

## *A Closer Look at Deficiency Symptoms in Major Crops*

**N**utrient deficiency symptoms are not commonly found in modern crops under good production agriculture practices. The classic signs of major nutrient deficiencies (or toxicities) do not normally appear in well-managed fields. However, knowledge of those symptoms and the conditions that cause them can be an important diagnostic tool.

In general, if deficiency symptoms do appear on crops during the growing season, significant yield loss has already occurred. Crops are more likely to suffer from “hidden hunger” or conditions which tend to limit yields or quality without apparent symptoms. More than one nutrient deficiency may occur at the same time.

Nutrient deficiencies can be prevented with intensive soil testing programs, followed by plant tissue testing. Tissue testing is an under-used tool that could help identify problems in time to take corrective action during the growing season.

The following photographs show symptoms of deficiencies in four major crops: corn, soybeans, wheat, and cotton. For each crop, deficiency symptoms are described for these nutrients: nitrogen (N), phosphorus (P), potassium (K), and sulfur (S).



**Marginal purpling** of corn leaves is a well known symptom of P deficiency. However, P deficiency can slow growth and delay maturity without purpling. The purpling may also be due to some restriction of root growth, rather than a shortage of P in the soil.



**Nitrogen deficiency** symptoms appear on this corn leaf.



**Potassium-deficient corn** ages too fast, cells die, and tissues deteriorate, inviting stalk rot. Potassium builds strong stalks and more brace roots and helps prevent decaying stalks.

**Sulfur deficiency** on corn may be confused with effects of low N.

## Corn

**Nitrogen deficiency** in young corn causes the entire plant to be pale and yellowish green, with spindly stalks. Later, V-shaped yellowing may appear on the tips of leaves. Nitrogen is a mobile nutrient in the plant. Thus, yellowing begins at the leaf tip, along the midrib on the lower, older leaves and progresses up the plant if the deficiency persists.

**Phosphorus-deficient** corn plants may be dark green with reddish purple tips and leaf margins. The deficiency is usually identified on young plants. Phosphorus is readily mobilized and translocated in the plant. Deficient plants may be smaller and grow more slowly than plants with adequate P. Some corn hybrids at early stages of growth tend to show purple colors similar to P deficiency when soil P is adequate. Some hybrids do not become purple even though P is severely limiting.

**Potassium deficiency** on corn may appear as yellowing and necrosis of the leaf margins, beginning on the lower leaves. If the deficiency persists, the leaf symptoms will progress up the plant. Potassium is a mobile nutrient in the plant and is translocated from old to young leaves. Under severe K deficiency, lower leaves will turn yellow while the upper leaves may remain green.

**Sulfur deficiency** on small corn plants may appear as a general yellowing of the foliage, similar to N deficiency. Yellowing of the younger leaves is more pronounced with S deficiency than with N deficiency because S is not easily translocated in the plant. Other symptoms may include interveinal chlorosis, stunting of plants, or delayed maturity. Sulfur deficiency is more likely on acid, sandy soils, on soils low in organic matter, or on cold, wet soils.

## Soybeans

**Nitrogen-deficient** soybean plants become pale green and leaves may later turn distinctly and uniformly yellow. Symptoms appear first on the basal leaves and quickly spread to upper parts. Soybean plants eventually defoliate and are spindly and stunted. The deficiency can be diagnosed by analyzing leaves for N, inspecting plant roots for nodule formation, and analyzing soil to determine pH and calcium (Ca) content. Soybeans do not normally need N fertilization, but it may be beneficial in high yield environments or in other special conditions.

**Phosphorus deficiency** symptoms in soybeans may not be well defined. Soybeans require large amounts of P, especially at pod set. It is required for normal N fixation. Phosphorus deficient soybean plants are spindly, with small leaflets and retarded growth. Leaves may appear dark green or bluish green. Leaf analysis for P content is the best way to

diagnose deficiency.

