Forage Research Update

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Minnesota - Brown Root Rot of Alfalfa: A Subtle Threat to Forage Production

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Brown root rot (BRR) of alfalfa has been identified in several states in the U.S. since 1996 (Figure 1), but it has been known as a damaging disease of alfalfa, sweet clover, and grass crops in Canada since the 1920s. During 2003, *Phoma sclerotioides*, the pathogen responsible for the disease, was recovered from roots of diseased alfalfa plants in northwest Minnesota. Since that time, BRR has been identified throughout the state.

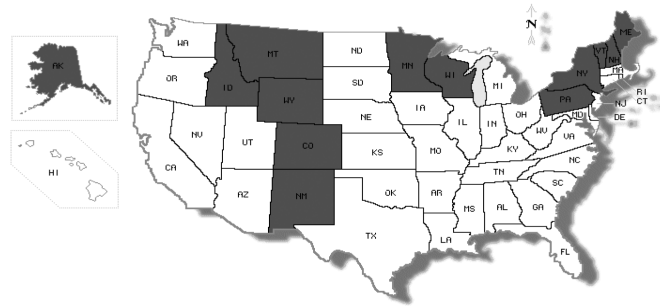

Figure 1. *BRR-diseased alfalfa plants reported from states with shading. States without shading have either not detected or reported the disease.*

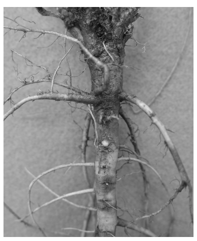

Figure 2. *Less severe BRR lesions can be seen on lower tap root while an extensive lesion is apparent on crown and upper tap root areas.*

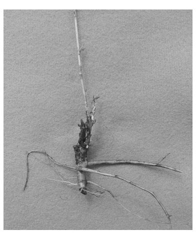

Figure 3. *Lower part of tap root has been severed by BRR. Plant has survived using its lateral roots to compensate for its rotted root.*

Termed a snow mold, cool soil temperatures are ideal for the pathogen. Fungal growth is most active during late fall continuing into late spring, depending on soil temperatures. Plants are infected when they are partially or fully dormant. Belowground symptoms of the disease begin as small dark lesions on roots and N-fixing nodules. Lesions enlarge, coalesce, and girdle roots of susceptible plants (Figure 2). When the disease severity progresses, roots are severed (Figure 3) which often results in plant death. Root rot and plant death can occur during a single winter season, which provides diagnostic aboveground symptoms the next spring. If disease severity progresses more slowly, a gradual decline in the number of live plants results. Often disease symptoms at this level are much less diagnostic since some stand loss and reduced plant vigor are normally expected as alfalfa stands age. When plants die during a winter season, adjacent surviving plants should be dug to check for root health. Yield reductions have not been quantified from BRR, but are expected if fewer healthy plants contribute forage yield.

Plants also die during Minnesota winters from non-disease, weather-related stresses (i.e., insufficient snow cover, ice sheeting), but these factors can easily be ruled out by a close examination of plants' root systems. Plants killed from BRR have brown root and/or crown lesions. In contrast, environmental stresses generally result in roots that are much lighter in color.

Collaborative research is ongoing among Univerity of Minnesota scientists located at the Northwest Research and Outreach Center and the St. Paul campus. The focus is to identify which crop residues promote vs. limit winter survival of the pathogen. The fungus is known to survive on various types of organic debris which makes identifying the residues that reduce in-field pathogen levels critically important in developing disease management recommendations.

During 2005 to 2007, seven crop species (alfalfa, canola, corn, oat, soybean, spring wheat, and winter wheat) were grown in pots containing field soil that was naturally infested with *P. sclerotioides*. A nontreated control (fallow) was also included. After the first freeze of the season, dried crop debris from each species was incorporated into the top 2 in. of soil, and pots were left outside during the winter at two locations (St. Paul and Crookston, MN). In the spring, *P. sclerotioides* density in soil was measured using a quantitative PCR assay. Density of the pathogen was highest in soil from pots with corn, soybean, and canola. Density of the pathogen following alfalfa, winter wheat, spring wheat, and oat was similar to the fallow treatment.

In separate experiments under controlled conditions, colonization by *P. sclerotioides* of stems, leaves, and roots of the same crops listed above plus barley, hairy vetch, and winter rye was measured using six different fungal isolates. The crop origin of the isolate, whether from alfalfa, perennial rye, or winter wheat, did not affect the success of the fungus at colonizing different crop species. A high level of colonization was observed in canola roots as well as leaf material from spring wheat, winter wheat, winter rye, and corn. Soybean roots supported the lowest amount of colonization. Results indicate that rotation to corn, soybean, or canola will not reduce in-field pathogen density sufficiently. Although colonization of spring wheat leaves was high, results indicate this type of residue does not increase pathogen density in soil. This may be, in part, due to rapid degradation of leaf material by soil-borne microbial communities.

Disease management strategies include reducing late-season stress on plants. This includes allowing plants a sufficient period of time to regrow and recover following the last cutting of the season, which also gives plants time to replenish their root reserves prior to the winter dormancy period. Adequate soil nutrition should also be provided. Rotate into a crop not known for BRR and whose residue does not support winter survival of the pathogen. A crop rotation using winter wheat is not recommended because *P. sclerotioides* has been shown to be a pathogen of that crop, as well. While resistant alfalfa varieties are not yet commercially available, 26 varieties are being tested at four commercial production field locations within Minnesota in soil infested with the BRR pathogen. The purpose of these trials is to determine if useful levels of resistance can be identified from current commercial varieties.