Why is My Alfalfa Yellow?

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In 2016, many parts of the Midwest experienced far wetter than normal summer weather and by August or September, many farmers were asking, "Why is my alfalfa yellow?" When all or part of an alfalfa field is yellow, it is a certain sign something has gone wrong.

In this case, the problem in most areas was due to the wet soil conditions resulting in nitrogen deficiency and root rot. Fields where this occurred should be monitored closely in spring to determine the amount of winter injury and winterkill. Plants under nutrient stress are more likely to succumb to crown rot and root rot diseases, especially those active in cold soil, such as brown root rot of alfalfa.

This article discusses the different causes of yellowing in alfalfa and with a little detective work, you can identify the most likely cause of yellowing in your alfalfa stand. With this knowledge you can take corrective action to get back to a lush green field of alfalfa.

First, gather the facts. Look closely at the location where yellowing is occurring. Is the problem across the entire field or in localized pockets? In low spots or on slopes? Next, examine the soil where the problem is occurring. Take note of whether the soil is heavy, or sandy, the amount of organic matter, and water ponding. Finally, take a close look at the plants. Determine if the yellowing is uniform across the leaf, between the veins, or in patches.

Don't just look at the shoots. It is also a good idea to dig up a few plants to take a look at root health. Evaluate the number of branch and fibrous roots and the number of nodules. A healthy alfalfa root will have many branch and fibrous roots while an unhealthy root will look somewhat like a carrot root. You are now ready to read through the descriptions of the causes of yellowing and make a diagnosis for your stand.

Figure 1. Nitrogen deficiency in alfalfa.

Nitrogen deficiency. Plants suffering from nitrogen deficiency are stunted, with short shoots and uniformly light green to yellow leaves (Figure 1). The oldest leaves tend to die and drop to the soil, with symptoms progressing up the stem to younger leaves. Symptoms are generally seen throughout the field and can occur in spring or summer. Nitrogen deficiency can occur in heavy wet soils, shallow soils, acid soils, sandy soils, and soils with low organic matter.

The main reason a nitrogen-fixing plant like alfalfa suffers from nitrogen deficiency is the lack of the symbiotic bacteria, *Sinorhizobium meliloti*, required for fixing nitrogen. It may be absent for many reasons. In fields where soil is consistently wet, there is little oxygen in the soil. Under low oxygen conditions, roots produce ethanol as a waste product. Plants can respire this way for only a short time before ethanol kills the root and nodule cells. This is the main reason alfalfa does not like "wet feet." Unfortunately, attempts to re-inoculate established plants are usually futile. If disease is not an issue, the soil dries out, and the root systems are not too damaged, nitrogen fertilizer will help yield rebound.

Another consequence of wet soils is the activity of pathogens, the water molds or oomycetes, which flourish in wet soils. The oomycetes include the root rot pathogens causing Phytophthora root rot (PRR) and Aphanomyces root rot (ARR). Although these are usually thought of as seedling diseases, adult plants can be severely damaged in persistently wet soil. Alfalfa plants suffering from PRR will often have short roots with dark "pencil points" while plants with ARR will lack fibrous and lateral roots. Selection of highly resistant cultivars, as well as installation of subsurface drainage, will help alleviate this problem.

Acid soils (pH <5) cause nitrogen deficiency by affecting the plant and the bacteria. In acidic soils, aluminum is soluble and can be taken up by roots. Aluminum causes stunting and cracking of alfalfa roots, interfering with nodule formation. Additionally, the bacteria are sensitive to pH and do not survive well under acidic conditions. Yellowed and stunted alfalfa will occur in patches if lime was not applied uniformly. Under favorable conditions, *S. meliloti* supplies sufficient nitrogen to meet plant needs and nitrogen fertilizer applications are not needed.

Sulfur deficiency. Plants with sulfur deficiency look similar to plants with nitrogen deficiency, with uniformly pale green to yellow leaves and short stems. Often the symptoms are more evident on the younger leaves. This is in contrast to nitrogen deficiency, which is more apparent on older leaves.

Sulfur deficiency occurs most commonly on excessively drained, sandy soils with low organic matter where manure has not been applied in recent years. Symptoms often occur in localized regions within a field.

Recent use of low sulfur phosphorus fertilizers and clean air standards of coal-fired power plants have increased the frequency of sulfur deficiency. Analysis of shoot tissues may help to identify a sulfur deficiency. Soil tests are of limited value because they do not detect the rate of sulfur release from soil organic matter and exclude sulfur located deeper in the soil profile accessed by the deep taproots of alfalfa. Sulfur fertilization can have highly profitable results.

Figure 2. Iron chlorosis in alfalfa.

Iron chlorosis. Plants with iron deficiency have pale green or yellow leaves but the leaf veins remain green (Figure 2). This interveinal chlorosis distinguishes iron deficiency from nitrogen and sulfur deficiency. Iron deficiency is relatively rare in alfalfa but can occur in alkaline (pH >8) or calcareous soils. Symptoms are most prominent in cool weather. Chelated iron application will help reduce yield losses.

Hopperburn. Feeding by the potato leafhopper on alfalfa leaves and stems disrupts the normal physiological functions of the plant and 7-10 days after feeding the foliage turns yellow, red, or purple. The discoloration begins at the tip of the leaflet, often resulting in a V-shaped area of damage (Figure 3).

Because the yellowing can be confused with other causes of yellowing, it is important to identify nymphs and adults on the plants to verify the cause as potato leafhopper. Injury causes reduced yields and residual effects can reduce yields of subsequent harvests and increase winter injury. Monitoring population levels and timely application of insecticides or use of resistant cultivars will reduce damage by this pest.

Figure 3. Hopperburn in alfalfa.

Foliar diseases. A number of diseases cause spotting and yellowing of alfalfa leaves. Wet summer weather can promote these diseases and cause significant leaf loss. Fungicide applications when foliage is 6-8″ high will reduce foliar diseases, but the fungicide must be applied before the observation of disease symptoms. One of the most dramatic yellow symptoms is caused by Lepto leaf spot (Figure 4). Yellowing caused by a foliar pathogen is usually patchy on the leaves, and older leaves are usually attacked before younger leaves. Early harvest will reduce leaf losses and build-up of the pathogen in the field.

Figure 4. Lepto leaf spot of alfalfa.

In early spring with cold wet weather occurring after plants break dormancy, alfalfa plants can have yellow, distorted leaves with dieback of stems (Figure 5). The pathogen causing this symptom has not been identified conclusively. However, plants typically recover rapidly and put out new healthy foliage once temperatures have increased.

Figure 5. Early spring chlorosis, leaf distortion, and shoot dieback.

Herbicide damage. Foliage yellowing can be caused by a number of herbicides in which excessive rates are used, there is non-uniform application, inappropriate timing, residual carryover, drift, contamination of equipment, or use of the wrong herbicide. In Roundup Ready® alfalfa treated with glyphosate, a low percentage of plants without the tolerance gene will be affected by the herbicide.