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University of Nebraska Cooperative Extension EC98-1875-B

Alfalfa Disease Management

John E. Watkins, Extension Plant Pathologist

Alfalfa is the most important forage crop in Nebraska. It is widely adapted, energy efficient and produces the most protein yield per acre. It is used widely for local livestock feed and its importance as a cash crop is growing rapidly. With good management, Nebraska producers can attain good alfalfa yields and high quality in either irrigated or dryland production systems.

Several factors contribute to poor forage yield, low quality and the decline in productivity of an alfalfa stand. Diseases are one component of the total stress load on a plant. They interact with each other, with other pests and with environmental conditions in what may be considered a cumulative stress load. Many of the diseases that attack alfalfa can limit production. Because a disease is apparent for a brief period at one harvest does not mean that the effects of the disease are limited to the same time span. The effects from one disease outbreak can adversely affect subsequent production, even into the following year.

Few alfalfa plants in any field are without some symptoms of disease. Many disease-causing organisms are common inhabitants of soil, roots and crowns and plant debris, and production practices often encourage disease development. Since most stands in Nebraska are cut three or four times a season, harvesting equipment will compact soil, injure roots and crowns and may spread many pathogens. Wounds from cutting alfalfa create entry points for infection by certain pathogens.

In Nebraska the diseases that most affect forage yields, forage quality and stand persistence are crown and root rots, phytophthora root rot, anthracnose, spring black stem, summer black stem and common leaf spot. Each will be discussed briefly in this publication.

Crown and Root Rots

Stand longevity often is shortened by alfalfa diseases that affect the crown and roots. Crown and upper root rots are chronic diseases that occur wherever alfalfa is grown. In stands more than two years old, most alfalfa plants show some crown and upper root rot. Vigorous plants survive by producing new crown buds and lateral roots.

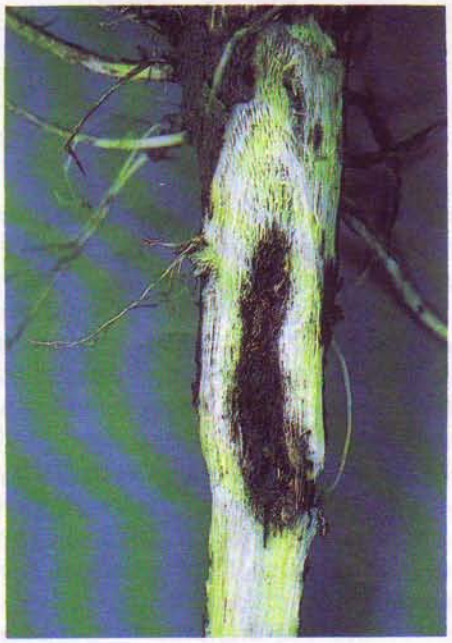

Figure 1. Rotting of upper taproot.

When pressures from disease and stress become too great, infected plants die. The stand becomes thin, weeds invade, and yield and quality are reduced. The term for this irreversible debilitation is known as "stand decline".

The general symptoms of crown and root rot are deterioration and discoloration of infected tissue *(Figure 1)*. Some crown and root rots such as violet root rot and anthracnose have distinctive symptoms and signs and are identified easily. Since most crown and root rots involve more than one type of organism, positive identification of the cause often requires laboratory examination. Even then, if several organisms are present, it may be difficult to identify the primary cause of decline.

Specific symptoms include diseased crowns and

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Figure 2. Fusarium crown rot.

Figure 3. Circular field symptoms of violet root rot.

upper taproots that appear shredded. The color of rotted tissue varies from dark orange to reddish-brown to violet to black. The outside of infected roots may show limited discoloration, but the core of the taproot and crown tissues will be rotted and appear reddish to dark brown. Rot in the center of the crown that extends into the upper taproot is called heart rot or hollow crown. This type of crown rot develops slowly; diseased tissues first appear moist, then later become dry and remain firm. Crown rot often causes plants to grow unevenly due to death of crown buds on one side of the crown. Plants often can survive for years with moderate injury.

Crown and root-rotting organisms are major contributors to the progressive decline of productive alfalfa stands. Managing an alfalfa stand for longevity, therefore, involves practices that prohibit or slow crown and root rot development.

Fungi are the primary organisms associated with crown and upper root rot of alfalfa. The most common fungi isolated from diseased crowns and roots are species of *Fusarium*. These fungi live in the soil or in infected crowns and roots of alfalfa plants. Crowns and roots of young plants may be invaded by one or more of the *Fusarium* fungi without the plant showing detrimental effects. Crowns and upper taproots infected by *Fusarium* fungi are reddish brown to dark brown *(Figure 2)*.

