2016 - 2017 Research Highlights

for Projects Supported by Prince Edward Island Potato Growers

In early 2013, Prince Edward Island potato growers overwhelmingly supported the expenditure of levy dollars to support provincial and national potato research that addresses the research priorities which Island potato growers helped to establish in recent years. Funding from the PEI Potato Board, combined with funds from other industry partners, has leveraged over $1.6 million in both provincial and national potato research spending in the 2016/2017 fiscal year.

Reports on the following pages outline some of the key results from completed and ongoing research projects that received support from the PEI Potato Board in the last year. These projects were primarily conducted here in Prince Edward Island, in cooperation with a variety of research partners.

The Potato Board has committed significant funds to the National Potato Research Cluster Project administered by the Canadian Horticultural Council (CHC) under the federal Growing Forward II program. As part of this cluster, PEI potato growers are supporting research into wireworm, variety evaluation, PVY, and Verticillium testing. Interim results in each of these research areas are reviewed here, and full reports on these projects are available on the Canadian Horticultural Council's website.

The Board's Research and Environment Committee will continue to review proposed research to determine whether it addresses the priorities of Island potato growers. This spring, the Committee and Board staff are working with the Canadian Potato Council's Research Working Group to assess research proposals for the next National Potato Research Cluster based on the priorities of Island growers. Full proposals will be reviewed and approved this summer to allow enough time to get funding in place to hit the ground running in April 2018, when the next national policy framework comes into effect.

The Board has also continued to support national potato research outside of the existing CHC Cluster on topics such as late blight, soil management, cover crops and crop rotation. In addition, the Board has worked with local researchers and agronomists to conduct research on a local level.

In addition, 2016 saw the launch of the Agronomy Initiative for Marketable yield (AIM), a collaboration between Cavendish Farms, the Province of Prince Edward Island, Agriculture and Agri-Food Canada, and the processing growers of Prince Edward Island through the PEI Potato Board. The goal of AIM is to increase marketable yield on processing varieties by 25 cwt over the next three years. This grower-led initiative will focus on improving the link between research and grower production practices through on-farm trials, demonstrations, grower workshops, and improved extension efforts. Results of relevant trials will be made available to growers as they come available via the Board's Growers Site.

Major Research Coordination and Funding Partners:

Canadian Horticultural Council

Prince Edward Island CANADA Agriculture and Fisheries

Growing Forward 2

A federal-provincial-territorial initiative

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

WIREWORM

CHC Cluster Project: Wireworm Activity
Research conducted by Dr. Christine Noronha (AAFC), Dr. Robert Vernon (AAFC), and Todd Kabaluk (AAFC). Research taking place in PEI and BC.

Research Purpose: A multi-faceted approach to identify tools which potato growers can use to reduce the impact of wireworm on their crops.

Key Findings:

Insecticide efficacy trials

- Products were tested in both British Columbia and PEI for tuber blemishes in fields heavily infested with wireworm.
- Both Thimet and Capture were evaluated and showed similar levels of control. Optimal application methods for Capture (wide spray in furrow) were also established and confirmed.
- Additional insecticides were tested, including some experimental products. Some of these proprietary products gave excellent results and are good candidates for registration.

Wheat seed-treatment trials:

- Studies to identify methods of controlling wireworms in cereal rotation crops were conducted in BC and PEI in 2016. Some new proprietary products provided excellent stand protection and wireworm mortality, and are candidates for registration.

Evaluation of brown mustard for bio-control:

- A trial using brown mustard as a nurse crop was conducted in PEI, seeded into plots on six dates over the growing season. Preliminary data appears to show that presence of mustard appears to have a protective effect on daughter tubers.

Evaluation of *Metarhizium* for bio-control:

- Work was done to address weather-proofing of biocontrol products, including those with the fungal agent *Metarhizium*, for click beetle attrack and kill. One method, used in the potato phase of rotation, reduced damage by 30%. In addition, a biocontrol spray strategy was investigated in BC and PEI. More refinement of control methods and *Metarhizium* strains will continue in 2017.

Trapping wireworms and click beetles:

- Development of a CO2 generating probe trap for wireworms is underway and will be further refined in 2017. Four years of on-farm testing has been performed in PEI, and a wireworm monitoring fact sheet is being prepared for growers.
- A study on the biology of wireworms and click beetles continued in PEI. Dr. Suqi Liu with the PEI Department of Agriculture and Fisheries is investigating time of egg laying, egg hatching, click beetle movement, and collection of adults in two type of traps. *A. sputator* females appear to lay between 50-100 eggs after each mating.
- National wireworm and click beetle surveys were completed in 2016, including 85 sites in PEI. On average, click beetle populations are increasing in PEI, and the presence of click beetles is spreading into regions of the province where there weren't significant finding of click beetles in 2012. There was also some findings of the species *Hypnoides bicolor* in PEI, requiring further investigation.

