

Workshop Title: Wireworm Management in Grain Production

Speaker(s) & their title(s): Dr. Christine Noronha, Agriculture and Agri-Food Canada

Executive Summary:

Christine provided a comprehensive presentation of wireworms, including topics such as wireworm identification, lifecycle, biology, ecology and their distribution in the soil profile. The damage, and effects on crops were identified, including what to look for. Lastly, Christine discussed some effective ways to reduce the population, and monitor it.

Detailed Notes:

Christine started off the presentation pointing out that wireworms are incredibly difficult to work with, control and find effective solutions to reduce their population and harm on crops both conventional and organic. They particularly affect grain production.

Wireworms are larvae of click beetles, which cause damage to crops. There are species that damage crops, and those that don't. The focus of this presentation is on those that damage crops (European species). At this time, their populations are increasingly rapidly worldwide.

Wireworms feed on a large variety of crops such as cabbage, corn, and root crops. Many times, they can leave crops unmarketable. Unfortunately, the signs that they are present in root crops are not clear until harvest.

Wireworms pupate in the soil, and have a 5-year life cycle. In the spring, they emerge as adults and lay around 100-200 eggs towards early summer. Through spring to fall, they damage crops. A final feeding frenzy occurs before hibernation in fall, and this is when damage to root crops occurs.

As the larvae progress to the latter years of their lifecycle, they do the most damage during this time, as they are larger. Christine described how growth initially can be slow, but then rapidly increases as the population gets larger. Damage of the crop is proportional to the age of these wireworms, and not just the number. A large younger population is less of a threat for crop damage than a small but older population.

Most species of wireworms take 5 years to mature, but this can differ as in European wireworms. In PEI there are 48 species, 98 in NB, and 101 in NS. In the maritimes, the *Agriotes Sputator* is most common. Recall that not all of these species are pests and cause damage to farms. The ones that do are referred to as the European wireworms.

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Wireworms commonly lay their eggs in undisturbed fields, preferable with green plant material. In pasture fields, they always have food and their eggs are more likely to survive with the consistent moisture content within the soil. They can lay their eggs in bare soil, however this poses a risk of them drying out. In the maritimes, we get a lot of rain so unfortunately this is an added benefit to their survival. As a last note for this section, their population density is usually scattered with a geographical area, making it difficult to quantify or predict.

For monitoring, Christine and her team use pheromone (chemicals omitted by the female wireworms) traps on PEI to attract only males of European species. Considering fields in PEI growing potatoes through a rotation, Queens County has the highest population followed by Prince and Kings counties. The numbers are also on the rise in western Canada.

Upon impact, this agricultural land is deemed infected until adequate control measures are present to eliminate larvae. If not controlled, this area becomes a source breeding ground which will infest other presently unaffected fields. It is unknown why they choose to lay their eggs in a variety of locations. Wireworms are difficult to control for a number of reasons:

- They have a 5-year life cycle
- They cannot grow in a lab setting, and thus if live insects die in a lab setting it will take another year until the study may be continued. Therefore, it takes a lot of time to gather data.
- They dwell within the soil
- Several generations are present in the same field
- Damage occurs in spring and fall
- Populations are randomly distributed within local geography
- They feed on a number of crops (most of which are conventionally planted e.g. corn, oats, peas, wheat, carrots, barley, potatoes etc.)

Christine presented two slides: one demonstrated how a whole wheat field in Alberta had been destroyed by wireworms, as there is no wheat present. The second, shows a barley field in PEI where there are some bare patches: this indicates that the population is on the rise in this part of the field.

In the spring, wireworms attack germinating seeds which give off CO₂. Commonly, the seeds may not recover from this damage and therefore the crop fails. Grain is the most susceptible crop to be attacked by wireworms, as it is a great food source. Successive planting of wheat supports their population. Similarly, under-seeding, results in abundance of food which helps survival of wireworms.

Luckily, Christine has also presented some solutions to reduce the wireworm populations:

- A study was conducted on PEI where mustard or buckwheat were planted within a potato crop rotation (early June) for a period of 2 years

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- This resulted in a major reduction in damage to market crops (potatoes) when they went to market following this rotation
- Brown mustard contains a chemical Allyl-glucosinolate (GTC)
- When the plant breaks down, it reacts with the enzyme Myronase to produce Isothiocyanates (ITC)
- Brown mustard also contains 2-phenylethyl within its roots which is harmful to wireworms

Here is some more specific information presented by Christine, for this crop rotation (taken from presentation):

- Brown Mustard (variety Centennial) 8-10lb/ac or 11.2kg/ha
- Buckwheat (variety Mancan) 40lb/ac or 44.8kg/ha
- 2 crops/year
- Fertilizer 300lb/ac or 335kg/ha 17:17:17 banded at planting in the spring
- Plant early June
- Disk the crop in late July before seeds mature

- After two-three weeks harrow the field to level it
- Depending on the seeder you may need to roll it before planting, mainly because you don't want the mustard seed planted too deep
- Do not need to add fertilizer for the second planting

- The 2nd crop should go in by mid-late August
- Wireworms come to the surface to feed by mid-late September
- You want the crop established and producing the chemicals by then
- This second crop does not need to be disked as it will act as ground cover and will not produce seeds

Although unfortunately there is no economic benefit directly from planting these crops, they still must be treated well so that they can prosper in order to have a large effect on reducing the wireworm population. A question was raised whether the second crop (for fall planting) could be acquired from mowing down the first one: Yes, let it go to seed, mow it down, and then it should return in the fall. In addition, it doesn't matter which 2 years out of the 5-year crop cycle that these crops are introduced.

Metarhizium spores have also presented as a way to reduce the wireworm populations. They are introduced to wireworms, by mixing *Metarhizium* spores with pheromones and put into pheromone traps. The idea is that the males will acquire these spores, and then transmit to the females to reduce the population. A high amount of *Metarhizium* spores must be used, as a dose is ineffective in killing the wireworms.

To access the wireworm populations within a field, the bait traps should be deployed in spring and fall, with at least 15 per acre. Bait traps are effectively just

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a cylindrical hole within the ground 3.5" in diameter, and 5.5" deep. The hole is then filled with ~3/4 cup of cut up carrots, and dirt lightly packed on top to level out the ground. A wire flag can be inserted in the center to indicate the trap location. After waiting at least 7 days, the samples may be collected. Insert the same probe which created the hole, to collect all of the original sample and some extra soil around the exterior of the trap to ensure that the whole trap has been collected. Place this material in a 12lb plastic bag, and store at 4°C until you have time to analyze the samples. Make sure to label each sample. Christine noted that one should (taken from presentation):

- Count the number of wireworms and calculate number per bait
- Threshold 1-2 wireworms per bait
- Finding no wireworms does not necessarily mean that none are present in the field. The higher the number of bait stations the better the accuracy.