Canadian Agri-Science Cluster for Horticulture 3

Update to Industry

Semi-Annual – Spring 2022

Activity title: Late blight: Tracking pathogen strains and their characteristics

Name of Lead Researcher: Rick Peters, Agriculture and Agri-Food Canada (AAFC), Charlottetown, PE

Names of Collaborators and Institutions: Khalil Al-Mughrabi (New Brunswick Department of Agriculture, Aquaculture and Fisheries), Vikram Bisht (Manitoba Agriculture), Fouad Daayf (University of Manitoba), Rishi Burlakoti (AAFC, Agassiz, BC)

Activity Objectives (as per approved workplan):

The overall objectives of the project are to track the distribution of strains of the late blight pathogen in Canada, determine various important biological characteristics of isolated strains including fungicide sensitivity, with the overall aim of improving disease management and economic returns.

The specific objectives of this project are:

Sub-activity 1.1 Tracking potato strains of *P. infestans* in Canada

To identify strains of *Phytophthora infestans* causing late blight of potato in production areas across Canada and to develop a map showing the distribution of strains in this country.

Sub-activity 1.2 Characterization of novel strains including host/cultivar preference, environmental triggers, fungicide sensitivities, and control options

To assess novel late blight pathogen strains in Canada for their ability to cause disease in above and below-ground tissues of solanaceous plants, and to determine their sensitivity to registered and novel fungicides as well as the optimal environments for infection, spore production and survival (with the aim of understanding the impact of climate change on late blight pathogen population dynamics).

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

Sub-activity 1.1 Tracking potato strains of *P. infestans* in Canada

Late blight was not a significant concern in much of Canada in 2021. This was likely due to the warm, dry growing conditions in most of the country. Some spores of the pathogen were captured in spore traps set up in Manitoba, but no disease was observed, so samples could not be assessed. In BC, no late blight was reported from commercial potato farms, likely due to weather conditions in summer which included a long drought and heat dome. Interestingly, late blight was found in October in tomato plants from community gardens in Abbotsford, Chilliwack and Agassiz. In total, 30 isolates of *Phytopthora infestans* were isolated from tomato samples and are currently being analyzed for strain composition using molecular tools, but preliminary results indicate a diverse population of the pathogen. Both US-8 and US-23 strains as well as other novel strains have been identified in BC in recent years. Two samples of tomato with late blight were received from Ontario in 2021, which yielded 6 isolates of the pathogen for further study in Charlottetown. Analysis of sensitivity to metalaxyl-m (Ridomil) revealed that the isolates were sensitive or only moderately-resistant to this chemistry. Mating type and assessment of allozyme banding patterns at the GPI locus indicated A1 mating type and a pattern consistent with that of the US-23 strain. This requires confirmation with further molecular screening conducted by Dr. Burlakoti in BC. No occurrences of late blight were reported in Atlantic Canada in 2021, even though there was adequate moisture present during the growing season and weather conditions were generally conducive to

disease development. This was likely due to the lack of available inoculum of the pathogen in the region after several successive years without disease development.

Sub-activity 1.2 Characterization of novel strains including host/cultivar preference, environmental triggers, fungicide sensitivities, and control options

In BC, under the direction of Dr. Burlakoti, 8 isolates of *P. infestans* (5 potato isolates, 2 tomato isolates and 1 US-8 reference strain) were evaluated at seven different temperatures (5 to 35°C) to assess the effect of temperature on pathogen growth on culture media. Seven isolates were able to grow at temperatures ranging from 5 to 30°C and one isolate was able to grow between 10 to 25°C. Several isolates had similar growth at 20 and 25°C. Two tomato isolates had higher colony growth than the potato isolates at 30°C. In 2021, five isolates of *P. infestans* (3 potato isolates and two reference strains US-8 and US-24) were inoculated onto potato tubers, and then evaluated at 10, 15, 20, 25, 30 and 35°C. Two potato isolates showed a great diversity in their ability to infect potato tubers between 10 to 25°C. One potato isolate caused 2-fold higher disease severity at 25°C than at 15°C.

Eleven NRBK differential potato lines were grown and then detached leaves inoculated with an isolate of the US-24 strain of the late blight pathogen at the greenhouse conservatory, Department of Plant Science, University of Manitoba under the direction of Dr. Daayf. The NRBK 4, 5, 8, 9 lines showed resistance against the tested US-24 isolate. Moderate infection was observed in NRBK 10 and 11. These data will allow further characterization and differentiation of pathogen isolates and also inform breeding efforts for disease resistance. More isolates of different strains will be tested on the differential potato lines (where enough leaf material is produced), gathered from the various seasonal collections during the final year of the project.

