UNIVERSITY OF WYOMING

Department of Plant Sciences
College of Agriculture

**PLANT SCIENCES TIMELY INFORMATION SERIES**

**No. 1** http://www.uwyo.edu/plants/publications/brrtimelyinfo2007update1.pdf **Revised February 2008**

# Brown Root Rot of Alfalfa

Brown root rot (BRR) was first identified in the continental U.S. in the spring of 1996 in an alfalfa field near Farson in western Wyoming. The disease was associated with severe winterkill of alfalfa plants. In addition, many surviving plants were severely stunted and slow to green-up. Roots of affected plants showed varying degrees of rot. Prior to this discovery, BRR had only been reported from Alaska in the United States. However, it had been known to cause stand and yield losses in alfalfa and other forage legumes in Canada for many years. The presence of BRR in established stands of alfalfa may result in shortened stand life and reduced hay yield.

***Symptoms.*** Although BRR may occur on some one- to two-year-old plants in the field, distinguishable root symptoms in Wyoming are usually not present until the second or third year after seeding. Root symptoms consist of root rot of the tap and secondary roots (Figure 1).

**Figure 1.** *Three-year-old alfalfa plants collected near Farson showing severe rot of the tap and secondary roots caused by brown root rot. Note the dark brown to black discoloration of the lower plant crown and upper root.*

Feeder roots and attacked nitrogen fixing nodules are often the first tissues to show discoloration and rot. Symptoms vary from small circular dark lesions (Figure 1) to larger areas with rot which may completely sever the root from the plant (Figure 2). Crowns and stems of affected plants may be partially or entirely killed. Fruiting structures of the fungus, *Phoma sclerotioides*, may be present as tiny black dots on the surface of diseased roots. Some plants with BRR may remain productive over the short-term while others exhibit varying degrees of above-ground stunting and decline. Winterkill, a symptom of BRR that is generally noticed in early spring, may vary from slight (< 5% dead plants) to severe (> 95% dead plants).

**Figure 2.** *Four-year-old plants affected by brown root rot. The attached plant on the right is dead with the tap root completely rotted, while the plant on the left has a brown girdling lesion on the root and was slow to produce spring growth.*

Diseased plants are often slow to green-up in the spring (Figure 3). In sprinkle irrigated fields, BRR appears to occur throughout rather than in localized areas. In an established alfalfa field near Eden, Wyoming an estimated 88% of plants sampled had BRR symptoms.

**Figure 3.** *Winterkill of alfalfa near Farson in 1996 due to severe brown root rot injury.*

***Distribution.*** Following the discovery of BRR in Eden, two-year-old or older alfalfa fields were randomly surveyed in Albany, Carbon, Lincoln, Sublette, Sweetwater and Uinta counties. Results of these surveys are presented in Figure 4. Plants with BRR were found in all six counties. A total of 37,255 acres were estimated to have BRR. Most recently, in 2005, alfalfa plants in fields in Big Horn, Hot Springs, Park and Washakie counties were all found to have BRR. A total of 69,777 additional acres, including both hay and seed fields, had plants with BRR. So far, a total of 107,032 A of alfalfa acreage in ten counties surveyed are estimated to have BRR. This disease is expected to be present in the remaining ten counties as well. Although Fremont County was not surveyed, BRR is expected to be present at levels similar to adjacent surveyed counties.

The BRR fungus was also identified from soil collected in the majority of alfalfa fields sampled. It was also identified from soil collected from both BLM and U.S. Forest Service grass and shrubland sites in and around the Big Horn Basin. Its recovery from non-agricultural sites in Wyoming is in agreement with a previous report from Canada. These findings suggest *Phoma sclerotioides* may be a native species to these regions.

In addition to Wyoming, BRR of alfalfa has now been identified in Montana and Idaho in the West, Wisconsin and Minnesota in the Midwest, and New York, Vermont and New Hampshire in the East. And, it most likely occurs in the entire upper two to three tiers of northern states from coast to coast. It also has been previously reported on alfalfa in the Canadian Provinces of British Columbia, Alberta, Saskatchewan and Manitoba and mostly likely occurs in the remaining eastern Provinces as well.

***Similarity to other diseases.*** Phytophthora root rot (PRR) is the only other root disease of alfalfa in Wyoming that could be confused with BRR. Although PRR was not detected in Lincoln, Sublette, Sweetwater, or Uinta counties during the field surveys, it was detected in Albany and Carbon counties. Also, it is a major disease in Park, Big Horn, Hot Springs and Washakie counties within the Big Horn Basin where alfalfa is mainly grown under flood irrigation. Positive diagnosis of BRR usually requires microscopic observation and fungal isolation from diseased tissue or laboratory testing with a PCR-SCAR molecular probe specific for *P. sclerotonia*. Familiarity with symptoms of both diseases will help in separating these two important root diseases. While PRR affects seedlings, as well as, older plants, BRR does not affect plants until they are several months old. Recognizable symptoms of BRR do not usually occur until plants are two-years-old and older. Also, while affected root tissue of BRR-diseased plants is usually dark brown to black, root tissue of PRR-diseased plants is usually reddish brown. Also, outer root tissue of BRR-diseased plants sloughs off exposing the dark cortex, while the outer root tissue layer of PRR-diseased plants usually remains intact. And lastly, while plants affected with BRR may have small black reproductive fungal structures embedded in the outer root tissue, PRR diseased plants do not. Both may result in winterkill of plants.

