Canadian Agri-Science Cluster for Horticulture 3

Update to Industry

Semi-Annual – Fall 2021

Activity title:
Generate and Evaluate Integrated Pest Management Tools for Wireworm Control in Potatoes in Canada

Name of Lead Researcher: Dr. Christine Noronha

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)

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, not to exceed 500 words):
Fields trials were conducted in heavily infested fields in PEI and BC, to test the efficacy of different application approaches and rates for several candidate chemicals alongside industry standards. Potato tubers harvested on two dates are currently being assessed for wireworm damage. Data input and analysis are underway. In PEI, two replicated field trials were established 1) Potatoes planted in plots following two years of barley, buckwheat, flax and sorghum sudangrass crops are currently being assessed for wireworm damage. 2) A replicated trial with four crop mixes (pearl millet, fodder radish, sorghum sudangrass, phacelia, peas + either 25% buckwheat or brown mustard or terminator mustard) was started in PEI. Baits traps were used to determine wireworm numbers. Data input and analysis are underway. In Ontario, replicated trials of five cover crops treatments (barley, buckwheat, 50:50 barley: buckwheat, sorghum-Sudan grass, and brown mustard) were planted at three different locations. The cover crops were terminated by mowing and plots were reseeded with winter rye grass. Soil cores and baits were collected to assess, wireworm feeding, soil nutrients and microbiome. Potatoes will be planted in these plots to assess wireworm population post-cover crops in 2022. To evaluate effects on weed suppression of double cropped buckwheat and brown mustard, buckwheat followed by brown mustard and brown mustard followed by buckwheat sequence, a four year field study was initiated in 2017 in PEI. Results showed weed density and biomass was highly suppressed in all four crop combinations. Analysis of seedbank samples is ongoing. To minimize volunteer buckwheat, a field trial was conducted in PEI to define the critical period for weed seed control (CPWSC). Preliminary analysis showed that buckwheat produced

seed 42 days after planting with maximum seed production at 70 days. Seed viability testing to define the CPWSC is ongoing. In Alberta wireworms were field-collected in the spring and stored live in the lab to test damage from different Prairie wireworm species to cereal seedlings in the greenhouse. Experiments with multiple replications are planned for January to March 2021.
Click beetles were collected and used for pheromone identification at Simon Fraser University. Prospective new pheromones were field tested for *Agriotes mancus* in QC and ON and *A. ferrugineipennis* in BC. Successful field tests were conducted for *L. canus, L. infuscatus, L. californicus* in BC, Alberta, Washington, and Montana and for *L. agonus* in Ontario. Light traps emitting different wavelengths (e.g. green, UV) were field tested in Pemberton BC to determine which are most attractive to click beetles. More work is needed on this, but pest species appear to differ in their response to different wavelengths. Wireworm specimens (~200) from the Prairies were received for ID. Click beetle specimens (>250,000) collected in southern BC, Alberta, Ontario, Quebec, Washington, and Montana, are currently being identified to species by van Herk, with assistance from Dr. Hume Douglas and Drs. Frank Etzler, Frank Ramberg, and Scott Gilmore. Click beetle were collected from 15 sites in southern New Brunswick and sent to Charlottetown RDC where identification is underway.

Extension Activities (presentations to growers, articles, poster presentations, etc.):
Field Guide:
Catton H, van Herk W, Saguez J and Svendsen E (2021) *Guide to pest wireworms in Canadian Prairie field crop production*. Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada
English: https://publications.gc.ca/site/eng/9.900365/publication.html
French: https://publications.gc.ca/site/eng/9.900369/publication.html

Articles:

1. Drahun I, Wiebe FK, Gohl P, Koloski CW, Koiter AJ, van Herk WG, Cassone BJ. (2021) Three years of surveillance associates agro-environmental factors with wireworm infestations in Manitoba, Canada. Pest Management Science http://doi.org/10.1002/ps.6650

2. Gries R, van Herk W, Alamsetti SK., Catton H, Meers S, Otani J, Gries G (2021). (*Z*,*E*)-α-Farnesene – sex pheromone component of female click beetle *Selatosomus aeripennis destructor* (Brown) with intra- and inter-sexual communication function. Entomol. Exp. Appl.

