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MONTANA STATE UNIVERSITY EXTENSION

MontGuide

Root Lesion Nematodes in Wheat

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These microscopic roundworms parasitize agricultural crops in every part of the world. Take the steps outlined here to recognize infestation, assess potential damage and protect your crops.

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ROOT LESION NEMATODES ARE MICROSCOPIC roundworms that parasitize agricultural crops in every part of the world. Two species of root lesion nematode, *Pratylenchus thornei* and *Pratylenchus neglectus,* are damaging to wheat. Our neighboring states of Washington, Oregon and Idaho experience annual yield losses in spring wheat due to infestations of both nematode species. Studies in Oregon and Washington have attributed up to 36 percent yield reduction in intolerant cultivars due to *P. neglectus*. Greatest losses occur in low-rainfall, annually cropped wheat. A survey of small grain fields in Montana for root lesion nematode was conducted in 2006 and 2007. The assessment showed damaging populations of *P. neglectus* occurring in north central counties of Montana, in fields of winter wheat and fields managed as no-till. No *P. thornei* was detected in the state. Trials conducted in summer 2007 reveal that McNeal and Outlook spring wheat display tolerance (by maintaining yield) in the presence of damaging *P. neglectus* populations.

Root Lesion Nematode

Root lesion nematodes are migratory endoparasites. They are mobile in water films among soil particles but move into host root tissue to feed and reproduce. The parasitic nematode penetrates and moves into plant root cells using its sharp, hollow stylet (Figure 1). Cell-wall degrading enzymes secreted from the nematode's stylet facilitate entry and feeding. As these nematodes feed and mature, they become reproductive and are able to lay an egg in root tissue every three days. There may be up to five generations of root lesion nematodes within one growing season. As eggs hatch, young nematodes can move back out into soil in search of new host plants. Since the nematodes usually live protected inside host roots, they are not dependent on soil moisture to survive. They can also enter a resting stage when field conditions are dry and hosts are not available. Subsequently, they revive under favorable conditions. This allows them to survive through fallow periods. Root lesion nematodes associated with soil particles are dispersed from field to field on farm equipment, shoes, animals and by wind.

FIGURE 1. A root lesion nematode and a close look at the darkened stylet, diagnostic to this group of nematodes. This nematode is 0.5mm long, or half the thickness of a dime.

Damage and Yield Loss

Damage from root lesion nematodes can be easily mistaken for nutrient deficiencies, root rot diseases and drought. Nematode affected plants display stunting, yellowing of older leaves, reduced tillering and loss in kernel weight. Damage is affected by a variety's tolerance and/or resistance and environmental factors including soil moisture and nutrient availability. In a low precipitation environment, winter wheat losses can be up to 37 percent at a level of 10,000 *P. neglectus*/kg soil. Spring wheat losses are less in high precipitation environments, but are still 14 percent at a level of 4,000 *P. neglectus*/kg soil.

TABLE 1. Increasing population densities of *P. neglectus* decreased yields of spring and winter wheat varieties in Montana.

P. neglectus kg dry soil	Low Precipitation Environment Winter Wheat	High Precipitation Environment Spring Wheat
0	16.4 bu/acre	94.3 bu/acre
2000	15.2 bu/acre	87.9 bu/acre
4000	14.0 bu/acre	81.5 bu/acre
6000	12.8 bu/acre	-
8000	11.6 bu/acre	-
10,000	10.4 bu/acre	-

Survey and Distribution for Root Lesion Nematode in Montana

In the spring of 2006 and 2007, populations of root lesion nematodes were surveyed with the assistance of Extension Agents in 17 counties, representing 82 percent of the total wheat acreage in Montana (Figure 2). Agents sampled 148 fields in 2006 and 116 fields in 2007. In 2006, *P. neglectus* was found in 12 of 17 counties, and in 41 percent of all fields surveyed. In 2007, *P. neglectus* was found in 11 of 15 counties, and in 37 percent of all fields surveyed (Table 2). The number of *P. neglectus* in fields was above the damage threshold of 2500 *P. neglectus*/kg dry soil in 14 percent and 13 percent of the fields in 2006 and 2007, respectively. The damage threshold of 2500 *P. neglectus*/kg soil is the population size above which significant yield losses occur. Significantly higher populations of root lesion nematodes were found in fields following a crop of winter wheat than in fields following crops of spring wheat (Figures 3A and 4A). When field management practices were compared, more root lesion nematodes were found in no-till fields versus conventionally tilled fields (Figures 3B and 4B). No trend was observed in fields that were annually cropped versus wheat-fallowed.

TABLE 2. Damage threshold of root lesion nematode in fields surveyed in Montana counties and crop districts in 2006 and 2007.