Winterkill may also be caused by the alfalfa stem nematode (ASN). This stem bud parasite causes stunting and swelling of stem buds thus reducing sugar production and carbohydrate storage in the upper tap root in the fall. However, ASN does not cause root rot. The ASN is a major stand decline disease in Albany and Carbon Counties, as well as in the Wind and Big Horn River Basins.

***Disease Cycles.*** Research conducted in Canada indicates *P. sclerotioides* may occur on plants native to North America. Many legume plant species including alfalfa (*Medicago sativa*), red clover (*Trifolium pratense*), sweet clover (*Melilotus* spp.), alsike clover (*Trifolium hybridum*), sainfoin (*Onobrychis viciifolia*), and bird's-foot trefoil (*Lotus corniculatus*) are known to be attacked by this fungus. It is considered to be highly pathogenic on sainfoin and sweetclover in Canada. Recent plant-tissue isolations from diseased cicer milkvetch (*Astragalus cicer*) plants from a field near Farson, Wyoming, exhibiting winterkill indicated the fungus was present.

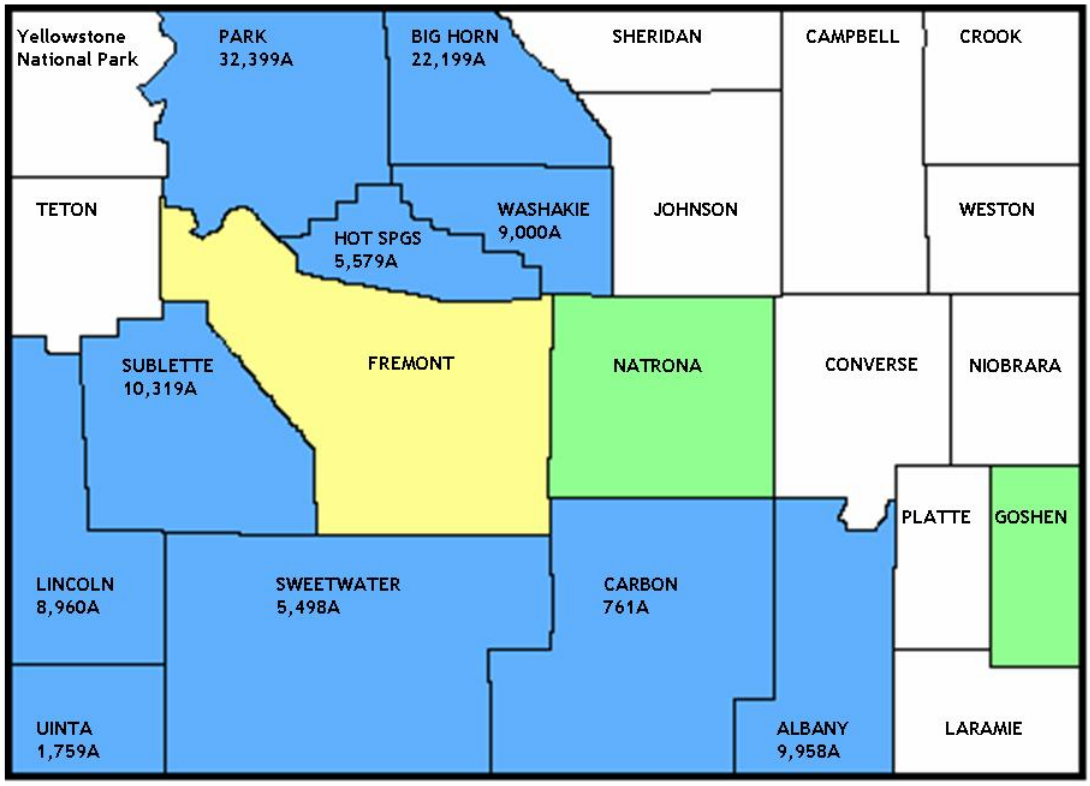


**Figure 4. Distribution of brown root rot of alfalfa in Wyoming. Blue = counties where extensive surveys have been conducted. Estimated area infested with BRR is given for each county; Green = counties where BRR has been found but an extensive survey has not been made; Yellow = not surveyed but expected to have BRR at levels similar to adjacent counties; White = counties where surveys have not been conducted, but where BRR is most likely expected to occur. So far, a total of 107,032 acres of alfalfa are estimated to have brown root rot present in the ten counties surveyed.**

