



Aphanomyces Root Rot of Alfalfa

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What is Aphanomyces Root Rot of alfalfa?

Aphanomyces Root Rot (ARR) is a disease caused by the oomycete pathogen, *Aphanomyces euteiches*. *A. euteiches* can infect many legume species, one of which is alfalfa (*Medicago sativa*). Aphanomyces is often seen in disease complex with other root rotting diseases, such as Phytophthora and Pythium Root Rot. Fieldwide symptoms of Aphanomyces infection include thin, stunted growth above soil with yellowing leaves and rotting root systems below the soil surface (Figure 1). ARR is an economically important disease because it affects alfalfa at both the seedling and mature plant stages causing severe yield loss.



Figure 1. Disease symptoms on non-resistant line (left) and a resistant line of alfalfa (right) after being infected with Aphanomyces. Infected plants show a reduced root system with honey-brown lesions. (Photo credit: Jenni Giles)

Symptoms of Aphanomyces Root Rot

Aphanomyces euteiches most commonly affects the roots of seedlings but can also cause root rot of established plants. The characteristic symptom of the disease includes infected roots that are soft with honey-brown colored lesions (Figure 1). Above ground symptoms such as chlorotic (yellowing) cotyledons and leaf tissue develop as the pathogen continues to spread (Figure 2). Unlike other root rotting pathogens, seedlings infected with Aphanomyces remain upright after infection (standing corpses), making the disease potentially less noticeable than others. Surviving infected plants may experience stunted growth, decreasing the ability to compete with weeds. Roots begin to decay and root mass is eventually greatly decreased in established fields (Figure 3). Lack of fibrous and lateral roots are common symptoms on adult plants. In addition, nodules also show signs of decay or are absent from the roots entirely, reducing nitrogen fixation. Alfalfa plants infected with Aphanomyces may be slow to grow after winter dormancy or following harvest due to poor root health. In severe cases, this disease may cause post-emergent death.



Figure 2. An alfalfa field infected with *Aphanomyces*. The field shows the characteristic symptoms of *Aphanomyces* such as stunted plant growth, standing corpses and yellowing of cotyledons. (Photo credit: Deborah Samac)



Figure 3. Stunted root systems of alfalfa caused by *Aphanomyces* infection. (Photo credit: Craig Grau)

Aphanomyces decreases overall alfalfa stand quality and longevity. Seed establishment is also negatively impacted in young stands. Alfalfa yield can be decreased by as much as 70% in highly infested fields due to premature stand thinning. Nitrogen production is greatly reduced when *A. euteiches* is present as well. It affects the yields of both newly seeded and established fields because the pathogen can infect alfalfa at any stage of the plant's life cycle.

Race 1 and Race 2 of *Aphanomyces*

Aphanomyces is categorized by races, which are defined with respect to variations of disease severity among *A. euteiches* isolates against different cultivars of alfalfa. There are two main races of *A. euteiches* (race 1 and race 2). Though disease symptoms caused by the different races are the same, genetic resistance in alfalfa cultivars to race 1 does not provide resistance to race 2. When selecting an alfalfa variety for production, cultivars with listed resistance to only

race 1 of *Aphanomyces* are still susceptible to race 2, so yield losses due to *Aphanomyces* are still possible when planting alfalfa cultivars with genetic resistance to race 1 only.

Races have been characterized at Dakota State University with *Aphanomyces* tests using collected soil from fields of interest. To complete *Aphanomyces* testing, a standardized set of alfalfa cultivars with varying resistance to *Aphanomyces* races is planted in collected soil and observed. Assessing seedling growth and disease symptoms of this standardized set of alfalfa cultivars is the only way to determine which races of *Aphanomyces* are present in the sampled fields.

How does *Aphanomyces* infect alfalfa?

Aphanomyces euteiches produces both oospores (via sexual reproduction) and zoospores (via asexual reproduction). Both types of spores can infect the roots of alfalfa and cause disease. Motile zoospores are carried by water throughout the soil, which then spread the infection. The production of thick-walled oospores allows for the pathogen to survive in environments with harsh winter climates. These spores are resilient and may remain dormant for up to ten years without a host, making the risk of this disease difficult to eliminate.

Optimal Conditions for *Aphanomyces* growth

Aphanomyces thrives in wet conditions. Saturated soils with poor drainage, compact soil, and or heavy clay soils are favorable for the disease, making the risk of infection more prevalent during wet growing seasons. *Aphanomyces* is a water-borne pathogen, so ensuring proper drainage is essential for reducing the proliferation of disease.

Management Strategies

Alfalfa seeds are frequently treated with Apron XL (Syngenta), which suppresses the growth of some alfalfa root rotting pathogens but fails to prevent *Aphanomyces* growth. Stamina (BASF) is labelled as a seed treatment against *Aphanomyces* and is effective against both races. Other strategies must be used to combat the pathogen if its presence is confirmed in fields.

Aphanomyces Race Resistance (ARR)

Management:

- The best management strategy is to survey lands, characterize races present, and plant alfalfa cultivars with resistance accordingly. There are numerous commercial alfalfa cultivars that are readily available with resistance to both races of *Aphanomyces*.
- Avoid planting in fields with poor drainage; *Aphanomyces* thrives in wet soil conditions.
- Avoid excessive irrigation to decrease excess water in alfalfa fields.
- Rotate alfalfa with a non-host crop. If fields are strongly infested, the best option may be to rotate to a non-legume plant.

Results from 2020 South Dakota Aphanomyces Survey

In 2020, a disease survey was conducted to determine the presence of *Aphanomyces euteiches* in South Dakota. Soil samples were collected from 14 eastern South Dakota counties (Figure 4). Samples were brought back to Dakota State University for testing where standardized bioassays were performed. Further experimentation involving DNA extractions from infected roots and PCR analysis confirmed the presence of *A. euteiches* in the counties listed in Table 1. This disease survey found widespread presence of both races of *Aphanomyces* throughout eastern South Dakota.

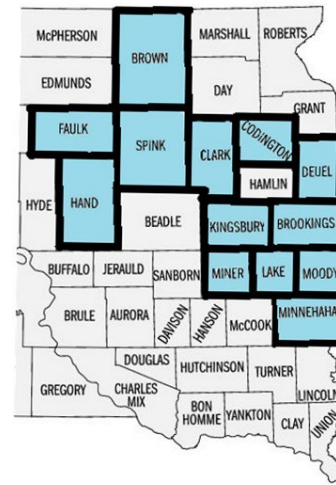


Figure 4. County map of eastern South Dakota. Counties in blue indicate the confirmed presence of *Aphanomyces*. Counties surrounded by bold lines indicate the county was surveyed for *Aphanomyces*.

Table 1. Counties confirmed to have *Aphanomyces* using PCR validation. Races were identified according to the results from standardized race-typing bioassays.

County	Aphanomyces	Races
Brookings	Confirmed	Undetermined
Brown	Confirmed	Undetermined
Clark	Confirmed	Races 1 & 2
Codington	Confirmed	Race 2
Deuel	Confirmed	Race 1
Faulk	Confirmed	Races 1 & 2
Hand	Confirmed	Races 1 & 2
Kingsbury	Confirmed	Race 1
Lake	Confirmed	Races 1 & 2
Miner	Confirmed	Races 1 & 2
Minnehaha	Confirmed	Races 1 & 2
Moody	Confirmed	Races 1 & 2
Spink	Confirmed	Race 1



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