Sulfur Deficiency in Corn

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Sulfur deficiency in corn is increasingly becoming a problem for growers. Sulfur (S) availability to crops during the growing season is a combination of soil, crop and environmental interactions. Sulfur is a macro-nutrient along with nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg) and calcium (Ca) and is an essential building block in chlorophyll development and protein synthesis.

Sulfur Availability and Use

Crops will remove S from the soil in both the residue and the grain. Corn grain contains about 0.5 lbs of S for every 10 bushels of grain, and soybeans contain about 1.7 lbs of S per 10 bushels. Thus, if you raise 200 bu/ac corn and 60 bu/ac of soybeans in a rotation, you remove approximately 10 lb/ac of S from the field each year. This removal increases with increasing yields over time.

If sulfur fertilizer is not applied, the S must come from the soil or the atmosphere. Historically, significant amounts of S have been deposited on the soil from the atmosphere, but due to reductions in S emissions from power plants, the amount of S deposited has dropped, especially in the Midwest region.

According to the National Atmospheric Deposition Program, Eastern Nebraska received a total atmospheric deposition of about 2 lbs of S per acre in 2017, with higher amounts (6–8 lb S/ac) along the Missouri River. In 2000, amounts in Eastern Nebraska were closer to 6–8 lbs S/ac with locations near the power plants along the Missouri River close to 12–16+ lb S/ac.

This combination of increased removal with higher crop yields and decreased atmospheric deposition, increases the overall depletion of soil S.

In-Season Availability

Approximately 90% or more of plant available S comes from mineralization of organic matter. Organic sulfur can be mineralized to sulfate (SO_4), which can be taken up by the crop. Every percent of organic matter in the top 6–8 inches of soil can produce about 100 lbs of S/ac, thus lower organic matter soil s produce less S. This mineralization process can be affected by soil temperature and moisture.

The spring of 2019 was cold and excessively wet, likely enhancing S deficiencies. Cold and excessively wet or dry conditions reduce the microbial activity required for mineralization, thus increasing S deficiency. Also, sulfate-S is a mobile nutrient, which behaves like nitrate, and can be lost through leaching from excess precipitation.

No-till, early planting and heavy residue may increase the occurrence of deficiencies. Corn and soybean residues are relatively low in S content, thus microbes breaking down the residue may use the inorganic S in the soil to aid in the process, temporarily making it unavailable to the crop, known as immobilization. This may cause S deficiencies to be more frequent early in the season with heavy residue. Sulfur availability can vary in the field and is likely lower in sandier soils, low organic matter areas and spots in the field with higher elevation.


Tyler Williams, Nebraska Extension in Lancaster County

Corn in Lancaster County showing sulfur deficiency.

Testing for Sulfur

Visually, sulfur-deficient plants have an overall yellow appearance, similar to N deficiency; however, S is not as mobile in the plant as N and S deficiency symptoms will be seen on upper and lower portions of the plant. Corn leaves are pale yellow with the veins remaining green. The leaf striping may be caused by S deficiency and will appear similar to magnesium, manganese and zinc deficiency. Symptoms will appear inconsistent across the field, possibly due to variations in soil properties, but research has not fully documented the cause of variability or deficiency within fields.

If S deficiency is misdiagnosed as N deficiency, the application of more N may actually make the S deficiency worse. The best way to diagnose is by tissue sampling. Collect above-ground whole plants at V4 or the youngest leaf with fully formed collar after V5. If at tassel or later, collect ear leaf samples. Make sure to collect plants from suspected areas and plants from healthy-appearing areas to have a comparison.

Soil sampling may not adequately predict S deficiencies. Typical soil testing is done in the fall or spring, and SO_4 is soluble and can be leached below the root zone by the time the crop needs it. Also, soil tests are often only taken to depths of 6–8 inches and may actually underestimate what is available to the crop below those depths. Common soil tests may not measure the organic S, which can be a significant portion of crop S uptake after mineralization. Soil tests can still be useful in tracking changes in soil S over time.

Correcting for Sulfur Deficiency

Research sites in Iowa only showed yield response to S applications three times in the approximately 200 trials before 2005, indicating sufficient S amounts, but this began to change in the early 2000s. From 2006–2013, there has been approximately 110 S trials in Iowa, with corn yield response at 47% of sites.

Recommendations from UNL for sulfur are primarily for coarse-textured soils, which are not common in Eastern Nebraska. The recommendation from Iowa State for confirmed S deficiencies in corn, on fine-textured soils, is to apply

see SULFUR DEFICIENCY on back page

Planting Garlic in the Fall Vegetable Garden

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Garlic produces well in Nebraska when planted in October or very-early spring, using individual bulb cloves or the small bulbils found on top-setting types. Fall or very-early spring planting is required because dormant cloves and young garlic plants must be exposed to cold temperatures of 32–50°F. for one to two months to induce bulb formation.

