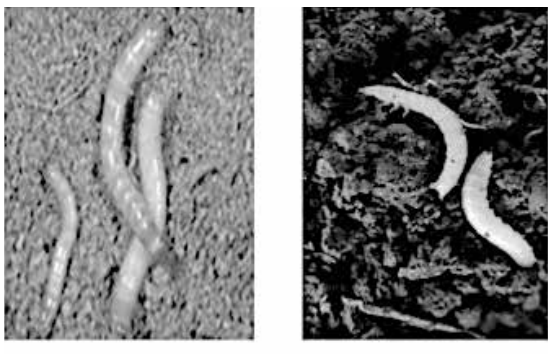
MSU Western Triangle Ag Research Center Develops Trap Crops for Wireworms

By Drs. Gadi V.P. Reddy and Govinda Shrestha, Montana State University-Bozeman, Department of Research Centers, Western Triangle Ag Research Center, Conrad, MT

Wireworms, the larvae of click beetles, are significant economic soil-dwelling pests in temperate and subtropical areas of the world. Larvae can be recognized in agriculture crops soil by their body structure and color. They are slender, with hard, smooth and jointed bodies, and often reddish-brown in color. However, larvae can be also yellow or white in color as well.

Regarding this insect pest life-cycle, overwintered adult click beetles usually emerge from soil in the spring, from late April to early May. Oviposition activity typically begin between late May and early June. Each female lays 200- 400 eggs by depositing on the soil surface down to a depth of nearly six inches. From three to seven weeks, the larvae hatch and spend several years feeding on roots and germinating seeds and moving up and down in the soil profile based on climatic conditions. Dr. Reddy and his team members previous research (2014. Journal of Invertebrate Pathology 120: 43–49) showed that Hypnoidus bicolor and Limonius californicus are two major wireworm species (Figure 1) damaging to spring wheat, particularly in the Golden Triangle, an important cereal-growing region in Montana. This research work was carried out in collaboration with Dr. Stefan T. Jaronski, Research Entomologist at USDA-ARS, Sidney, Montana. In addition, three insect pathogenic fungi (Metarhizium brunneum F52 (formerly M. anisopliae F52), Beauveria bassiana GHA, and Metarhizium robertsii DWR 346) when applied as granules in furrow or as soil drenches, were more effective than when used as seed-coating treatments for wireworm control, and provided an efficacy comparable or superior to imidacloprid. Further research is going on cost: benefit ratio as to make these products cheaper to the growers.



Limonius californicus *Hyponoidus bicolor*

Figure 1: Wireworm species common in Golden Triangle area of Montana

Within a last five to ten years, wireworm's management have become an increasing problem, particularly for spring wheat crop production in Golden Triangle area of Montana. Wireworm damages to spring wheat has been shown to inflict significant losses in crop yield, quality and marketability. They cause damage in seeds, root, stems or other plant parts by feeding, chewing, or drilling into below-ground plant tissues and structures, thereby enhancing plant diseases, stopping plant growth or killing plants completely. Wireworms also attack on stems later in the growing season that can stimulate excessive tillering and inhibit wheat head formation. Wireworm injury can cause wilting, stunting, thinning, delay in plant maturation, and seedling death, which leads to yield reduction and affects crop value. When wireworm populations are extremely high, entire fields may be lost. In many fields, wireworm infestation results in an uneven plant stand, which allows weeds to outcompete the crop using up available moisture and preventing or lessening the normal tillering of adjacent uninjured plants.

Because of wireworms' hidden nature as it lives in soil, control of this insect pest has been very difficult. Montana farmers have tended to control wireworms primarily with insecticides.. Beginning in the 1950s, wireworm populations were suppressed by conventional insecticides, such as Lindane, to a low pest status for nearly 40 years. The resurgence of wireworms in United States including Montana is rampant in recent years as because of the recent removal of conventional insecticides that were used to control them.

