

Canadian Agri-Science Cluster for Horticulture 3



Update to Industry

2019-2020

<p>Activity title: Generate and Evaluate Integrated Pest Management Tools for Wireworm Control in Potatoes in Canada</p>
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<p>Names of Collaborators and Institutions: Dr. Wim Van Herk (Agassiz Research and Development Centre) Dr. Gerhard Greis (Simon Fraser University) Dr. Haley Catton (Lethbridge Research and Development Centre) Dr. Ian Scott (London Research and Development Centre) Dr. Andrew Mackenzie-Gopsill (Charlottetown Research and Development Centre)</p>
<p>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.</p>
<p>Research Progress to Date (use plain language): Wireworm damage to tubers can cause major economic loss for the potato industry in Canada. There are several species of wireworms and they differ between provinces. Because wireworms feed on a wide variety of crops, it is challenging for growers to determine which crops to grow in a wireworm infested field. The limited number of registered insecticides that can kill this pest increases the difficulty associated with controlling them. This project focuses on developing techniques to reduce wireworm populations and mitigate the economic impact of this pest on the industry. In its second year, the project progressed as planned. There were five outcomes this year, 13 scientific presentations and posters and 14 presentations and posters at industry and growers meetings, 1 scientific paper, 4 new technologies assessed under research conditions and 5 new knowledge transfer products were developed.</p> <p>Accomplishment for each of the four objectives in 2019-20 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, ON and PEI. Results demonstrate that Thimet 20G (Phorate), the product registered for wireworm control, continues to be effective in reducing damage to daughter tubers by <i>Agriotes obscurus</i>, <i>Agriotes sputator</i> and <i>Limonius agonus</i>. Other registered products such as Verimark tested in Ontario, did not reduce wireworm damage. Some novel experimental products (e.g. broflanilide) appear to successfully reduce damage to daughter tubers by <i>A. obscurus</i> and <i>A. sputator</i>, reduction in damage with this product was equivalent to or better than the current standard Thimet 20G, even under high wireworm pressure.</p>

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

For this objective 4 different trials were carried out in PEI, 1 in ON, and 1 AB

2.1. In 2019 in PEI, rotation crops Flax, Buckwheat, Sorghum Sudangrass and Barley were planted in a one and two year rotation study to determine their efficacy against wireworm. As expected, the root and shoot biomass along with plant height was significantly higher for the buckwheat and sorghum sudangrass crops, thus contributing to soil organic matter. This was the first year of the study which will continue in 2020-21 with the one year rotation plots planted with potatoes and the two year rotation plots planted with their respective rotation crop. The efficacy of these crops will be evaluated based on the damage to potato tubers.

2.2. IPM studies were also initiated in four 50ac growers' fields in PEI to determine if trapping and removing egg laying females using the NELT™ trap would reduce the resident wireworm population. Efficacy of this method will only be learned after three years of trapping mainly because of the long life cycle of this pest.

2.3. In PEI, greenhouse studies to determine the impact of buckwheat at different rates in a seed mixture on, wireworm suppression and its allelopathic activity on the growth rate of other crops in the mixture, was initiated. Results shows that 50% buckwheat in a seed mixture significantly reduced growth in other crops. The presence of only 20% buckwheat in the seed mixture provided statistically comparable wireworm reduction as a pure stand of buckwheat. These studies will be carried out under field conditions in 2020-21.

2.4. Trials were set up in PEI to test ability of wireworm suppressive rotation crops buckwheat and brown mustard in addition to non-suppressive crops such Timothy and a mix of hairy vetch, crimson clover and annual rye on in season weed suppression and their effect on the weed seedbank. Buckwheat and brown mustard provided comparable levels of weed suppression to other cover crops evaluated and resulted in a decline of weed density with increasing stand density. Termination of cover crop buckwheat via mowing, discing or glyphosate provided significantly greater weed suppression than using a roller-crimper whereas brown mustard terminated by discing or glyphosate provided significantly greater weed suppression than mowing or use of a roller-crimper. Method of termination had no impact on potato yield potato in the following season.

