Crown and root diseases occur to some extent in every alfalfa stand in Iowa. The perennial nature of the alfalfa plant subjects it to chronic diseases unlike those that affect other crops. These chronic diseases slowly destroy the crown and roots, which slows growth and eventually kills the plant. Some root and crown diseases act more quickly and can kill plants within a few weeks.

Environmental conditions have a strong influence on the susceptibility of alfalfa plants and the development of the pathogens. Problems that predispose alfalfa to crown and root disease include poor winter hardiness, acid soils, poor drainage, nutrient deficiencies, heaving and other winter injury, shading, insect pests, and foliar diseases.

Symptoms of these diseases are difficult to recognize because the damage occurs underground and the above-ground symptoms may not be noticeable until plants are severely diseased. Above-ground symptoms usually are poor growth, yellowing, wilting, and death. Each disease can have additional symptoms, above or below ground, that help to distinguish it from the others.

Seedling Blights and Seed Rots

These diseases are caused by soil-borne fungi, primarily in the genera *Pythium*, *Phytophthora*, *Rhizoctonia*, *Aphanomycyes*, and *Fusarium*. *Pythium* is probably the most common cause. It destroys seeds before germination or kills seedlings after emergence. Roots or stems appear water-soaked at first, and the seedlings usually collapse and die. *Aphanomycyes* can cause the cotyledons to turn purple before the seedling dies, and the seedlings may not collapse, but remain standing (Figure 1). Cool, wet soil encourages infection. Seed treatment with metalaxyl controls seedling blights caused by *Pythium* and *Phytophthora*. *Aphanomycyes* and *Fusarium* are not affected by metalaxyl. A well-prepared seedbed and planting when the soil is not too cold or wet will reduce the risk of seedling blights.

Phytophthora Root Rot

Phytophthora root rot, caused by *Phytophthora medicaginis* or *Phytophthora megasperma*, affects plants at all stages of development and is probably the most common root rot. It occurs when the soil is poorly drained or during periods of excessive rainfall. Above ground, the plants appear stunted and discolored yellow or reddish purple, and they may be wilted. The taproots can have brown lesions, often where a lateral root emerges (Figure 2). Internally, the root tissue is discolored yellow. When the roots are severely rotted, the plants are pulled up easily, leaving the roots in the soil.

Seed treatment with metalaxyl will reduce damping off and early Phytophthora root rot. In adult plants, the disease can be managed by planting resistant varieties. Most of the recently developed varieties have some resistance, and many are highly resistant. Under extremely wet conditions, there still can be some losses to Phytophthora root rot. Adequate drainage will reduce the risk of serious root rot, regardless of the variety.
Aphanomyces Root Rot

This disease, caused by the fungus *Aphanomyces euteiches*, is a more recently recognized problem in alfalfa. In Iowa, the extent of losses from this disease is unknown. On adult plants, the symptoms are very difficult to distinguish from Phytophthora root rot, and the two diseases often occur together. The root symptoms of Aphanomyces root rot are less distinct than those of Phytophthora root rot, sometimes only displaying a reduced root mass with little indication of decay. Above ground, the symptoms are essentially the same as Phytophthora root rot. Some varieties with resistance to this disease have been released. Adequate drainage will reduce the risk of serious root rot, regardless of the variety. Aphanomyces also infects peas and *Phaseolus* beans; rotating alfalfa with these crops may result in more severe root rot and seedling blight.

Pythium Root Rot

In addition to their effects on seedlings, *Pythium* species, such as *Pythium ultimum* and *Pythium irregularare*, can cause damage to adult plants. These fungi are very common on alfalfa roots in Iowa. They are often referred to as “root nibblers” because they destroy the fine roots of plants without causing noticeable decay. This type of root damage can lead to measurable yield reduction. Poor growth above ground is usually the only symptom. The disease is more common in soils that are wet for prolonged periods, and it may occur along with other root rots. There are no resistant varieties, although some may be less susceptible.

