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Phytophthora Root Rot of Alfalfa

Disease cycle, symptoms and management practices for phytophthora root rot are discussed in this NebGuide.

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Phytophthora root rot (PRR) is a major cause of seedling death in newly established alfalfa, and causes a progressive decline of established stands in Nebraska. This disease is caused by the fungus *Phytophthora megasperma* f. sp. *medicaginis* and occurs in most of the alfalfa producing areas in North America.

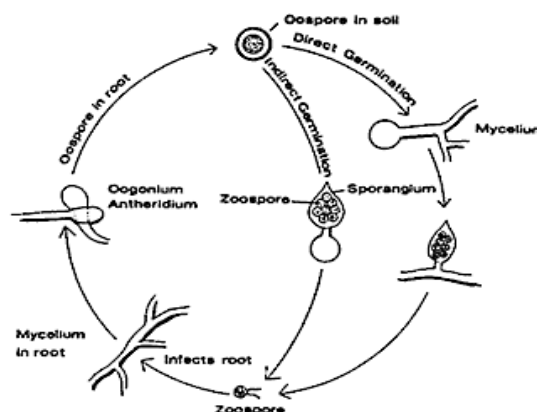
The *Phytophthora* that infects alfalfa is different from the *Phytophthora* that causes root rot in soybeans. Growers sometimes think the two diseases are the same for the respective crops, but they are two different diseases with the common name of phytophthora root.

Phytophthora root rot 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. It also weakens plants, making them more susceptible to injury during severe winters.

Disease Cycle and Occurrence

P. megasperma f. sp. *medicaginis* survives in the soil as resting spores called oospores. Oospores are formed in infected roots and eventually are released into the soil following breakdown of the rotted roots. Optimum conditions for oospore spore germination, infection and disease development include temperatures of 65° to 75° F and nearly saturated soils. Under these conditions the oospores germinate to produce sporangia which release the infective motile zoospore stage.

Figure 1. Life cycle of *Phytophthora megasperma* f. sp. *medicaginis*.



The life cycle of *P. megasperma* f. sp. *medicaginis* is shown in Figure 1. The fungus is spread within and between

fields by irrigation water carrying zoospores. it can survive and spread further in waste water from diseased fields that is rechanneled back to the irrigation canal for use elsewhere. Oospores also can spread in soil attached to machinery or hooves of animals.

Phytophthora root rot is most severe in fields with poor internal drainage or in fields where soils become saturated by excessive irrigation or rainfall. Flood irrigated fields that stay wet for up to 10 days are more likely to develop phytophthora root rot than are sprinkler irrigated stands. However, severe root rot damage has occurred in the Nebraska Sandhills on sprinkler irrigated fields that were continuously irrigated in spring, resulting in saturated sandy soils.

Damage by *Phytophthora* may occur rapidly in spring in young stands when plants may die shortly after infection; or it may be delayed until summer in older stands when injured roots cannot adequately replenish moisture lost to hot, drying winds. Many older plants that have severe root rot die during the winter months. This results in severe stand thinning by spring.

Phytophthora root rot is only one of the problems that develops in wet fields or during wet years. Nutrient deficiencies may occur since sulfur, boron, potassium and magnesium readily leach from sandy soils. in waterlogged clay soils roots don't absorb nutrients easily, resulting in nutrient deficiency symptoms expressed in leaves and stems.

Another problem with saturated soils involves soil oxygen and its effect on root development. Roots need soil oxygen to grow and survive. Alfalfa is more sensitive to a lack of soil oxygen than most crops; two or three days of soil moisture saturation can initiate root degradation due to poor soil oxygen exchange.

Plants with damaged roots may appear healthy when the water demand is low during cool temperatures, but during hot, dry periods of high water demand, affected plants easily are stressed. Injured root systems cannot absorb enough soil moisture to replace that lost from leaves and stems, so plants wilt and even may die.

Root rot due to prolonged periods of waterlogged soils does not occur frequently. However, when it does occur, it easily can be confused with root rot caused by *Phytophthora*.