For more information on wireworm-related research, please visit the PEI Potato Board Grower Site for presentations from the 2017 Wireworm Research and Extension Seminar.

www.peipotato.org/growers-site

Potato Virus Y (PVY)

CHC Cluster Project: Potato Virus Y
Principal Investigator: Dr. Mathuresh Singh, Agricultural Certification Services, Fredericton, NB. Primary research taking place in New Brunswick.

Research Purpose: To survey populations across Canada for strain identification; to characterize response of major varieties to PVY strains; to explore management practices to reduce on-farm spread of PVY

Key Findings:

Tracking PVY strains in Canada

It appears that PVY^{NTN} has replaced PVY^{O} as the dominant strain of PVY in Canada, making up 56% of identified samples. This recombinant strain shows relatively mild symptoms in most commercial potato cultivars in comparison to PVY^{O}, making it difficult to Identify and remove infected plants from the field. Also, research indicates that the PVY^{NTN} strain is naturally more efficient at transmission than PVY^{O}. Work will be ongoing to continue monitoring the status of PVY strains present across the country.

Varietal response to PVY strains

The research team has been investigating the response of each variety to the various strains of PVY, including effect on foliage and tubers. The recombinant strains of PVY (PVY^{NTN} and $PVY^{N:O}$) have been shown to display necrotic symptoms on some tubers. Meanwhile, the PVY^{O} strain displays the largest effect on foliage, along with plant stunting and reduced tuber yield. In most varieties, PVY^{NTN} and $PVY^{N:O}$ caused more mild symptoms and tuber yield loss, though in a few varieties, leaf mosiac was evident.

To date, 27 potato varieties have been screened for the effect of PVY strain. Three varieties (Envol, Pacific Russet and AC Chaleur) show distinct tuber necrosis from PVY^{NTN}. The variety Eva shows strong resistance to PVY for all strains, both in plant tissue and tubers, and it is the only resistant variety identified so far.

Management practices to reduce PVY

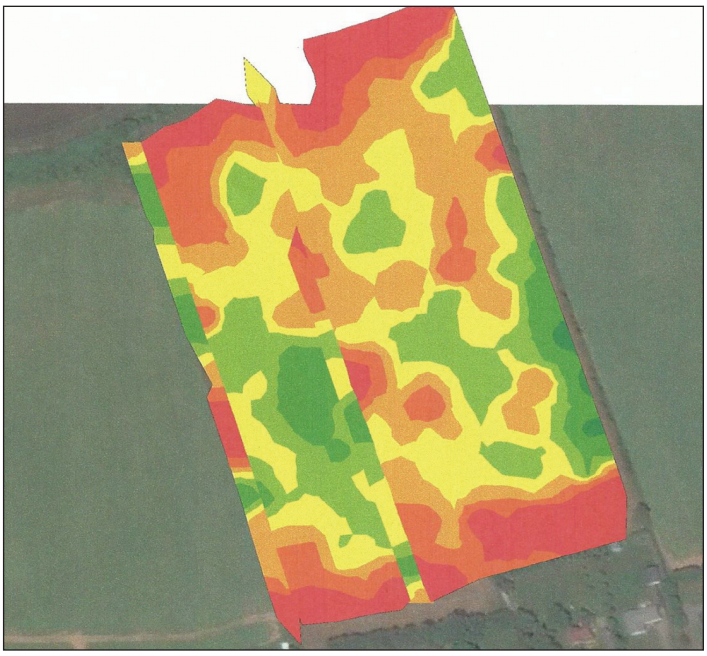
In 2016, an experimental field trial was undertaken in Manitoba to test the efficacy of several treatments of mineral oil sprays, insecticide sprays or combined mineral oil and insecticide sprays to reduce PVY spread.

In this controlled and replicated trial, PVY inoculum of all three strains was planted to an initial 3% level, allowing for considerable virus spread. Under strong PVY spread conditions, the research team confirmed that frequent mineral oil spraying (ie. every 5 days), beginning early and continuing season long, and supplemented often with insecticides in simultaneous spray, showed the greatest potential for reducing on-farm spread of PVY. This is consistent with the 2015 Manitoba trial under low PVY spread conditions, and two identical trials (2014 and 2015) in New Brunswick (NB). These data also confirm that PVY^{NTN} has the greatest capacity to spread even when all strains were inoculated into the field at equal levels, followed by $PVY^{N:O}$ and PVY^{O}.

