

## Aphanomyces Root Rot of Sugarbeet

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This NebGuide covers the life cycle, identification and management of *Aphanomyces cochlioides* in sugarbeet, including photos to aid in diagnosis of symptoms.

Diseases are one of the primary yield-limiting factors affecting successful sugarbeet production in the Nebraska Panhandle and other areas in the central High Plains. Foliar diseases such as *Cercospora* leaf spot and powdery mildew commonly occur, but normally are easier to control than soilborne diseases. Diseases caused by soilborne, root-rotting pathogens often cause more devastating losses because they are difficult to detect before serious damage occurs, and control measures are often ineffective or impractical.

One of the most important root diseases in sugarbeet production is *Aphanomyces* root rot, caused by the soilborne oomycete *Aphanomyces cochlioides*. Today *A. cochlioides* is well recognized as a pathogen wherever sugarbeet is grown worldwide. In the United States, the pathogen occurs infrequently in the far west states but is a growing problem in other regions, particularly southern Minnesota and the Red River Valley of North Dakota and Minnesota. Over the last decade, the incidence of this pathogen has decreased as a result of the extended drought. However, after extensive soil testing, the pathogen has been demonstrated to be widely

distributed (identified from one-third of samples tested) throughout western Nebraska and other areas of the central High Plains. The purpose of this publication is to inform sugarbeet personnel of the presence of the disease, how to identify it, and how to best manage it.

### Symptoms

Root disease caused by *A. cochlioides* can occur as two distinct forms: the acute and chronic phases. The acute seedling phase is commonly referred to as black root. It does not rot the seed or affect initial stand establishment, but can significantly affect plant stands by inducing seedling damping-off several weeks after emergence. Symptoms on infected seedlings begin as grayish, water-soaked lesions on stems near the soil level. Lesions soon progress from gray to black, causing the stem to become thin and thread-like (*Figure 1*). Cotyledons seldom wilt before seedlings die, which helps distinguish this disease from the wilting associated with seedling disease caused by *Rhizoctonia* and *Pythium*.

If conditions become unfavorable for further disease development, plants may recover and still produce a relatively normal crop. Severely affected plants from black root have very delicate, thin stems, and are often more susceptible to breakage from high winds in the spring (*Figure 2*).



**Figure 1.** Black, thin stems and lack of cotyledon wilting, characteristic of acute seedling phase of the disease caused by *A. cochlioides*. Note the pink-colored stem of healthy plant.



**Figure 2.** Young sugarbeet plant infected by *A. cochlioides*. Thin, delicate stems are more susceptible to breakage and stand loss from high winds (inset).



**Figure 3.** Foliar symptoms (yellowing and stunting) characteristic of *Aphanomyces* root rot.



**Figure 4.** Foliar symptoms (yellowing and wilting) characteristic of *Aphanomyces* root rot.



**Figure 5.** Root lesions of *Aphanomyces* root rot of sugarbeet — initial water-soaked lesions (*left*) and scabby lesions after drying (*right*).



**Figure 6.** Early tip rot symptoms of *Aphanomyces* root rot of sugarbeet.

The chronic root rot phase occurs on plants infected earlier in the season or from new infections on older plants, and is more common than the acute phase in many production areas. Foliar symptoms consist of stunted, yellowed leaves with non-vigorous growth (*Figure 3*). Wilting also may occur during the day, but plants often recover at night (*Figure 4*). Permanent wilting is not common, in contrast with *Rhizoctonia* root rot. Leaves also may take on a scorched appearance and become brittle. Root symptoms begin as yellowish-brown, water-soaked lesions on taproots, (*Figure 5, left*) that later become dry and necrotic (scarring) if infection ceases (*Figure 5, right*). These lesions can occur anywhere on the taproot, but often occur toward the distal end as a tip rot (*Figure 6*). If disease continues to progress, the lesions penetrate into the root interior, causing a yellowish-brown discoloration of infected tissues (*Figure 7*). Similar to the acute phase, if environmental conditions become more favorable for plant growth, plants may recover to produce a relatively healthy crop; however, many roots may still exhibit varying degrees of root distortion and/or scarring (*Figures 8 and 9*), which are indicative of previous *A. cochlioides* infections. In severe cases, the extent of the disease can completely destroy taproots, leaving

little except the crowns (*Figure 10*), yet often still may maintain deceptively healthy looking tops. Economic loss also may occur at harvest due to this disease because beets affected to this degree are easily dislodged from soil, and roots knocked into furrows during the defoliation process are not subsequently retrieved by the harvester (*Figure 11*).

