Characterization and Tracking of Strains of the Potato Blight Pathogen in Canada

AgriInnovation Program

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CHC Potato Council

Government and industry collaborators across Canada

Activity Objectives (as per approved workplan):

Activity 1: 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.

Activity 2: To assess novel potato late blight pathogen strains for their ability to cause disease in foliage and tubers of registered cultivars and hence determine field and storage disease risk.

Activity 3: To ascertain the influence of environment on spore production, infection and survival of major potato late blight pathogen strains.

Research Progress to Date:

Activity 1:

2016

Over 80 samples of plant tissues with late blight were received in Charlottetown and Lethbridge in 2016 representing disease incidences in BC, AB, MB, SK, QC, NB and PEI. The most severe late blight epidemic occurred in MB in 2016. Multiple isolates of the late blight pathogen were recovered from each sample and a subset was fully characterized. Results showed that the majority of isolates from across Canada were of the US-23 genotype (A1); however the US-8 genotype (A2) was recovered in BC and both US-23 (A1) and US-24 (A1) genotypes were recovered from samples from Quebec. Isolates of US-23 were often sensitive to metalaxyl-m (Ridomil) early in the season but showed increasing resistance to this chemical as the season progressed.

2017

Late blight was once again a disease issue of importance in both potato and tomato crops in Canada in 2017. As in most years, the disease was most problematic in production areas that received significant moisture during the growing season. The disease was first noticed in the potato crop in British Columbia. Overall disease pressure was low in Alberta and Manitoba, although Manitoba did experience some late season pressure. However, the disease pressure in Manitoba in 2017 was not nearly as great as the severe epidemic experienced in 2016. The growing season was mainly warm and dry through most of the prairie provinces, conditions not conducive to high disease pressure. Conversely, the extreme rains and floods

experienced in Ontario contributed to making this province the 'hot spot' for late blight in both potato and tomato crops in 2017. Late blight was also reported from Quebec, but the warm, dry conditions in the Maritimes contributed to a virtually 'blight-free' season for growers in this region. A couple of late season cases were reported in New Brunswick but no late blight was reported in Prince Edward Island.

Samples of plant tissue potentially infected with the late blight pathogen were received from British Columbia (12 potato samples in total; 2 samples with confirmed late blight), Alberta (10 plant samples in total; 2 confirmed potato samples and 1 confirmed tomato sample with late blight), Saskatchewan (3 plant samples in total; no confirmed late blight), Manitoba (22 plant samples in total; 16 potato samples and 2 tomato samples with confirmed late blight), Ontario (18 plant samples in total; 6 potato samples and 12 tomato samples with confirmed late blight), and New Brunswick (5 potato samples in total; all with confirmed late blight).

Pathogen isolates from British Columbia were determined to be of the US-11 genotype, which is A1 mating type and highly resistant to Ridomil. This genotype has been found on the west coast of North America periodically since the late 1990s. Samples received from all other production regions, including potato and tomato crops in Alberta, Manitoba, Ontario and New Brunswick yielded isolates of the US-23 genotype, which is A1 mating type and sensitive to Ridomil. Although isolates of US-23 were often sensitive to Ridomil early in the season, increasing resistance to this chemical was documented as the season progressed. Therefore, a maximum of one application of Ridomil was recommended if this product was chosen to arrest disease development noticed in the crop, followed by other locally-systemic specialty products for late blight management. The US-23 genotype has become the predominant genotype in most growing regions of Canada in recent years, however, every year there are fluctuations in which genotypes occur which underscores the importance of continuous monitoring of strain distribution.

Activity 2:
Greenhouse trials were conducted to compare the aggressiveness of the different late blight pathogen strains on various hosts, including different potato cultivars and various tomato, pepper and petunia varieties. US-23 was less aggressive on potato foliage than US-8 or US-24, but was very aggressive on tomato foliage (conversely, US-8 and US-24 were less aggressive on tomato). Only trace disease was found on pepper or petunia. Tomato varieties varied in their response to disease, and those varieties with at least 2 known late blight resistance genes were highly resistant to disease caused by US-23. Most commonly-grown tomato varieties were very susceptible to disease caused by US-23. Tuber inoculation studies conducted in a potato storage showed that both US-23 and US-24 were as aggressive or more aggressive than US-8 on potato tubers and caused severe tuber rot. Commonly grown commercial potato cultivars were all susceptible to tuber rot caused by these pathogen strains.
Activity 3:
Trials were conducted in incubators set at a range of temperatures to determine the infection potential

(latent period and generation time) and reproductive capacity of various pathogen strains. Tuber slices were inoculated with the isolates of interest and then monitored over time at each temperature. Total spore counts indicated that US-23 and US-24 strains had a higher reproductive capacity (produced more spores) than US-8, especially at cooler (10°C) or warmer (20°C) temperatures. As well, the generation time (time between infection and subsequent sporulation) was up to 24 hours shorter for US-23 and US-24 compared to US-8. These observations imply that current predominant genotypes in Canada (particularly US-23) have higher fitness and epidemic potential than US-8 over a wider range of temperatures. This increased competitive ability and adaptation to climate variance may partly explain why US-23 has come to dominate pathogen populations in Canada and the USA.