Symptoms

In any field phytophthora root rot is most likely to occur in areas where water collects. Symptoms often are severest in poorly drained areas in the field, but in some 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. Seedling failures appear to be more common in direct seeded fields. Infected seedlings turn reddish-yellow, wilt, and die very rapidly (Figure 2).

Figure 2. Damping-off of seedlings caused by phytophthora root rot. (33K JPG)

It is not uncommon for complete stand loss to occur in low areas of a field in just a few days. Stand failures often reoccur if these fields or diseased areas are reseeded immediately, even if resistant varieties are used for the second planting. 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 *Phytophthora* from that caused by other root rotting fungi such as *Pythium*. Plants having a reddish to yellow cast are usually infected by *Phytophthora*. The taproot of *Phytophthora*-infected plants will be rotted and collapsed at a given depth 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 four or six inches below the soil surface and causes a yellow to

brownish-red discoloration of the outer cortical tissue which eventually moves into the central cylinder (*Figure 3*). Rotted taproot tissue remains firm.

Figure 3. Rot of the central cylinder of a taproot caused by phytophthora root rot. (19K JPG)

Under dry soil conditions, *Phytophthora* lesions become brownish to black in color, resembling the feeding injury caused by root curculio insects. When severe, the lower taproot is completely rotted off (*see Figure 4*). These plants are severely stunted and yield less than one half that of healthy plants. Branching of the taproot often occurs above the point where the taproot is rotted off (*see Figure 4*). Plants with rotted taproots are more easily removed from the soil.

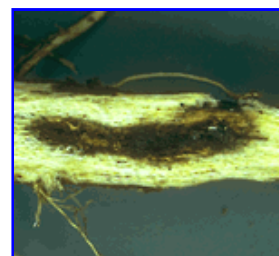


Figure 4. Branching and rotting-off taproots due to infection of Phytophthora. (23K JPG)

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.



If you suspect phytophthora root rot but lack confidence in your field diagnosis, collect several diseased (not dead) plants, including roots and soil, place in a plastic bag with pencil-size holes for ventilation, and take them to your local extension office. If the extension agent cannot make the diagnosis, the sample will be sent to the Plant Disease Diagnostic Clinic, Rm. 448, Plant Sciences Bldg., University of Nebraska-Lincoln, 68583.

Management Practices for Phytophthora Root Rot Control

Management practices to prevent or reduce losses to phytophthora root rot include soil and water management and the use of PRR resistant or highly resistant alfalfa varieties adapted to Nebraska.

Resistant Varieties: Alfalfa varieties resistant or highly resistant to phytophthora root rot currently are available. Varieties rated PRR resistant vary greatly in degree of resistance as shown in *Table I*.

Studies conducted in west-central Wyoming in a field naturally infested with *P. megasperma* f. sp. *medicaginis* illustrated the value of phytophthora root rot resistance to stand establishment, stand longevity, and forage yield in alfalfa. In the year after seeding, stands of resistant (R) varieties were significantly denser than stands of moderately resistant (MR), low resistant (LR), or susceptible (S) varieties. Yield loss occurred due to early stand loss and reduced yields of the surviving infected plants.

Table I. Disease resistance in alfalfa is characterized according to the frequency of resistant plants in a population.	
<i>Classification</i>	<i>Percent of Plants Having Resistance*</i>
HR = Highly Resistant	more than 50
R = Resistant	31-50
MR = Moderately Resistant	16-30
LR = Low Resistant	6-15*
S = Susceptible	less than 6
*Avoid planting susceptible varieties or those with only a low level of resistance to phytophthora root rot, anthracnose, and bacterial wilt.	

Phytophthora root rot-infected plants produced 68 percent less forage over two years than plants free of the disease. Diseased plants had more winter injury due to the elimination of sufficient upper taproot tissue needed for carbohydrate storage.

As the level of resistance to phytophthora root rot increased, alfalfa plants had less disease, better stand establishment and persistence, and increased forage yield. After four years, yields of R and MR varieties still were increasing, while yields of LR and S varieties were declining.

