Insect pathogenic (Insect killing) nematodes for the management of wireworms

By Ramandeep Kaur Sandhi, Shabeg S. Briar and Gadi V.P. Reddy, MSU Western Triangle Agricultural Research Center, Conrad, Montana

Wireworms are the larval stages of click beetles. They are generalists and cause damage to many cereals, vegetable and other field crops. They are widely distributed throughout the Northern Great Plains (Montana, North and South Dakota and, Minnesota). In the recent past, wireworms and damage to crops have become a major problem for the growers in the Golden Triangle region of Montana. They dwell into the soil surface and injure plants by boring into stems, roots, and tubers. They damage the plants and go deep into soil for overwinter and come up onto the top layers in the early spring when the soil temperature reaches about 10° C. Wireworms are therefore, difficult to manage because of their hidden behavior.

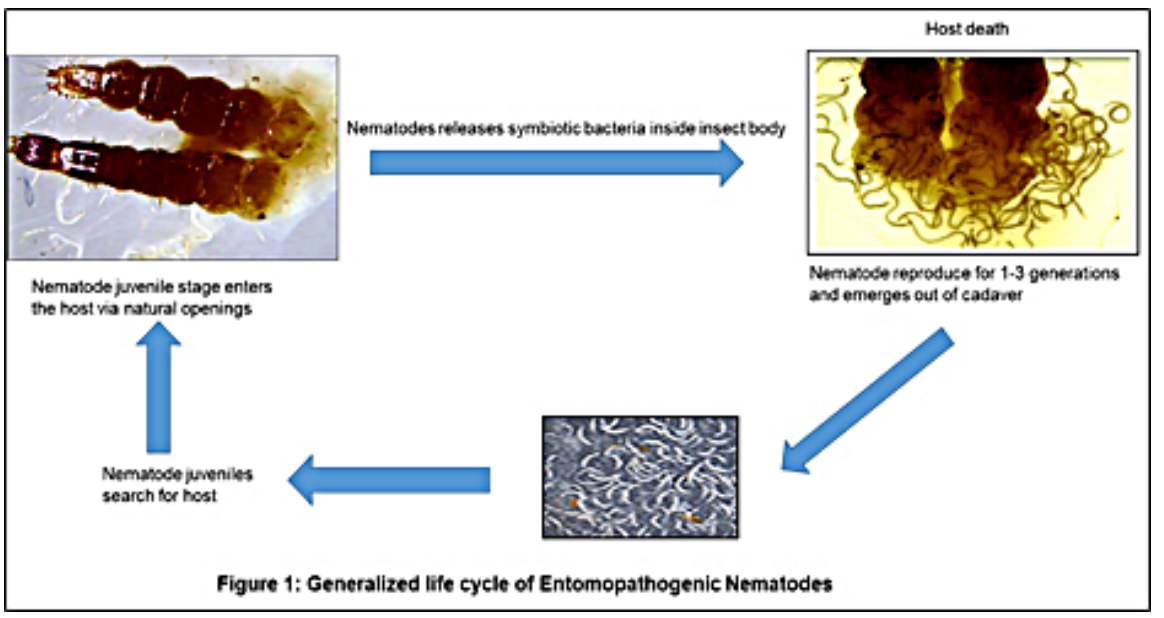

Figure 1: Generalized life cycle of Entomopathogenic Nematodes

Lindane was commonly used in early 1950's for wireworm suppression. Recently, more and more cereal fields are found positive for moderate to heavy population of wireworms in Golden Triangle region of Montana. It appears that banning of Lindane in the year 2009 and eventually some other insecticides used for wireworm management may have resulted in wireworm resurgence. Currently, insecticides mainly neonicotinoids (Imidacloprid) are being used for wireworm management mainly as pre-plant treatments like seed treatment and pre-plant broadcasting. However, for post-emergence control, these insecticides are not very effective against wireworms. In addition, neonicotinoids can only repel the wireworms but do not kill them. Also, there are reports on the neonicotinoids affecting the beneficial insects and pollinators. The development of effective biological control strategies is therefore, required to manage this pest to avoid crop yield losses.

Currently, we are evaluating the efficacy of Entomopathogenic nematodes (EPN's) against wireworms at Western Triangle Agricultural Research Center (WTARC) located in Conrad, Montana. This research project has been funded by the Montana Wheat and Barley Committee to Dr. Gadi V.P. Reddy for developing sustainable manage-

CONTINUED ON PAGE C44

New N.D. 4-H Ambassadors selected

By NDSU Extension Service

Eight youth have joined the North Dakota 4-H Ambassadors team. Pictured are (from left, front row): Eva Lahlum, Mary Goroski and Mara Bornemann; (back row) Victoria Christensen, Brittany Barnhardt, Nora Larson, Alyssa Kemp and Seth Nelson. (NDSU photo)

Eight youth were selected to join the North Dakota 4-H Ambassadors team at a recent selections event.

