Sulfur Fertilization of Alfalfa

Sulfur deficiency can result in significant yield loss. It is characterized by an overall light green color; somewhat similar to nitrogen deficiency; other symptoms include spindly stems and weak growth. However, yield loss will often occur before symptoms are visible.

The best way to identify a sulfur deficiency is by tissue sampling. Whole plant samples should be collected at harvest or just before 50% bloom stage. Collect the upper 6 inches of stem and leaf tissue from 15-20 plants from the area suspected of deficiency and a second sample from a healthy area of the field for comparison. Samples should be air-dried before shipping to the laboratory in paper bags. Tissue sulfur greater than about 0.25% on a dry matter basis indicates sufficiency.

Soil testing is not useful for predicting sulfur deficiency since it measures sulfate-sulfur (SO₄-S) only and, therefore, does not include organic sulfur of the soil. Further, SO₄-S is mobile in most soils, so measured sulfate-sulfur may be leached from the soil between the time of sampling and crop need.

Sulfur used to accumulate in fields from acid rain, which has now greatly declined. Fertilizer, manure and soil organic matter are the main sources of sulfur. Each percent organic matter in the plow layer contains about 100 pounds of sulfur per acre. Organic sulfur (from soil organic matter or manure) must be mineralized to sulfate-sulfur (SO₄-S) to be taken up by crop plants. Therefore, soils of low organic matter are more likely to suffer sulfur deficiency.

Potassium sulfate and sulfate-of-potash-magnesia (sul-po-mag or K-mag) are often good fertilizer choices for alfalfa since the products will also replace some of the large amounts of potassium removed by the alfalfa. Either of these sources can be blended with muriate of potash (0-0-60) to provide an economical source of both potassium and sulfur. Inclusion of magnesium from sul-po-mag may be an extra benefit compared to potassium sulfate if soil magnesium levels is low. Ammonium sulfate and gypsum are also potential sources of sulfur for alfalfa.

Use of most sulfur fertilizer sources does not increase soil acidity (lower soil pH), including the sulfate in ammonium sulfate (though conversion of ammonium to nitrate generates acidity which lowers soil pH). Only elemental sulfur or chemically reduced sulfur (thio-sulfate for example) create soil acidity.

Each ton dry matter of alfalfa removes about 5 lbs sulfate-sulfur. Fertilizations should be made as two applications annually to improve efficiency of sulfur fertilization by avoiding luxury consumption by the alfalfa plant. Fertilizer applications should be made after first cutting and after the third or fourth cutting.

-Dr. Dan Undersander—Emeritus Alfalfa Agronomist, UW-Madison
Potassium for alfalfa

Potassium (K) is needed by plants for activation of some enzymes, synthesis and degradation of carbohydrates, the synthesis of protein, and the opening and closing of stomata (the pores in leaf surfaces that open during day to let water and oxygen out of plant and carbon dioxide in). Alfalfa needs about 50 to 55 lbs of K2O per ton dry matter of forage removed.

Potassium deficiency can appear as chlorotic (yellow) spots along leaf margins (Figure 1). These symptoms are especially evident on older leaves because potassium is mobile in plants and transport of limited potassium occurs from old leaves to young leaves. However, yield loss and reduced winter survival occur long before the deficiency is severe enough to show symptoms.

Potassium is very soluble, so it moves into the soil rapidly. It is not tied up in the soil as phosphorus is. This means that applied fertilizer will rapidly alleviate a deficiency. On the other hand, over application can result in leaching losses into the water table. It also means that high soil levels can result in luxury uptake of potassium by alfalfa and associated grasses (in a mixture) which reduces the efficiency of the fertilizer use and the elevated plant levels may cause animal health problems.

These factors mean that potassium should be applied as a split application to minimize leaching losses and luxury consumption. The recommendation is one application after first cutting and the second application after 3rd or 4th cutting. Areas taking 6 or more harvests may need to apply a third application potassium fertilizer.

The late application will provide potassium for winter survival and nutrients for spring growth, eliminating the need for a fertilizer application on the soft ground before first cutting. An application of additional potassium after the first harvest is recommended for high second and third crop yield.

If a soil test indicates potassium is in the optimum range, then fertilization can be an amount to replace removal. If tissue testing, sample the top 6 inches just prior to harvest and the tissue should have at least 2.25% potassium. After 3rd or 4th cutting of the growing season, make a second application to replace potassium removal (50 to 55 lb/t forage). Fall potassium can be applied until the ground is frozen. It is important to recognize that the potassium yield response is assuming that other nutrients are not lacking.