Fusarium Root Rot

Several *Fusarium* species can cause seedling blight and root and crown rot of alfalfa. Fusarium root rot is often a chronic condition, causing the plant to slowly decline. On adult plants, the impact of the disease is influenced by other stress factors, as described above. Cutting frequently also can increase susceptibility of the plants. Above-ground symptoms are similar to other root rots. The roots have brown to reddish brown lesions, or smaller roots are brown and decayed. Fusarium root rot is very common in Iowa, but its impact on the plant may be small in many cases. When other stresses are present, Fusarium root rot can become severe. Chronic Fusarium root rot often is accompanied by crown rot, and the combination eventually kills many plants. Most varieties are susceptible, and management of this disease depends on maintaining favorable growing conditions.

Crown Rots

Crown rots occur to some extent in every alfalfa stand that is over one year old. They are a major factor in the limited life span of alfalfa stands. The repeated wounding of stems and crowns, which occurs during harvest, provides abundant infection sites for fungi that are often weakly pathogenic. These fungi slowly decay the crown tissue during a period of months or years, eventually killing the plant or predisposing it to winter kill. *Fusarium* species, such as *Fusarium oxysporum* f.sp. *medicaginis*, *Fusarium solani*, and others, are the most common fungi associated with chronic crown rot. Other fungi, such as *Rhizoctonia solani*, *Phoma medicaginis*, and *Pythium* species, also can be involved. The stem nematode can predispose plants to severe crown rot. Because several fungi and possibly the nematode can be involved, crown rots often are referred to as a disease complex.

The symptoms of the crown rot complex are a brown to reddish brown decay of the crown and root cortex and eventually the vascular tissue (Figure 3). This decay usually originates from cut stems and progresses downward. In severe cases, the central core of the crown and taproot are hollow. Plant vigor slowly declines until the plants are noticeably stunted. Eventually, the plants wilt and die due to destruction of the crown bud tissue and/or the root tissue.

*Colletotrichum trifolii* (anthracnose) also causes a severe crown rot in addition to stem lesions. Anthracnose crown rot is distinct from other crown rots because it causes a blue-black decay (Figure 4).

All varieties are susceptible to crown rot (some are resistant to anthracnose), and management practices for this disease consist of maintaining good growing conditions, planting adapted varieties, and maintaining a proper cutting schedule. Maintaining adequate levels of potassium and phosphorus will reduce susceptibility to root and crown rots. Cultivation causes injuries that allow entry of these pathogens, so it is not recommended. Cutting
too frequently stresses plants and predisposes them to crown and root rots. Do not cut within 4–6 weeks prior to the first killing frost. This allows plants to build up reserves before winter. A final cut may be made after the plants are dormant.

These practices will decrease the rate of decline, but crown rots will still occur. The condition of stands should be monitored every spring to determine when they have declined sufficiently to warrant replanting or rotation (see ISU extension publication Pm-1362, *Evaluating Hay and Pasture Stands for Winter Injury*). Stands with severe crown or root rot should not be reseeded to alfalfa, but replanted with a grass or rotated to another crop.

**Other Root and Crown Roots**

A few other root and crown root pathogens occur in Iowa. *Rhizoctonia solani* causes a root rot characterized by localized sunken brown lesions, especially where lateral roots emerge. It attacks plants at any stage under warm, wet conditions, killing seedlings or older plants. *Rhizoctonia crocorum* is the cause of violet root rot. Symptoms of this disease are a distinct purple mycelial covering of the crown and taproot, accompanied by yellowing and death of foliage. The disease usually occurs in expanding patches. Sclerotinia crown and stem rot, caused by *Sclerotinia trifoliorum*, usually develop during the fall and winter, destroying fall seedings or established plants. It is not common in Iowa.

