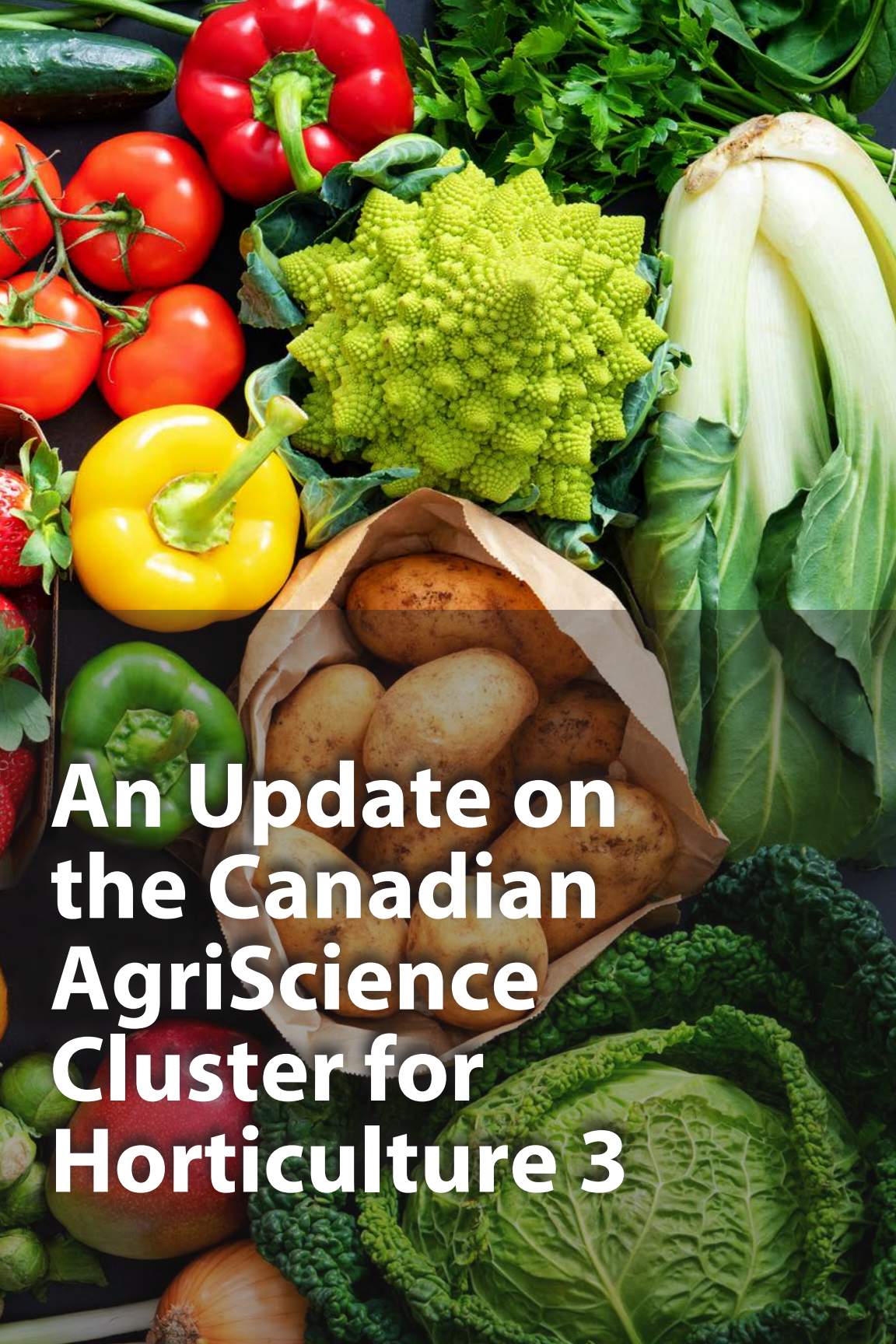

An Update on the Canadian AgriScience Cluster for Horticulture 3

An Overview

Fruit and Vegetable Growers of Canada supports the Canadian fruit and vegetable sector in part by managing funding applications and subsequent research and promotion activities that address the sector's top priorities.