County	Crop District #	Average 2006 *P. neglectus* kg soil	2006 RLN Incidence above damage threshold	Average 2007 *P. neglectus* kg soil	2007 RLN Incidence above damage threshold
Chouteau	5	3844	30%	3306	40%
Fergus	4	3375	70%	2400	20%
Cascade	4	3252	40%	2670	50%
McCone	6	1440	20%	1285	10%
Hill	5	880	10%	953	10%
Pondera	5	679	10%	811	18%
Toole	5	565	10%	2375	10%
Glacier	5	89	0%	100	20%
Phillips	5	73	0%	0	0%
Roosevelt	6	61	0%	24	0%
Valley	6	5	0%	29	0%
Daniels	6	0	0%	0	0%
Liberty	5	0	0%	385	10%
Sheridan	6	0	0%	0	0%
Dawson	6	0	0%		
Richland	6	0	0%		
Yellowstone	3	301	0%		

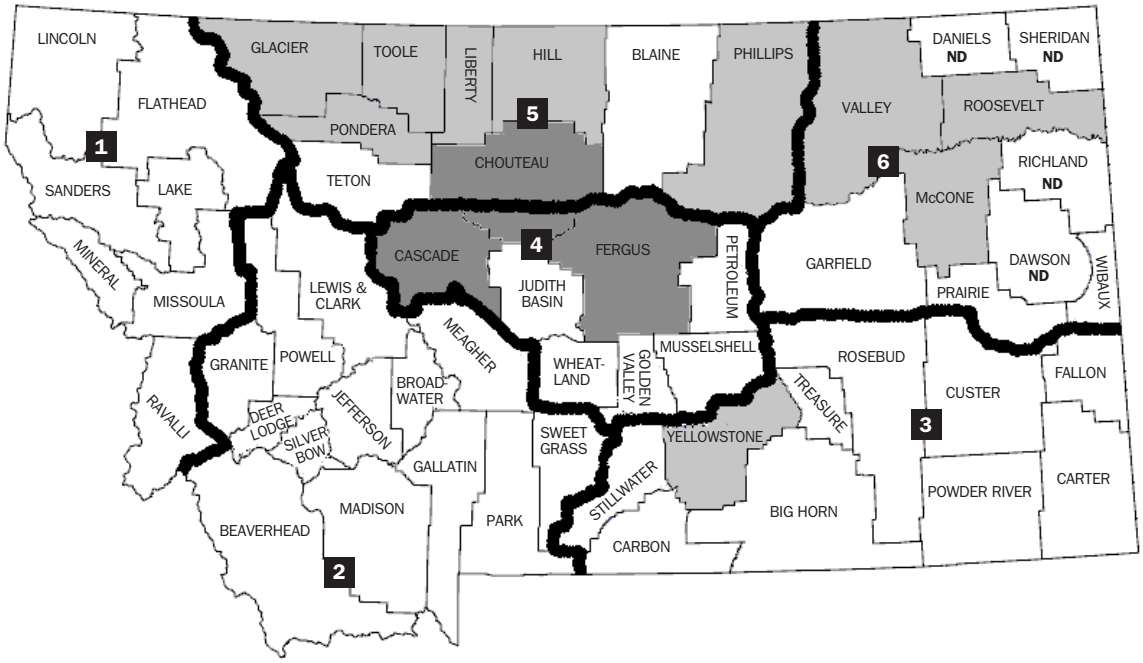

FIGURE 2. A map of wheat growing districts in Montana. Nematodes were detected in light grey counties. Dark grey counties contained average *P. neglectus* populations exceeding the damage threshold. Counties listed as ND are counties where root lesion nematode was not detected.

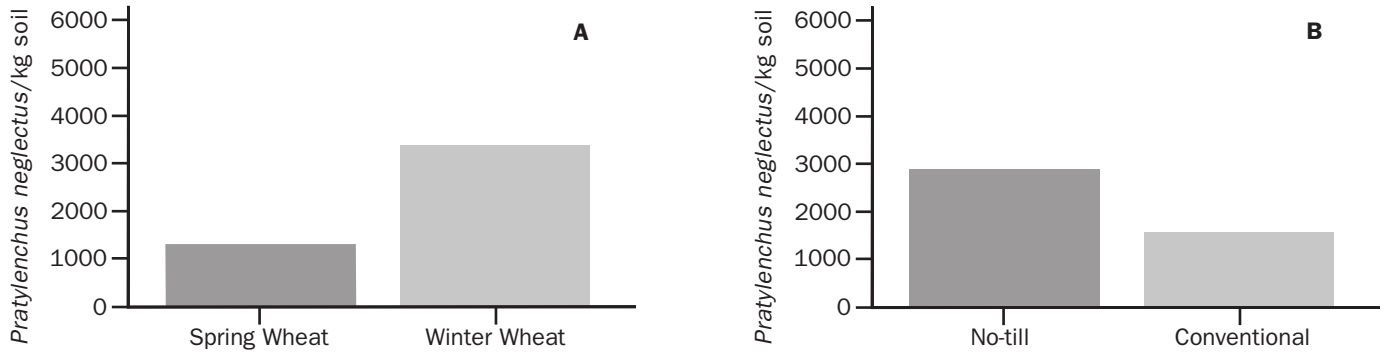

FIGURE 3. Spring 2006 populations of root lesion nematodes for fields (A) previously cropped to spring and winter wheat and (B) cropped under no-till and conventional tillage systems.