**Potassium deficiency** symptoms of soybeans are well defined. Soybeans require large amounts of K...it is important for all aspects of plant growth and influences the plant's nutritional balance. It is also involved in the uptake of Ca and magnesium (Mg). Potassium deficiency symptoms appear first on older leaves. In early stages of growth, an irregular yellow mottling appears around leaflet margins. The yellow areas may coalesce to form an irregular yellow border.

**Sulfur deficient** soybean plants will be pale green with the youngest leaves often appearing more yellow. Stems are thin, hard, and elongated, with small, yellow-green leaves at the top of the plant. Sulfur deficiency may lead to reduction of protein synthesis. Availability of S depends on the rate at which it is released from organic matter, influenced by plant residues, soil moisture, temperature, and soil pH.



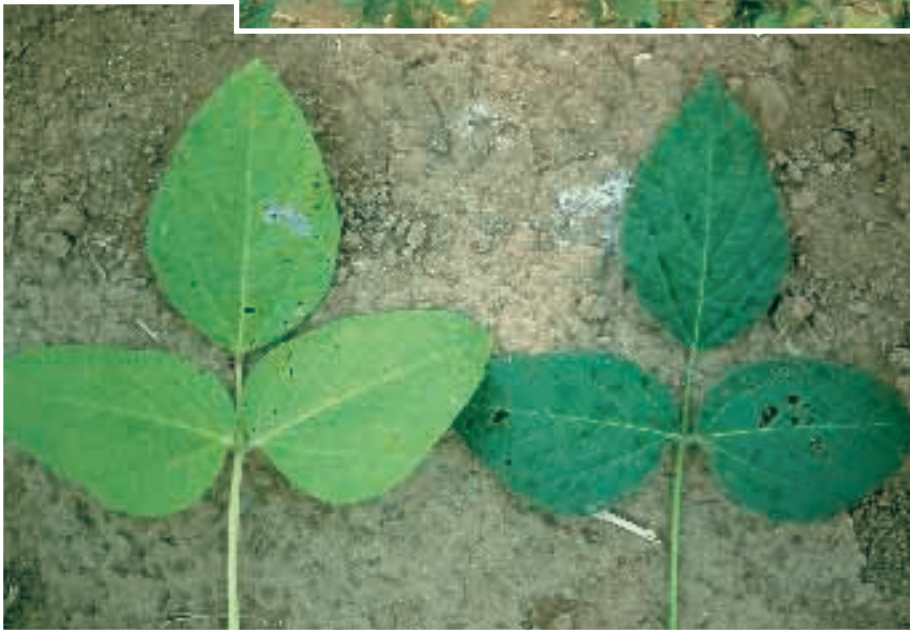
**Potassium-deficient** soybean plants show symptoms first on older leaves.





**Sulfur-deficient** soybean plants (left pot) have pale-green leaves, especially at the top of the plant.

**Phosphorus-deficient** soybean plants.



**Nitrogen-deficient** soybean plants (left) appear pale green...leaves may turn uniformly yellow.

## Wheat

**Nitrogen deficiency** in wheat and other small grains may first appear as yellowing and then as stunted growth. Chlorosis usually begins on older tissues such as lower leaves. Cell growth and division as well as protein synthesis may be slowed. Wheat and other small grains and grasses are generally sensitive to insufficient N and responsive to supplemental N applications.

Wheat and other small grains deficient in P may be more subject to stress and diseases.

**Phosphorus-deficient** plants maintain their green color and may be darker green than plants with sufficient P. However, they are also slow growing and slow to mature. Tillering is often reduced or lacking completely. Leaf tips die back when shortages are severe and foliage of some varieties may show shades of purple or red. Older leaves and other tissues are the first to show P deficiency symptoms.

**Potassium deficiency** more commonly occurs where straw and grain are both harvested from small grain fields. Sandy, coarse-textured, intensively cropped soils are most likely to provide insufficient K. Chlorosis due to K deficiency may appear uniformly at first on older plant parts. Leaves may eventually become streaked with yellow. Certain plant diseases are more common when K is deficient.