WITH AN INVESTMENT OF NEARLY $21 MILLION ($13 MILLION BY AGRICULTURE AND AGRI-FOOD CANADA'S AGRIINNOVATION PROGRAM AND $8 MILLION BY INDUSTRY), THE CANADIAN AGRISCIENCE CLUSTER FOR HORTICULTURE 3 (CLUSTER 3) FOCUSES ON INNOVATION, COMPETITIVENESS, AND SUSTAINABILITY TO ENSURE CANADIAN FRUIT AND VEGETABLE GROWERS HAVE THE TOOLS AND RESOURCES THEY NEED TO CONTINUE TO GROW HIGH-QUALITY, HEALTHY FRUITS AND VEGETABLES FOR CANADIANS AND THE WORLD.

Cluster 3 addresses key challenges and innovation priority areas in horticulture, including:

- Maximizing quality and minimizing loss;
- Sustainable practices;
- Pest and disease management;
- Variety development and evaluation;
- Labour efficiencies; and
- Precision agriculture.

With a total of 16 highly collaborative research activities across five commodity groups (apple, berry, greenhouse, potato and vegetable), Cluster 3 facilitates cooperation between Agriculture and Agri-Food Canada, universities, colleges, and private researchers to best utilize the scientific expertise available.

Clusters by the Numbers

Growth Over the Years

$4.7 million
Total investment for Cluster 1 (2009-2013)

$8.3 million
Total investment for Cluster 2 (2013-2018)

$21 million
Total investment for Cluster 3 (2018-2023)

Cluster 3

$21 million
Total investment over five years (2018-2023)

$13 million
Agriculture and Agri-Food Canada's contribution

70
Number of industry contributors investing in activities

$8 million
Industry's contribution

16
Number of research activities across Canada

59
Number of researchers collaborating in the field and in the lab

32
Number of institutions (government, universities and colleges, private)

$1.3 million
Value of the berry activity

$1.3 million
Value of the two apple activities

$1.35 million

Value of the three greenhouse activities

$4.2 million

Value of the two vegetable activities

$9.85 million

Value of the eight potato activities

Cluster 3 Success Stories

THE CANADIAN AGRISCIENCE CLUSTER FOR HORTICULTURE 3 (CLUSTER 3) BRINGS EXPERTISE FROM ACADEMIA, INDUSTRY, AND GOVERNMENT TOGETHER ON 16 RESEARCH ACTIVITIES ACROSS FIVE COMMODITY GROUPS: APPLE, BERRY, GREENHOUSE, POTATO, AND VEGETABLE.

Activity 2 (Apple) – Sustainable Control Practices for Apple Pests in Canada

The apple maggot, the apple leaf curling midge, and the leaf roller complex; a trio of culprits that will eventually become—or already are—a challenge for Canadian growers to overcome in all apple production regions across the country. As such, the research within this project seeks to develop sustainable control practices that will help industry curb the impact of these destructive apple pests.

For apple maggot, the project team explored the efficacy of using fewer pesticide applications to determine if it would result in sufficient control for this pest. However, after two years of field study, it was found that fewer applications did not demonstrate effective control and it is recommended that industry continue following pesticide label recommendations.

Researchers in Nova Scotia observed that growers who rely on "softer" products to control other pests may not achieve control of the apple leaf curling midge and that knowing when leaf curling midge are in the orchard will help growers better-time their spray applications for effective control. The project team has developed a degree-day model for this pest to provide growers this information.

The leaf roller complex is a group of moth species that damages fruit in all apple-producing regions across Canada, with the specific species of moth varying by region. To mitigate this damage, researchers are exploring host volatiles in a mass trapping strategy.

"One benefit of these host volatiles is their ability to attract both males and females of multiple species, and the sex ratio recorded in Nova Scotia and Quebec was close to 50:50," says project lead, Suzanne Blatt, Agriculture and Agri-Food Canada. "Using these host volatiles in mass trapping field experiments in British Columbia and Nova Scotia showed promise in the preliminary analysis, with complete analysis still to come."