*P. sclerotiodes* may also live saprophytically on dead roots of many plant species, including small grain crops. *P. sclerotioides* can survive for several years in dry soil as small dormant fungal structures called pycnosclerotia. These structures may be responsible for its spread via soil and plant debris. In the presence of a host plant root, pycnosclerotia germinate under favorable environmental conditions and infect the root. Later, after the fungus colonizes the root, black fruiting structures (pycnidia) are formed on and in root tissue. When mature, these structures produce spores (conidia).Observations by the authors indicate spores from pycnidia on dead lower stems may play a role in secondary, above ground spread of this fungus.

Root infection appears to occur during the spring when plants emerge from their winter dormant state. Prolonged periods of snow cover during this time may provide an extended period of favorable environmental conditions for infection. Optimum mycelial growth and sporulation of the fungus occurs at 60°F while minimum and maximum temperatures are 32°F and 81°F. However, host root infection most likely occurs between 35°F and 40°F. Upper crown and lower stem areas of diseased plants may also be infected by this fungus.

***Control.*** The following management practices, recommended by Canadian researchers, are suggested to help reduce alfalfa yield loss from BRR in Wyoming. Additionally, alfalfa varieties that have exhibited long-term persistence in areas known to have BRR may provide additional disease control.

***Crop rotation.*** A rotation including three years with spring-sown annual crops such as barley, wheat, oats, or hay millet between alfalfa crops is recommended. This should reduce the soil population of *P. sclerotioides* in alfalfa fields. Alfalfa should not be planted following other susceptible legumes such as yellow sweetclover, cicer milkvetch or sainfoin since this may worsen the disease on alfalfa.

***Host resistance and variety selection.*** Developed for Alberta, Canada, 'Peace' is the most resistant alfalfa variety tested for BRR in Canada. Until recently, 'Peace'

was the only variety of alfalfa known to have resistance to BRR. Field trials conducted near Farson have shown Peace to have excellent persistence. However, since it was developed for Canada with a fall dormancy rating of 1 (most dormant), it has not produced the best yield in our trials. The best yielding varieties in the Farson tests have been Winterstar and Avalanche + Z.

***Something new for Wyoming.*** In 1998, plants were selected from a six-year-old alfalfa variety trial near Farson where BRR was known to occur. These plants were taken to Laramie and bred to produce a new variety with resistance to BRR. This variety has maintained excellent plant stands and produced good to excellent yields in field trials conducted in both Wyoming and Montana. Certified seed of this new Brown root rot resistant variety 'Lander' was produced in the Big Horn Basin of Wyoming for the first time in 2007. Certified seed of 'Lander' is now available and can be purchased from Allied Seeds in Worland (gwhite@alliedseed.com), phone number 307-347-2616.

***Cultural management.*** Additional recommendations from Canada are: (1) avoid excessive cutting, (2) avoid cutting between mid-August and late fall, (3) avoid grazing in the fall before the ground is frozen, (4) avoid overgrazing, and (5) maintain optimum soil fertility.

Alfalfa should not be cut more than is recommended for a given production area (two cuts for Sweetwater County). Alfalfa hay should be cut so as to allow sufficient regrowth (6-8 inches) to supply carbohydrates in the upper root and crown prior to the first hard freeze (28$^{o}$F or below). Only graze fields in the fall after plants are frosted-down and after the ground is frozen.

***Summary.*** Brown root rot appears to be widespread throughout the growing areas of Wyoming with an estimated 107,032 acres currently infested. This estimate will likely climb following additional surveys. Severe winterkill in 1995-1996 (50% loss) and again in 1998-1999 (80% loss) in the Farson area was attributed, in part, to BRR. While severe winterkill is not expected to occur every year, it will undoubtedly occur again when winter conditions are favorable for BRR. Limited winterkill with associated forage yield loss from stunted, diseased plants is expected to occur yearly. Integration of a 3-year crop rotation with a spring-sown small grain or corn, good harvest management practices, and growing an alfalfa variety which is known to have long-term persistence in your area, should help to reduce loss from this disease.

***Acknowledgements.*** We would like to acknowledge personnel with the Sweetwater County Weed and Pest District and the University Extension Educators in Albany, Carbon, Sublette, Uinta and Washakie counties for assisting in field surveys. We would especially like to thank John Peden, Kim Brown and Don Miller for allowing us to collect data from alfalfa test plots located on their farms.

***Funding.*** Appreciation for funding to support this project is acknowledged to the following, without which, this project could not have been accomplished: University of Wyoming, College of Agriculture, Agricultural Experiment Station Competitive Grants Program and the IPM Grants Program; USDA/Special Grants Program; Graduate School assistantship funding and Wyoming Weed and Pest Board, S.E. District.

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