Management of Seedling Damping-Off of Alfalfa

Laurine Berg, Deborah A. Samac, USDA-ARS Plant Science Research Unit

A vigorous and productive alfalfa stand starts with strong and uniform seedling establishment. However, many factors can interfere with seed germination and growth. Seed rot and seedling damping-off are a significant cause of poor stand establishment in wet soils. Damping-off, the rotting of a seedling, can occur either before or after the seedling emerges from the soil. A number of organisms cause seed rot and seedling damping-off, including several species of *Pythium*. Diseases caused by *Pythium* species pose significant threats to seeds and seedlings of many plants across the globe. Alfalfa, wheat, corn, soybeans, barley, sorghum, cotton, and common bean are susceptible crop hosts, but agricultural fields are not the only places these organisms can be found. Natural landscapes, aquatic environments, and even mine slag heaps are home to members of this diverse and nearly ubiquitous genus.

As members of the Oomycetes or 'water molds', *Pythium* species can be distinguished from true fungi in part by their mobile spores called zoospores. Swimming through water films on soil particles, the zoospores quickly home in on the trail of chemicals released by seeds and roots. Using mechanical pressure to pierce plant tissue, the invading organisms employ toxins to kill plant cells. The sexual oospore of *Pythium* species can survive on plant debris or in soil for years, germinating under the right conditions to produce either the mobile zoospores or to directly infect vulnerable plant tissue within four hours of exposure to plant exudates. Mature alfalfa plants are also at risk with succulent feeder roots being as vulnerable to *Pythium* species as a germinating seedling. These ongoing, chronic root rots reduce the energy available for growth in established stands, causing yield reductions and shortened stand life.

Several strategies are used to combat alfalfa seed and seedling loss due to diseases. A high seeding density can compensate for moderate seed loss due to disease. Fungicide seed treatment using Apron XL® reduces losses due to *Pythium* seed rot and damping-off as well as to Phytophthora root rot. However, this fungicide does not protect mature roots nor is it effective against Aphanomyces root rot or Rhizoctonia root rot. The fungicide Stamina™ has been used for protection against Aphanomyces root rot but as detailed below, Stamina seed treatment provides little protection from *Pythium* species. Recent results suggest that crop rotation will not reduce diseases caused by *Pythium* species because of the broad host range of many strains. *Pythium* disease resistance would improve the stand establishment and stand productivity.

Many species of *Pythium* can be present in a single soil, but generally only one pathogenic species predominates. As a first step toward developing alfalfa resistant to diseases of *Pythium*, we undertook a survey in five Minnesota soils with a higher than expected incidence of damping-off. Soil samples were collected from fields under alfalfa for at least three years after corn or soybean, and were cultured in the lab to isolate *Pythium* species. Eight species were recovered from diseased alfalfa seeds and seedlings. Only three, *P. irregulare*, *P. ultimum*, and *P. sylvaticum* proved to be pathogens of alfalfa (Figure 1). The other species are assumed to be saprophytes surviving on plant material in the soil, and sometimes competing for nutrients with the pathogen species when no host plant is present. Because corn, soybean, and alfalfa are commonly rotated to reduce disease pressure, we obtained and tested 21 *Pythium* pathogens of corn and soybean for their ability to cause disease in alfalfa. Of those, seven proved capable of attacking all three crop plants. Clearly, rotation is not a solution to reducing *Pythium* pathogen pressure.

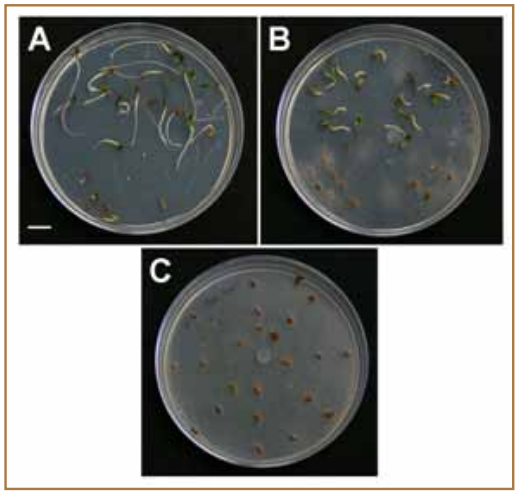

Figure 1. A petri plate assay to identify alfalfa pathogens. A. Healthy seedlings; B. Damping off caused by *Pythium sylvaticum*; C. Seed rot caused by *P. ultimum*.

We assessed all of the alfalfa pathogens for sensitivity to Apron XL and Stamina in a petri plate test. The Stamina seed treatment was generally not effective against *Pythium*. Of the 16 strains tested, only one was sensitive to Stamina. Apron XL reduced the incidence of damping-off caused by the pathogens, but the level of protection varied considerably among and within species. Half of the strains tested had low or moderate sensitivity to the Apron XL seed treatment resulting in less than 50% of the seeds protected from disease.

Management measures must suffice until alfalfa germplasm with resistance to *Pythium* diseases can be developed. Damping-off disease and seed rot is essentially a developmental race between alfalfa and *Pythium*. A five-day-old alfalfa seedling is more able to withstand pathogen attack, therefore, fast-germinating varieties planted in well-drained soil under ideal temperature and pH are able to develop faster than the pathogen can attack. In cool moist conditions, the pathogen has the advantage and wins the race to overwhelm and kill the still-vulnerable seedlings.