Activity 3 (Apple) – Optimizing Storage & Postharvest Practices to Reduce Apple Loss & Improve Quality

The work of this project seeks to extend the storage of the different apple cultivars in Canada and is divided into three components: optimizing postharvest practices and storage regimes for rising cultivars; evaluating new, low-oxygen storage and dynamic regimes to reduce apple loss; and investigating new technology for harvest management and fruit maturity.

"We always want to be able to keep apples fresh longer," says project lead, Jennifer DeEll, at the Ontario Ministry of Agriculture, Food & Rural Affairs. "We already know some cultivars last a little longer than others and we are trying to determine what combination of treatments and historic regimes might improve on that and extend the timeframe. To this end, we are continuing to test and try to figure out what works and what doesn't."

One of the key findings so far from this research has been that the later in the season the apple is harvested, the more issues growers will have in maximizing the fruit's storage. This means that apple growers need to be always cognizant of the fruit's maturity at the time of harvest.

"We also found the lower you can safely go, in regard to oxygen concentration, the better quality you're going to have; and that's in terms of firmness and reducing internal browning," says DeEll. "We are looking to discover the base oxygen level you can go down to without harming the fruit and still take all the benefits from the process."

The combinations of different factors that can impact fruit storage are virtually endless, and the learning in this area continues to evolve year after year. Looking ahead, the project team will continue to explore the different storage components such as lower oxygen levels and new technologies coming to market and then monitor the impact of these components on different fruit cultivars.

Activity 4 (Berry) – The Canadian Berry Trial Network

Supported by four research centres in British Columbia, Ontario, Quebec, and Nova Scotia, the Canadian Berry Trial Network has three primary objectives. The first two are to establish and enact a network of interprovincial testing for strawberry, raspberry, and blueberry varieties in a scientifically relevant manner to collect a wealth of data, from plant growth and climate adaptation, to yields and berry quality.

The third objective is to then communicate the results of that research with growers and industry stakeholders through presentations and high-level annual reports to the the Fruit and Vegetable Growers of Canada. This important work will ultimately help determine the value of the different varieties as potential commercial products.

"When growers invest in new plant varieties, there is currently a lot of uncertainty around whether it will be productive in a given environment and whether it will ultimately give a decent return on investment," says project lead, Beatrice Amyotte, Agriculture and Agri-Food Canada (AAFC). "The work we are doing on our research farms takes away some of that uncertainty and allows growers to make informed decisions, taking some of the risk out of planting new varieties."

To date, the project team has designed the Canadian Berry Trial Network and the participants are fully integrated into the project. However, the work of evaluating varieties is ongoing and researchers will continue to plant new trials through to 2023. The sharing of those results is also ongoing and will continue up to the project's anticipated completion next year.

"We've received some good indications that the Canadian Berry Trial Network will be a good model to continue on past 2023, and we hope the industry will support us through the next cycle," says Amyotte.

Activity 5 (GH) – Integrated Management of the Pepper Weevil, an Invasive Pest of Greenhouse Pepper Crops in Canada

The pepper weevil is one of the most important pests affecting pepper crops across North America. In 2016 alone, the Canadian greenhouse pepper industry suffered massive crop losses from the pest that amounted to a staggering $67 million, a loss exacerbated by the lack of effective management tools—something researchers in Canada hope to rectify.

However, natural enemy surveys have also led to renewed interest in developing biological control strategies targeting this species. In Mexico, among the three top wasp species known to attack the pepper weevil was *Jaliscoa hunteri*. Project lead, Dr. Roselyne Labbé, and her AAFC research group also identified *Jaliscoa* as one of seven parasitoid species attacking this pest in Canada.

"Based on trials performed in Florida showing that *Jaliscoa* could significantly reduce the number of weevil-infested bell pepper fruit, we felt it was important to examine this wasp's potential as a biological control agent for pepper weevil in Canada" says Labbé. "To date, studies performed in commercial Ontario greenhouses showed the wasp could, indeed, reduce pest pressure."