Research in 2015 and 2016 also seems to indicate recombinant strains of PVY are also more easily spread through mechanical transmission, such as rubbing of leaves and stems. This is most often the case in sprayer tracks, and studies definitively showed that rates of PVY spread were higher in sprayer track rows than in adjacent rows with no mechanical contact. Consequently, it would be prudent for seed growers to rogue sprayer tracks first and more often, and to consider tram lines for early generation seed if practical.

YIELD VARIABILITY

PEI Potato Yield Variability Study
Research conducted by Genesis Crop Systems.
Initial three year project funded through Applied Research Program of the Canada-PEI Growing Forward 2 Agreement. Followed with a two year project started in 2016.



Research Purpose: To assess biological and physical characteristics of soil which may help to identify reasons for regions of high and low yields within a single field. Yield are assessed through yield monitors on harvesters, creating GPS yield maps of 15 individual fields. The following spring, each field is soil sampled to assess nutrients, structure, and soil-borne pests according to zones determined from yield maps from the previous potato crop.

Key Findings:

In each field, samples were analyzed for soil chemical analysis, soil organic matter, compaction, Verticillium, and root lesion nematode. In addition, samples were sent to Agriculture & Agri-Food Canada (AAFC) for analysis of additional soil health and soil structure attributes.

In all three years of our initial study, root lesion nematode (RLN) counts were high. The average number of nematodes per kg of soil in 2016 was 5,478, which is higher than the previously determined economic threshold level of 5,000 for Russet Burbank. Thirty out of sixty samples had RLN counts greater than 5,000 in 2015. When comparing low yielding areas of fields with high yielding areas, the results were variable. Out of 45 fields that were sampled over the three years of this study, there were fourteen fields that showed RLN counts that were at least 20% higher in the low yielding areas of the field.

One parameter which was consistently high across all fields was levels of *Verticillium dahliae*. Dectection of Verticillium at the Potato Quality Institute was expressed on a 0 to 3 scale, with 3 indicating high levels of DNA present. In both 2013 and 2014 samples, 56 out of 60 samples rated at "3" for *V. dahliae*, while 45 out of 60 samples rated at "3" in 2015. Both high and low yielding areas of the fields showed high levels of Verticillium in the soil.

Soil compaction also appears to be a widespread factor in the fields that were tested. The average penetrometer reading at eight inches across all samples was between 199 and 207 psi across the three years of study. There was not a clear trend for compaction to vary between the high and low yielding areas, as penetrometer levels did not seem to vary much within fields. With literature noting that root growth is inhibited above 150 psi, the penetrometer readings obtained in this study indicate that compaction may be a yield limiting factor in many Island potato fields.

None of the other soil chemical analyses provided any clear trends toward yield limitation in low yielding areas. There were some differences seen in particular fields for individual soil nutrients, but there was no observable trend across fields or across years. Results from additional soil physical attributes conducted by AAFC are still being analyzed and will be shared in the final report.

In an effort to better identify what the direct limitations on yield are within a field, research in 2016 and 2017 is focusing on only two fields, with thirty samples per field to hopefully identify with more precision what factors have the greatest effect on yield variability. This project will conclude at the end of 2017.

SOIL MANAGEMENT

Mitigating Limitations to On-Farm Yield
Three year funding commitment through AgriInnovation Program, Potatoes New Brunswick, McCain Foods, Prince Edward Island Potato Board, and additional partners.

Research Purpose: To identify limitations for yield, and to explore ways to counteract these limitations through addressing soil erosion, soil health, and other beneficial production practices.

Key Findings of PEI trials:

Nurse Crops (crops seeded between potato rows to contribute to soil health and reduce potential for soil erosion early in the season)

- In 2016, both small plot and field scale trials were performed.
- In plots, both winter rye and ryegrass were compared with a control. For both, two killing methods were compared: mechanical control by hilling, and herbicide applied without subsequent hilling. Preliminary results showed that the nurse crop treatments had a negative impact on yield compared to the control, with the nurse crop not being satisfactorally killed early in the growing season.
- On a field scale, winter rye was planted at two seeding rates (80 lb/ac and 120 lb/ac) compared to a control. Nurse crops were killed mechanically through hilling, followed by two herbicide applications. Once again, data indicated that the nurse crop at both rates had a negative impact on marketable yield.
- Research will continue in 2017 at both field and plot scale to refine the nurse crop species, seeding rate, and both method and timing of nurse crop killing.