2.5. Trials with rotational crops were conducted on 2 field sites in southwestern Ontario: Oxford county (north of Woodstock) and in Norfolk county (west of Port). At these locations wireworm, *Melanotus* spp., *Agriotes* spp., *Hypnoidus* spp. (Oxford), and *Aeolus* spp., *Hypnoidus* spp. and *Limonius* spp. were present. Cover crop mixtures (barley, buckwheat, and combinations of both plants) were seeded in August to test for wireworm suppression. Bait traps were used to collect wireworms after 4 weeks. Because, a low number of wireworms were recovered in the fall, further baiting in spring 2020 will be undertaken to obtain better evidence of the effects of cover crop on wireworms.

2.6. In Alberta a greenhouse experiment was initiated to assess the performance of a main prairie pest wireworm *Selatosomus aeripennis destructor* on 3 crops: wheat, buckwheat, and brown mustard. Data collection had to be terminated early because of the shutdown due to covid-19. Data collect until the shutdown is in the process of being analysed. These trials will continue in 2020-21.

Objective 3: Identify click beetle monitoring tools:

In 2019, field trials to determine the attractiveness of a pheromone to three species of click beetles, *Limonius canus*, *Limonius californicus* and *Selatosomus aeripennis destructor* were conducted in AB, BC and Oregon. Results from the first year of field testing indicate that the compounds identified in the lab. Attracted male click beetles in the field, traps baited with these compounds collected 7x (*S. destructor*) or approx. 100x (*Limonius* spp.) more beetles than control traps. Attempts to extract pheromone from two *Hypnoidus* species was unsuccessful. These studies will continue in 2020-21.

Objective 4: Surveillance of click beetle population expansion in Canadian potato growing regions:

Wireworm and click beetle samples were collected by various parties and submitted to Dr. van Herk for identification in 2019. Approximately 1,000 larvae were identified from southern Alberta (predominately *Limonius californicus*) and southwestern Manitoba (almost exclusively *Hypnoidus bicolor*). Click beetles were also collected throughout southern BC (predominantly *A. obscurus* and *A. lineatus*), and northern BC, and southern and northern Alberta (predominantly *Selatosomus destructor*, and *H. bicolor*), and PEI (predominantly *A. sputator*). Over 100,000 beetles were collected and identified. No *A. sputator* have been found in western Canada to date.

In Prince Edward Island, a province wide survey was conducted in 2019 to evaluate the populations' size of *Agriotes sputator*, *A. lineatus*, and *A. obscurus*. These surveys are conducted every three to four years to determine spread and population size. Pheromone traps were of all three species were placed in 85 farm fields. Click beetles were collected weekly from the 1st week in May to the end of June. Results show a significant decrease in the population across the province from 2012 and 2016 levels, this decline in population could be attributed to the IPM technique used on farms in PEI. Another survey will be conducted in 2023 or 2024.

Research in all four objectives needs to continue in order to validate research findings, increase our knowledge and develop efficient control options. In the case of insecticides, continued research will provide PMRA with sufficient data for potential registration of new chemistries for wireworm control. Testing efficacy of rotation crops in suppressing the wireworm species in the different provinces is essential for growers to obtain a more accurate measure of the crops they can grow to reduce the economic loss caused by this pest. Pheromones play an important role in monitoring pest species and surveillance of click beetles is important to track movement, expansion and population size of these pests. The information generated will aid in on-farm making decisions on the need to use wireworm control strategies in a field. It also provides a way to gauge the success of wireworm control strategies implemented on a farm. All four objectives will continue in 2020-21.

