Plant parasitic nematodes: A threat to crop production in Montana?

By Shabeg S. Briar and Gadi V.P. Reddy, Montana State University, Western Triangle Ag Research Center, Conrad, Montana

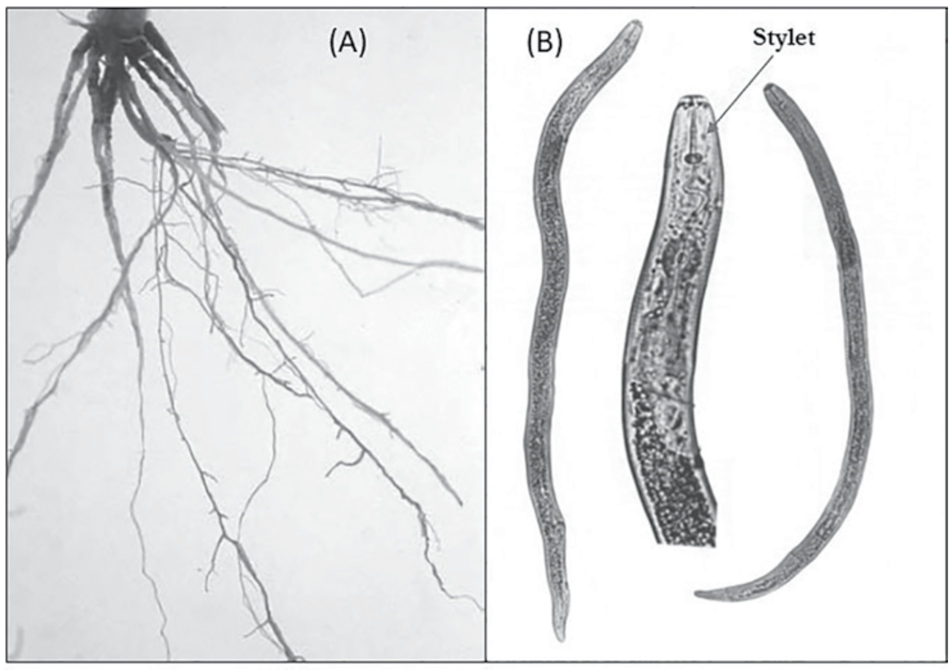

Figure 1: (A) Symptoms of plant parasitic nematode damage on wheat roots caused by root-lesion nematode. Note a general absence of branched roots on the main root axis **(B)** A root lesion nematode and a close look at the stylet, diagnostic to plant parasitic nematodes. Photo courtesy Dr. Vivien Vanstone, Dept. of Agr., W. Australia

Nematodes are unsegmented roundworms usually shorter than 2 mm in length. All soil inhabiting nematodes are not parasitic to crop plants. Majority of the described nematode species feed on other microorganisms (bacteria and fungi), protozoans and other nematodes, and many are parasites of animals including insects. Those feeding on microorganisms play important role in the soil food web and contribute significantly to the soil health while those feeding on insects (entomopathogenic) are commercially available in the US as biological control agents for managing the insect pests. Nematodes which feed on plants and better known as plant parasitic, have been dealt here in this article. This group of nematodes not only cause crop yield losses but some species of are of regulatory concern for Montana producers. Plant parasitic nematodes including root lesion, and sugarbeet cyst nematode are of direct economic concern due to damage to crop plants, while some nematodes such as white potato cyst (*Globodera pallida*) on potatoes and stem nematodes (*Ditylenchus dipsaci*) on pulses especially peas could negatively impact Montana agricultural export market. In addition, limited occurrence of stem nematode on alfalfa, false root knot nematode on sugar beet and cereal cyst nematodes on wheat, are also reported from Montana, which are causing economic losses to crop in the neighboring states.

Plant parasitic nematodes are often referred as hidden enemies of crops and it should not be surprising that producers would notice a nematode problem in their fields when it is already too late. Plant parasitic nematodes share some common features and possess a specialized feeding structure in their anterior region called a spear or stylet. They feed mainly on the roots of plants and reduces the plant's ability to absorb water and nutrients. Typical damage symptoms are a reduction of root mass and a distortion of root system. Aboveground symptoms of nematode damage are relatively nondescript including nutrient deficiency, wilting, stunting and poor yield. Field patterns of nematode damage begin in a small area and spread radially, often assisted by farm equipment.

The only way to accurately diagnose nematode problem is to sample soil and plant material from the suspected field. If a nematode problem is suspected by a producer in the field, then best way to confirm is to get soil checked for presence of plant parasitic nematodes by a Nematologist. Sampling from the depth of about 8-12 inches is recommended during the cropping season following W -shaped pattern.

Root lesion nematodes are tiny roundworms that damage wide variety of agricultural crops worldwide. However, in Montana only one species of root lesion nematode, *Pratylenchus neglectus*, is reported to cause damage to wheat crop. Their infestations on wheat roots cause reduction in lateral root growth, and the formation of extensive dark, necrotic lesions, thereby, predisposing the root system to secondary fungal root pathogens. Cereal crops grown in infested fields, in conjunction with moisture stress conditions, may manifest even higher crop yield losses. Montana State University researchers' reports that a population level of 2500 kg^{-1} soil of root lesion nematode was estimated to cause significant yield losses and nearly 13% of the surveyed wheat production fields had the population levels exceeding this threshold level.