Late-Season Cover Crops

- There is a desire to identify plant species which can serve as an effective late-season cover crop after potato harvest. A number of growers already broadcast cover crops like winter rye or ryegrass, but this is most prevalent in potatoes harvested in September (seed, early table, chip, etc).
- In the fall of 2016, a replicated trial was established at Harrington Research farm evaluating three winter cover crops (winter wheat, winter rye, and spring barley) on two seeding dates (Sept 28 and Oct 5).

Potatoes grown following a winter rye nurse crop in 2016.

- All of these crops established at the two seeding dates. The spring barley appeared to establish slightly better than the winter rye and winter wheat. There was a noticeable difference in establishment between the early and late seeding dates for winter wheat. Full analysis of ground cover and plant density will follow.
- Field scale trials were also established following potatoes with both winter rye and winter wheat. Soil samples were taken before seeding and after soil freezing to analyze nitrate concentrations. Plant density and ground cover measurements were also taken and are still to be fully analyzed.

Residue Tillage Systems

- This work continued in 2016, with potatoes planted following residue tillage work completed in the fall of 2015. Full results of this research will be made available later this summer following data analysis in concert with other residue tillage research also completed in Prince Edward Island in recent years.

Spring barley on Nov 21, 2016 (48 days after planting)

LATE BLIGHT

Characterization and Tracking of Potato Late Blight Pathogen in Canada

National Project led by Dr. Rick Peters, AAFC Charlottetown. Funded through AgriInnovation Program under Growing Forward 2.

Research Purpose: To identify strains of late blight across Canada, to assess novel strains for their impact on foliage and tubers on a range of cultivars, and to ascertain the influence of the environment on transmission and infection of late blight.

Key Findings:

Over 80 samples of plant tissues with late blight were received in 2016 from seven provinces, including PEI. The most severe late blight epidemic occurred in Manitoba 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.

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).

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.

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.

VARIETY EVALUATION

Canadian Potato Variety Evaluation Program

Research in PEI conducted by David Main, AAFC as part of the CHC National Potato Research Cluster Project (Growing Forward 2).

Climate Zone Variety Evaluation

Research at four American universities. Three year project funded through Applied Research Program of the PEI Department of Agriculture & Fisheries (GF2).

Variety Evaluation for Starch Purposes

Research conducted by Genesis Crop Systems. Two year project funded through Applied Research Program of the PEI Department of Agriculture & Fisheries (GF2).

Key Findings:

Cluster Variety Trial, Harrington, PEI

- The highest marketable yields were obtained from Electra (423 cwt/ac) and Lanorma (303 cwt/ac), outperforming the standard varieties by wide margins.
- The AAFC red skinned variety AR2015-12 outperformed the red standard (Norland) with a high marketable percentage.

Climate Zone Trial

- Results were quite variable in 2016 between the four American trial sites.
- No varieties performed consistently across the four sites, with most yielding similarly or below the yields of standard varieties.

Starch Variety Trial, Augustine Cove, PEI

- Generally, an increase in plant population (tighter spacing) results in higher total yields.
- The highest yields were obtained from Horizon (596 cwt/ac at 9 inch spacing), Russet Burbank (533 cwt/ac at 9 inch spacing) and Marcie (494 cwt/ac at 9 inch spacing).
- Four varieties produced in excess of 7500 lbs/acre of starch.

A more detailed report on 2016 variety trial results can be found on pages 23-28 of the March-April 2017 issue of the PEI Potato News.

CROP ROTATION

Evaluating Oilseeds in Rotation with Potatoes
Research in PEI and Quebec by the Eastern Canadian Oilseeds Development Alliance Inc. Funded through an AgriInnovation Program project (Growing Forward 2).

Research Purpose: To evaluate different crop rotations involving potatoes in combination with oilseed crops (soybeans, canola) and other crop species.

Key Findings:

2016 was the potato year in rotation across 10 different three year rotations which featured a variety of commercial rotation crops (corn, barley, canola, soybean, spring wheat) along with soil-building non-commercial rotation crops (buckwheat, forage mix, clover).

One soil health measure that was used to assess soil health was fungal:bacterial biomass. Rotations with corn had the lowest F:B biomass measurements.

There was no statistical difference seen in potato yield or quality between the rotations. Numerically, the rotations with corn in the rotation performed the best, but it should be noted that these corn crops were a crop failure in two out of three years of the study, and that no corn was harvested from the plots.

Potato yield exceeded 400 cwt/acre in the corn/canola/potato rotation, the highest numerically in the study.