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

SCIENTIFIC PRESENTATIONS

- Noronha C.**, M.D. Bahar, S. Liu, N. Mosher-Gallant. 2019. Buckwheat: A promising IPM tool for wireworm management. Joint Meeting of the Acadian Entomological Society, Entomological Society of Canada, and Canadian Society for Ecology and Evolution, Fredericton, NB, August 20, 2019
- Liu S., **C. Noronha**. 2019. A biological study of *Agriotes sputator*, (coleoptera:elateridae) the dominant wireworm species in PEI. Joint Meeting of the Acadian Entomological Society, Entomological Society of Canada, and Canadian Society for Ecology and Evolution, Fredericton, NB, August 20, 2019
- Vernon B., **W van Herk**. 2019. "Biology and management of wireworms and click beetles: challenges facing the global research community" Norsk institutt for bioøkonomi (NIBIO), Oslo, Norway, October 2.
- Vernon B., **W van Herk**. 2019. "Wireworm damage to potatoes and wireworm and click beetle identification" Norsk institutt for bioøkonomi (NIBIO), Oslo, Norway, October 23.
- Vernon B., **W van Herk**, J Borden. 2019. Considerations in the development and selection of pheromone traps for the study and management of click beetles (Coleoptera: Elateridae). IOBC-WPRS working group "integrated protection of field vegetables", Stratford-upon-Avon, UK, October 14
- van Herk W.** 2019. Wireworm research in the Prairies: past & present, similarities & differences. 6th Joint Annual Meeting of the Entomological Societies of Alberta and Saskatchewan, Elkwater, AB, October 4, 2019 (invited presentation for the George Ball memorial symposium) (30 min)
- Goudis L., A. Arevalo, J. Clark, **C. Noronha**, **W. van Herk**, B Vernon R Willis. 2019. Broflanilide Insecticide In-Furrow Treatment: a new active ingredient to control wireworms (Coleoptera: Elateridae) in potatoes. Joint Meeting of the Acadian Entomological Society, Entomological Society of Canada, and Canadian Society for Ecology and Evolution, Fredericton, NB, August 20, 2019
- van Herk W.**, J. Rush, B. Vernon, L. Goudis, W. Barton. 2019. Broflanilide, an effective new insecticide for managing wireworms (Coleoptera: Elateridae) in cereals. Joint Meeting of the Acadian Entomological Society, Entomological Society of Canada, and Canadian Society for Ecology and Evolution, Fredericton, NB, August 20, 2019
- van Herk W.**, G. Gries, R. Gries, H. Catton, S. Meers, P. Landolt, J. Otani. 2019. Identification of sex pheromones of Canadian pest click beetle species. Joint Meeting of the Acadian Entomological Society, Entomological Society of Canada, and Canadian Society for Ecology and Evolution, Fredericton, NB, August 20, 2019
- Posters:**
- Drahunl., K. Wiebe, B Cassone, **W van Herk**. 2019. "Risk assessment to wireworm crop production" Entomological Society of America, St. Louis, MO, (November 18 2019)
- Catton H.**, **W van Herk**. 2019. "Wireworm pests in spring wheat in southern Alberta, Canada." 1st International Wheat Congress, Saskatoon, SK, July 23, 2019
- Catton H.**, **W van Herk**. 2019. "Wireworm pests in spring wheat in southern Alberta, Canada." 6th Joint Annual Meeting of the Entomological Societies of Alberta and Saskatchewan, Elkwater, AB, October 4, 2019

Larney F.J., **Catton, H. A.**, Geddes, C.M., Lupwayi, N.Z., Forge, T.A. 2020. Cover cropping for organic carrot production. Presentation at Organic Alberta Conference, January 31, 2020, Camrose, Alberta.

INDUSTRY PRESENTATIONS

Noronha C. 2020. Wireworm management in potatoes - Research Update. 2020 wireworm workshop-webinar. March 24.

Liu S., C. Noronha. 2020. Unique function of buckwheat in the Seed Mixture of Rotational Crops. 2020 wireworm workshop-webinar. March 24.

MacKinnon L., C. banks, S. Ibarra, **C. Noronha**, N. Mosher-Gallant. 2020. 2019 click beetle survey results. 2020 wireworm workshop- webinar. March 24

van Herk W., T. Mitchell, B. Vernon. 2020. "Wireworm Management – Searching for Alternatives" Professional Pest Management Association Meeting (Burnaby, BC) Feb 21. (30 min)

van Herk W., T. Mitchell, B. Vernon. 2020. "Broflanilide – A new chemistry for managing wireworms in potatoes and cereals." BC Fresh Vegetables Inc. grower meeting (Delta, BC) Feb 13. (20 min).

van Herk W., T. Mitchell, B. Vernon. 2020. "Wireworm Management – Searching for Alternatives." Lower Mainland Horticultural Improvement Association, Growers' Short Course (Abbotsford, BC) Jan 31. (30 min).