The current wireworms management practice relies mainly on the use of chemical-neonicotinoids (imidacloprid, principally), used as seed treatments, to provide seed and foliar protection for several weeks after planting. Neonicotinoids are widely used for control for many crop pests due to the low rates required and the compounds' long residual activity. However, some neonicotinoids have been also found to have adverse effects to the environment, especially on pollinators and other beneficial insects. For this reason, there is a need to develop other alternative control options such as a trap crop that are safe to environment and humans.

Trap cropping is a method, in which a crop that is more attractive to a pest is planted either before or alongside the main crop. Trap crops can be used to simply lure pests away from main crops, or they can be used in association with toxic agents (biological or chemical) to attract-and-kill pests in a number of imaginative ways. If a trap crop can be found to distract the pests at least during the sensitive growth periods of the main crop, sustainable and long-term pest management solutions can be achieved.

Montana Wheat and Barley Committee has been funding the project dealing in developing trap crops for wireworms at Western Triangle Ag Research Center in Conrad. Dr. Reddy, who is the principle investigator for this project, says this project has been funded since 2014 and includes researching various techniques in developing trap crops for wireworms. Dr. Reddy hired Ashish Adhikari who worked on this project as a graduate student for his master program. In this study, we examined the effect of seven trap crops: pea, lentil, canola, corn, durum, barley and wheat, for their attractiveness to wireworms compared to spring wheat. Experimental plots were located in two commercial grain fields in Valier and Ledger, Montana, USA and the trials took place from May to August in 2015 and 2016. Wheat plants damaged by wireworms were recorded and their relative locations in wheat rows and adjacent trap crop rows within a plot was determined using destructive soil samples (procedure that causes a permanent change to a specimen). In 2016, variable row spacing (0.25, 0.5, 0.75 and 1 m) between the trap crops (pea and lentil) and wheat was assessed. Shade house bioassays were conducted using potted pea, lentil and wheat plants to support field trial results. For bioassay studies, Limonius californicus larvae, released at the center of each pot were sampled four and 10 days after sowing.

Interestingly, the two years studies clearly indicate that wheat intercropped with pea and lentil had significantly fewer damaged wheat plants. In addition, wireworm num-

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bers were found lower in wheat intercropped with pea compared to the control for both locations and years. Shade house results corresponded with field results, with more wireworms collected from pea and lentil than wheat. In the spacing trials, wheat plant counts were also significantly higher when paired with pea and lentil, particularly at 0.5 m spacing. Regardless of inter-row spacing, significantly fewer wireworms were associated with wheat when intercropped with pea and lentil trap crops. This work has been accepted for publication in an International Journal, Arthropod-Plant Interactions. These results are very promising and can be used in management for wireworms in Golden Triangle area of Montana.

Dr. Reddy has hired Dr. Anamika Sharma as a postdoctoral researcher to continue the research work with trap crops. During the summer months, this researcher will be performing the field experiments on the effect of seeding density of wheat, peas and lentils against wireworms in Ledger and Valier (Montana). The seeding densities will be 0, 11, 22, 28/sq. ft for wheat; 0, 4, 8, 14 per sq. ft/peas, and 0, 6, 12, 18/sq. ft for lentils. Thanks to the four Pondera County producers who have provided plots for our experiments. Without cooperators help this project would not have been successful.

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To get rid of bugs that are harming your houseplants, place the entire plant (pot and all) in a clear, plastic dry-cleaning bag. Throw several mothballs in with it, and tie a knot at the top. The sun will still get through, but the bugs will die after a week in seclusion with the mothballs.

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If you can't escape static electricity on your carpet, here's an easy fix. Mix 3 cups water with 1/2 cup liquid fabric softener, put it in a spray bottle, and apply to your carpet. Not only will the static electricity disappear, but the mixture will serve as a carpet deodorizer too.

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If you make rice and it won't fluff, add a few drops of vinegar before running through with a fork.