The research team also evaluated 16 reduced-risk conventional and bio-pesticides that could be used to manage pepper weevil and identified kaolin clay and mineral oil as particularly effective agents, which could ultimately improve year-round crop protection in Canadian greenhouses.

Work is also underway to explore how the Sterile Insect Technique (SIT) might control pepper weevil populations. In collaboration with Nordion Inc. and Dr. Cynthia Scott-Dupree at the University of Guelph, the team developed an optimized irradiation protocol that confers sterility in weevils, which could one day be used for managing this pest following future invasions.

"The work we are doing with SIT represents a novel and exciting opportunity to explore new and better ways to control crop pests in greenhouses and is a first-of-its-kind in Canada," says Labbé.

Activity 6 (GH) – Evaluating Biological Control Strategies for the Tomato Leaf-Mining Moth (Tuta absoluta), a Potential Invasive Greenhouse Pest in Canada

Tuta absoluta is a globally invasive leaf-mining moth responsible for tomato yield losses that can reach up to 100 per cent for both fresh market and processing tomatoes grown in fields and greenhouses.

And while the tomato leaf miner has not yet made its way into North America, it has enormous potential for population growth in Canada. To prepare for the possibility of an inadvertent introduction of *Tuta absoluta*, researchers at AAFC are exploring possible native Canadian predators to efficiently manage the pest, should it ever arrive at our doorstep. Their work has so far led to the identification, study, and development of novel agents for the biological control of this pest in Canada.

During recent surveys in Ontario, more than1,300 hemipteran specimens have been collected, from which three key native predatory species were identified, including mirids *Dicyphus discrepans, Dicyphus famelicus,* and *Macrolophus tenuicornis*. These represent valuable candidate hemipteran biocontrol species.

The research team is also DNA barcoding and databasing the diversity of hemipterans collected to produce a database for the future study of predator diversity.

"We are extremely pleased with these findings and continue to study the life history and predatory capacities for three of the most promising predators," says project lead, Dr. Roselyne Labbé. "We anticipate these predators will have significant value for commercial greenhouse crop protection, both here and abroad, and will contribute to improve the overall sustainability of pest management in greenhouse environments."

Given this success, the project team is currently in conversation with potential partners that may assist in the commercialization of these predatory species, so Canadian greenhouse producers can thwart future risks associated with arthropod pests.

Activity 7 (GH) – Reduced Production Cost & Enhanced Labour Efficiency Using the Guelph Intelligent Greenhouse Automation System

The goal of the Guelph Intelligent Greenhouse Automation System is to automate the most labour-intensive tasks found in a vegetable greenhouse, like harvesting and de-leafing for tomatoes. As the project progressed, the team worked with growers on additional applications for automation such as disease detection and yield prediction.

The value of this work cannot be overstated. Today's vegetable greenhouses require significant labour resources that make up approximately 30 per cent of the total operating costs. In addition, a domestic labour shortage has meant that a significant portion of this labour force is comprised of temporary foreign workers, a significant issue throughout the pandemic.

"During COVID-19, the problems facing growers have only increased because of the evolving quarantine and testing requirements for temporary foreign workers working in the greenhouse," says project lead, Medhat Moussa at the University of Guelph. "The closed indoor work environment of the greenhouse doesn't help to contain outbreaks, so there is a strong market pull from growers for us to explore the opportunities presented by automation, post-pandemic."

Project researchers are closing in on solving many of the technical problems involved with automated harvesting. That being said, there are still challenges to be addressed such as making the business case for automation.

"There are several companies focused on the automation of various tasks, but there aren't any commercially viable products currently available that can provide immediate solutions," says Moussa. "But as the cost of the hardware becomes less expensive and the cost of labour keeps growing, commercially viable solutions are certainly possible within the next three to five years."

Looking ahead, researchers will be field-testing several technology components with grower partners to validate both the productivity and reliability of automation. Once this is complete, and depending on market conditions, the project team plans to seek industrial partners to start the commercialization of the technology.

