

Canadian Agri-Science Cluster for Horticulture 3



Update to Industry

Semi-Annual – Fall 2021

Activity title:

Development of Regional Management Strategies and Decision Making Tools for Control of Colorado Potato Beetle

Name of Lead Researcher:

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Names of Collaborators and Institutions:

Cam Donly, AAFC; Jessica Vickruck, AAFC; Jean-Philippe Parent, AAFC; Pier Morin, U Moncton; Sheldon Hann, AAFC; Richard Hardin, AAFC; Lorraine MacKinnon, Province of PEI; Ryan Barrett, PEI Potato Board; Newton Yorinori, Cavendish Farms; Yves Leclerc, McCain Foods Canada; Mathuresh Singh, Agricultural Certification Services Inc.; Marie-Pascale Beaudoin, MAPAQ; Pierre Lafontaine, CIEL; Jean-Philippe Légaré, MAPAQ; Dennis Van Dyk, OMAFRA; Tracy Shinnners-Carnelley, Peak of the Market; Shelley Barkley, Alberta Agriculture and Forestry

Activity Objectives (as per approved workplan):

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OBJECTIVES: Our overall objective is to reduce economic losses to potato in Canadian growing regions due to herbivory by the Colorado potato beetle (CPB). Specifically, we aim to determine local susceptibility of CPB populations to several classes of insecticides through a national resistance-monitoring network, improve resistance management, better characterize the molecular basis of developing resistance, and develop novel extension tools to improve management practices. To accomplish this, the deliverables are divided into four objectives as follows:

1. Determine susceptibility of Colorado potato beetle populations to multiple classes of insecticides in different potato growing regions in Canada;
2. Develop an interactive online mapping tool for growers to access results of susceptibility surveys to inform local decision making for optimal insecticide selection;
3. Identify molecular signatures of insecticide resistance that can be used to monitor the occurrence and spread of resistance in regional CPB populations and identify new pest control targets;
4. Develop a novel resistance monitoring tool for extension and diagnostic labs as a within-season decision making tool, based on molecular signatures of developing resistance

Research Progress to Date (use plain language, not to exceed 500 words):

We have made very good progress on the project and achieved the majority of our milestones, even with challenges in obtaining samples and conducting laboratory work. We have focused on ensuring open and frequent communication with our project partners, particularly extension specialists in each region, and have added new insecticides to our screening this year in response to grower interest. We have also worked closely with AAFC management to ensure as much laboratory access as is feasible under changing restrictions, and have been able to successfully prioritize screening of Colorado potato beetle (CPB) populations most informative to the project.

Objective 1: Our goal each year is to obtain a minimum of 25 populations of Colorado potato beetle from various potato growing regions across Canada to complete insecticide resistance screening. We have exceeded our target population numbers in most years. In 2021, we maintained a high number of populations/samples for resistance screening even with COVID-19 impacts. I. Scott and J. Vickruck conducted resistance screening on a total of 34 CPB populations, AB (4), MB (6) ON (7), QUE (6), NB (3), PEI (8). Testing has been conducted for seven insecticides, Actara, Delegate, Entrust, Exirel, Harvanta, Titan and Vayego. The diagnostic LC₉₀ concentrations for three diamide insecticides, Exirel, Harvanta and Vayego (the last 2 are new this year) were developed this year and used in the susceptibility survey.

Objective 2:

We have made excellent progress on the interactive mapping tool, with S. Hann working very closely with the AAFC Agri-Geomatics team. We presented an overview of the tool capabilities at the recent Spud Smart Webinar. Next stages are to determine the best method to anonymize data and show regional trends in a grid, raster or heat map visualization, such that locations are masked from view. We are interested in further input from our stakeholders on the development of the mapping tool.

Objective 3/4: Progress on the molecular diagnostics of resistance in CPB has proceeded very well. Expression of RNA transcript targets with relevance to response and/or resistance to insecticides measured in CPBs has been investigated by both Donly (AAFC) and Morin (U Moncton), assessing different targets and using different experimental techniques. The majority of empirical work to date has used 2018-2020 samples from resistance screening, and the most relevant results of the resistance screening for 2021 will be added this year. Restrictions at the research centres have somewhat impacted our ability to maintain pace with the progress we planned to achieve project goals. As such, we have some impacts to molecular diagnostics and will unfortunately have to defer the development of the molecular genetic resistance screening tool (Obj. 4). However, new developments on the molecular signature of insecticide resistance and the application of RNAi technology to improve the susceptibility of beetles to insecticides (Bouafoura et al., submitted) is a promising new development and has the potential to be developed into a novel management tool.