Other crown rotting fungi invade plants soon after the initial invading fungi and contribute to the overall crown and root rot complex. Usually rot develops slowly in crown tissues and in upper taproots and is ultimately responsible for stand decline.

Violet root rot, caused by *Rhizoctonia crocorum*, occasionally occurs in Nebraska in fields with poor drainage. This fungus infects mature plants. Diseased areas form discrete patches that appear roughly circular in the field *(Figure 3)*. Diseased roots develop a violet color due to fungal mycelium on the infected root. The violet color is a key diagnostic feature of this disease.

The anthracnose fungus, *Colletotrichum trifolii*, causes a crown rot that leads to a rapid deterioration of alfalfa stands. Infected plants are either killed outright by the fungus or die during winter because of reduced cold tolerance. Infected crowns appear bluish-black near the origin of the stems *(Figure 4)* and reddish-brown near the inner crown tissues.

Proper management of alfalfa can slow the development of crown and root rots and cold temperature injury *(Table I)*. While disease management practices for crown and root rots are not well defined, it is known that high levels of stored nutrient reserves in roots will improve the plant's ability to withstand severe winters and overcome winter injury from crown and root rot.

Phytophthora Root Rot

Phytophthora root rot is a major cause of seedling death in newly established alfalfa and causes a progressive decline of established stands in Nebraska. It is most damaging on susceptible cultivars, and where the soil remains wet due to high clay content, poor drainage, over-irrigation or a combination of these. The fungus *Phytophthora megasperma* causes damping-off of seedlings, root rot, and rot of lower stems. It also weakens plants, making them more susceptible to injury during severe winters.

Phytophthora root rot is most likely to occur where water collects. Symptoms often are severest in poorly drained areas in the field, but in fields with a high clay content the disease may occur throughout the field. Normally, plant death occurs in an irregular pattern in the field.

New Stands: Newly seeded stands often suffer the greatest damage from phytophthora root rot. Infected seedlings turn reddish-yellow, wilt, and die rapidly *(Figure 5)*. These seedling failures appear to be more common in direct seeded fields.

It is not uncommon for complete stand loss to occur in low field areas in just a few days. Stand

Table 1. Managing Alfalfa to Reduce Crown and Root Rot Development and Increase Stand Longevity

- Select cold-tolerant alfalfa varieties resistant to bacterial wilt, anthracnose, and phytophthora root rot.
- Plant into soil with good surface and subsurface drainage.
- Fertilize with phosphorus and potash as needed, based on soil tests.
- Adjust soil pH to 6.8 to 7.0 by liming.
- Irrigate stands prior to cutting.
- Allow soils to become firm before driving heavy equipment on them; delay new irrigations until regrowth has begun.
- To lessen injury to the crown, do not cultivate stands for weed control or fertilizer incorporation, especially if soil is moist and/or alfalfa is actively growing.
- Harvest when soil is firm.
- Adjust harvest intervals to plant growth.
- Do not harvest stands after Sept. 15. It is important to have at least 6 inches of regrowth after the final harvest and before the first killing frost.
- Control alfalfa and clover leaf weevil, aphid, and potato leaf hopper infestations.
- Graze stands only after alfalfa is fully dormant and ground is dry; remove animals when dormant growth is gone.
- Avoid growing alfalfa in compacted soils.

Figure 4. Bluish-black crown rot symptom characteristic of anthracnose.

failures often reoccur if these fields or diseased areas are reseeded immediately, even if resistant varieties are used. Replanting a field lost to phytophthora root rot is costly and lowers the net economic return from that field due to higher establishment costs and delayed production.

Since infected seedlings die rapidly, it is difficult, if not impossible, to distinguish death caused by *P. megasperma* from that caused by other root rotting fungi such as *Pythium* spp. Plants with a reddish to yellow cast usually have been infected by

Figure 5. Loss of seedlings due to Phytophthora root rot.

Phytophthora. The taproot of *Phytophthora*-infected plants will be rotted and collapsed at some point below the soil surface. Plants infected by *Pythium* usually show a rot of the smaller feeder roots only.

Established Stands: On most plants affected by phytophthora root rot, the taproot has a reddish-brown rot of the cortex. Rot of mature taproots typically starts 4 to 6 inches below the soil surface and causes a yellow to brownish-red discoloration that begins in the outer cortical tissue and eventually moves into the central cylinder. Rotted taproot tissue remains firm.

