

INTRODUCTION

- Blackleg of potato is caused by pectinolytic bacteria: *Pectobacterium* spp. (*P. atrosepticum* and *P. carotovorum* *susp. carotovorum* are most common causal organisms in Alberta).
- Other species of *Pectobacterium* have been isolated in different potato growing regions.
- Dickeya* spp. cause similar symptoms and are considered more aggressive.
- Both *Pectobacterium* and *Dickeya* are Gram-negative, necrotrophic, rod-shaped bacteria with peritrichous flagella (aids in motility and finding a host).
- There are no pesticides registered against bacteria for field application. Strategies are needed to ensure losses to blackleg can be minimized



Figure 1: Blackleg of Potato

OBJECTIVES

- Early detection of blackleg in fields
 - Evaluate use of fluorescence and image-based analyses to identify diseased plants in field by agronomists and producers.
 - Evaluate use of species specific in-field assays (similar to pregnancy test-strips) for pathogen identification for use by agronomists and producers.
- Early detection of soft rot in storage
 - Evaluate the use of electronic sensor technology and gas spectroscopy (electronic nose) as an early indicator of rot in seed lots/shipments.
 - Develop rapid diagnostics to discriminate between soft rot pathogens.
 - Evaluate biocontrol therapeutics to control blackleg and soft rot
 - Develop novel biocontrol approaches to reduce blackleg inoculum levels at the seed production step.
- Agronomic practices to control blackleg in-field
 - Plot work to use gypsum to reduce blackleg in seed fields
- Outreach sessions to share agronomic recommendations from literature

METHODS

Anecdotal information suggests that some potato varieties are more susceptible to the blackleg pathogen. We need to determine whether this is a varietal difference (transcriptomics, etc.) or whether the pathogen associated with seed of some varieties is more aggressive.

Dr. Neilson is using a petiole assay and a tissue culture plantlet assay to challenge different varieties with the same pathogen to determine the response.

These assays will be useful for germplasm screening, for our work with endophytes and for future trials looking at differential gene expression.

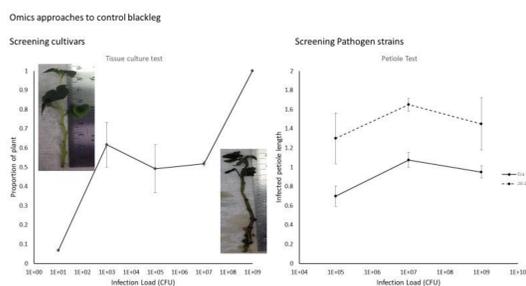


Figure 4: Dose response curves to screen cultivars and differences in aggressiveness between strains

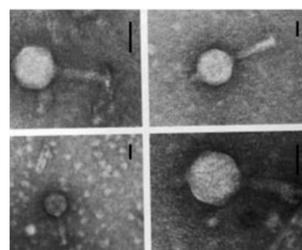


Figure 6: Scanning electron micrographs of bacteriophage associated with *Pectobacterium* samples

Lytic bacteriophages (phages) are bacterial viruses that invade bacterial cells and disrupt the bacterial metabolism, causing them to lyse.

Phages are quite specific to their target bacteria, so they pose no threat to other organisms.

They are self-replicating, relatively inexpensive to culture and degrade rapidly in the absence of their host.

Consequently, they can be useful as biological agents for disease control.

Dr. Kawchuk's lab isolated and sequenced phage from *Pectobacterium atrosepticum* (Kalischuk et al., 2015) called Peat1.

Proof of concept studies showed phage to be an effective method of controlling blackleg symptoms (Lee et al., 2017).

RESULTS

- A total of 52 diseased potato samples exhibiting blackleg symptoms or early generation seed were collected from southern and central Alberta during the 2021 season.
- Almost all blackleg samples were affected by the common *Pectobacterium atrosepticum* or the slightly more aggressive *Pectobacterium carotovorum*.
- A single *Pectobacterium wasabiae* infection was identified in 2021 and several more were observed in 2022.
- Most importantly, no *Dickeya* species were identified in 2021 or 2022.
- Dickeya* species specific sequences have been identified and are being used to develop an in-field diagnostic tool.

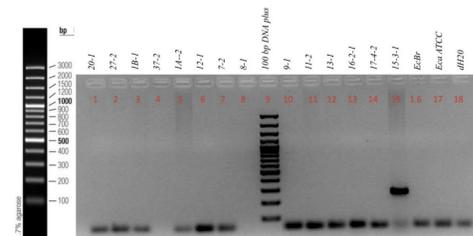


Figure 2: Agarose gel – arrow showing the diagnostic 270 bp amplified DNA sequence for *P. wasabiae*

- Work has begun with electronic nose technology – sensors that detect volatile compounds connected to a computer motherboard.
- This technology is expected to assist with early detection in seed potato storages so that affected tubers can be removed before spreading disease.
- Work will also be conducted with reflectance imagery to differentiate diseased from healthy plants.
- If it is possible to detect plants with blackleg before visual symptoms appear, plants can be rogued out of seed fields prior to inspection and harvest.

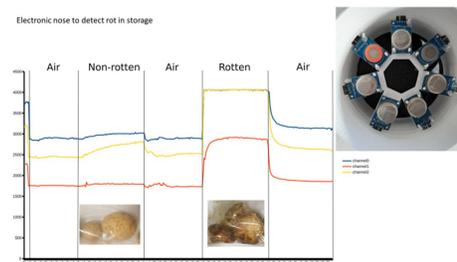


Figure 3: Action curve from three volatile gas sensors to ambient air, non-rotting and rotting tubers.

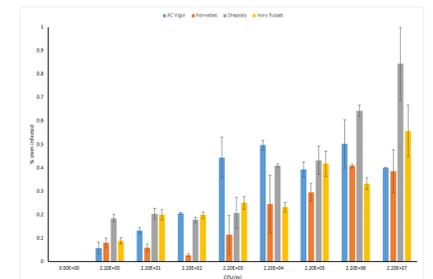


Figure 5: Differential responses of potato varieties to increasing concentrations of *Pectobacterium carotovorum*

PRELIMINARY CONCLUSIONS

- All blackleg samples submitted in 2021 and 2022 were *Pectobacterium* spp. No *Dickeya* was found.
- New strains of *Pectobacterium* have been isolated. These may be associated with new potato varieties or with environmental changes observed in the past few years.
- Preliminary work with electronic sensors for volatile compounds may lead to storage tools for early detection of the pathogen in seed potatoes.
- Tissue culture and petiole assays allow us to quickly screen varieties using different blackleg isolates to determine the susceptibility of each variety to strains of blackleg pathogen.
- There are differences in susceptibility of potato varieties to specific *Pectobacterium* isolates.
- These differences will be explored in a preliminary genomics project with potato germplasm.
- Bacteriophage have been isolated from the *Pectobacterium* strains found in Alberta and may be suitable as localized biocontrol agents to reduce disease pressure.

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