

# Aphanomyces Root Rot: Widespread Distribution of Race 2

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The early spring of 2012 with prolonged wet soil conditions in many parts of the country resulted in reports of poor performance of alfalfa due to *Aphanomyces* root rot (ARR) of seedlings and adult plants. Varieties with resistance to ARR are available, although fewer varieties have resistance to both race 1 and race 2 of the pathogen. Recently, the fungicide Stamina, which protects seedlings against ARR, was labeled for use as an alfalfa seed treatment, and will be offered by some seed marketers for 2013 spring seeding. This article describes how to identify ARR, the test used to distinguish races, and what is known about distribution of race 2.

Alfalfa seeds are small and seedlings are rather fragile and vulnerable to several diseases. Wet soil conditions favor the development of diseases caused by Oomycetes or “water molds,” namely *Phytophthora* root rot (PRR), ARR, and damping off (rotting) by species of *Pythium*. The pathogens causing these diseases produce mobile swimming spores called zoospores that require water for development and infection of alfalfa. When rain is excessive after sowing, stand establishment may fail due to seed and seedling rot caused by these pathogens.

Both ARR and PRR occur in poorly drained soil and both infect seedlings and established plants. However, symptoms help to distinguish the two diseases. Seedlings infected by ARR become stunted and chlorotic (yellow) before they wilt and die and infected seedlings usually remain upright (Figure 1). In adult plants the root mass is reduced and lateral roots have brown decay. A brown lesion on the taproot may mark the location where lateral roots were rotted off. Nodules are frequently absent or decaying. Foliage is stunted, becomes chlorotic and resembles symptoms of nitrogen deficiency. Infected plants are often slow to regrow or may fail to grow after harvest or winter dormancy. Chlorotic foliar symptoms occur in soils that are deficient in sulfur. So it is prudent to examine roots of plants for evidence of root rot as well as to test plant tissue or soil for sulfur content to determine the cause of the symptoms.

Seedlings infected by PRR collapse and decay rapidly. In established stands when soils remain wet PRR attacks lateral roots and the taproot. The rotted tissue turns dark brown-black forming a pencil point-like symptom and foliage turns yellow or reddish (Figure 2). Seed treatments with Apron (metalaxyl) help to protect seed from damping off and early season PRR. Also, most alfalfa varieties have high resistance (>50% of plants with resistance) to PRR. Because of these control measures, damage from PRR has been reduced significantly in modern alfalfa varieties.

Developing control measures for ARR has been more difficult. Soon after identifying the significance of

Figure 3. Evidence for race 3 of ARR. Varieties with resistance to race 1 and race 2 (A, B, C, D1, D2, D3, D4, WAPH-5) are susceptible to isolate 6 of *A. euteiches*, which came from an alfalfa production field. Vernal is susceptible to race 1 and race 2. The Vernal control was not inoculated. A Disease Severity Index (DSI) >2 is considered to be a susceptible response.

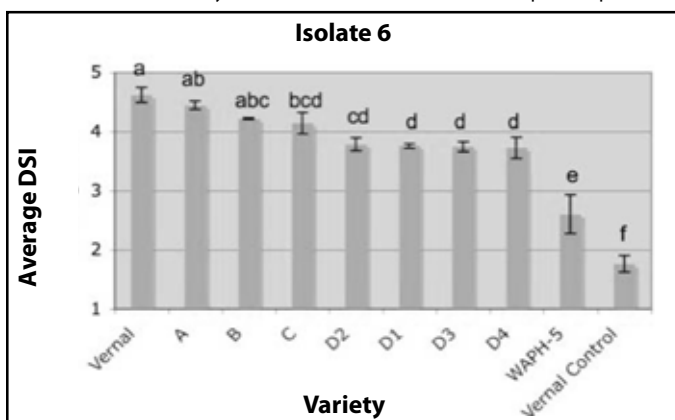
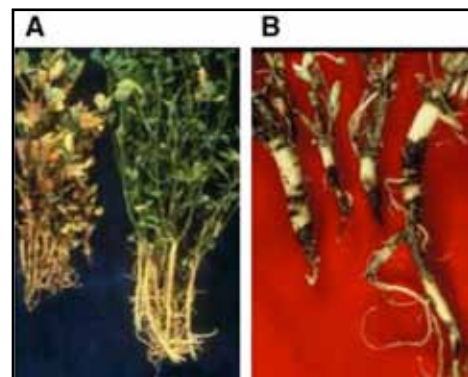


Figure 1. Symptoms of *Aphanomyces* root rot (ARR). (A) Seedling bioassay. Variety on the right is resistant to race 2 while other varieties are susceptible. (Courtesy D. Johnson) (B) Root rot on established plants. (C) Foliar symptoms on established plants.



Figure 2. Symptoms of *Phytophthora* root rot (PRR). (A) Foliar symptoms on seedlings. (B) Root rot on established plants.



ARR, resistance to a common isolate (race 1) was widely incorporated into alfalfa varieties. However, it was not long after that a second group of strains (race 2) that could overcome resistance to race 1 was identified. To date, race 2 strains have been identified in commercial production fields from Idaho, Maryland, Minnesota, Mississippi, North Carolina, Tennessee, Virginia, and Wisconsin. This spring, race 2 strains were identified in New York for the first time. Surveys conducted within several states found race 2 strains are as prevalent, or more prevalent, than race 1 strains and often both strains occur in the same field. Race 2 is a widespread risk to alfalfa cultivars having resistance to only race 1. The method used to identify races is based on an alfalfa seedling bioassay using different resistant lines and takes approximately 3 weeks to conduct. Soil to be tested is seeded with alfalfa varieties with different responses to race 1 and race 2. At the end of the test the seedlings are rated for disease symptoms on a 1-5 scale in which 1 is a healthy seedling and 5 is a dead seedling. A rating of  $\leq 2$  is considered a resistant response. The surveys found race

2 strains are present in soils with no recent history of alfalfa cultivation and in fields where race 1 resistant cultivars had not been planted. This indicates races have not developed in response to cultivation of race 1 resistant varieties.

Evidence is mounting that additional races of ARR are present in alfalfa fields that can overcome race 2 resistance. As shown in Figure 3, a strain isolated from an alfalfa production field overcomes the race1 and 2 resistance in seven commercial cultivars. WAPH-5 performs better than the other race 2 resistant varieties, suggesting that resistance to the new races can be increased by selection and breeding. In barrel medic (*Medicago truncatula*) a non-race specific resistance has been identified based on changes in root cells and production of anti-microbial compounds that restricted growth of the pathogen and enabled plants to grow normally. Identifying such non-specific resistance is needed for improving alfalfa establishment and production in areas with ARR.