

Canadian Agri-Science Cluster for Horticulture 3



Update to Industry

2019-2020

<p>Activity title: Canadian Potato Early Dying Network (CanPEDNet)</p>
<p>Name of Lead Researcher: Mario Tenuta, University of Manitoba</p>
<p>Names of Collaborators and Institutions:</p> <p>Non-AAFC: Khalil Al-Mughrabi, Department of Agriculture, Aquaculture and Fisheries; Ryan Barrett, Prince Edward Island Potato Board; Sebastian Ibarra, PEI Department of Agriculture and Fisheries; Katrina Jordan, University of Guelph; Mathuresh Singh, Agricultural Certification Services; Dmytro Yevtushenko, University of Lethbridge; Herve van der Heyden, Phytodata.</p> <p>AAFC: Dahu Chen (lead for AAFC team), Fredericton Research and Development Centre; Tanya Arseneault, Saint-Jean-sur Richelieu Research and Development Centre; Louis-Pierre Comeau, Fredericton Research and Development Centre; Claudia Goyer, Fredericton Research and Development Centre; Benjamin Mimee, Saint-Jean-sur Richelieu Research and Development Centre; Oscar Molina, Morden Research and Development Centre; Judith Nyiraneza, Charlottetown Research and Development Centre; Cameron Wagg, Fredericton Research and Development Centre.</p>
<p>Activity Objectives and Leads (as per approved workplan):</p> <ul style="list-style-type: none"> • Sub-activity 1 (SA1): Verticillium and root lesion nematode survey and relation to PED disease and yield [Barrett, Chen, Ibarra, Jordan, Tenuta, van der Heyden, Yevtushenko] This activity aims to determine the species and population levels of the major causal agents of PED (Verticillium and root lesion nematode) in commercial potato fields and their impact on PED disease symptoms and yield. • Sub-activity 2 (SA2): characterization of isolates of <i>V. dahliae</i> and <i>V. albo-atrum</i> [Arsenault] This sub-activity is to characterize isolates of <i>V. dahliae</i> and <i>V. albo-atrum</i> from the major potato producing provinces in Canada obtained in SA1 for aggressiveness to cause PED in cv. Russet Burbank. • Sub-activity 3 (SA3): Root lesion nematode species and interaction with <i>V. dahliae</i> isolates [Mimee] This sub-activity is to identify parasitic nematodes to the species level in major potato production provinces of Canada. Determine if the population of <i>Pratylenchus penetrans</i> is genetically homogenous or if sub-populations could be related to PED disease symptoms. • Sub-activity 4 (SA4): Other soil-borne pathogens associated with the PED complex [van der Heyden] This activity will determine the population levels, distribution and co-distribution of other soil-borne diseases associated with the PED complex. • Sub-activity 5 (SA5): Validation of real time PCR protocol for Verticillium quantification in soils across Canada [Singh] This activity will validate the standardized polymerase chain reaction (PCR) protocol developed in GF2 for quantification of Verticillium's deoxyribonucleic acid (DNA) in soil.

- Sub-activity 6 (SA6): Reducing analysis variability through development of high-throughput system for large soil samples [van der Heyden]
This activity aims at developing a high through-put DNA-based platform for quantification of soil-borne pathogens using large sample sizes.
- Sub-activity 7 (SA7): PED control through disease control products [Al-Mughrabi, Jordan, Molina]
This activity will assess the potential to control PED through newly registered fungicide and nematicide disease control products applied alone or in combination.
- Sub-activity 8 (SA8): PED control through improved cropping systems [Chen, Nyiraneza]
This sub-activity aims to assess the potential to control PED through improved cropping systems.
- Sub-activity 9 (SA9): Soil building and health: Preventing reliance on sustained chemical fumigation [Jordan, Tenuta]
This activity will develop a cropping system whereby fields with heavy PED disease pressure are brought to high levels of sustained productivity through a one-time only fumigation followed by soil building practices.
- Sub-activity 10 (SA10): Field scale evaluation and demonstration of practices to manage PED [Cavendish, McCain]
This activity will evaluate selected PED control practices at the field-scale in commercial fields to obtain realistic estimates of the benefits of these practices to growers, to identify any practical limitations to the implementation of these practices, and to demonstrate the use of these practices to other growers.
- Sub-activity 11 (SA11): Soil health property analysis [Comeau]
This sub-activity is to assess 1) which properties of soil health (physical, chemical or biological) correlate with PED pathogen populations and disease severity in the major potato production regions of Canada (SA1); and 2) how improved cropping systems and soil management practices (SA8 and SA9) influence soil properties, as measured by soil health assessment, in relation to PED control.
- Sub-activity 12 (SA12): Soil microbial and micro-arthropod communities [Goyer]
This sub-activity is to obtain samples from field sites for future studies characterizing soil microbial, fungal and micro-arthropod community responses to management practices used to control PED.

