Canadian Agri-Science Cluster for Horticulture 3

Update to Industry

2018-2019

Activity title: Generate and Evaluate Integrated Pest Management Tools for Wireworm Control in Potatoes in Canada
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Activity Objectives (as per approved workplan): Objective 1: Test the efficacy of new insecticides to control wireworms and click beetles. Objective 2: Evaluate an integrated approach to manage wireworm damage. Objective 3: Identify and apply novel click beetle monitoring tools. Objective 4: Surveillance of click beetle expansion in Canadian potato growing regions.
Research Progress to Date (use plain language): Wireworms are a major problem faced by the agricultural industry. Because they feed on the roots and seeds of several crops the economic impact of damage caused by wireworm feeding is experienced across all commodities. It is especially a problem in potatoes where damage can result in millions of dollars in economic loss. In this project we endeavored to increase our knowledge on wireworms and develop control strategies to mitigate their impact on the potato industry. Progress in the first year of the project advanced as planned. Outcomes in 2018 include, 16 scientific presentations and 16 presentations at industry and growers meetings and 1 tour, 9 media interviews and 6 reports were submitted to industry partners.

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Accomplishment for each of the four objectives in 2018 are as follows:

Objective 1- Test the efficacy of new insecticides to control wireworm and click beetle: Several registered and experimental insecticides and insecticide combinations were tested in BC, Ontario and PEI. Results demonstrate that the registered insecticides continue to be effective in reducing damage to potato tubers by *Agriotes obscurus*, *Agriotes sputator* and *Limonius agonus*. Several experimental products and product combinations appear to successfully reduce damage to daughter tubers equivalent to or better than the current standard Thimet 20G, even under high wireworm pressure. Capture (bifenthrin) provided better protection from wireworm damage, followed by Titan in Ontario where *Limonius agonus* was the main wireworm species.

Objective 2: Evaluate an integrated approach to manage wireworm damage in potatoes:

Trials were conducted in grower and research fields to evaluate implementation of IPM measures.

In PEI, control measure used were trapping and removing click beetles females, rotation crops and tuber evaluation in year 2018.

Trial 1: A 50 acre field was divided into two halves in 2016, one half planted to brown mustard (a wireworm suppressive crop) and the other with ryegrass (a non-suppressive crop). Two lines of 28 traps (NELT™) were placed one in the ryegrass and the other in the mustard sections of the field. The traps were collected weekly. A potato crop was planted in 2018. On October 26th 2018, potato tubers were harvested by hand and 16 samples consisting of tubers from a 15ft row samples per section (Mustard and Ryegrass) were collected. Tubers were graded and washed and evaluated for wireworm damage by assessing the number of holes per tuber and marketable yield was assessed using the processing industry standards. Results in 2018 show a 70% reduction in holes/ tuber when the field was planted with brown mustard for two years and 23% reduction when planted with ryegrass. Click beetle numbers were significantly lower showing an 85% reduction in 2018 when compared to 2016 trap catches.

Trial 2: A 70 acre field was used to determine the impact of growing brown mustard for one vs two years was established in 2016. A potato crop was planted in 2018. Tubers were hand dug and evaluated for damage. Results showed a higher yield in the following two year vs mustard when compared to one year. Damage was also lower, although not significantly in the two year mustard when compared to one year mustard planting. Click beetle population was significant reduced (91%) following trapping of females for two year.

Trial 3: A new IPM study was set up in three commercial fields in PEI in 2018, to determine the baseline damage to potato tubers before implementing IPM strategies (rotational crops plus female click beetle trapping) in the upcoming years. Tubers collected in 2018 were evaluated for damage and base line damage level was established. Click beetles were also collected and counted and a base line for population numbers before the implementation of IPM strategies was established.

Trial 4: An experiment investigate the horizontal and vertical movement of wireworms were set up in the laboratory and field. Results show that 30% of the wireworms can move 3.6m horizontally through soil to a food source within 24 hours and can move vertically up to 80cm to overwinter.

