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Alfalfa Crown and Root Rots and Stand Longevity

Causes of crown and upper root rot, symptoms and management are discussed here.

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[Previous Category] [Catalog] [Order Info]

- Causes of Crown and Upper Root Rot
- Symptoms
- The Role of Crown Injury and Stress in Crown and Root Rot Development
- Managing Alfalfa to Reduce Crown and Upper Root Rot

Alfalfa (*Medicago sativa L.*) is the most important forage crop species in North America. It is widely adapted, energy efficient, and produces the most protein yield per acre. Alfalfa is well-suited to both dryland and irrigationd soils of Nebraska.

Many factors contribute to the decline in productivity of an alfalfa stand. Under favorable growing conditions and proper management, alfalfa stands in Nebraska can last over 10 years.

Unfortunately, the productive life of alfalfa can be shortened by poor management practices, unpredictable weather or pest problems. Proper management will reduce the risk of losing plants to environmental stresses, disease and insect invasion, poor soil conditions and other factors that relate to

stand decline.

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.

When pressures from disease and stress become too great, infected plants die. The stand is thinned, weeds invade, and both yield and quality are reduced.

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 down crown and root rot development.

Causes of Crown and Upper Root Rot

The term crown and root rot complex describes a group of general crown and upper root diseases known as crown rot, collar rot, heart rot and hollow crown. It does not refer to diseases of the lower taproot or feeder roots caused by *Phytophthora*, *Pythium*, and several other root-rotting fungi.

Figure 1. Rot of the central cylinder of a taproot caused by Phytophthora root rot. (19K JPG)

Many different organisms, including fungi and bacteria, cause decay of crowns and roots of alfalfa. Most occur in complex interactions and usually involve several of these organisms. Some are aggressive pathogens while others invade crowns and roots but do not cause disease symptoms until plants are weakened or stressed. The crown and root rot complex probably differs between geographical areas, environmental conditions and cultural practices.

Fungi are the primary organisms associated with crown and upper root rot of alfalfa. The most frequently isolated fungi 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.

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 over a period of several months or years.

Some of the other fungi isolated from diseased crowns and roots include species of *Phoma*, *Colletotrichum*, *Phytophthora*, and *Rhizoctoni*. Research at the University of Wyoming attributed

discoloration of crowns and upper taproots to infection by *Phoma medicaginis*, the fungus that causes spring black stem. Many of these plants also were infected with the stem nematode *Ditylenchus dipsaci*.

The fungus *Rhizoctonia solani*, which causes *Rhizoctonia* stem canker in alfalfa when in combination with either *Fusarium* or *Phoma*, causes a brown necrosis of crown bud tissue. As infected plants age, more crown buds are invaded each season until most regrowth tissue has been killed. In addition, *Rhizoctonia* also invades the crown directly, either from stem lesions or from the soil.

Violet root rot, caused by *Rhizoctonia crocorum*, occasionally occurs in Nebraska in fields with poor drainage. This fungus infects mature plants. Diseased areas form a roughly circular pattern in the field.

The anthracnose fungus, *Colletotrichum trifoli*, 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. Infection by this fungus apparently reduces cold tolerance of the plant.

It is not unusual to find both anthracnose crown rot and Fusarium-caused crown rot in the same plant. More detailed information on this serious disease can be found in NebGuide *G89-931, Alfalfa Anthracnose*.

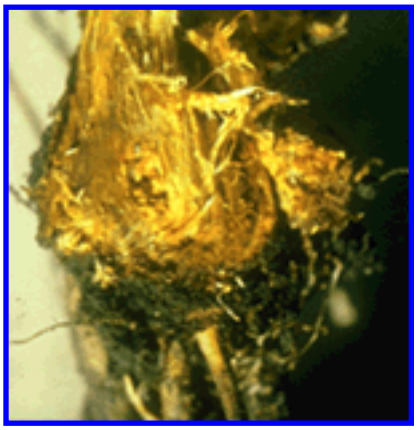

Figure 2. Diseased crown and upper taproot. (17K JPG)

Phytophthora root rot caused by *Phytophthora megasperma medicaginis* 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. *Phytophthora* causes damping-off of seedlings, root rot, and rot of lower stems (*see Figure 1*). Additional information on Phytophthora root rot is available in NebGuide *G89-900, Phytophthora Root Rot of Alfalfa*.

Symptoms

The general symptoms of crown and root rot are deterioration and discoloration of infected tissue. Some crown and root rots have distinctive symptoms and easily are identified. Since most crown and root rots involve more than one type of organism, however, 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.

Figure 3. Reddish brown crown rot caused by *Fusarium*. (17K JPG)

Diseased crowns and upper taproots appear shredded, and the color of rotted tissue varies from dark orange to reddish-brown to purple to black (*Figure 2*).

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. Crowns and upper taproots infected by *Fusarium* fungi are reddish to dark-brown (*Figure 3*.).

Rot of 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. Plants often can survive for years with moderate injury.

Figure 4. The dark purple discoloration of taproot by violet root rot. (17K JPG)

In the later stages the rot may involve both cortex and vascular tissues. If *Phoma* is present, the rotted area appears as dark brown to black wedge-shaped lesions or as long lesions on crown branches. Crown rot often causes plants to grow unevenly due to death of crown buds on one side of the crown.

Taproots of plants having violet root rot are covered with a dark purplish-brown mat of fungus mycelium (*Figure 4*).

Figure 5. Bluish black crown rot caused by anthracnose. (25K JPG)

Anthracnose spreads from the base of stems into the crown and upper taproot. It causes a bluish-black crown rot (*Figure 5*) that may extend from the base of infected stems into the upper taproot. Anthracnose and fusarium crown rot sometimes are present in the same crown. The bluish-black symptom of anthracnose is distinctive enough to distinguish it from other crown rots.

