



Canadian Agri-Science Cluster for Horticulture 2

Progress Report April 2016

Activity 13, Potato 12

Understanding of Potato Virus Y (PVY) Complex in Canada and Development of a Comprehensive On-Farm Management Strategy

Lead Researcher

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- Potatoes New Brunswick
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Activity Objectives

- Survey the occurrence of PVY strains across Canada and characterize the genetic affiliation and pathological properties of novel strains;
- Characterize the responses of common potato varieties to the major PVY strains;
- Investigate the efficacy of mineral oil, insecticide and combination mineral oil/insecticide foliar sprays to reduce on-farm PVY spread.

Research Progress to Date

Potato samples were received from three provinces in 2015 to screen for PVY infection and strain determination. New techniques developed in 2014 allowed rapid screening of large sample volumes for PVY presence (by ELISA) then subsequent strain determination by RNA extraction and RT-PCR.

To date, 17 potato varieties in three sets have been artificially inoculated with PVY^O, PVY^{N:O} and PVY^{NTN} strains and grown in the greenhouse. Varieties included are: Norland, Norchip, Eva, Shepody, Innovator, Envol, Atlantic, Bintje, Chieftain, Sangre and Snowden xxx. Twenty replicate plants were mechanically inoculated 40-50 days after planting (5 each with PVY^O, PVY^{N:O}, PVY^{NTN} and no-virus control), symptom development was followed for 8 weeks, then tubers dug and held dormant for ca. 5 months. Foliage and tuber symptoms were observed frequently after initial infection and during tuber storage, and compared to foliage and tubers from uninfected control plants of each variety. Tubers were then replanted to observe symptoms in foliage and tubers from secondary (tuber borne) infection in these progeny plants.

Two controlled, replicated field trials were conducted in NB and MB to comparing the effectiveness of 10 combinations of mineral oil spray alone, insecticide alone and mineral oil-insecticide combination spray to reduce on-farm PVY spread. Average PVY spread of four replicates of each treatment were compared to each other and unsprayed control plots to assess the efficacy of the treatments at reducing PVY spread to new plants. Also, 100 random tubers were dug from each plot (4000 total tubers) for PVY incidence, to replicate a typical seed certification protocol for commercially harvested seed lots.

Extension Activities

Results from the three sub-activities in this research project have been communicated through nine presentations across Canada as well as in the several states of the USA and India during 2015-16. Four of these presentations were made to primarily academic audiences, totaling ca. 1200 attendees. The remaining five meetings were generally PVY-specific workshops with local industry and growers, with the audience of ca. 400 being directly responsible for managing potato crops or local extension specialists. Also, results from our field trials have been summarized in a manuscript submitted to a major peer-reviewed journal important to the potato industry in North America.

Early Outcomes (if any) or Challenges

Our main objectives are to (1) survey PVY strain populations across Canada, (2) characterize responses of major potato varieties in Canadian industry to different PVY strains, and (3) conduct experimental field trials to determine science-based best management practices to reduce on-farm spread of PVY.

During the 2015-2016, >300 potato samples from three widely separated provinces were surveyed for strain populations across Canada. In all provinces, the novel recombinant strains of PVY have come to dominate the viral population, even more so than in our 2014 survey. This continues a steady trend toward these strains observed in Canada and around the world in recent years. During this reporting period, new techniques including DNA sequencing were developed to more distinctly identify PVY in the survey samples to compare to sub-strains known to cause varied severe symptoms. Our initial analysis, based on a subset of the 2015 strain survey, shows that the relatively severe variant of PVY^O dominates that strain, while several tested PVY^{NTN} samples matched best to a relatively mild Eurasian isolate of this strain.

To date, we have characterized the responses to infection with three major PVY strains of 17 commercially important potato varieties representing a major fraction of potato acreage across Canada. We have generally found that infection with PVY^O causes most severe foliar symptoms and reduction in plant vigour and tuber yield, followed by more mild effects of PVY^{NTN} and PVY^{N:O}. Approximately 40% of tested varieties show only minor symptoms and low tuber yield loss, including variety Eva, which showed complete resistance to infection from any strain. Worrisome in the industry is the increasing prevalence of PVY^{NTN}, which can cause tuber necrotic lesions in

susceptible varieties. Out of the 17 varieties we have screened, however, only one: Envol, has clearly shown such lesions.

In 2015, two field trials, in NB and MB, were conducted to test the efficacy of several treatments of mineral oil sprays, insecticide sprays or combined mineral oil and insecticide sprays to reduce PVY spread. In these rigorously controlled and replicated trials, it is clear that frequent mineral oil spraying (ca. 5 days), starting early and continuing season long, supplemented often with insecticides in simultaneous spray, showed the greatest potential for reducing on-farm PVY spread. These data support early results from 2014. The data from 2015, however, resulted from a better designed and controlled experiment, replicated in two distinct potato growing regions across Canada, demonstrating the year-to-year and cross-region generality of the treatment effects.

Key Message(s)

Our research is revealing the current and evolving status of major PVY strains across Canada, and has identified how these strains affect major potato varieties of commercial importance, and has generated best management practices to reduce on-farm spread of PVY. Specifically:

- Necrotic PVY strains, particularly PVY^{NTN} which is of greatest concern in the potato industry, continue to dominate our nation-wide survey in 2015, and to a greater extent than in 2014
- The symptom response of 17 commercially important potato varieties to three common PVY strains has been characterized. Generally, PVY^O causes most severe symptoms, PVY^{N:O} and PVY^{NTN} had more cryptic foliar symptoms, though still yield reduction in some varieties. Several varieties have been identified that show relatively mild symptoms or yield reduction. Only one variety has been identified which shows tuber necrosis from PVY^{NTN} infection.
- Field trials undertaken over two years and in two widely separated regions consistently show that frequent and early mineral oil spray continued throughout the growing season, supplemented with insecticide spray, significantly reduce PVY spread in small experimental plots. Mineral oil alone is also somewhat effective, though insecticide spray alone (without oil) had no effect on PVY spread.

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