Activity 8 (Vegetable) – Optimizing Delia Pest Monitoring & Management in Vegetable Brassicas

The variety of root maggots impacting vegetable brassicas are typically either generalists or specialists, and across the country, but particularly in eastern Canadian provinces, like Quebec, different species will contribute to the damage done to an assortment of crop types.

"As an example, the seed corn maggot and its allies are generalists and will feed on a wide range of things, including onions and cultivated crops," says project lead, Jade Savage at Bishops University. "This is what helped set the table for our project; one that looks to document the relative contribution of the various species in the different provinces producing cruciferous crops."

To this end, the research team is seeking to explore, validate, and optimize the approach known as the Sterile Insect Release method, specifically targeting *Delia radicum,* aka the cabbage maggot. The project team is also looking to develop threshold-based models that will better-inform growers as to the best time for spraying to maximize results when it comes to the different *Delia* species.

"Growers tend to think more is better, but with Delia flies, it's been clearly demonstrated that if you just spray more, it doesn't really change anything," says Savage. "Our work aims to improve on conventional management."

Although more work still needs to be done, the research team is beginning to see trends emerge such as a high prevalence of generalist species, like the seed corn maggot in most sampled crops and provinces.

"We also see there is a lot of inter-annual variability that makes this problem difficult to follow with a short-term perspective," says Savage. "So, while we are starting to see trends, we will obviously need more long-term monitoring to ensure we are not drawing conclusions that don't stand the test of time."

Activity 9 (Vegetable) – Development of All-Male Asparagus Hybrids with Improved Traits

The goal of researchers in this area is to develop new, all-male asparagus hybrids that will deliver improved yield, quality, and disease resistance for Ontario growers. The project team is currently conducting research that will lead to new information that can optimize grower returns on a hybrid-specific basis and be applied to future breeding efforts. Their work includes the development of a reliable growth chamber screening method for spear purple spot resistance; identifying genes up- and down-regulated as asparagus acclimates in the fall (becoming winter-hardy) and then deacclimates in the spring (losing freezing tolerance); mapping genes for yield, quality, and disease resistance; and better-understanding the effects of planting depth and density on yield, quality, and spear diameter for individual cultivars.

"Both long- and short-term research projects will provide improved cultivars to Canadian growers, maintaining a sustainable industry thought to increase productivity and profitability," says project lead, David Wolyn at the University of Guelph.

Preliminary and multi-location trials have so far uncovered new experimental hybrids with improved traits and, based on one year of data, a growth chamber screen for spear purple spot has identified important parameters to achieve high correlations with levels of natural field infection. In addition, specific genes related to freezing tolerance have been identified and assigned to physiological pathways.

"We also found that planting density enhanced spear number and decreased diameter, while the opposite effects were observed with increased depth," says Wolyn. "The total yield was not affected by treatments due to compensation of spear number and diameter effects."

In the year ahead, researchers will continue their multi-year evaluation of experimental asparagus hybrids and continue to validate growth chamber spear purple spot screening protocols and the gene expression data for winter hardiness with a second year of data. The project will also continue to evaluate depth and density affects as plots mature over time and will map genes related to yield, quality, and disease resistance.

Activity 10 (Potato) – Development of Regional Management Strategies & Decision-Making Tools for the Control of Colorado Potato Beetle

The Colorado potato beetle is one of the main insect pests affecting potato production across Canada and is primarily managed through the use of insecticides. That being said, the beetle has an amazing adaptive ability to evolve resistance to insecticides, which has resulted in an ongoing battle for Canadian potato growers to fight. Researchers hope to better understand the variation in insecticide resistance across growing regions and give growers the tools they need to implement regional-specific management strategies.

"The move to neonicotinoid insecticides has provided really good control so far, but the beetle is able to respond to pretty much any insecticide thrown its way by evolving resistance through changes to their gene expression," says project lead and entomologist, Chandra Moffat, AAFC. "This presents a real challenge for growers across Canada."