### Pathogen and Disease Cycle

Both forms of the disease are caused by the same oomycete “water mold,” *A. cochlioides*. This pathogen produces two types of spores. Zoospores are motile, tadpole-like spores that can spread through soils high in water content and are produced asexually. Oospores are sexually produced spores that are circular, thick-walled structures capable of surviving for long periods in soils under adverse conditions (*Figure 12*).

Disease is initiated when soils become warm and very wet. Under these conditions, the overwintering resting spores (oospores) germinate and can infect plants directly, or through the production of zoospores. These spores can swim independently through soil water. Therefore, the presence of saturated soils helps this disease to progress



Figure 7. Internal discoloration of taproot as disease progresses from initial infection.



Figure 8. Mild scarring of sugarbeet due to previous *A. cochlioides* infection.



Figure 9. Severe distortion of sugarbeets due to previous *A. cochlioides* infection.



Figure 10. Severe rotting symptoms of *Aphanomyces* root rot of sugarbeet.



Figure 11. *Aphanomyces*-infested field at harvest and severely scarred and distorted roots broken off at ground level after defoliation (inset).

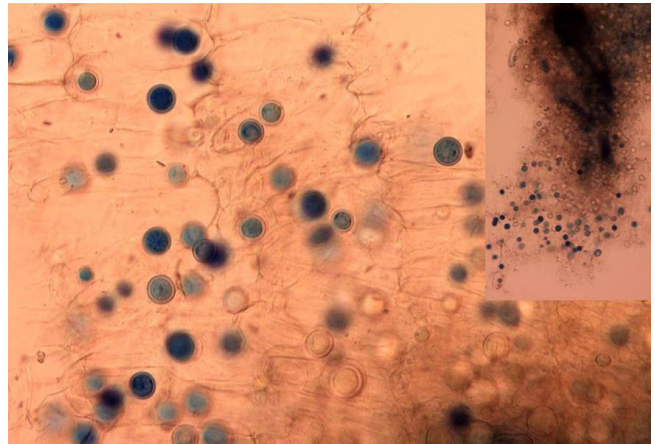


Figure 12. Light microscopy of small infected feeder root. Circular, darkly stained structures are overwintering oospores.

rapidly throughout fields and cause significant losses. Disease severity in the chronic root rot phase depends largely upon available soil moisture and temperatures. Infection has been reported to occur in soil temperatures ranging from 65-90°F, but the optimum is about 78°F.

### Disease Management

- Chemical control is possible only as a seed treatment with the fungicide Tachigaren (active ingredient hymexazol). This fungicide is active for a few weeks after planting, depending on the rate applied to seed, soil moisture and temperature, and microbial activity. It is the only registered fungicide that controls *Aphanomyces* and, thus, is used worldwide as a standard treatment for sugarbeet seed. This method can significantly reduce postemergent damping-off of seedlings and help to establish a vigorous stand; however, it is effective only for the acute seedling phase of the disease.
- Plant cultivars with some resistance to the pathogen. Resistance is not expressed until several weeks after planting. Current recommendations for those with known high disease potential are to plant seed of resistant, locally adapted cultivars treated with hymexazol.
- Some cultural practices that are moderately effective are primarily based on exploiting environmental conditions necessary for reducing or avoiding disease development and progression. They include early planting to establish stands before soil temperatures are favorable

for infection and reducing irrigation. Seedling disease from *A. cochliformis* was reduced under irrigation conditions that provided enough soil moisture to allow emergence, but not enough to stimulate zoospore production or movement.

- Control weed pressure. Several common weeds, including pigweed, lambsquarters, and *Kochia* (fireweed), have been reported to be hosts for the pathogen. These weeds may serve as a reservoir for harboring or increasing pathogen populations in soils, even in the absence of sugarbeets.
- Do not evaluate plants for moisture stress in the afternoon. Both infected and healthy plants can wilt at this time of day. If already infected, further irrigations can cause the disease to become more severe.
- In general, avoid undue stress on plants as this can make them more susceptible to this disease. Any practice that creates a vigorous, well-established crop more rapidly also will help to lessen disease problems.

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