Higher incidences of rhizoctonia were observed in rotations that contained canola.

The highest percentage of cull tubers were observed in plots that were preceded by two years of soybean and in canola followed by forage mix.

The 2017 growing season will see a change in rotations, with adjustments to focus more on cover cropping and diversity of rotations. As well, and economic analysis of each cropping system will be performed.

AIM PROJECTS

Whole Seed

Plot sites were established in grower fields at three sites in 2016. At each site, seed from three different seed lots was evaluated. Whole seed tubers of two different sizes (1.5 - 2.5 oz; 2.5 - 4.0 oz) was compared with a cut run of seed from the same seed source. Cut seed was planted at 15 inch spacing, the smaller whole seed was planted at two spacings (12 and 15 inches) and the larger whole seed was planted at two spacings (15 and 18 inches).

This was an observational trial, with no statistical analysis applied to the data at this point. Small sized tubers used for the trial were not grown to be small, so we can't know the reason that they were small. The primary goal was to understand if whole tubers would perform differently than cut sets from the same seed lot under the same growing conditions.

One of the three trial sites was compromised by heavy weed pressure, so those results are omitted. One of the three seed lots saw lower yields at all three trial sites, demonstrating the variability in the potential seed performance with any seed lot.

Some summary results are presented in the table below:

	Marketable Yield per acre	Total Yield per acre	Payout per acre
Cut Seed	335	383	$4225
Small Whole (12 in)	363	454	$4184
Small Whole (15 in)	387	443	$4291
Large Whole (15 in)	402	494	$4481
Large Whole (18 in)	404	475	$4422

Generally, whole seed of different sizes and spacings performed as well or better than the regular cut seed lots for both yield and payout.

This plot-based research will be replicated in 2017, as well as including seed from other sources that was grown and managed for a smaller size profile. In additional, it is hoped to do two field-scale trials comparing small whole seed with cut seed.

The PEI Potato Board is coordinating and contributing funding to the following projects in 2017-2018:

PEI Potato Yield Variability Study
Two year project funded with PEI Agriculture Applied Research Program (GF2). Research performed by Genesis Crop Systems

Resistance to Metalaxyl-M in Populations of the Potato Pink Rot Pathogen (*Phytophthora erythroseptica*) in Canada
Two year project funded with Potato Growers of Alberta, Keystone Potato Producers Association, Prince Edward Island Potato Board, and Syngenta Canada. Research performed by Agriculture & Agri-Food Canada.

National Potato Research Cluster, investigating PVY, Wireworm, PCR testing for Verticillium, Variety Evaluation, and Zebra Chip.
Five year funding commitment through Growing Forward II Program and multiple industry partners

Oilseeds East: Market-Driven Research for Soybean and Canola Supply Chain Profitability
Five year funding commitment through AgriInnovation Program, ECODA and its multiple industry partners
Research into rotations with potatoes performed by Dr. Aaron Mills, Agriculture & Agri-Food Canada

Securing Export Markets for Potato Processors by Mitigating Limitations to On-Farm Yield
Three year funding commitment through AgriInnovation Program, Potatoes New Brunswick, McCain Foods, Prince Edward Island Potato Board, and additional partners. Research conducted by Agriculture & Agri-Food Canada in New Brunswick, Manitoba and Prince Edward Island.

Characterization and Tracking of Strains of Potato Late Blight Pathogen in Canada
Three year funding commitment through AgriInnovation Program and multiple provincial grower organization industry partners. Research conducted by Agriculture & Agri-Food Canada in Prince Edward Island and Alberta.

Development of an RNAi Approach to Control Wireworms on PEI
Two year project funded with PEI Agriculture Applied Research Program (GF2), Prince Edward Island Potato Board, Cavendish Farms, PEI Horticultural Association, and Genome Atlantic. Research conducted by Dr. Gefu Wang-Pruski, Dalhousie Faculty of Agriculture.

Agronomy Initiative for Marketable Yield (AIM)
Three year project funded with Cavendish Farms, PEI Department of Agriculture & Fisheries, Agriculture & Agri-Food Canada, and levy dollars provided by growers delivering potatoes to Cavendish Farms. Multiple trials and agronomy projects established by three Working Groups (Soil Improvement, Seed Management, Science & Technology).

More details on Board-supported research projects are available by contacting Ryan Barrett, Research Coordinator, at: ryan@peipotato.org or (902) 892-6551

As they become available, full results of research projects will be made available on the PEI Potato Board Growers Site: www.peipotato.org/growers-site