Kinds of Garlic

There are two main types of garlic — soft neck and hardneck. Don't buy garlic bulbs at the grocery store to plant in your garden. These are mainly softneck varieties, adapted to warmer climates, and usually have not been stored at temperatures conducive to good bulb formation if they are grown in the garden.

Hardneck garlic, *Allium sativum* subsp. *ophioscorodon*, produces a woody flower stalk and also is known as "top-setting" garlic because it produces clusters of bulbils after the mostly sterile flowers bloom. Many hardneck types tend to produce large underground bulbs made up of a few large cloves and yield best when planted in the fall.

Softneck garlic, *A. s.* subsp. *sativum*, does not form a woody stalk but has flexible leaves that can be braided. Bulbs of softneck types usually have more individual cloves and yield higher than hardneck types. Softneck types also are generally better adapted to a wide range of climates. They can be spring-planted with more success than spring-planted hardneck cultivars. However, garlic connoisseurs say that softneck cultivars lack the subtle flavor differences found in hardneck cultivars.

Garlic Types and Cultivars

Deciding what kind of garlic to plant is a challenge since there are over 100 cultivars available from specialty suppliers!

Rocambole — hardneck. Bulbs off white with purple stripes. Clove skins brown and easy to peel. Stores about 4–5 months. Cultivars include Kilarney Red, German Red, Spanish Roja and Carpathian.

Porcelian — hardneck. Smooth white skins. Cloves more difficult to peel than Rocamboles. Stores about 5–7 months. Cultivars include German Extra Hardy, Georgian Crystal and Music.

Purple stripe — hardneck. Bulbs white with purple streaks. Clove skins brown and more difficult to peel than Rocamboles. Stores 5 to 7 months. Cultivars include Persian Star and Metechi.

Silverskins — softneck. White bulbs and clove skins. Best adapted to warm climates with mild winters. Stores for up to one year. Cultivars include Silver White, Idaho Silverskin and California Select.


LoboStudioHamburg, Pixabay

Artichoke — usually a softneck, but may flower following a cold winter. Bulbs white or purple blushed. Named for their layers of overlapping cloves. Difficult to peel. Stores 6–9 months. Cultivars include Inchelium Red, Kettle River Giant and Early Red Italian.

Garden Preparation

Garlic grows best in well-drained, friable loam soils that are fertile and high in organic matter. If your soil is high in clay, add organic matter to break up clay particles for better drainage. Organic matter also will help a sandy soil hold more water. Like onions, garlic needs a steady and fairly high level of nutrients in the soil while actively growing, but they have shallow, coarse roots that are not as efficient at nutrient uptake as other crops.

When preparing the soil for planting, apply 3–4 pounds of 10-10-10 fertilizer per 100 square feet (or follow soil test recommendations) and spread one to three inches of organic matter such as chopped leaves, dry grass clippings or compost over the soil surface. Use a spading fork to mix in the organic matter. A rototiller also can be used to prepare the soil.

When incorporating organic matter that must be decayed, such as dry leaves and grass clippings, it is best to do it a few weeks before planting so soil microbes will have a chance to start breaking these materials down.

Planting

Just before planting, separate bulbs into individual cloves and sort by size. Do not divide the bulbs more than a few days before planting because early separation results in decreased yields. Reserve the largest cloves for planting and use the smaller cloves for cooking.

For best yields, garlic should be planted in early- to mid-October. Planting before mid-September is not recommended. Garlic cloves should begin growing and then go dormant when cold weather arrives.

For single-plant rows, plant the cloves 3–5 inches apart in an upright position (pointed end up) to ensure good emergence and straight necks. Cover cloves to a depth of about 2–3 inches. Allow 12–24 inches between rows.

Garlic also lends itself well to wide-row planting. In this planting system, space cloves five inches apart in all directions in foot-wide rows or raised beds. This requires considerably less garden space for the same yield, but weeding must be done by hand.

Water thoroughly after planting to stimulate growth. The soil must be kept evenly moist during active growth. Garlic is quite drought-sensitive, so a weekly application of one inch of water will increase yields if rainfall is lacking. Dry soil will result in irregularly shaped bulbs.

A light application of mulch (1–2 inches) after the ground freezes will help prevent frost heaving throughout the winter.

Fall-planted garlic is ready to harvest from late June to mid-July.

Composting Demonstrations

For information on creating a compost pile, attend one of this month's composting programs presented by Nebraska Extension and the City of Lincoln Recycling office.

- Saturday, Oct. 12, 10–10:30 a.m., Sheridan Elementary School's outdoor classroom, 3100 Plymouth Ave.
- Saturday, Oct. 12, 10 a.m., at Pioneer's Park Nature Center backyard composting demonstration area across the street from the Nature Center (look for the Extension banner).