Potassium fertilizer should not be over applied. Alfalfa needs about 2.25% potassium content for optimum growth but will take up much more potassium if it is available, reducing fertilizer efficiency and increasing cost. Further, excessive potassium fed to cattle in the 4 to 6 weeks prior to calving can result in hypocalcemia (milk fever). During this period when large amounts of calcium are transferred from the cow’s blood to the mammary gland, high potassium, makes the blood more alkaline and interferes with this process. Alfalfa with 2.2 to 2.5% potassium is generally safe for freshening cows (depending on how much alfalfa is in the diet). On the other hand, milking cows need potassium, especially in early lactation, and any level up to 4.5% potassium is generally safe to feed.

-Dr. Dan Undersander—Emeritus Alfalfa Agronomist, UW-Madison

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Anthracnose in alfalfa

Anthracnose is a plant disease that reduces yield up to 25% or more, potentially rendering fields unproductive within one or two seasons. Anthracnose of alfalfa is caused by the fungus *Colletotrichum trifolii*.

Anthracnose generally appears in stands two or more years old. It can occur anytime during the growing season but is most common after the second cutting (note the new Race 5 can occur on first season growth). Anthracnose causes stems to have large, sunken, oval- to diamond-shaped lesions. Lesions are straw colored with brown borders. Black fruiting bodies (acervuli), which look like small dots under a hand lens, develop in the lesion. Lesions can enlarge and join together to girdle and kill one or more stems on a plant. Girdled stems may wilt suddenly, sometimes resulting in a characteristic "shepherd crook" on top of stem. Because stems die suddenly, the dead leaves do not drop from the stem. In summer and fall, dead shoots (light in color) are scattered throughout the field. Crown rot is the most important phase of the disease. A bluish-black, V-shaped rot appears in the crown.

With warm, wet weather, spores are produced on stems and spread from stem to stem and plant to plant by wind, splashing rain, or irrigation water. Anthracnose can exist as spores on plant debris in the field or on harvesting equipment. Stacked hay also serves as a potential source of fungus inoculum.

Spread of the disease from one field to another is by wind-blown spores or by the movement of infected stems on machinery. Cleaning debris from haying machinery before the first cutting in spring and during the growing season can help to prevent introduction of the anthracnose fungus into clean fields. Anthracnose is not spread through seed. Fields with a previous history of alfalfa crown rot should be rotated to another crop for at least two years before being replanted to alfalfa to reduce fungus inoculum.

Producers are strongly urged to plant varieties resistant or highly resistant to anthracnose. The common anthracnose resistance in alfalfa is for races 1 and 2. Recently, a more virulent race 5 has been identified and is moving through regions where anthracnose is a problem. A small number of premium alfalfa varieties have resistance to this new race. In the interim, if growing an alfalfa variety without resistance to race 5 and if anthracnose lesions are visible on the stem, consider spraying some cuttings with fungicide (Headline®, Quadris® or Priaxor®).

-Dr. Dan Undersander—Emeritus Alfalfa Agronomist, UW-Madison

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Aphanomyces Root Rot in Alfalfa

Aphanomyces root rot (*Aphanomyces euteiches*) is an important alfalfa disease. It occurs all over all alfalfa growing regions. The pathogen that causes Aphanomyces root rot is an oomycetous fungi that are especially present in wet and poorly drained soils (Schneider et al. 2008).

**Aphanomyces stunts and kills seedlings.** Multiple races of this organism exist. A number of varieties have resistant to the two dominant races, Race 1 and Race 2, with Race 2 considered more virulent. Race 3 has been identified and some resistance exists.

Infection of alfalfa is due to zoospores, which are motile in wet soils over a very wide temperature range.

Infected seedlings develop yellow cotyledons followed by chlorosis of other leaflets. Roots and stems initially appear gray and water-soaked and then turn light to dark brown. Seedlings become stunted but remain upright. Seedlings that die can result in stand failure as shown to right.

**Aphanomyces also causes a chronic root disease in established plants,** reducing root mass. Nodules are frequently absent or in some stage of decay. Infected plants show yellowing and stunting symptoms similar to nitrogen deficiency and are slow to regrow following winter dormancy or harvest. The slow regrowth often allows weed infestation over time. Symptoms typically appear on slopes of fields.

Soil samples can be submitted to the UW Plant Disease Diagnostic Clinic for confirmation of the disease or to learn which race(s) of aphanomyces you may have in the field (submit 2 to 3 gallons of soil, see [http://pddc.wisc.edu/](http://pddc.wisc.edu/))

Premium alfalfa varieties are also often treated with the fungicide, Stamina®, which further suppresses Aphanomyces euteiches and Phytophthora medicaginis.

-Dr. Dan Undersander—Emeritus Alfalfa Agronomist, UW-Madison

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