

Canadian Agri-Science Cluster for Horticulture 3



Update to Industry

Final Report – 2018 – 2023

Activity title:

Common Scab: Increasing profitability of Canadian potato producers by controlling common scab

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Activity Objectives:

Common scab results in significant economic losses every year in Canada. Common scab symptoms are characterized by brownish lesions on potato tubers that can result in declassification of tubers in seed production, rejection for the table market and difficulty in peeling the tubers leading to significant losses in the processing industry. There is currently no chemical registered specifically to control common scab in Canada.

The overall objective of the project was to evaluate several methods to control common scab of potato under a range of environmental conditions and soil types across Canada.

The specific objectives of this project are to:

Sub-activity 1.1 Characterize the genetic diversity of *Streptomyces* spp. causing common scab and develop tools to measure specific genotype,

Sub-activity 1.2. Evaluate methods to control common scab using small plot and field-scale trials in commercial potato fields,

Sub-activity 1.3. Determine the effect of common scab control methods on soil health and quality parameters,

Sub-Activity 1.4. Determine the concentrations of soil isothiocyanates produced through the degradation of a mustard meal and mustard residues

Sub-Activity 1.5. Evaluate the effect of common scab control methods on microbial communities.

Research Progress & Results

A large number of pathogenic *Streptomyces* spp. causing common scab were isolated from tubers collected in PE, NB and MB. The isolates were classified into more than 20 genetically-different groups using a fingerprinting molecular method, which was then refined to fourteen genetic groups based on their entire genome sequences. The isolates belonged to *S. scabies* and *S. acidiscabies*. There were large differences in the genomes of *S. scabies* and *S. acidiscabies* but also among genetic groups of *S. scabies*. Specific *Streptomyces* species and strains belonging to different genetic groups were quantified using 14 novel molecular bioassays. The result showed that the different genetic groups display various frequencies across different fields under study. Interestingly, weakly virulent genotypes dominated the fields under study, independently of time or their location. Among them, three weakly virulent genotypes accounted for more than 80 % of the genotypes' combined population. While the three most virulent genotypes were detected in lower relative abundance than the weakly virulent ones, an increase in their population size was observed over the growing season in most fields under study. These results will be useful for the development of targeted common scab control strategies.

Several methods to control common scab were tested including increasing the resistance of existing potato varieties (Riverdale Russet and Prospect) using a technique named somaclonal variation, fertilizers (Tropicote (CaNO₃), ammonium sulfate, elemental sulfur and ammonium nitrate as a control), barley as a nurse crop, peroxide-based products (drench in-furrow or on the hill, with and without irrigation), liquid mustard (in the furrow, MustGrow, 2.5 and 5 gallons/ acre), composted beef manure (10 t./ha), biopesticide (in-furrow, Serenade Soil, 4.2L/ha) and foliar applications of auxins (2,4-D (238 ml/ha), Fruitone (142 ml/ha), Rejuvenate (seed treatment (3.4 ml/t of seed) and foliar application (142 ml/ha)). These methods failed to control common scab except for Serenade Soil and 2,4-D. Serenade Soil reduced common scab severity (i.e. the extent of lesion coverage) by about 40% and increased the tubers with less than 5% lesion coverage by 20% compared to the control at the MB field site in 2020. Two foliar applications of 2,4-D Ester on AC Peregrine plants decreased common scab severity by 40-69% and increased tubers with less than 5% lesion coverage by 20-70% compared with the control at the MB field site in 2020, 2021 and 2022. Application of 2,4-D reduced common scab severity for AC Peregrine, Fenway, and Sangre varieties but not for the Colomba, DRN, and Musica varieties however, 2,4-D application increased the number of tubers with less than 5% of the lesion for AC Peregrine, Fenway, Sangre and Musica in 2022. In Eastern Canada, there was a significant reduction of the common severity by 2,4-D applied on Red Norland plants at the NB site in 2021. Concomitantly, the abundance of the common scab pathogens was reduced in the rhizosphere of 2,4-D treated plants compared to the control in 2021. However, 2,4-D failed to control common scab in PE (2021 and 2022) and NB (2022). Furthermore, there was no effect of 2,4-D on the amount of deep-pitted lesions on Shepody and Prospect which is the most important criterium for the processing industry. Temporary symptoms of phytotoxicity including curling, yellow and necrotic lesions were observed on the foliage of some varieties in some years. Given this, the use of 2,4-D to reduce common scab would not be appropriate for the seed production sector. The use of 2,4-D had no adverse effect on total yield, tuber size grade, hollow heart and specific gravity at the NB, PE and MB field sites.

In addition, the effect of the rotation crop systems on the severity of common scab was also evaluated in PE using several field sites per year. The fields were split in the year previous to potato with a variety of rotational crops including brown mustard, sorghum-sudan grass, red clover, buckwheat, ryegrass, pearl millet or a variety mixture. Throughout this project, rotational crops had marked and definitive impacts on soil properties and disease organisms. Increasing soil organic matter did not always lead to increased common scab – factors including crop type and impact on soil properties affected common scab incidence and severity. Crops including buckwheat and mustard, before potatoes tended to reduce the incidence of tuber disease in the subsequent potato crop or at least have a neutral effect. Residues of grasses, including ryegrass and the sorghum-sudan grass/pearl millet combination, seemed to exacerbate disease. As a rule, increasing soil pH led to increased common scab in PEI soils, but this was not always the case and other factors could have impacted the results including the use of crops with biofumigation and chemical suppression as with mustards and buckwheat, respectively, that are known to reduce pathogen abundance and enhanced communities of beneficial microbes.

Key Message(s):

- The genetic diversity of pathogenic *Streptomyces* was shown to be much greater than anticipated in Canada. The population size of the different pathogenic strains/species *Streptomyces* belonging to 14 different genetic groups varied among different fields. The weakly virulent strains/species were more abundant than the more virulent strains/species however, the population size of more virulent strains/species increased over the growing season in most fields under study.
- Serenade Soil applied in-furrow reduced common scab severity at the MB field site showing promise in controlling common scab.
- Foliar application of 2,4-D reduced common scab severity for AC Peregrine and increased tubers with less than 5% of the lesion under the field conditions of MB over three years of testing, however, the 2,4-D application did not control common scab for some varieties thus the response to the treatment is variety specific. In Eastern Canada, 2,4-D did not reproducibly control common scab severity i.e. reduce the extent of lesion coverage for table market or the amount of deep-pitted scab for the processing market indicating that the soil properties or environmental conditions between NB/PE and MB influenced the response of the plants to 2,4-D. Further investigations are required to understand why 2,4-D is not as effective in Eastern Canada.
- At present, only a few formulations of 2,4-D are registered by Health Canada for use on red-skinned potatoes for color enhancement.
- Crops with pest-suppressive properties, such as mustard and buckwheat, and reducing the use of grass crops before potatoes can contribute to soil-borne disease management including common scab, while maintaining soil organic matter and microbial diversity recognized as markers of soil health. Preventing significant increases in soil pH could also be beneficial, but more information is needed to fully understand the soil's chemical and physical properties that contribute to increased disease.

Overall benefit to the industry:

- There are regional differences concerning common scab within Canada including differences in environmental conditions, the soil physico-chemical properties and the crop production systems that resulted in differences in what genetic groups/species are present region-wide or field-wide and what strategy of control was successful.
- The foliar application of a low dose of 2,4-D was an effective tool for some varieties in MB, but results were not reproducible over time in Eastern Canada. At present, the use of 2,4-D is limited to red-skinned varieties as this product is only registered for red color enhancement: the label will need to be expanded to include other potato varieties.

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