Catton H. 2019. Wireworm research on the farm. Lamb Farms Field Tour. July 10, 2019, Claresholm, AB. (~60)

Catton H. 2019. Crop entomology research at AAFC-Lethbridge. Presentation at International Triticale Symposium Field Day, July 18, 2019, Lethbridge, AB.

Catton H. 2019. Wireworms in organic production. Presentation at Organic Field Tour, August 7, 2019, Coaldale, AB.

Catton H. 2019. Prairie wireworms: what pulse growers need to know. Invited Presentation at Alberta Pulse Growers Zone 1 Meeting, December 2, 2019, Taber, AB.

Posters:

van Herk W., B. Vernon, S. Acheampong. 2020 "Distribution of two invasive wireworm pests in British Columbia: New records, and implications of their spread." Professional Pest Management Association Meeting (Burnaby, BC) (Feb 21)

Ni M., A. Janmaat, **W. van Herk.** 2020 "The correlation of female *A. obscurus* click beetle ovary maturity levels with the female *A. obscurus* mating receptiveness and male *A. obscurus* mating preference." Professional Pest Management Association Meeting (Burnaby, BC) (Feb 21)

van Herk W., B. Vernon, S. Acheampong. 2020 "Distribution of two invasive wireworm pests in British Columbia: New records, and implications of their spread." Islands Agriculture Show (Duncan, BC) (Feb 7-8)

van Herk W., B. Vernon, S. Acheampong. 2020 "Distribution of two invasive wireworm pests in British Columbia: New records, and implications of their spread." Lower Mainland Horticultural Improvement Association, Growers' Short Course (Abbotsford, BC) (Jan 30 – Feb 1)

MEDIA INTERVIEWS

Mark Halsall (interview with **McKenzie-Gopsill, AG**). War on Weeds. SpudSmart Spring 2020

<https://spudsmart.com/war-on-weeds/>

Catton H., J. Boychyn. 2019. Wireworm research. The Growing Point Podcast, produced by the Alberta Wheat Commission. May 27, 2019. <https://podtail.com/podcast/the-growing-point-podcast/dr-haley-catton/>

Gavloski J., and **Catton, H.** 2020. Insect management in cereal grains in western Canada. In: Western Committee on Crop Pests Guide to Integrated Control of Insect Pests of Crops. (updated Feb 2020).

www.westernforum.org

Hart L. (**interview with Catton H**). 2019. Wily wireworm remains a mystery. Grainews 45:1&5. December 3, 2019. Front page article. <https://www.grainews.ca/news/wily-wireworm-remains-a-mystery/>

Doig I. (**interview with Catton H**). 2020. Know your enemy: an integrated approach to wireworm. GrainsWest Magazine. Spring 2020:10-11. <https://grainswest.com/2020/03/know-your-enemy/>

SCIENTIFIC PUBLICATIONS

van Herk WG, Vernon RS (2020). Local depletion of click beetle populations by pheromone traps is weather and species dependent. Environmental Entomology.

Early Outcomes (if any) or Challenges:

Pheromone extraction of most native click beetle species is complicated by the absence of pheromone glands. This has made identification of sex pheromones for *H. bicolor* and *H. abbreviatus* extremely difficult.

Key Message(s):

1. Novel products / formulations (e.g. broflanilide) appear to successfully manage *A. obscurus* and *A. sputator* damage to potatoes, even under high pest pressure, providing protection equivalent to or better than the current industry standard (Thimet 20G).
2. Preliminary results suggest that buckwheat included in seed mixtures even as low as 20% is capable of reducing wireworm populations in the greenhouse. Field trials are needed.
3. The stand density of buckwheat and mustard can significantly reduce the common weed lamb's quarters (*Chenopodium album*) and the overall weed density. The termination method of rotation crop buckwheat and brown mustard can also impacts weeds seed suppression.
4. It appears 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, far outside the Fraser Valley and Vancouver Island where they were first reported. Species identified from the other regions conform to the predominant pest species previously reported for those areas (e.g. *Limonius canus*, *L. infuscatus*).
5. The survey in PEI has shown a decrease in click beetle population, this may be related to the wide spread use of wireworm suppressive rotation crops such as brown mustard and buckwheat, for several years. This trial was a good gauge to evaluate the efficacy of IPM techniques. Further surveys are needed to validate this trend.

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