Under dry soil conditions, lesions become brown to black, resembling the feeding injury caused by root curculio insects. When severe, the lower taproot is completely rotted off. These plants are stunted, wilt during mid-day heat and yield less than one half that

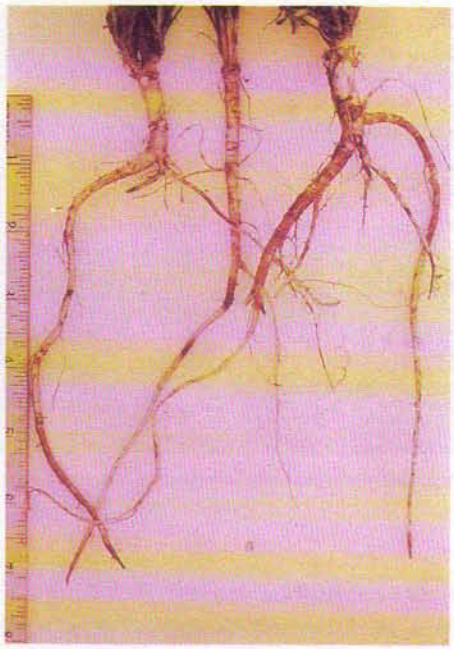

Figure 6. Branching of taproot caused by Phytophthora root rot.

of healthy plants. Branching of the taproot *(Figure 6)* often occurs above the point where the taproot is rotted off. However, plants with rotted taproots still are more easily removed from the soil than healthy plants.

One of the best indicators of possible phytophthora root rot is a thin, weedy stand with plants having irregular growth, i.e., some normal and some stunted. If some of the stunted plants have the taproot rotted off, it is phytophthora root rot. Regrowth of diseased plants is often slow after each cutting.

Management practices to prevent or reduce losses to phytophthora root rot include soil and water management and the use of resistant alfalfa varieties adapted to Nebraska *(Table II)*.

Anthracnose

In certain years anthracnose can severely damage established stands in Nebraska. Historically, anthracnose has been more of a problem in hay production in the eastern and southeastern United States, but in the last 20 years it has become a much more predominant factor in the north central states.

Figure 7. Dying of stems due to anthracnose.

Anthracnose may appear any time during the growing season and on any age of stand. It typically appears after the second or third cutting and on stands two or more years old, but it has occurred on seedlings in early summer before the initial cutting.

From a distance, infected fields show dead, straw-colored stems scattered throughout the stand. Infected stems are curved at the tip similar to a shepherd's crook. Leaves wilt, turn tan, and the entire stem dies *(Figure 7)*. At first only a few, individual stems on scattered plants are affected; but on susceptible varieties, the disease progresses rapidly until at the one-tenth bloom stage, 30 to 50 percent of the plants within the crop may show symptoms.

Typical stem lesions are diamond-shaped and ash-gray *(Figure 8)*. They have a dark-brown to purple border and usually form on the lower stem. The gray centers of the lesions are dotted with small, black fruiting bodies of the fungus. More than one lesion may be found randomly distributed along the stem. Lesions may coalesce and girdle the stem, resulting in wilt and subsequent death. Those lesions

Table II. Management Practices to Control Phytophthora Root Rot of Alfalfa.

- Select fields with good surface and internal drainage and without a history of phytophthora root rot or at least improve soil drainage; level fields to prevent puddling; and irrigate to meet the needs of the crop and growing conditions.
- Plant varieties that are highly or at least moderately resistant to phytophthora root rot, anthracnose and bacterial wilt.
- Treat good quality seed with the fungicide Apron and plant into a firm, mellow seedbed.
- Fertilize newly seeded and established stands to promote vigorous growth and good root development.

Figure 8. Anthracnose stem lesion.

Figure 9. Irregularly-shaped black lesions of spring black stem.

occurring just above the crown may not have the typical diamond shape.

The anthracnose fungus may advance downward from the infected stem into the crown tissues. Infected crowns appear bluish-black near the origin of the stems and reddish-brown near the inner crown tissues. Crown symptoms may occur without stem lesions.

Major stand reductions occur when anthracnose crown rot is widespread. Infected plants usually die within one to two seasons after invasion of crown tissues. Plants may be killed outright by the disease or later because of reduced cold tolerance. Many die during the winter and fail to initiate growth the following spring. When this occurs, plants should be dug, cleaned, and the crowns examined for evidence of anthracnose.

Leaf and Stem Diseases

Foliar diseases such as spring black stem, summer black stem and common leaf spot are widespread throughout the alfalfa growing areas of Nebraska. They reduce yields of forage and seed and lower the quality of harvested hay.