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

Webinars/Presentations

Chandra Moffat, Ian Scott, Jess Vickruck, Cam Donly, Sheldon Hann, Pamela MacKinley, Sophie Krolkowski & Pier J. Morin. Controlling Colorado potato beetles on your farm. Spud Smart Webinar, Nov 30, 2021. 71 attendees, 151 registrants (who may watch the youtube version) <https://spudsmart.com/controlling-colorado-potato-beetles-on-your-farm-a-spud-smart-roundtable-webinar-podcast/>

Ian Scott, Chandra Moffat. Presentation to Manitoba potato growers (included personnel from Peak of the Market, Simplot, Keystone Potato Producers and McCains) on insecticide resistance findings of years 1-3. May 10, 2021.

Print articles/interviews

Chandra Moffat, Ian Scott. Colorado Potato Beetles are a Mile-High Headache. Print article, Aug 9 2021. <https://spudsmart.com/colorado-potato-beetles-are-a-mile-high-headache/>

Interview – Doug Ferguson – Western Producer

Manuscript submissions

Mariem Ben Yousef, Brigitte Christelle Ouédraogo, Pierre Bastarache, Pascal Dumas, **Chandra E. Moffat**, **Jessica L. Vickruck** and **Pier Jr Morin**. Modulation of small non-coding RNA-associated transcripts in response to temperatures or insecticide exposure in the Colorado potato beetle *Leptinotarsa decemlineata*. Journal of Insect Science (submitted Sept. 2021).

Raed Bouafoura, Pierre Bastarache, Brigitte Christelle Ouédraogo, Pascal Dumas, **Chandra E. Moffat**, **Jessica L. Vickruck** and **Pier Jr Morin**. Characterization of insecticide response-associated transcripts in the Colorado

potato beetle: relevance of select cytochrome P450s and clothianidin. Pest Management Science (submitted Oct. 2021).

Poster presentations

Ben Youssef, M, Ouedraogo, C, Bastarache, P, Dumas, P, Vickruck, J & Morin, P, Jr. 1May 2021, online. Expression status of targets involved in the synthesis of small non-coding RNAs in Colorado potato beetles exposed to heat, cold and insecticides. 60th Canadian Society of Zoologists Annual Meeting.

COVID-19 Related Challenges:

AAFC: Our project has been able to proceed quite well, but we still have impacts. The reduced capacity seen in the summer and fall of 2020 meant that we were not able to receive or screen as many populations of CPB from across Canadian potato growing regions. Restrictions on lab activities particularly in 2020 and early 2021 have meant that a much more limited amount of molecular diagnostic work has been able to take place relative to our planned project milestones. AAFC researchers and technicians were able to focus on more in-depth analyses of molecular genetic data in late 2020 and earlier 2021 in place of conducting a greater breadth of lab work. While we have made very substantial progress, unfortunately the cascading impacts of restricted lab access have meant we are not forecasting to be able to meet milestones pertaining to Objective 4. We are requesting deferment of Objective 4 beyond the project timelines, and development of a molecular genetic tool for resistance screening would be modified and deferred to subsequent project, subject to receiving funding.

U Moncton: The research laboratory in Moncton has been for the most part functional during the first half of this fiscal year. Nevertheless, challenges were experienced regarding the sourcing of insects from collaborators at the Fredericton Research and Development Centre in early summer 2021. Number of live insects on which to perform functional validation of the targets of interest has thus been limited due to restrictions related to COVID. Limited number of insects on which to work with has impacted budget expenses that were originally planned for this year notably with respect to reagents and hiring of personnel. These constraints are expected to ease as we move into the second half of this fiscal year.

Key Message(s):

The national Colorado potato beetle insecticide resistance monitoring network is flourishing in the partnering provinces (AB, MB, ON, QC, PEI). We have built excellent relationships with stakeholders involved in different aspects of potato production and pest management, and hope to continue the resistance monitoring work beyond 2023. The development of interactive online mapping tool is proceeding very well and approaching readiness for further stakeholder feedback. There has been a strong interest in our research, as evidenced by interviews conducted for the Western Producer and Spud Smart, as well as the recent Spud Smart Webinar.

The identification of molecular genetic signatures of insecticide resistance have been obtained in insects treated with various insecticides or in insects with confirmed resistance to select compounds. Subsequent work is planned to assess the relevance of modulating these transcripts with respect to insecticides response in Colorado potato beetle, and the use of RNAi technology to increase susceptibility of insecticides shows promise. This work is well aligned with the overarching objective of identifying novel control targets underlying resistance in this insect pest.

We are confident that we will meet 2021-2022 deliverables pertinent to Objectives 1, 2 and 3. Due to cascading impacts of COVID-19, we are requesting deferment of progress on Obj. 4 to the next iteration of the project (post 2023).

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