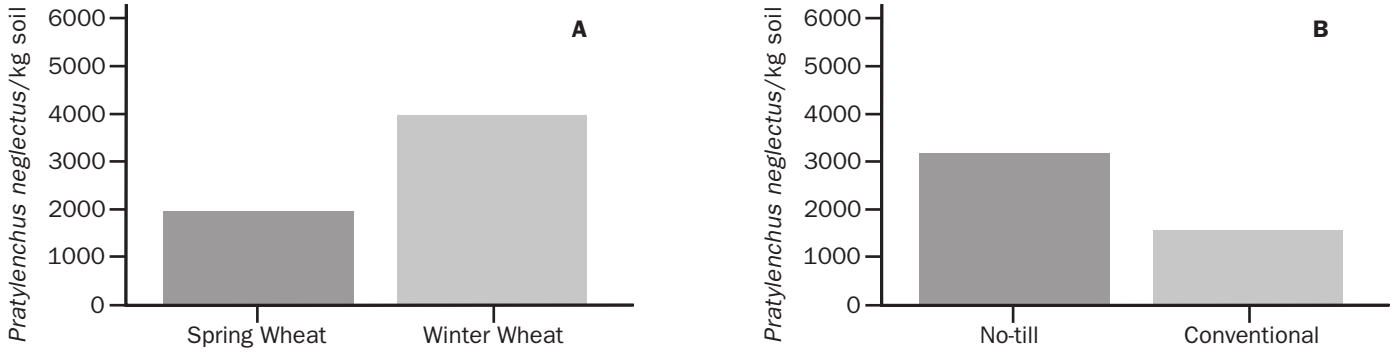

FIGURE 4. Spring 2007 populations of root lesion nematodes for fields (A) previously cropped to spring and winter wheat and (B) cropped under no-till and conventional tillage systems.

Variety Tolerance to Root Lesion Nematodes

Nematode tolerance refers to the amount of injury or yield loss caused by the nematode that a plant can withstand or recover from. Trials conducted in the summer of 2007 reveal that the spring wheat varieties McNeal and Outlook displayed nematode tolerance by maintaining their yields in the presence of high *P. neglectus* populations (Table 3). A tolerance index value (higher number = less yield loss) is used as a predictive measure of performance in areas of high infestation. In contrast, nematode resistance refers to the ability of a plant to prevent reproduction of the nematode. Currently, there are no known Montana-adapted varieties that display resistance to root lesion nematode. Where resistance is lacking, tolerant varieties are a desirable control method. In Montana, spring wheat rotations appear to reduce nematode populations relative to winter wheat. However, since root lesion nematodes are parasitic to most small grains, rotation to non-host crops is a recommended control strategy. Non-host crops including safflower, flax, triticale and field pea do not allow reproduction of *P. neglectus* and therefore help manage nematode populations.

Currently, the MSU wheat breeding programs are evaluating germplasm for resistance and tolerance to root lesion nematodes. Since high numbers of nematodes were found following winter wheat, studies are focused on the development of resistant winter wheat varieties. At this time, there are no commercially available lines with complete resistance to root lesion nematodes. However, resistant and tolerant cultivars will ultimately be the most economically important management practice for *Pratylenchus* due to a lack of chemical control and limited rotational schemes.

TABLE 3. Montana spring wheat varieties tested for yields in the presence of high populations of *P. neglectus* (3879 nematodes/kg of soil).

Cultivar	Untreated Yield kg/ha	Tolerance Index
Vida	721	86
Choteau	724	96
Scholar	945	109
√ **Outlook**	**1006**	**112**
Reeder	488	84
√ **McNeal**	**1124**	**112**
Conan	794	93
Hank	773	74
Alsen	433	104
Ernest	619	105

Tolerence Index is used as a predictive measure of performance in areas of high infestation (higher number = less yield loss).

Assessing Root Lesion Nematodes in Your Fields

Unthrifty plants appearing in patches across a field may indicate a nematode infestation. Early damage signs to look for are yellow lower leaves and loss of secondary branching in the root system. Since populations of nematodes occur in 'hotspots', extensive soil sampling is required in order to accurately evaluate nematode populations. Soil testing for root lesion nematodes can only be performed by a laboratory. Soil testing and sampling instructions for root lesion nematode can be found at the Western Laboratories website, www.westernlaboratories.com.

Acknowledgments

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