The peak disease period for spring black stem, caused by the fungus *Phoma medicaginis*, is in May when cool, wet conditions prevail. The fungus attacks leaves, petioles and stems and may contribute to crown and root rot involved in stand decline. Crowns of plants, stem lesions, dead stubble and debris as well as the soil are natural habitats for the causal pathogen.

Symptoms occur primarily on stems and leaves, but seedpods, crowns and upper taproots also may become infected. In spring small black spots develop on leaves, petioles and stems of new shoots. The leaf lesions are irregular, and enlarge and merge until much of the leaflet is covered *(Figure 9)*. Infected leaves yellow and drop from the plant. Lesions on stems and petioles turn black. As stem lesions enlarge and merge, most of the stem becomes black. If the stem is girdled by the advancing lesions, it will die. The fungus also can invade the plant base and cause the crown and upper taproot to rot.

Spring black stem usually is a problem only on the first cutting. Regrowth from this cutting may become diseased but severity is generally low. If environmental conditions between mid-April and mid-June are favorable (cool and wet) for disease development, diseased lower leaves may drop off plants before the stand is cut. When severe, two-thirds to three-fourths leaf defoliation can occur. When this happens the first cutting is primarily

Table III. Management Practices to Prevent Losses from Anthracnose

- Plant alfalfa varieties resistant to anthracnose for the best protection from forage and stand losses.
- Clean debris from haying machinery before first cutting in spring and during the growing season to provide some protection against introducing the anthracnose fungus into clean fields.
- Mow young stands before old stands to reduce anthracnose spread.
- Rotate fields with a previous history of anthracnose crown rot to another crop for two years before replanting to alfalfa. This reduces the survival of the anthracnose pathogen.

Figure 10. Large ash-gray circular lesions of summer black stem.

Figure 11. Circular leaf spots of common leaf spot (Courtesy of Fred Gray, University of Wyoming).

stems, which not only reduces yield but also significantly lowers quality.

In central and eastern Nebraska, summer black stem (caused by the fungus *Cercospora medicaginis*) rarely causes losses to the first cutting but can be a problem in the second and third cuttings. Warm-to-hot, wet or humid weather favors disease development. When the humidity approaches 100 percent in the plant canopy in July and August, plants become infected by spores that have survived on the previous crop residue. Secondary spread occurs within the plant canopy on infected leaves and stems. Wind, rain and irrigation spread the fungus spores.

As with most leaf and stem diseases of alfalfa, losses are greatest if harvest is delayed until full bloom. Summer black stem and leaf spot can develop rapidly the final week before harvest.

This disease may not always be severe enough to cause economic loss, but in the presence of other leaf diseases, defoliation may be substantial.

The most obvious symptom is premature leaf droppage starting with the lower leaves and progressing upward in the canopy. The leaf spots are ash-gray and roughly circular *(Figure 10)* and develop before the stem lesions. These leaf spots are quite distinct. Once you are familiar with them they can easily be distinguished from those of other leaf spot diseases. Lesions on the stem are long and range from reddish to chocolate brown. Sometimes these lesions can be severe enough to kill the stem.

Common leaf spot, caused by the fungus *Pseudopeziza medicaginis*, is most prevalent on first cutting alfalfa but can be present throughout the growing season. Like other leaf-spotting fungi, *P. medicaginis* survives the winter on undecomposed leaves on the soil surface.

Symptoms are small, circular, dark brown or black spots on the leaflets *(Figure 11)*. These symptoms differ from those of summer black stem in size and from spring black stem by their circular appearance. It commonly occurs together with these two diseases and other leaf spot diseases.

Monitoring for Diseases

Although specific scouting guidelines have not been developed for alfalfa diseases, keeping accurate records of disease occurrence can greatly help in making management decisions. In addition, periodically dig up random plants and examine the crowns and roots for rot. Key times to scout fields are 10-14 days before harvest. This is especially important in preventing losses to the first cutting from spring black stem and to the last cutting from anthracnose (stem phase).

Table IV. Management Practices to Reduce Losses from Foliar Diseases

- Scout fields regularly during the growing season to detect early development of black stem and leaf diseases
- Adjust the cutting schedule and harvest diseased stands early, if possible, to retain foliage and maintain forage quality.
- For summer black stem a copper hydroxide fungicide can be applied 10 to 14 days before harvesting the second and third cuttings to reduce disease severity and early foliage loss.
- Some resistance to common leaf spot and summer black stem is available. It can be one tool in disease management.