The goal of the project is to develop a regional monitoring network, and researchers work closely with provincial partners and extension specialists (primarily potato grower associations) to identify growers that might have potential issues with insecticide resistance in the beetle and then collect beetle populations from those farms. The live beetles are sent to AAFC labs for a series of insecticide resistance tests, screening trials, and bio-assays; the results are then shared with grower partners.

The second part of the project is to develop a web-based and colour-coded online mapping tool that the research team is right now in the process of rolling out.

"Growers will be able to go take a look in their region and review our results over the last number of years to see how the beetles have responded to each insecticide class we've tested over time" says Moffatt. "This will allow them to consider rotating their chemistries, since one class of insecticide might not work as well as it used to."

Activity 11 (Potato) – Generate & Evaluate Integrated Pest Management Tools for Wireworm Control in Potatoes in Canada

There are currently more than 800 known species of wireworm (the larval stage of a group of beetles known as click beetles) globally and, since the soil-dwelling insects feed on the seeds, roots, and the lower stems of a wide variety of crops, including potatoes, they can be a significant problem for many growers across the country.

"If an infestation and damage is high for crops such as corn, growers may need to consider replanting their fields. And for root crops, if the damage is too extensive, they simply won't be able to harvest," says project lead, Christine Noronha, AAFC. "Nobody wants to buy potatoes with holes in them."

Wireworm has historically responded well to the use of older classes of insecticides, but, currently, there are fewer choices for insecticides on the market. And because of the wide variety of wireworm species present in Canada—and the insect's complex biology and lifecycle—pesticide screening can often prove difficult for growers to accomplish.

The AAFC has been tackling this problem since the late 1990s, and researchers have developed multiple new management strategies for growers. The efficacy of new chemistries has been evaluated, resulting in the registration of a new insecticide; pheromones for new species have been identified for use in monitoring populations and species; and the benefits of wireworm-suppressive crops such as buckwheat and brown mustard grown in a crop mix have been evaluated, along with surveying species across the Canada.

"Over the past decade we have increased our knowledge of the biology of the insects themselves," says Noronha. "Our studies have provided information on when the insects go down into the soil to overwinter and when they come back to the surface in the spring. This information helps growers monitor the population at the correct time and make better decisions when putting in a crop."

Looking ahead, the project will continue to develop, identify, and apply new click beetle and wireworm monitoring and management tools and will study click beetle expansion across Canadian potato-growing regions.

Activity 12 (Potato) – Common Scab: Increasing Profitability of Canadian Potato Producers by Controlling Common Scab

Common scab is difficult to control, partly because plant residues are enough to maintain the soil-borne bacterial populations that cause the disease, but also because there aren't any chemicals registered in Canada to specifically target the ailment. And while potato cultivars resistant to common scab currently exist, growers are often restricted in their choice of cultivars by their clients, by the market, or by their region's specific soil and environmental conditions.

Over the course of this project, researchers tested several methods to control common scab, including biopesticides, peroxide-based products, cropping systems (with crop rotation species with high biomass or biofumigation effect (Brassicas) and organic amendments (nurse crops, beef compost, and mustard meal). They were also able to isolate a large number of pathogenic *Streptomyces spp*. causing common scab from tubers of New Brunswick, Prince Edward Island, Quebec, and Manitoba and classify them into more than 20 genetically different groups using a molecular technique.

"Our study has shown there is a large variability in the genetic background of the pathogenic *Streptomyces* in Canada, which might explain, in part, why controlling common scab is so challenging," says project lead, Claudia Goyer, AAFC. "In the future, the new bioassays we developed will allow us to determine which species are present in soil and their abundance."

Several methods to control common scab were also tested, based on traditional knowledge that, in some instances, there was some success in controlling the disease. While most of these control methods did not significantly reduce common scab, the application of the herbicide 2,4-D Ester did result in significant reduction in the severity of common scab.

Going forward, the plan is to continue trials with different products and crop rotations through next summer, including trials with the 2,4-D Ester product to see if the results that were obtained in 2020 and 2021 are reproducible and to further optimize the time and rate of application.