Segun Babarinde, graduate student at Dalhousie University supervised by Drs. B. Prithiviraj and K. Al-Mughrabi, conducted a number studies to determine the effectiveness of a range of fungicides registered for the control of late blight in Canada. All tested fungicides (Ridomil Gold® (metalaxyl-m and –s isomer), Ranman® (cyazofamid), CurzateTM (cymoxanil), Allegro® (fluazinam), Bravo®ZN (chlorothalonil), Reason® (fenamidone), Revus® (mandipropamid) and Orondis®Ultra (mandipropamid and oxathiapiprolin)) were able to reduce the growth of a US-23 isolate of *P. infestans* in culture, at varying concentrations of active ingredient, depending on the product used. Similarly, all tested fungicides were able to significantly inhibit germination of spores of the US-23 strain of the pathogen. Fungicide efficacy studies were also performed on living plants in a growth chamber environment. Fungicides were applied at recommended rates prior to inoculation with an isolate of the US-23 strain of *P. infestans*. Results showed that all fungicide products were able to significantly reduce disease development compared to an untreated control. As well, fungicides were all similar in their ability to control disease.

Greenhouse studies on the susceptibility of host tissues (potato and tomato varieties) to inoculation with isolates of either the US-8 or US-23 strains of the late blight pathogen were completed in winter and spring. Results showed that isolates of both strains were able to infect potato, but US-23 was more aggressive on tomato than US-8. Tomato varieties with genes for late blight resistance were significantly less diseased than varieties without resistance and maintained a strong level of disease suppression against isolates of either pathogen strain.

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

Presentations and Webinars

Bisht, V. 2022. Potato Grower Meetings in Manitoba.
Presentation: Work on late blight monitoring in fields and also *Phytophthora infestans* spore trapping.

June 22, 2021. Prince Edward Island Crop Scout Workshop. Virtual Event, On-Line (MS Teams).
Presentation: Potato diseases observed throughout the cropping cycle.

News Releases

Payne R. 2021. Research sheds light on late blight strains. Country Life in BC. June 2021, Page 39. Magazine.
https://news.countrylifeinbc.com//june2021#page=39

Provincial Outreach

Weekly reports on potato diseases and insects were sent to growers and others in the potato industry and information placed on-line (for example, in Manitoba reports were recorded on www.mbpotatoes.ca ; New Brunswick's reports were recorded on the NB Potato Crop, Weather and Pest Information website https://agri.gnb.ca/010-001/Index.aspx?lang=en).

Although some challenges due to COVID-19 still prevented some in-person meetings, potato pest updates were discussed in various forums with growers and potato agronomists. These included phone calls, virtual meetings, radio interviews and email/website transmission of information.

COVID-19 Related Challenges:

Industry and academic collaborators continued to collect and provide disease samples that were received for examination and extraction of pathogen isolates, even though the Covid-19 pandemic still provided some challenges. A more normal work environment and research capacity was achieved this year, although absences due to illness were sometimes a factor as Covid-19 transmission rates increased in 2022. However, the impact on project goals was minimal, and we have been able to accomplish our targeted goals. No funds were requested to be moved to future years of the study and the project remains on track.

Key Message(s):

Even though late blight was not prevalent in Canada in 2021, samples were obtained from BC and ON, yielding collections of pathogen isolates for further study. A continued understanding of the prevalence and characteristics of pathogen strains will be critical for successful disease management. Some of the key findings to date would include:

- Identification of predominant strains US-23 (in most of country) and US-8 (in BC)
- Characterization of a diverse population of the late blight pathogen in BC
- Identification of tomato varieties with genes for late blight resistance that mitigate disease caused by novel strains
- Identification of strains that grow and reproduce at warmer temperatures than previous strains
- Confirmation that current fungicides still provide efficacy against the new common US-23 strain of the pathogen

We are using other molecular tools to examine the collections of isolates from BC, since the diversity apparent there could indicate a reproducing population of the pathogen which could lead to the generation of even more new strains and the potential for overwintering structures which would start disease earlier in the season. A good news story is that although some strains are resistant to Ridomil, US-23 is still effectively controlled by a variety of currently registered fungicide tools used for disease control. Some of the newer strains have adapted to infect and reproduce at warmer temperatures which may be one reason they are becoming more common. As mentioned previously, there is increased interest among the public to grow food plants, including tomatoes and potatoes in home gardens. We are encouraging home gardeners to grow late blight-resistant tomato varieties, so they are not a risk factor in spreading disease to surrounding commercial crop production areas.

This project under the Canadian Agri-Science Cluster for Horticulture 3 is funded in part by the Government of Canada through the Canadian Agricultural Partnership's AgriScience Program, a federal, provincial, territorial initiative, with support from the Fruit and Vegetable Growers of Canada (formerly the Canadian Horticultural Council) and industry contributors.

CANADIAN AGRICULTURAL PARTNERSHIP
Innovate. Grow. Prosper.

Canada

FRUIT & VEGETABLE GROWERS OF CANADA | PRODUCTEURS DE FRUITS ET LÉGUMES DU CANADA