Weed Trial: Rotational crops have been known to suppress weed seed germination and growth. Therefore, trials were established in PEI, to evaluate the effects of full-season cover crops grown for wireworm control on weed suppression and the weed seedbank. experimental crops included brown mustard, buckwheat, timothy and a mixture of hairy vetch, crimson clover and annual rye using different methods of termination such as disk, mow and disk, glyphosate, and roller-crimped. Data was collected and weed identity, density, and biomass is ongoing. These experiments will be repeated in 2019-2020. The results of these experiments will determine the potential added benefit of full-season wireworm cover crops on weed suppression and manipulation of the weed seedbank as part of a fully integrated IPM program for potatoes.

Trial in Ontario: Researchers at AAFC London conducted trials with cover crops on the research farm at London Ontario. At this location *Aeolus* sp. *Aeolus mellilus* was the main wireworm species. One block with 10 different cover crop mixtures (mustards, radish, buckwheat, and small amounts of peas, sainfoin, sunflower, oats and ryegrass, with 3 replicate plots per mixture) or no cover crop (control) had been seeded in 2017. After sampling in June 2018, more than twice as many wireworm were found in control plots (total of 10 wireworm) relative to plots where brown mustard (4), oriental mustard (3), oilseed radish (1), Brassica mixes (1) or seed mixes including buckwheat (1). In summary, different mixes of cover crop species appear to have a negative effect on wireworm.

Objective 3: Identify click beetle monitoring tools: Four click beetles species *Limonius canus*, *L. californicus, Selatosomus destructor*, and *Hypnoidus bicolor* were collected from several locations from interior BC and southern and central Alberta and sent to Dr. Gries (Simon Fraser University) for pheromone extraction and isolation. Preliminary extractions were conducted and GS-MS analyses of these extractions undertaken. Initial preparations of synthetic compounds will be attempted over the next few months, for screening in the field during the 2019 season.

Objective 4: Surveillance of click beetle population expansion in Canadian potato growing regions: Wireworm and click beetle samples were collected from southern and northern Alberta, southern Manitoba, and southern and northern BC and identified by Dr. van Herk in 2018. Approximately 250,000 beetles were collected and identified. It does not appear the invasive European pest species (*A. obscurus* and *A. lineatus*) have spread to northern BC and Alberta, but they have established in important farming areas of southern BC outside of the Fraser Valley and Vancouver Island where they were first reported. Research will continue for all four objectives in 2019-2020

Extension Activities (presentations to growers, articles, poster presentations, etc.):

The outcomes for this year include, 16 scientific presentations and 15 presentations at industry and growers meetings, 1 tour, 9 media interviews, 4 scientific publications and 6 reports submitted to industry partners.

Early Outcomes (if any) or Challenges:

1) Several experimental products and product combinations appear to successfully reduce damage to daughter tubers equivalent to or better than the current standard Thimet 20G, even under high wireworm pressure.
2) Rotation crops brown mustard and buckwheat continue to successfully reduce wireworm damage not only with the *Agriotes sputator* and *Hypnoidus abbreviates* species found in PEI but also *Limonius agonus* found in Ontario.
3) Although planting brown mustard for one year suppresses wireworm damage, planting it for two years appears to be better giving lower tuber damage and higher market yield.
4) It does not appear the invasive European pest species (*A. obscurus* and *A. lineatus*) have spread to northern BC and Alberta, but they have established in important farming areas of southern BC outside of the Fraser Valley and Vancouver Island where they were first reported.
5) Initial preparations of synthetic compounds extracted from click beetle females (*Limonius canus, L. californicus, Selatosomus destructor,* and *Hypnoidus bicolor*) is underway. If successful screening in the field during the 2019 season will take place.
6) One of the challenges faced for objective 3 is collecting unmated beetles of the right age from the field in order to extract pheromone making the extraction process more complex.

Key Message(s):

For the first time the movement of wireworms within the soil has been recorded and understood. New knowledge was generated on the time and speed at which wireworms move in the soil to locate a food source was found to be much quicker than previously thought. This information is critical to determine the time required from bait instillation to removal to obtain an accurate representation of the population when monitoring fields. We have also demonstrated for the first time that wireworms are capable of digging to depths of 80cm to overwinter. We also discovered that beetles can survive in a frozen state over the winter months when trapped in frozen soil.

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