**Wilt Diseases**

Wilt diseases infect the roots and stem of the plant, but do not cause extensive decay. The damage they cause is limited to the vascular system, but this damage can lead to death of the plant. These diseases share common symptoms that also can be confused with those of root rots: wilting, stunting, yellowing, and death (Figure 5). However, wilt diseases have other distinct symptoms, primarily discoloration of the vascular tissue without accompa-

**Bacterial Wilt**

This disease is caused by the bacterium *Corynebacterium michiganense* subsp. *insidiosum*. It overwinters in infected plants and in plant residue in the soil. It is spread by splashing water, animals, equipment, and movement of hay. The stem nematode can be a vector of this pathogen. The bacterium infects through wounds in the roots, crown, or stems. Yellowing and poor growth are most evident after cutting. Plants can be killed by plugging of the vascular tissue and production of a toxic compound by the bacterium. Infected plants are very susceptible to winter kill. Bacterial wilt was once a major disease, but can now be controlled through resistance.

**Fusarium Wilt**

Fusarium wilt is caused by the fungus *Fusarium oxysporum* f.sp. *medicaginis*. This fungus and other *Fusarium* species can be involved in root and crown rot, but the wilt disease is distinct. The fungus can survive in soil or residue as chlamydospores. It infects plants through wounds in the roots and develops slowly in the plant. A stand usually will suffer gradual thinning over a period of months or years. Fusarium wilt is controlled by resistant varieties.

**Figure 4. Blue-black discoloration and decay caused by the anthracnose pathogen**

**Figure 5. Above-ground symptoms of stunting and yellowing can be caused by wilt diseases or crown and root rots.**

**Figure 6. Wilt diseases cause discoloration of the vascular tissue in stems and roots.**
Verticillium Wilt

This disease is caused by the fungus *Verticillium albo-atrum*. Verticillium wilt causes discoloration of the vascular tissue, and scorching and wilting of individual leaves, often appearing as a V-shaped chlorosis at the tip of the leaflet. The leaves become dried and curl upward slightly. The stem remains green and erect until all the leaves are dead. The fungus can be seed borne, but also survives in the soil. Infection occurs through roots and stem wounds.

This disease is not widely distributed in Iowa, and apparently occurs only occasionally. It is a major disease in other parts of the U.S. Resistant varieties provide control. Rotation does not reduce the disease because it infects many weed hosts. For more information on this disease, see North Central Regional Publication No. 181, *Verticillium Wilt of Alfalfa: A New Disease for the Midwest*.

Nematodes

Nematodes are microscopic worms that live in the soil. There are several types of nematodes capable of causing disease in alfalfa. These include root-knot nematodes (*Meloidogyne* species), root-lesion nematodes (*Pratylenchus* species), and others. They cause various types of damage to alfalfa roots. These nematodes also predispose plants to many of the root and crown pathogens listed above, causing even more severe decay of these plant parts.

The most important nematode of alfalfa is the stem nematode (*Ditylenchus dipsaci*). Unlike most nematodes, this species infects the growing buds in the plant crown, not the roots. Infected buds swell, and the stems fail to elongate, resulting in swollen, compact plants (Figure 7). The stems and leaves can become bleached and distorted. Severe infections result in blackening and decay of the stem and crown, accompanied by fungal infection, and eventual death. Thus, the stem nematode is a factor in the crown and root rot complex and can contribute to winter kill.

The nematode can survive in or on infected seed, which is a major cause of spreading. The nematode also survives in soil residue and can be spread by water, machinery, or animals that move this residue. The disease is most severe in heavy soils and under extremely wet conditions. Temperatures of 60° to 70° F are optimum for infection and development, but *D. dipsaci* can adapt to a wide range of temperatures.

Stem nematodes can survive for many years in dry, fallow soil or on stored seed. But in Iowa field conditions, they do not survive more than two years in the soil. Therefore, rotation can reduce their numbers. Resistant varieties are the best control.

Prepared by G. P. Munkvold and X. B. Yang, extension plant pathologists.

This material is based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project number 93-EFRA-1-0002.

*Figures 1, 2, 4, 5, 6, and 7 courtesy of American Phytopathological Society.*

... and justice for all

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Many materials can be made available in alternative formats for ADA clients. To file a complaint of discrimination, write USDA, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964.