Sugarbeet cyst nematode (*Heterodera schachtii*) is another destructive pest of sugar beet worldwide and reported to occur in 17 US states, including, Montana. This nematode attack and destroys feeder roots of plants causing severe stunting. Fields under continuous sugarbeet production are most likely to show high counts of sugarbeet cyst nematodes above the damage threshold level.

Another closely related nematode species are cereal cyst nematodes. Mature females become inactive and surrounded in the host roots. The presence of the white swollen female body about the size of a pin head can be seen around the flowering stage of the wheat. Upon the death of the host roots, the female body dies, dislodges, and forms a hardened dark-brown cyst. Cysts serves as a protective structure for eggs and juveniles during the host-free periods. Total crop failures have been reported in severely infested fields in Oregon. First report of cereal cyst nematode *H. avenae* in Montana is documented in the year 2006. Dr. Alan Dyer and his coworkers at the Montana State University confirmed cereal cyst nematode species, *Heterodera filipjevi*, on the roots of stunted winter wheat plants, in 2015. Cyst nematodes are efficiently disseminated by different modes of soil movement. Once introduced into a new region or country it is difficult to restrict their spread. Full extent of spread of cereal cyst nematodes in Montana is currently unknown.

Stem nematodes *Ditylenchus dipsaci* is the most widely recognized nematode parasitizing the shoots of alfalfa especially

CONTINUED ON PAGE C4

Detecting defects hidden in hides

By Agricultural Research Service

An Agricultural Research Service (ARS) scientist has found a way to find hidden defects in the animal hides that become our footwear, sporting goods, fashion accessories and other leather goods.

About 90 percent of the 32 million hides produced by the meat industry in the United States each year are exported. Before they are sold in international markets, they are visually inspected, weighed and given a numeric grade. Many hides, however, have hidden defects caused by insect bites, abrasions, scars and natural rough spots.

Processing and selling animal hides is a $2 billion industry in the United States, and the lack of any technology for measuring defects and characterizing quality often leads to disputes after the hides are sold, states Stephen Sothmann, president of the U.S. Hide, Skin and Leather Association, which represents leather goods manufacturers and meat packers, processors and traders who export hides.

Cheng-Kung Liu, an ARS materials engineer in Wyndmoor, Pennsylvania, may have found a solution: the use of ultrasonic waves.

Ultrasonic waves are sound waves, and when they are transmitted through an object, defects or rough spots on the object's surface—even those that can't be seen by the naked eye—will change the intensity of the signal. Ultrasonic waves are now used to grade lumber and identify defects on aircraft parts, NASA technology and the surfaces of other precision materials, according to Liu.

Liu scanned hides by sending low-frequency airborne ultrasonic (AU) signals through the hides to a receiver a few centimeters away. He collected enough data to accurately assess defects—and predict the potential quality of the leather's toughness, strength, stiffness and other factors. The scans also did not cause any damage.

Because the equipment is based on commercially available technologies, Liu anticipates having a scanner available for industrial use in two to three years.

For more information contact Dennis O'Brien, ARS Office of Communications.

Plant parasitic nematodes:

CONTINUED FROM PAGE C2

in the irrigated fields. Limited occurrence of stem nematode is also reported from Montana on alfalfa in the past, but current status is unknown. Statewide survey of the irrigated alfalfa fields is needed to ascertain the spread and damage potential of this nematode in Montana.

False root knot nematode (*Nacobbus aberrans*) is an endoparasite and is observed throughout the Great Plains region of the United States. Although reported from Montana on sugar beet, no significant damage has been reported from the state.

Even though some chemical nematicides are still widely considered for nematode management, there use especially in a large-scale dry land production fields of Montana may not be economically feasible, due to environmental toxicity and higher application cost. Other methods of nematode control such as breeding nematode resistant cultivars, crop rotation with non-hosts, and seed treatment with microbial products are under progress in Montana. Nematode management could be best approached by integrating crop rotation with non-host crops and planting tolerant crop cultivars. Preventive sanitation management methods such as avoid moving contaminated farm machinery from an infested field to a clean field and reusing contaminated irrigation water are some of the effective strategies against nematode management in general.

In summary, plant parasitic nematode problems are gradually increasing in Montana. Large fields, dominated by mono-cropping system with limited crop rotations options and mainly rain fed based cropping system are some of the agronomic challenges faced by the Montana producers. In addition, soils are shallow, prone to nutrient leaching, and heavy nitrogen applications are gradually contributing to soil acidification in some areas. Development of sustainable nematode management practices such as biological control, better crop rotation, resistance and soil biological conservation are much needed in this region for agricultural sustainability.

For more information, visit Montana State University, Western Triangle Agricultural Experiment Station website- http://agresearch.montana.edu/wtarc/news.html or contact Entomology and Nematology Research and Extension Team Members: Drs. Shabeg S. Briar or Gadi VP Reddy.