Research Progress to Date (use plain language):

Sub-activity 1

Composite soil samples each from at least 20 commercial fields in Alberta, Ontario, Quebec, New Brunswick and PEI were collected and analyzed for *Verticillium* and Nematodes species and densities in fall 2019. Fields were not surveyed in Manitoba because of delayed harvest and extremely wet soil conditions.

Sub-activity 2

Soil samples collected from Sub-activity 1 were received. Isolation of *Verticillium* cultures began but had to stop because of COVID-19.

Sub-activity 3

Soil samples collected from Sub-activity 1 were received. Populations of root lesion nematodes from the soils was in progress until COVID-19 restrictions were introduced. Individual nematodes from the soils were hand picked and frozen for genetic marker analysis of species. This work also had to stop with COVID-19 restrictions.

Sub-activity 4

Soils from in Sub-activity 1 were analyzed by real-time PCR for various plant pathogens other than *Verticillium* and root lesion nematode. They included *Collectotrichum coccodes* (black dot of potato), *Spongospora subterranean* (powdery scab), *Helminthosporium solani* (silver scurf), *Rhizoctonia solani*, *Phytophthora erythroseptica* (pink rot), *Fusarium solani* (Fusarium dry rot), and *P. ultimum* (Pythium leak of potato). For the Quebec samples, all the pathogens except *H. solani* and *P. erythroseptica* were present in at least one of the soil samples.

Sub-activity 5

Several commercial DNA extraction kits were compared using potato soils from NB, PEI and Manitoba. The E.Z.N.A Soil DNA extraction kit from Omega Bio-Tek provided the best recovery of quality DNA. Soil samples from Sub-activity 1 were then extracted and quantified for *Verticillium* species (*V. dahliae*, *V. albo-atrum*, *V. tricorpus*, and *V. nonalfalfae*) based on real-time PCR. *Verticillium* DNA concentrations were low and varied with sample. Using the standard dilution plating method for colony counts for microsclerotial producing *Verticillium*, 44% of samples produced colony counts. However, the PCR method found that 86% of the samples had quantifiable *Verticillium* levels. The relationship between colonies and DNA levels in soil samples was not strong.

Sub-activity 6

This activity was not planned to begin in 2019-2020.

Sub-activity 7

Late funding allocation and wet soil conditions preventing conducting a field trial in NB. A replicated greenhouse trial was conducted in NB. The treatments included a control, the fungicide Aprovia (Syngenta), the nematicide and fungicide Velum Prime (Bayer), and the fungicide Senator PSPT (Nippon Soda Co.). Aprovia and Velum Prime were applied in-furrow at the recommended rate while Senator PSPT was applied as a dust on the surface of the potato seed. The cultivar Russet Burbank was grown. Soil samples (one soil sample/replicate) were collected at the beginning and at the end of the growth cycle. *Verticillium* wilt severity was also scored. Analysis of results continues.

Late funding allocation meant a field study in ON was not possible. Planning of studies for May 2020 were done. Exceptionally late harvest and wet soil conditions prevented conducting a field study in MB. Carrying over the field study to 2020 is planned.

Sub-activity 8

NB: Two-year Rotation Study- an experiment was initiated in 2018 with 12 treatments of rotation crops at the FRDC Central farm. The potato phase was completed in 2019 -2020 to assess the effect of the treatments on potato productivity and disease suppression. The population levels of *V. dahliae* and root lesion nematodes at planting in the spring and at harvesting in the fall were determined in both years. The potato yield, the severity of PED and tuber diseases were assessed.

NB: Green Manure Study- a field study was initiated at the FRDC Central farm in 2019. Fields were planted Pearl Millet, Brown Mustard and a mix of the two to compare to current land management and soil building practices (typical red clover-barley rotations and grain rotation crops). Biomass and yield data have been collected in plots where appropriate. The same green manures or crops will be grown on plots in 2020 with 2021 with a potato test crop.

PEI: Rotation Study- an experiment was initiated in 2017 at the Harrington Research Farm. Eight rotation systems and a control (bare soil) with and without manure were treatments in 2017 and potato in 2018 the test crop. In 2019 a second phase of a 3yr rotation was initiated and a potato test crop planned in 2021. Cover crop biomass and their total nitrogen and total carbon accumulations, soil nitrate dynamics during the potato phase were monitored monthly, selected physical-chemical soil properties and potato yield and quality were assessed. Samples were also taken for *V. dahliae* and root lesion nematode assessments.

Sub-activity 9

ON: Late funding allocation did not allow establishment of a study. Establishment is planned for 2020.

MB: An exceptionally late harvest and wet soil conditions did not allow establishment of this study. The study is carried over to 2020 and will be initiated this year.

Sub-activity 10

Unable to ascertain activities initiated.

Sub-activity 11

The soil samples from Sub-activities 1 and 8 for NB and PEI were submitted to the Comeau Lab for soil property analysis. The samples are currently been processed and analyzed.

Sub-activity 12

Samples from Sub-activity 8 have been frozen at -80 C. Analyses are scheduled to occur in 2021-2022 after potato test crops are completed in those studies.