Activity 13 (Potato) – Late blight: Tracking Pathogen Strains & Their Characteristics

Spreading quickly in fields, late blight is a potentially devastating disease of tomato and potato that infects leaves, stems, tomato fruit, and potato tubers. The objectives of the late blight program are two-fold, with the first objective having researchers collect specimens from across the country to track the different strains of the late blight causing pathogen, *Phytophthora infestans*, in any given year. The second objective is to then learn more about the particular characteristics of each strain.

"The late blight pathogen has various strains that each have unique characteristics that set them apart," says project lead, Rick Peters, AAFC. "We are trying to hone down which ones growers are facing in the different production areas across Canada, so we can get a better feel for how best to manage and control them."

One of the key findings of this research has indicated the make-up of the strains impacting Canada has shifted from US-8 to the aggressive US-23 strain.

"That's not to say we don't find some other strains sometimes, but, by and large, US-23 has become our most dominant here in Canada, and it's quite different from US-8," says Peters. "For one thing, it's really aggressive on tomatoes, much more so than the US-8 strain was."

Because of this, the consideration of tomatoes has become more important, even for potato growers, since pathogen spores are able to easily move from infected tomato plants and transplants used in home gardens over to commercial potato fields. This is very concerning for researchers and highlights the importance of their ongoing work in understanding the characteristics of US-23.

"Like the old adage states, 'You have to know your enemy to be able to fight them,'" says Peters. "The work we are doing on late blight is driving that information to growers, so they are able to combat the enemy in the most effective way possible."

Activity 14 (Potato) – Enhancement of Canadian Potato Industry Through Smart Agriculture

The objective of this project is to develop and evaluate smart or precision agriculture practices suitable for applications in several major potato production areas of Canada. The research included the delineation of management zones and variable rate application of fertilizer (nitrogen, phosphorus, and potassium) and plant density as compared to uniform rate application on the basis of tuber yield and quality, nutrient leaching, and economic benefits in the provinces of Quebec and Prince Edward Island.

"Our goal is to determine the best way to create management zones by applying specific inputs based on the needs of the potato," says project lead, Dr. Athyna Cambouris, AAFC. "By doing so, we aim to enhance precision agriculture for Canadian potato growers and help them increase profitability, decrease environmental risk, and improve overall crop productivity."

Through their work, the research team found benefits to variable rate applications of three main nutrients (nitrogen, phosphorus, and potassium), but it also found that results were site-specific and linked to soil properties, field topography, and past yield data.

"It will take some time for the potato sector to change the way it operates and develop management zones in the fields," says Cambouris. "But, little by little, growers are coming around. They pick one of their fields and want to know more about why one part is giving a lower yield than another, and our work will hopefully give them some of the answers."

Looking ahead, the project hopes to look outside of Quebec and Prince Edward Island and expand its field of research westward, increasing the number of provinces and participants within the study.

"The western part of Canada is becoming more significant as potato growers, but they also have different way of doing things from how we operate in the east," says Cambouris. "It will be a challenge, but we will continue to work at helping them increase the use of new technologies to better-control their specific variability."

Activity 15 (Potato) – Investigating the Occurrence & Distribution of Potato Tuber Necrosis-Inducing Viruses in Canada & Studies on Varietal Responses to the Viruses for Minimizing Economic Losses Caused by the Pathogens

Over the last two decades, North America's potato industry has experienced various levels of potato tuber necrotic disease caused by viruses, with the diseased tubers losing their market value and leading to significant economic losses for the potato industry. However, there is limited knowledge available about the potato varietal responses to these viruses and the occurrence of the viruses in Canada.

"Our goal is to improve our knowledge and understanding on these aspects and pave the foundations for developing management strategies to minimize losses caused by the most prominent virus(es) identified," says project lead, Xianzhou Nie, AAFC.

Researchers looked to generate knowledge about the occurrence of potato tuber necrosis-inducing viruses, including potato mop-top virus (PMTV), tobacco rattle virus, alfalfa mosaic virus (AMV), and the potato virus Y tuber necrotic strain within participating provinces in Canada. Researchers also aimed to learn more about the sensitivities of potato cultivars to tuber necrotic diseases caused by these viruses.