**Symptoms of S deficiency** in wheat and other small grains are similar to those of N deficiency. Sulfur deficiency is more common in mineral soils that are well drained, coarse textured, and low in organic matter. Sulfur deficiency in wheat typically appears first on younger tissues, but eventually causes the entire plant to take on a pale green appearance.



**Nitrogen-deficient** wheat and other small grains show yellowing or chlorosis on older leaves first.



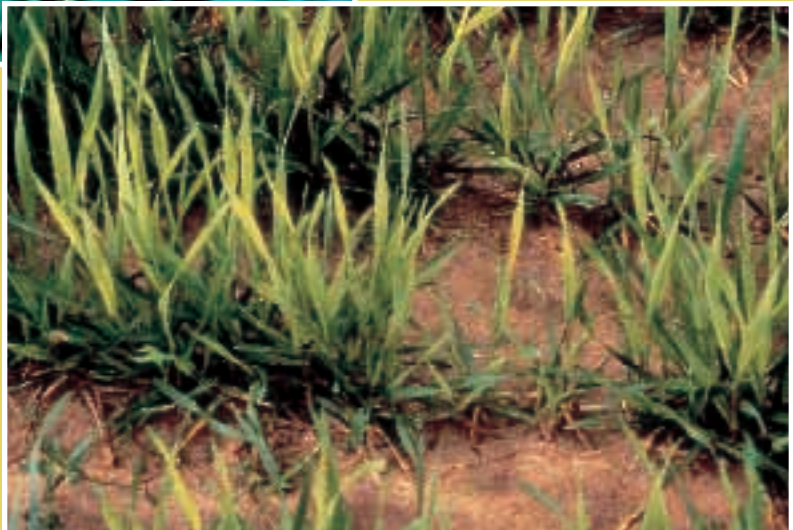


**Adequate P fertility** in plot at left above improved growth, tillering and yield potential of wheat.



**Potassium-deficient** wheat.

**Sulfur deficiency** of wheat occurs where soils are acid, well drained, and low in organic matter.



## Cotton

**Nitrogen deficiency** symptoms on cotton early in the season include yellowish green leaf color, first appearing on older leaves. Younger leaves may be reduced in size. Plant height is also reduced, few vegetative branches develop, fruiting branches are short and bolls

may be shed soon after flowering. When N deficiency occurs later in the season on plants with a moderate load of maturing bolls, foliar symptoms appear as reddening in the middle of the canopy. Few bolls are retained at late fruiting positions.

**Symptoms of phosphorus deficiency** in cotton rarely occur during early growth and are not distinct. Plants may be stunted, leaves darker green than normal, flowering delayed, and boll retention poor. Later in the season, leaves on P-deficient plants undergo premature senescence.

**Foliar symptoms of K deficiency** on



**Phosphorus-deficient** cotton may undergo premature senescence.



**Nitrogen deficiency** in cotton may occur early or late in the season.

cotton that occur before peak bloom may include interveinal light green to gold mottling first on older leaves, with yellowing and necrosis developing at leaf margins under severe deficiency. Late-season K deficiency results in foliar symptoms that differ from early season deficiency. After peak bloom, K deficiency symptoms first appear on the younger mature leaves in the upper third of the canopy. Potassium deficiency symptoms are sometimes confused with plant diseases such

as Verticillium wilt.

**Sulfur** is not mobile in the cotton plant (unlike N), and thus S deficiency symptoms occur on younger leaves in the upper canopy. Older leaves retain a normal green color. Sulfur-deficient leaves turn pale green, then a yellowish green similar to N-deficient leaves, but leaf veins tend to remain somewhat greener than interveinal tissue. Plants deficient in S are short and have few vegetative branches and small bolls. **BC**

**Sulfur-deficient** cotton may show symptoms on younger leaves.



**Potassium deficiency** in cotton is more widely recognized in recent years.