3. van Herk WG, Lemke E, Gries G, Gries R, Serrano JM, Catton H, Wanner K, Landolt PJ, Cooper WR, Meers S, Nikoukar A, Smith JL, Alamsetti SK, Etzler FE. Limoniic acid and its analogue as trap lures for pest *Limonius* species (Coleoptera: Elateridae) in North America. J. Econ. Entomol. 114: 2108-2120. https://doi.org/10.1093/jee/toab154

4. van Herk WG, Vernon RS, Acheampong S, Otani J, Uloth K. (2021) Distribution of two European elaterids, *Agriotes obscurus* and *A. lineatus* in British Columba: New records, and potential implications of their spread. Journal of Asia-Pacific Entomology 24: 688-694. https://doi.org/10.1016/j.aspen.2021.06.001

5. van Herk WG, Vernon RS, Richardson J, Richardson M, Beaton A. (2021) Evaluation of pheromone traps and lures for trapping male *Agriotes sputator* (Coleoptera: Elateridae) beetles in eastern Canada. Florida Entomologist 104: 42-50. https://doi.org/10.1653/024.104.0107

6. van Herk WG, Vernon RS, Labun T, Sevcik M, Schwinghamer T. (2021) Distribution of pest wireworm (Coleoptera: Elateridae) species in Alberta, Saskatchewan, and Manitoba (Canada) Environmental Entomology 50: 663-672. https://doi.org/10.1093/ee/nvab006

7. Gries, R, Alamsetti S.K., van Herk, W.G., Catton, H, Meers, S., Lemke, E., Gries G. (2021). Limoniic acid - major sex pheromone component of the click beetles *Limonius canus* and *L. californicus.* Journal of Chemical Ecology https://doi.org/10.1007/s10886-020-01241-y.

8. Drahun I, Wiebe K, Koloski C, van Herk W, Cassone B. (2021) Genetic structure and population demographics of

Hypnoidus bicolor (Coleoptera: Elateridae) in the Canadian Prairies. Pest Management Science https://doi.org/10.1002/ps.6255

9. Scott, I.M., Hatten, G., Asztalos, A., Bechard, A., Kim, H. W., Krolikowski, S., Mabed, E., Pranger, J., Tuncer, Y. 2021. Field evaluation of cyantraniliprole for the control of wireworm damage on early and late season potatoes, 2019. 2020 Pest Management Research Report, Agriculture and Agri-Food Canada.