To date, project researchers have developed a reliable and efficient molecular methodology called high-resolution DNA melting assay to detect PMTV and its fungus-like vector, *Spongospora subterranea f. sp. Subterranean (Sss)*, directly from soil samples. Their work has been published in the pages of the prestigious scientific journal, *Plant Disease*.

"Using this method, we identified a field that is infested with PMTV and Sss for the field trial of potato varietal sensitivity to PMTV infection," says Nie. "We also demonstrated that the internal tuber necrosis caused by AMV is potato variety-dependent, rather than AMV stains, as previously thought."

Looking ahead, further research on various aspects, like the development of integrated management for PMTV, is anticipated, should it be funded.

Activity 16 (Potato) – Variety Evaluation

The goal of Agriculture & Agri-Food Canada's potato breeding program is to help develop new varieties to improve the sustainability of potato production by incorporating disease resistance and adaptation to climate change into the germplasm suitable for Canadian growers. To do this, AAFC makes crosses among the best available parents, and as their offspring advance through the program, they are evaluated, the best ones are kept, and the rest are gotten rid of.

Because factors like climate, soil types, and crop management regimes tend to differ across the country, projects like the National Potato Variety Trials (NPVT) have become extremely important to AAFC's objectives.

"The NPVT gives us the opportunity to see how the clones perform in each province, as they reach the fifth field generation," says project lead, Erica Fava. "We have re-examined all aspects of our program and are trying to make them more relevant, efficient, and meaningful. In doing so, we are ensuring the results we obtain from the quality lab in future should be more in line with the results the industry gets when they decide to trial a selection for themselves."

The AAFC uses genomics technology in new and exciting ways, and DNA markers for disease resistance are showing promise in screening breeding program material as early as in the second field generation. Genome-wide DNA marker data is also being combined with trait data to develop new breeding strategies for improved genetic gain within AAFC's breeding populations, and new experimental designs and data analysis techniques have been applied to breeding and NPVT trials to improve their ability to identify the best selections.

"We are examining the climate and irrigation data from the NPVT trial sites to find clones that may have drought tolerance—something that is becoming increasingly important with climate change," says Fava. "Each year, we expect to have more clones that are better adapted to diseases, pests, and climate pressures in the NPVT."

Activity 18 (Potato) – Canadian Potato Early Dying Network (CanPEDNet)

The Canadian Potato Early Dying Network (CanPEDNet) aims to help Canadian potato growers identify instances of *Verticillium* in their fields, predict potential yield losses, and provide tools to reduce the impact of PED and manage the disease.

While other potato diseases, like late blight, respond well to treatments such as fungicides sprayed onto potato foliage, PED is found in the soil and difficult to treat. The problem is compounded by microscopic parasitic worms (nematodes) living in the soil that also feed on the roots of the potato.

"This is the first time there's been a concerted, coordinated effort to examine the disease, identify the type of *Verticillium* present, and then determine how to control it," says project lead, Mario Tenuta at the University of Manitoba. "To this end, we have developed a molecular PCR test for detecting *Verticillium* DNA in the soil that can replace the manual, laborious, and very costly method traditionally done."

The work of the project has found that *V. dahliae* is, by far, the most dominant strain of *Verticillium* present across the country; not *V. albo-atrum*, as was thought previously. The PCR testing has also revealed that there are several species of nematodes present across the country, and the project is currently looking at how these different varieties interact with the dominant *Verticillium*. This important knowledge will allow researchers to focus their efforts on finding a more targeted control strategy for the disease.

"In New Brunswick, we have projects looking at fumigation, fungicides, and pesticides—and a mixture of those types of treatments. In Ontario, we're still in the early days with those trials, but I can say we're already finding there have definitely been some signs of improvement, in terms of reducing disease and proving yield," says Tenuta.

Canadian AgriScience Cluster for Horticulture 3

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Fruit & Vegetable Growers of Canada | Producteurs de fruits et légumes du Canada

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Canadian Agricultural Partnership | Partenariat canadien pour l'agriculture