The new team members, the county where they are enrolled in 4-H and the school they attend are:

• Brittany Barnhardt, Morton, Mandan High School, Mandan

• Mara Bornemann, Morton, New Salem-Almont High School, Center

• Victoria Christensen, Stutsman, Christensen Academy, Courtenay

• Mary Goroski, Richland, Wahpeton High School, Wahpeton

• Alyssa Kemp, Pembina, Cavalier High School, Cavalier

• Eva Lahlum, LaMoure, homeschooled, Marion

• Nora Larson, Adams, Larson Homeschool, Lemmon, South Dakota

• Seth Nelson, Walsh, Park River High School, Park River

The North Dakota State 4-H Ambassadors are a group of young adults from across the state who are actively involved in 4-H. They coordinate many activities that involve teaching youth and adults about topics such as leadership, team work and citizenship.

They specialize in planning and facilitating 4-H events, such as the annual statewide Extension Youth Conference, workshops, training sessions and regional events. They strive to create events that are fun, educational and skill building, and promote self-improvement. They also are active volunteers for 4-H programs in every North Dakota county.

Insect pathogenic (Insect killing) nematodes for the management of wireworms

CONTINUED FROM PAGE C42

ment strategies for the wireworms on spring wheat. Briefly, EPN's are a group of nematodes that can infect and kill the insect and are therefore known as entomopathogenic or insect pathogenic nematodes. They are novel biological control agents that have a broad host range, safer to humans, and have no known negative or toxic effects on the environment. Mainly, the members of two nematode families including and are commonly studied EPNs and are considered effective biological control agents for the management of harmful insects.

Figure 2: Large number of insect pathogenic nematodes (EPN's) emerging from its host wireworm larva cadaver.

The life cycle of EPNs starts with an infective juvenile (Figure 1), that has ability to seek out and infect new hosts. Once the host is found, the infective juveniles penetrate into the insect body mainly through natural body openings like mouth, anus, spiracles, and insect cuticle. After entering into an insect, nematodes release a mutualistic bacterium that multiplies in the insect body. These bacteria cause host insect mortality typically within 24-48 hours. There is mutualistic relationship between nematodes and bacteria as nematodes provide shelter to the bacteria and bacteria provide nutrients to the nematodes by killing the insects. Inside the insect body itself, nematodes reproduce and go through several generations. When food become scarce, the adults produce new infective juveniles that can adapt to the outside environment. In a week, hundreds of thousands of infective juveniles burst out from the insect cadavers (dead larvae) and start looking for new hosts as shown in figure 1 and 2.

In summer of 2017, a graduate student, Ramandeep Sandhi has conducted laboratory bioassays for checking the ability of EPN's to cause wireworm mortality. The medium sized larvae of 3 species of wireworms; *Limonius californicus*, *Hypnoides bicolor*, and *Aeolus mellilus* were selected in this experiment. These species are predominantly reported to occur and are damaging the spring wheat fields in the Golden triangle areas of Montana. Ten strains of EPN's namely, *S. carpocapsae (*A11 and Cxrd strain*), S. feltiae* SN strain, *H. bacteriophora* (HP88 and VS strain), *S. riobrave* (355 and 7-12 strains), *H. floridensis* (K22 strain), *H. georgiana* (Kesha), and *S. rarum* (17 c+e). Different doses (2000, 1000, 500, 250, 100 and 50 Infective Juveniles/ml of water) were used in these tests. The mortality was observed for 30 days at 24 intervals. In case of wireworm, *L. californicus*, *H. floridensis* (K22 strain) followed by *S. riobrave* 355 strain and *S. carpocapsae* A11 strain showed high mortality as compared to other strains. In case of second pre-dominant wireworms species *H. bicolor*, higher wireworm mortality was obtained in *S. carpocapsae* A11 strain followed by *S. feltiae* SN strain, *S. rarum* 17 c+e, and *S. carpocapsae* Cxrd strain. In *A. mellilus*, *S. rarum* 17 c+e and *S. carpocapsae* A11 strain showed more mortality followed by *S. carpocapsae* Cxrd strain. On the basis of these positive results, further research will be carried out whether EPN's strains with higher doses can cause mortality in less time at high doses. The strains showing prominence in the laboratory tests, will be used to evaluate in the greenhouse and field experiments for their field efficacy. Optimistically, this new technology can be successfully implemented for wireworm management. This strategy is expected to have a significant and positive impact on the Northern Great Plains agriculture and will greatly help the farming community.