Resistance to phytophthora root rot, bacterial wilt and anthracnose is essential to establishing and maintaining a healthy and productive alfalfa stand in Nebraska. Only plant cold-tolerant varieties resistant or highly resistant to these three diseases. NebGuide G77-357, *Selecting Alfalfa Varieties for Nebraska*, provides current information on alfalfa varieties for Nebraska.

Soil and Water Management: Use PRR resistant varieties along with good soil and water management practices. Not all plants within a resistant variety (*Table I*) will be resistant, so resistant varieties can show disease damage if the inoculum level of *P. megasperma* f. sp. *medicaginis* spores is abundant and the soil remains wet for several days.

Irrigation length and frequency greatly can affect the severity of phytophthora root rot.

Since the disease is aggravated by extended wet periods, avoid frequent irrigations of excessive duration. Allow the top foot of soil to dry out periodically to inhibit disease, enhance oxygen exchange, control annual weeds and permit harvest.

If moisture is in the subsoil, alfalfa's deep root system will continue to supply adequate moisture for growth. Excessive irrigation not only saturates the soil, but runoff water carries spores of the pathogen, causing further spread of the disease.

Do not allow irrigation water to stand on fields longer than two days. Most irrigation is scheduled using plant or soil-based criteria. Where phytophthora root rot is involved, short frequent irrigations or deep infrequent irrigations will aggravate the disease less than long frequent irrigations.

Successful water management and flexibility to adjust water management depends on drainage characteristics of the soil and on prevention of flooding all or parts of the field for extended periods. Land leveling to eliminate low areas and any other methods that provide better distribution of irrigation water help reduce disease development.

Alfalfa does not tolerate 'wet feet'. Fields with poor drainage probably should be planted to grasses or a grass-alfalfa mix rather than solid alfalfa.

Stand Establishment: Greater loss of seedlings occurs in fields with a history of phytophthora root rot. These fields should be rotated out of alfalfa for two or three years. This will reduce, but not eliminate, *Phytophthora* from the field, so that field should only be replanted to a PRR resistant variety.

Even fields with a history of healthy alfalfa should be rotated to other crops to interrupt disease cycles and permit replenishment of subsoil moisture whenever possible. On irrigated fields apply water prior to planting, and irrigate sparingly after planting to avoid saturation.

Plant alfalfa seed treated with the systemic fungicide metalaxyl, sold as Apron¹, to provide added protection for the resistant varieties in the critical first three weeks of a seedling's development. Metalaxyl does not appear to inhibit either Rhizobia bacteria or the nodulation process.

Many seed dealers offer pre-treated alfalfa seed with inoculant and Apron covered by a lime coating. Sometimes additional inoculation can benefit preinoculated seed.

Apron provides protection for 14 to 21 days, which usually is long enough for the plants' resistance to take over. It is recommended that seed be treated regardless of the level of resistance of the variety being planted.

In summary, assess the phytophthora root rot potential of the site before planting, and plant only PRR resistant varieties using seed treated with Apron. Avoid extended irrigation.

Good management practices can prolong the productive life of diseased stands. Maintain good soil fertility to promote extensive lateral root development above the diseased region of the taproot, and allow extra time between harvest for plants to recover (*Table II*).

Table II. Management practices to control phytophthora root rot of alfalfa.

1. **Site Selection:** Select fields with good surface and internal drainage and without a history of phytophthora root rot problems.
2. **Resistant Varieties:** Use varieties that are resistant or highly resistant.
3. **Water and Soil Management:** Improve soil drainage, level fields to prevent puddling. and irrigate to meet the needs of the crop and growing conditions.
4. **Stand Establishment:** Treat good quality seed with Apron and plant into a firm, mellow seedbed.
5. **Other Practices:** Fertilize newly seeded and established stands to promote vigorous growth and good root development.

¹The mention of fungicide trade names does not constitute endorsement by the University of Nebraska nor criticism of products not listed. Read and follow all product label directions for mixing and application.

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