Presentations

1. Noronha C and W van Herk, Integrated wireworm Management. Sasketchewan Seed Potato Growers Association meeting August 10, 2021. (Virtual presentation)
2. Noronha C, L MacKinnon, C Banks and S Ibarra. Surveillance Of Click Beetle Populations On PEI. Entomological society of Canada Jam annual meeting November 15-18 2021.
3. J Saguez, K Singleton, E Lemke, L Nadeau-Lachance, A Cornellier, S Chaussé, M Neau, W van Herk. Utilisation de pièges à phéromones pour la capture de taupins. La Société d'entomologie du Québec (November 25 2021) (virtual meeting)
4. K Singleton, R Gries, SK Alamsetti, W van Herk, J Saguez, E Lemke, G Gries. Identification of sex-pheromones of two Nearctic *Agriotes* species (Coleoptera: Elateridae). Entomological Society of Canada (18 November 2021) (virtual meeting)
5. E Lemke, W van Herk, G Gries, K Singleton, J Saguez. Investigating mechanisms of reproductive isolation between *Limonius* congener*s* (Coleoptera: Elateridae) and testing of 'catch-all' click beetle pheromone lures. Entomological Society of Canada (18 November 2021) (virtual meeting
6. E Lemke, W van Herk, G Gries, K Singleton. Investigating mechanisms of reproductive isolation between *Limonius* congeners (Coleoptera: Elateridae) and testing of 'catch-all' click beetle pheromone lures. Entomological Society of America (31 October – 3 November 2021) (virtual meeting)
7. K Singleton, R Gries, SK Alamsetti, W van Herk, J Saguez, I Scott, E Lemke, G Gries. Identification of sex-pheromones of two Nearctic *Agriotes* species (Coleoptera: Elateridae). Entomological Society of America (31 October – 3 November 2021) (virtual meeting)
8. W van Herk, B Vernon, EA Lemke, G Gries, K Singleton. Use of sex pheromones for wireworm (Coleoptera: Elateridae) management in Canada. Entomological Society of America (31 October – 3 November 2021) (virtual meeting)
9. E Lemke, W van Herk, G Gries, K Singleton. Investigating mechanisms of reproductive isolation between *Limonius* congeners (Coleoptera: Elateridae) and testing of 'catch-all' click beetle pheromone lures. Entomological Society of BC (20 October 2021) (virtual meeting)
10. K Singleton, R Gries, J Saguez, E Lemke, W van Herk, G Gries. Identification of sex-pheromones of two Nearctic *Agriotes* species (Coleoptera: Elateridae). Entomological Society of BC (21 October 2021) (virtual meeting)
11. K Furtado, K Singleton, A Blake, W van Herk, G Gries. Testing attraction of click beetles (Coleoptera: Elateridae) to green and UV light. Entomological Society of BC (19 October 2021) (virtual meeting)
12. K Singleton, A Blake, W van Herk, G Gries. Spectral sensitivity of North American pest click beetle species (Coleoptera: Elateridae). Early Career Living Light Conference (22-23 September 2021) (virtual meeting)
13. E Lemke, W van Herk, G Gries, K Singleton. Communication ecology of pest *Limonius* species (Coleoptera: Elateridae) in North America. International Society of Chemical Ecology (virtual meeting) 9 Sept 2021. 40 participants
14. K Singleton, R Gries, S Alamsetti, J Saguez, E Lemke, W van Herk, G Gries. Identification of candidate sex-

pheromone components of two Nearctic *Agriotes* species (Coleoptera: Elateridae). International Society of Chemical Ecology (virtual meeting) 9 Sept 2021. 40 participants

15. W van Herk, B Vernon, G Gries, R Gries, E Lemke, K Singleton. Use of sex pheromones for wireworm (Coleoptera: Elateridae) management in Canada. International Society of Chemical Ecology (virtual meeting). 9 Sept 2021. 40 participants

16. W van Herk, T Mitchell, B Vernon, E Lemke, J Serrano "New tools for wireworm monitoring and management" Entomological Society of America—Pacific Branch (online). 5 April 2021. 40 participants

17. EA Lemke, W van Herk, G Gries, R Gries, J Serrano, H Catton, K Wanner, P Landolt, W Cooper, S Meers, A Rashed, J Smith, S Kumar,F Etzler. "Limoniic acid as a sex attractant of *Limonius* spp. (Coleoptera: Elateridae) pests across North America" Entomological Society of America—Pacific Branch (online). 5 April 2021. 40 participants

Featured in media articles:

Nancy Russell. 2021 P.E.I. research digs into wireworm behaviour to help fight costly pest. June 18 2021. CBC Television https://www.cbc.ca/news/canada/prince-edward-island/pei-wireworm-behaviour-research-1.6069053

Nancy Russell. 2021. P.E.I. potato growers have new pesticide to fight wireworm. CBC Television https://www.cbc.ca/news/canada/prince-edward-island/pei-new-pesticide-wireworm-potatoes-1.5935366

