

Canadian Agri-Science Cluster for Horticulture 3



Update to Industry

Semi-Annual – Spring 2022

Activity title: CanPEDNet – The Canadian Potato Early Dying Network

Name of Lead Researcher: Mario Tenuta, University of Manitoba

Names of Collaborators and Institutions:

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.

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.

Activity Objectives (as per approved workplan):

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 V. dahliae and V. albo-atrum

[Arsenault]

This sub-activity is to characterize isolates of *V. dahliae* and *V. albo-atrum* 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 V. dahliae 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 *Pratylenchus penetrans* 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, not to exceed 500 words):

SA1: This activity has been completed and results are being processed and synthesized across researchers. Fields with greater *Verticillium* levels in soil and higher incidence and severity of PED in potato plants had reduced marketable yield of Russet Burbank for processing.

SA2: This activity is in progress. Isolates of *Verticillium* have been obtained from researchers and are being screened for vegetative compatibility groupings and illumina sequencing. Aggressiveness studies are planned for the final year.

SA3: This activity is in progress. Root lesion isolates have been obtained from researchers and most have been processed for sequencing for species identification. Several species of root lesion nematode were found to be common with a large difference between east and western Canada. The synergism study of *Verticillium* aggressive isolates and the species of root lesion nematodes is in progress.

SA4: This activity is complete. Soil samples from researchers have been processed and analyzed for *Collectotrichum coccodes* (black dot of potato), *Spongospora subterranea* (powdery scab), *Helminthosporium solani* (silver scurf), *Rhizoctonia solani*, *Phytophthora erythroseptica* (pink rot), *Fusarium solani* (*Fusarium* dry rot), and *P. ultimum* (*Pythium* leak of potato). Many of the pathogens were present across Canada with some prevalent in the east than west.

SA5: This activity is complete. A new qPCR method was developed and has been applied for use in quantifying *Verticillium* species from across Canada in this Study. The new method showed less variability than the traditional plate count method. Further farmers and researchers are now able to submit samples to the ACS laboratory for analysis using the new method.

SA6: This activity is near complete. Various commercial extraction kits were optimized for yield of DNA from soil as well as clean-up of PCR inhibitors. Methods of concentrating *Verticillium* propagules from soil were deemed unsuitable for commercial application due to variation contributed by soil texture as well as excessive processing time required.

SA7: This activity is complete. Replicated field trials have been done in NB, ON and MB. The control products examined were the fungicide Aprovia, the nematicide and fungicide Velum Prime, the fungicide Senator PSPT, and the fumigants chloropicrin or vapam. The fumigants showed the best opportunity to increase yield. However, yield increase only occurred where yields were severely depressed by poor soil health and high *Verticillium* levels. The other products showed a slight trend to a small increase in yield when stacked upon each other.

SA8: This activity continues in NB and PEI as part of long-term potato cropping studies. One cycle of rotations has been completed with 2021 being the potato test year. Those results are still being processed.

SA9: This activity continues in ON and MB as part of long-term potato cropping studies. Both studies are completed a common potato crop as baseline in the first year and subsequent rotation and management practices to build soil health leading to a potato test crop in two years.

SA10: This activity continues with our industry partners establishing demonstration plots/fields in PEI, NB, MB and AB for farmers to observe the benefit of fumigation, new cultivars and improved soil health on PED reduction and yield improvements.

SA11: This activity is in progress with the analysis of soil health properties from the long-term studies in this project.

SA12: This activity is near completion. The objective for this project was to obtain and store samples for use in future AAFC funded studies. Samples from the long-term projects and from fumigation studies have been obtained. Analysis has been undertaken for fumigation studies under this project.

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

Nyiraneza, J.; Chen, D.; Fraser, T.; Comeau, L.-P. Improving Soil Quality and Potato Productivity with Manure and High-Residue Cover Crops in Eastern Canada. *Plants* 2021, 10, 1436. <https://doi.org/10.3390/plants10071436>

Friesen, R. Potato Early Dying a Silent Killer: Industry network seeks to reduce impact of the disease. Interview with Mario Tenuta. Manitoba Co-operator April 28, 2021.

Halsall, M. Banding Together to Stop Potato Early Dying in Canada. Spudsmart. Interview with Mario Tentua. June 7, 2021

C. Quinche, CSM-SCM Annual Conference Remote 2021 (8 June 2021): Poster (Virtual).

Tenuta, M. Tuber Talk: Potato Early Dying and CanPEDNet Update with Mario Tenuta. Potatoes in Canada Podcast. June 21, 2021.

C. Quinche, Congrès de la SPPQ: L'intelligence artificielle au service de la phytoprotection (16 September 2021) : Oral Presentation (Virtual).

C. Quinche, 12e édition du Congrès Armand-Frappier 2021 (11 November 2021) : Oral Presentation and poster (Virtual).

C. Quinche, Colloque sur la pomme de terre – CRAAQ (19 November 2021) : Oral Presentation and poster (Partly virtual)

T. Arseneault, Seminar presentation upon invitation at IRBV (Université de Montréal), Nov 19, 2021.

Julienne Isaacs. Putting the Root Lesion Nematode Under the Microscope. Potatoes in Canada, January 25, 2022.
<https://www.potatoesincanada.com/putting-root-lesion-nematode-under-the-microscope/>

COVID-19 Related Challenges:

2021-2022

Sub-activities 1, 4, 5, 6, 10, and 12 were not majorly affected by COVID-19 in 2021. Sub-activity 2 greenhouse baiting experiments in potted potato plants were delayed by over 7 months but are now completed. Interaction experiments will likely be delayed. No end-point deliverable is currently in danger. Sub-activity 3 in vitro cultures of nematodes are established but with a reduced number. However, the interaction tests with *Verticillium* will be delayed in time. Sub-activity 4 was not affected by COVID-19 in 2021. Sub-activity 5 had been completed. Sub-activities 7, 8, and 9 did not have field tours because of COVID-19 restrictions. Sub-activity 11 lab activities were greatly reduced to process samples. All sub-activities having to process samples in AAFC and University laboratories were constrained but not halted by COVID-19 restrictions.

Key Message(s):

We have successfully continued the CanPEDNet project. We have had several group meetings and many email and phone discussions among researchers. The project is moving along. The soil survey is completed and development of molecular diagnostic methods is complete. The root lesion nematode, *P. crenatus* was more prevalent than expected. This species is not known to interact with *Verticillium* (to be confirmed by our test) and is a weak pest of potato. This reinforces the need to have appropriate diagnostic tools allowing RLN species identification to make better management recommendation. Fumigants show good results in improving yield and reducing PED in severely affected fields only. Preliminary results showed that manure applied on cover crops preceding potato, and high-residue cover crops such as pearl millet and sorghum sudangrass are promising means to enhance soil health and to increase potato yield based on the PEI 2 year rotation study. Good progress has been made in molecular diagnostic and quantification methodology with commercial options now available to growers and industry as a result of this project.

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