growth, such as compaction, water-saturated soils, or insect feeding, can lead to nutrient deficiency because the roots cannot reach sufficient levels of nutrients to sustain normal plant growth and development.
- Diseases in soybean, such as sudden death syndrome and brown stem rot, can resemble nutrient deficiency symptoms.

Essential Nutrients

Nitrogen (N), phosphorous (P), and potassium (K) are the three most important soil-supplied nutrients and are referred to as essential or macro nutrients. Other nutrients are called micro nutrients because they are required in much lower amounts. These nutrients are calcium (Ca), magnesium (Mg), iron (Fe), boron (B), manganese (Mn), zinc (Zn), copper (Cu), and molybdenum (Mo).

The maximum nutrient demand occurs during seed fill. Since the soybean seed contains high levels of protein, the demand for nitrogen is particularly high during seed fill. Throughout the growing season, nutrients are acquired from the soil and nitrogen is also acquired through nitrogen fixation in the root nodules; however, late in the season, if there are not adequate amounts of nutrients in the soil, many of the nutrients are moved from the older tissues to support seed development. When these nutrients are remobilized, the leaf will turn yellow (chlorosis), which is an indication that there is a nutrient deficiency.

Nitrogen Deficiency

Symptoms

- Poor nodulation on roots.
- Stunted, spindly plants with light green color, which appears first on lower (older) leaves.

Causes

- Compacted soils, water-saturated soils, lower pH (<6.5).

- Few or no nitrogen-fixing bacteria present in the soil.

Treatment

- Conduct a soil test and make lime applications where needed.
- The use of an inoculant can also help where there has not been a legume planted in the past two years.



Figure 1. Nitrogen Deficiency caused by water-saturated soil. Photo courtesy of Bill Meecham, University of Kentucky, Bugwood 5368795.

Phosphorous Deficiency

Symptoms

- Leaves usually have a dark green to bluish tint.
- Interveinal chlorosis starting from the base of the leaf.
- Reduction in overall growth.

Causes

- The uptake of phosphorus is inhibited in acidic as well as cool, wet soils.

Treatment

- Conduct a soil test and adjust pH to 6.5-7.0 with lime application.



Figure 2. Phosphorous deficiency, photo courtesy of Dr. Bobby Golden, Mississippi State University.

Potassium Deficiency

Symptoms

- Yellowing, reddening and dying leaf margins on lower (older) leaves during vegetative growth and on upper (younger) leaves during grain fill.
- Basal portions of the leaf remain green.
- Ragged appearance of older leaves.
- Stunted and slow growth.
- Development of purple seed stain, and misshapen and wrinkled seeds.

Causes

- Low soil levels of potassium.
- Restricted root growth.

Treatment

- Conduct a soil test and adjust potassium levels based on test results. Soybean has a high potassium requirement.
- Relieve soil compaction so root growth can expand in the soil.



Figure 3. Potassium deficiency. Photos courtesy of Dr. Bobby Golden, Mississippi State University.

Magnesium Deficiency

Symptoms

- Intervinal chlorosis.
- Leaf margins bend down.
- Older (lower) leaves are affected first.

Causes

- Magnesium deficiency is most prevalent in deep, sandy, acidic soil.

Treatment

- Conduct a soil test and apply dolomitic limestone if magnesium and pH levels are low.
- Foliar apply a magnesium product. Consult product label for treatment rates.



Figure 4. Magnesium deficiency, photo courtesy of Dr. Bobby Golden, Mississippi State University.

Calcium Deficiency

Symptoms

- Poor nodulation.
- Leaf symptoms appear similar to nitrogen deficiency.
- Rarely occurs in soybean.

Causes

- Very low exchangeable calcium, usually associated with low pH (mineral soils <5.5, organic soils <4.8).

- Low soil pH.
- Soils very high in potassium and magnesium.

Treatment

- Conduct a soil test and adjust the pH to the optimum level for soybean (6.5 – 7.0).



Figure 5. Calcium deficiency. Photo is provided courtesy of the International Plant Nutrition Institute (IPNI) and its IPNICrop Nutrient Deficiency Image Collection, T.L. Roberts, 2018.

Sulfur Deficiency

Symptoms

- New leaves (upper) are small and pale yellow-green.
- Stems are thin, hard, and elongated.

Causes

- Found on sandy soils low in organic matter.
- Wet, cool soils.

- Soils with reduced tillage or heavy residue.

Treatment

- Conduct a soil test and apply sulfur based on test results.
- Use a foliar application of sulfur. Consult product label for treatment rates.



Figure 6. Sulfur deficiency. Photo courtesy of Dr. Bobby Golden, Mississippi State University.

Boron Deficiency

Symptoms

- Shortened internodes and yellowing or reddening of upper (newer) leaves.
- Poor flowering.
- Low yield.
- Poor seed quality.

Causes

- Drought on sandy soils.
- Over-liming of sandy soils low in organic matter.