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

Conference Abstracts

Peters, R.D., L.M. Kawchuk, F. Daayf, K.I. Al-Mughrabi, A. MacPhail, D. Gregory, K.A. Drake, M. Trenholm, and B. Crane. 2016. The changing epidemiology of tomato and potato late blight in Canada. Canadian Journal of Plant Pathology 38: 145.

Peters, R.D. and L.M. Kawchuk. 2016. Periodic displacement of *Phytophthora infestans* strains in Canada necessitates re-evaluation of late blight control strategies. Page 27 in 31st Annual Tomato Disease Workshop Program, November 1-2, 2016, Hendersonville, NC USA.

Kalischuk, M., M. Harding, R. Howard, R.D. Peters, C. Wijekoon, J. LeBoeuf, S. Sabaratnam, D. Waterer and L. Kawchuk. 2017. Characterization of the *Phytophthora infestans* strains causing late blight provides new disease prevention strategies. American Journal of Potato Research 94: 231.

Technical Presentations

March 1, 2016. Ontario Potato Conference. Delta Hotel & Conference Centre, Guelph, ON.
Presentation: Late Blight: All You Need to Know to Win the Battle.

March 3, 2016. McCain Foods (Canada) Spring Grower Meeting. Meyers Norris Penny Exhibition Building, Portage la Prairie, MB.
Presentation: Managing Pink Rot and Late Blight in Canada

November 21-23, 2016. Potato Growers of Alberta Annual Potato Conference. Banff Springs Hotel, Banff, AB.

Poster: Kawchuk, L.M. and R.D. Peters. Best management practices required for new *Phytophthora infestans* strains

January 24-26, 2017. Manitoba Potato Production Days. Keystone Centre, Brandon, MB.
Presentation: Late blight 2016: The New Face of an Old Foe

February 15, 2017. Prince Edward Island Potato Day 2017. Credit Union Place, Summerside, PE.
Presentation: From Top to Bottom: Disease Pressure on the PEI Potato Crop in 2016

Technical Publications

Peters, R.D. and L.M. Kawchuk. 2016. Le mildiou au Canada. Web publication in Producteur Plus, Le MÉDIA de l'INFORMATION AGRICOLE au QUÉBEC.
http://producteurplus.com/index.php/specialites/pomme-de-terre/

Interviews and News Releases

February 8, 2017. Cory Knutt, Farm Broadcaster, Golden West Radio.
Topic: The current status of late blight in Canada.

June 1, 2017. Vanessa Vander Valk for CBC Radio, New Brunswick.
Topic: Preventing late blight.

October 17, 2017. Mark Halsall for Potatoes in Canada.
Topic: Top 5 potato diseases in storage.

Late Blight Offensive: Targeting Tomatoes. Mark Halsall for SpudSmart, Issues Ink. SpudSmart, Vol., No., Spring 2016.

Preventing late blight in potato and tomato plants. Andy Walker for Island Farmer, Montague, PE. Page 8 in Island Farmer, Vol. 43, No. 24, May 3, 2017.

Late blight prevention important. The Guardian, Charlottetown, PE. Page 1 in The Guardian, Monday May 15, 2017.

Strain tracking: Information on shifting late blight strains is helping to control this devastating disease. Carolyn King for SpudSmart, Issues Ink. Pages 14-16 in SpudSmart, Vol. 14, No. 3, Summer 2017.

Storage disease watch. Mark Halsall for Potatoes in Canada. Pages 9-11 in

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Potatoes in Canada, January 2018.

Early Outcomes (if any) or Challenges:

- US-23 is the major strain of the late blight pathogen in Canada, but other genotypes still occur and cause disease (ie. US-8 and US-11 in BC; US-24 in QC)
- US-23 is less aggressive than other strains on potato foliage, but very aggressive on tubers and has strong epidemic potential
- Tomato is now a key player in late blight epidemic development in commercial potato production areas
- Available LB-resistant tomato varieties are effective tools to manage disease emanating from home gardens
- The challenge of getting the message out to all industries in Canada and the general public remains – we still have much work to do in several provinces!

Key Message(s):

The epidemiology of late blight has completely changed in Canada with the distribution and spread of new pathogen strains. Infected tomatoes found in retail outlets and home gardens are now key factors in the spread of disease among regions and in the spread of inoculum to commercial production areas. We are engaging in various tech transfer initiatives (radio, TV, meetings, LB-resistant tomato seed distribution) with the industry and the general public to raise awareness of the issue. Encouraging home gardeners to grow late blight-resistant tomato varieties has been a very successful initiative in some provinces and has contributed to reduced disease development in commercial production settings. Controlling the initial inoculum at the start of the season is key to managing this disease. Although some sensitivity to Ridomil has been found in US-23, at most only one application early in the season can be beneficial; late pathogen populations are more insensitive to this chemistry. Classical and novel late blight fungicide tools are effective against the new strains as are other classic control measures, including disposal of culls, destruction of volunteer potatoes and the use of clean/treated potato seed.

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Canadian Potato Council
Conseil canadien de la pomme de terre

Canadian Horticultural Council