Barnard, A. 2021. Know your enemy. Top Crop Manager West Magazine April 2021: 22-24. https://www.topcropmanager.com/know-your-enemy/

Arnason R (2021) Drones put to work studying wireworm damage in Alberta. Western Producer. May 20, 2021. https://www.producer.com/news/drones-put-to-work-studying-wireworm-damage-in-alberta/

Unglesbee, E. (2021). How wireworms play the long game. Progressive Farmer magazine (USA). June 2, 2021. https://www.dtnpf.com/agriculture/web/ag/crops/article/2021/06/02/trouble-kicking-fields-wireworm

Kalinowski, T. 2021. Wireworm a threat to local cereal crops. Lethbridge Herald, June 2, 2021. https://lethbridgeherald.com/news/lethbridge-news/2021/06/02/wireworm-a-threat-to-local-cereal-crops/

Arnason R (2021) Got wireworms? There's a guide for that. Western Producer. September 30, 2021. https://www.producer.com/crops/got-wireworms-theres-a-guide-for-that-2/

Cottee E (2021) Bug bible: visual guide will help Prairie farmers monitor and manage wireworms. GrainsWest Magazine. November 10, 2021. https://grainswest.com/2021/11/bug-bible/

Prairie wireworm field guide. Bug of the Month, Farming Smarter, November 22, 2021. https://www.farmingsmarter.com/new-prairie-wireworms-field-guide/

Podcasts or video interviews:

The life cycle, management, and research of wireworms with Dr. Haley Catton. Sask Wheat, Wheat Profit Podcast, March 24, 2021. https://anchor.fm/saskwheat/episodes/The-lifecycle--management--and-research-of-wireworms-with-Dr--Haley-Catton-ete6ja/a-a51rch5

RealAg Radio, May 31: Flea beetles, scouting, wireworms, and assessing frost. Epidsode 122, May 31, 2021. https://www.realagriculture.com/2021/05/realag-radio-may-31-flea-beetles-scouting-wireworms-and-assessing-frost/

Oosterhuis, K. 2021. Wheat School: Scouting for wireworms is key for future control. Wheat school, Season 12 (2021) Episode 21. Real Agriculture, May 26, 2021. https://www.realagriculture.com/2021/05/wheat-school-scouting-for-wireworms-is-key-for-future-control/

Wily wireworms and tips for managing them. Inputs: the Podcast, by Top Crop Manager. Epidsode 33, July 6, 2021. https://inputs-by-top-crop-ma.captivate.fm/episode/wily-wireworms-and-tips-for-manage-them

COVID-19 Related Challenges:

COVID-19 affected this activity in the following ways: In Agassiz, only limited field and field work was possible over the summer and the ability to travel and hire students was also curtailed, however this objective was achieved by conducting a smaller insecticide efficacy trial compared to other years.

In Alberta, COVID-19 restrictions at AAFC-Lethbridge were strict in 2021. Field work and hiring was limited however some field work with a reduced crew, using separate field vehicles and following strict safety protocols was conducted. Restrictions on the number of people allowed to work indoors, coupled with Alberta declaring a state of public health emergency due to high COVID-19 case counts in September impacted greenhouse trials. However, a student has now been hired and plans are in place to complete greenhouse trials between January to March, as long as no new pandemic restrictions are imposed.

Key Message(s):

This project has been very successful to date, and it would be of real advantage to industry if we could continue this work for another 5 years (i.e. for the next CAP funding cycle) to increase our knowledge about wireworms and develop new mitigation strategies for wireworm suppression in farm fields across Canada.

An AAFC field guide on Prairie wireworms was published in September 2021 as part of another wireworm project led by Haley Catton. The guide is available in English and French as a free downloadable pdf or hard copy. As of November 25, 1,487 hard copies have been distributed. Download numbers are not available at this time. The guide is an extension document, and has resulted in other extension opportunities.

The pheromone for the western *Limonius* species is expected to be commercially available in 2022.

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