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

M Tenuta. (2019). Metam Sodium Trials in Manitoba for the Control of Potato Early Dying. Oral Presentation at J. R. Simplot Growers Meeting, June 13, 2019, Carberry, Manitoba.

V Currie and K Jordan. (2019). Potato research. Tour to Canadian Horticultural Council Board of Directors, July 12, 2019, Simcoe, Ontario.

C Robertson and D Yevtuschenko. (2019). Exploring fumigation as a strategy to manage Potato Early Dying in Southern Alberta. Oral presentation at the Potato Association of America Annual Meeting - Changes and Challenges in Potato Marketing Sectors, July 28-August 1, 2019, Winnipeg, Manitoba.

M Tenuta, D Gibson, V Bisht, M LeMere, O Molina, A Nelson. (2019). Soil Fumigation to Determine Yield Loss of Russet Burbank Irrigated Processing Potato from Potato Early Dying in Manitoba. Poster presentation at the Potato Association of America Annual Meeting - Changes and Challenges in Potato Marketing Sectors, July 28-August 1, 2019, Winnipeg, Manitoba.

D Yevtushenko. (2019). Potato Research at the University of Lethbridge. Booth display at the Alberta Potato Conference. November 19-21, 2019, Red Deer, Alberta.

C Robertson and D Yevtuschenko. (2019). Exploring options to manage potato early dying in Southern Alberta. Oral and poster presentation at the Alberta Potato Conference and Tradeshow, November 19-21, 2019, Red Deer, Alberta.

M Tenuta. (2019). CanPEDNet - The Canadian Potato Early Dying Network. Oral presentation to the Manitoba Potato Research Committee Meeting, Dec 9, 2019, Portage La Prairie, Manitoba.

Neilson, J.A.D., Robertson, C.J., Snowdon, E.W., Yevtushenko D.P. (2020). Impact of Fumigation on Soil Microbial Communities under Potato Cultivation in Southern Alberta. American Journal of Potato Research, 97, 115–126.
<https://doi.org/10.1007/s12230-019-09761-4>

R Barret. (2020). Choosing the Right Rotation Crops to Meet the Needs of Your Field. Agronomy Initiative Meeting, January 20, 2020, Emerald, Prince Edward Island.

R Barret. (2020). Soil building Crops in Prince Edward Island. Oral presentation to Manitoba Potato Production Days, January 28-29, 2020, Brandon, Manitoba.

K Al-Mughrabi. (2020). Potato Early Dying and Its Management. Oral presentation to the New Brunswick Potato Conference and Trade Show, February 6, 2020, Woodstock, New Brunswick.

R Barret. (2020). Agronomy Initiative Project in PEI. Oral presentation to the New Brunswick Potato Conference and Trade Show, February 6, 2020, Woodstock, New Brunswick.

M Epp. (2020). Research Roundup: Potato Early Dying Complex. Spudsmart, February 10, 2020.

www.spudsmart.com

K Al-Mughrabi. (2020). Potato Early Dying and Its Management. Oral presentation to the McCain Research Meeting, February 11-12, 2020, Florenceville-Bristol, New Brunswick.

T McDade. (2020). CanPEDNet. Article in The Potato Minute, March 1, 2020. www.albertapotatoes.ca

K Davidson. (2020). Funding for Potato Early Dying Complex. Article in The Grower, March 12, 2020. www.thegrower.org

D Chen (2020). Management of Potato Early Dying Complex. Presented to East Prince Agri-Environment Farmer Group, March 12, 2020, Emerald, Prince Edward Island.

Staff Writer (2020). Canada to Invest Millions into Potato Early Dying Disease Research. Article in Potato News Today, March 12, 2020, www.potatonewstoday.com.

O Anderson. (2020). Canadian Government Announces \$2.3M for Potato Early Dying Disease Research. Office of the Minister of Agriculture and Agri-Food Canada, Press Release. March 13, 2020.

D Modney (2020). Agriculture and Agri-Food Canada Financing Research Project into Potato Disease. Lethbridge News Now, March 13, 2020, www.lethbridgenewsnow.com

K Al-Mughrabi. (2020). Potato Early Dying and Its Management. Maine Potato Conference, March 22-23, 2020, Caribou, Maine.

Early Outcomes (if any) or Challenges:

Not applicable because of late funding allocation, conditions preventing field work in some regions last fall, and COVID interruption in sample processing and lab work.

A late and in many cases, no harvest, in fall 2019 in MB and wet conditions in NB in fall 2019 have affected getting field trials set up. Late funding allocation also was an issue in initiating the field trial in ON for fall 2019.

COVID-19 restrictions in laboratory activities has stopped analyses of soil samples. Phase openings should allow resumption of laboratory activities.

A major concern is reestablishment of laboratory restrictions is COVID-19 cases increase substantially this fall.

Key Message(s):

We have successfully initiated the CanPEDNet project. We have had several group meetings and many email and phone discussions among researchers. The project is moving along. COVID-19 restrictions will affect activities, particularly lab analyses. However, we are striving hard to continue field studies and catch up on field studies where some have been postponed.

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