Treatment

- Conduct a soil test prior to planting and adjust boron based on test results.
- During the growing season, use a foliar application of boron. Consult product label for treatment rate. Do not exceed the recommended rate with a foliar application of boron, plant injury can occur.



Figure 7. Boron Deficiency, photo courtesy of Dr. Nathan A. Slaton, University of Arkansas.

Copper Deficiency

Symptoms

- Very rare in soybean.
- Lower yield.
- Interveinal chlorosis.

Causes

- Found primarily on organic soils, especially those with high pH.

- Acidic, highly-leached, sandy soils.

Treatment

- Conduct a soil test prior to planting and adjust levels based on test results.
- Use a foliar application of copper, preferably a chelated

formulation. Consult product label for recommended treatment rates.

Iron Deficiency

Symptoms

- Stunting, interveinal chlorosis of younger (upper) leaves.
- Veins may also become chlorotic.

Causes

- High pH soils with free lime on the surface of the soil.
- Cold, wet, poorly aerated soils with high levels of manganese.

- Some soybean products are more susceptible.

Treatment

- Conduct a soil test and adjust the pH if needed.
- Use a foliar application of an iron chelate product. Consult product label for treatment rates.



Figure 8. Iron deficiency. Photo courtesy of Dr. Bobby Golden, Mississippi State University.

Manganese Deficiency

Symptoms

- Intervinal chlorosis; whole plants can appear pale green.
- Stunting, brown necrotic (dead) spots, and early leaf drop.
- Early manganese deficiency resembles early iron deficiency.

Causes

- Low soil levels of manganese combined with high soil pH and/or organic matter.

- Depressed areas in fields.
- Organic peats and muck.

Treatment

- Conduct a soil test and apply supplemental manganese based on test results.
- Use a foliar application of a manganese chelate product. Consult product label for treatment rates.



Figure 9. Manganese deficiency, photo courtesy of Dr. Bobby Golden, Mississippi State University.

Molybdenum Deficiency

Symptoms

- Ineffective or few nodules on root results in nitrogen deficiency symptoms. Nitrogen-fixing bacteria require a sufficient level of molybdenum to function correctly and produce adequate amounts of nitrogen.

- Chlorosis/necrosis of leaf tips and margins.

Causes

- Found on acidic, prairie soils.
- Highly acidic, strongly weathered, leached soils.

Treatment

- Apply a seed treatment with

molybdenum. Consult product label for treatment rates.

- Conduct a soil test and apply lime to the optimum pH for soybeans (6.5-7.0).

Zinc Deficiency

Symptoms

- Stunting of the stems in young plants with interveinal chlorosis on younger (upper) leaves.
- Leaves become bronzed or gray with necrotic tissue between veins, and leaves drop early (resembles sudden death syndrome).
- Few flowers form, pod development is abnormal, and plants are slow to mature.

Causes

- Low soil zinc levels combined with high soil

pH or high soil phosphorus levels.

- Cool, wet soils low in organic matter.
- Cool, cloudy weather during early growth.
- Soil compaction limits root growth.

Treatment

- Conduct a soil test and make applications based on test results.
- Use a foliar application of a zinc chelate product. Consult product label for treatment rates.



Figure 10. Zinc Deficiency, photo courtesy of Dr. Bobby Golden, Mississippi State University.

Diseases that Resemble Nutrient Deficiencies

Sudden Death Syndrome (SDS) Leaf Symptoms

Symptoms

- Interveinal leaf chlorosis and necrosis develop after growth stage R2.
- Leaflets quickly turn brown and fall off, leaving the petioles.
- The cortex of the lower stem has brown or gray streaks, but the pith is normal.
- Infection occurs during the vegetative stages of growth, but leaf symptoms usually appear during flowering and early pod development.

Causes

- Wet, cool soils at or shortly after planting.

- Soil compaction, restricted root growth.

Treatment

- Select soybean products that are less susceptible to the disease.
- In fields where SDS has been a problem delayed planting will help avoid cool, wet soil conditions that favor initial infection.
- Avoid soil compaction.
- Symptoms may appear more severe where there are high soybean cyst nematode populations.



Figure 11. SDS leaf symptoms.

Brown Stem Rot Foliar and Stem Symptoms

Symptoms

- Interveinal chlorosis and necrosis on leaves. Leaf symptoms are similar to SDS, but dead leaflets tend to remain attached to the stem.
- The onset of foliar symptoms typically occurs at growth stage R4 and R5.
- The stem pith is brown, but the cortex is normal.

Causes

- The disease survives on infected soybean residue,

especially when left on the soil surface.

- Cool, wet weather during flowering promotes this disease.

Treatment

- Select soybean products that are less susceptible to the disease.
- Rotation away from soybean for two or more years can help minimize disease impact.
- Tillage helps destroy infected soybean residue.



Figure 12. Brown Stem Rot.

Sources

Purdue Extension, Corn and Soybean Field Guide. www.agry.purdue.edu/dtc

Iowa State University Integrated Crop Management, Soybean Nutrition Requirements. https://crops.extension.iastate.edu/soybean/production_soilfert.html

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Legal Statements

Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields.

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