The Role of Crown Injury and Stress in Crown and Root Rot Development

Crown injury and plant stress strongly influence the development and severity of alfalfa crown and root rots. Crown or root injury often provides a point of entry for crown and root-rotting fungi. Crown and root feeding insects, the alfalfa stem nematode, machinery traffic from harvesting and cultivating, and improper fall grazing practices all are associated with crown injury and the resulting infections.

Stored carbohydrates (sugars) in taproots are essential for winter survival, regrowth in the spring, and crown and root rot resistance. After alfalfa is cut, carbohydrate reserves are used during new shoot regrowth.

By early bud stage new shoots are beginning to produce enough sugars to replenish carbohydrates lost from the taproot during early regrowth. If alfalfa is cut at bud stage or earlier while root reserve carbohydrates are low, these reserves will be reduced further when regrowth occurs, and will cause crowns and roots to become especially vulnerable to infection by certain crown and root-rotting organisms.

Low levels of reserve carbohydrates also can occur if stands are cut in late September or early October, allowing only a couple weeks of regrowth before the onset of winter dormancy. Later cutting may not allow sufficient time for new shoots to replenish carbohydrates depleted in the taproot during regrowth.

Plants going into winter with low carbohydrate levels in the upper taproots may not have sufficient cold tolerance to protect them from winter injury. These weakened plants also are susceptible to infection by crown and root-rotting fungi and to winter injury.

When winter injury occurs, the wounded crown tissue soon is invaded by primary and secondary rot organisms. Then it becomes difficult to determine where winter injury ends and rot begins.

Due to the close relationship between winter injury, the crown and root rot complex and stand decline, growing winter-hardy alfalfa varieties in Nebraska is vital.

Managing Alfalfa to Reduce Crown and Upper Root Rot Development and Increase Stand Longevity

Proper management of alfalfa can reduce the development of crown and root rots and cold temperature injury (*Table I*). Development of the crown and root rot complex can be slowed or increased by management practices. While control practices are not well defined, it is known that high levels of stored carbohydrate reserves in roots will improve the plant's ability to withstand severe winters and overcome winter injury and crown and root rot.

Since more than one type of organism causes crown and root rot, varieties with resistance have not been developed. It is best to use alfalfa varieties with good cold tolerance and resistance to stem nematode, phytophthora root rot and anthracnose since they are directly, or indirectly, involved in the crown and root rot complex.

Crown and root rot can be reduced in alfalfa by maintaining proper soil fertility and pH. Alfalfa is a heavy user of phosphorus and potash, and adequate amounts of these help reduce *Fusarium* crown and root rot. Top dress established stands when necessary according to soil tests to achieve maximum yield

and sustain productivity. Adjust soil acidity to a pH of 6.8 to 7.0 before planting alfalfa.

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

- Select cold-tolerant alfalfa varieties resistant to bacterial wilt, anthracnose, Phytophthora root rot, stem nematode, and Verticillium wilt.
- Plant in soil suitable for growing alfalfa.
- Fertilize with phosphorus and potash as needed, based on soil tests.
- Adjust soil pH to 6.8 to 7.0 by liming.
- irrigation stands prior to cutting.
- Allow soils to become firm before driving heavy equipment on them, and delay new irrigations until regrowth has begun.
- Do not cultivate stands for weed control or fertilizer incorporation.
- Harvest when soil is firm.
- Adjust harvest intervals to the growth of the plant.
- Do not harvest stands after Sept. 15.
- Control alfalfa weevil, aphid, and potato leaf hopper infestations.
- Graze stands only after alfalfa is fully dormant and ground is dry and remove animals as soon as aftermath is gone.

Do not cultivate to incorporate top-dressed fertilizer or to control weeds. Top-dressed fertilizers do not need to be incorporated to be absorbed, and injuries to crowns from disks, springtooths or harrows provide ideal entry wounds for crown and root-rotting fungi.

Harvest timing and cutting intervals greatly affect root carbohydrate reserves, which in term affect plant vigor, winter injury, crown and root rot and, ultimately, stand longevity. Under normal growing conditions it takes about two or three weeks of regrowth before new shoots begin to manufacture enough food to start to replenish reserves in the root used during new shoot elongation. Four or five weeks are needed before reserve levels are as high as they were before harvest.

A shortened harvest interval produced by cutting at or before the flower bud stage depletes carbohydrate reserves in roots faster than they can be replenished. Shortened cutting schedules are tolerated by plants better during mid-season than in May or September.

The old rule of thumb to cut at one-tenth bloom balances forage quality with yield while allowing adequate time for root reserves to be replenished.

Cutting or grazing alfalfa three to four weeks before the first killing frost forces plants to regrow and use carbohydrate reserves that may not be replaced adequately before cool weather and frost stops growth. The resulting carbohydrate levels may be too low for winter survival or to resist crown and root rots, especially if the alfalfa plants have been harvested frequently during the year and/or stands are showing

signs of weakness or stress.

In Nebraska take a final cutting before mid-September to allow time for sufficient (six to 10 inches) top growth prior to the onset of dormancy. Alfalfa may be cut or grazed after dormancy without seriously reducing root carbohydrate levels.

Standing alfalfa stubble traps snow to provide some insulation against cold, drying winter winds. Stands slow to green up and grow rapidly in spring due to winter injury may recover if first harvest is delayed until close to full bloom.

Many interrelated factors are associated with crown and root rot development and so, ultimately, to stand longevity. Alfalfa is an important crop, so manage stands accordingly. The quality of the management often makes the difference between profit and loss over the life of a stand.

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