2026 NORTHEAST POTATO TECHNOLOGY FORUM

March 24-25, 2026
Charlottetown, PE

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2026 NORTHEAST POTATO TECHNOLOGY FORUM

March 24-25, 2026 | Rodd Royalty Hotel, Charlottetown, PE

AGENDA

Tuesday, March 24th

12:00 Registration

1:15 Welcome and introductions

1:30 **Oral Presentations A:** Breeding & Genetics / Sustainability
Chair: Rodrigo dos Santos, PEI Department of Agriculture

1:30 Yefang Jiang, AAFC Charlottetown
The Contribution of Red Clover in Potato Rotations to Nitrate Loading

1:45 Judith Nyiraneza, AAFC Charlottetown
Integrating crop rotation strategies with optimized nitrogen fertilization lowers greenhouse gas emissions in potato systems without reducing yield

2:00 Qifan Yang, CFIA Charlottetown
Bacterial Ring Rot of Potato: Biology, Detection, and Management

2:15 Jiancheng Chuan, CFIA Charlottetown
From pathotype to genotype: a genome-wide framework for intraspecies classification of *Synchytrium endobioticum*

2:30 David De Koeyer, AAFC Fredericton
Digital image analysis for potato quality assessment

2:45 Bourlaye Fofana, AAFC Charlottetown
Unlocking the Potential of Diploid Potatoes for Commercial Production

3:00 Nutrition Break and Poster Session

3:30 **Oral Presentations B:** Digital Agriculture/Pest Management
Chair: Ryan Barrett, Prince Edward Island Potato Board

3:30 Seerangurayar Thirupathi, UPEI
Remote Monitoring and Efficient Aeration for Sustainable Potato Storage

3:45 BKR Kaushik Raja, UPEI
An Integrated Classical Vision and Deep Learning Approach for Severity-Based Defect Grading Across Potato Processing Stages

4:00 Kiana Kiani, UPEI
Modeling Greenhouse Gas Emissions Using the DNDC Model: Long-Term Adaptation and Mitigation Scenarios in Prince Edward Island

4:15 Avneet Kaur, UPEI
HYDRA-SE: A Stacked Ensemble Model for Soil-Based Potato Yield Prediction in Atlantic Canada

4:30 Masoud Karbasi, UPEI
Soil-Driven Potato Yield Forecasting in Maritime Canada: An Interpretable Hybrid Deep Learning Framework

4:45 Nicolle MacDonald, AAFC Charlottetown
Crushing it: Evaluation of the Potato Vine Crusher For Harvest Weed Seed Control In Potatoes

5:00 **Hospitality Suite**: sponsored by Syngenta Canada

Wednesday, March 25th

For those staying at the Rodd Royalty, breakfast is included in your stay in the hotel dining room. For other attendees, coffee/tea/continental breakfast items will be available in the meeting area (courtyard).

8:30 **Oral Presentations C**: Potato Agronomy
Chair: Judith Nyiraneza, AAFC Charlottetown

8:30 Sheng Li, AAFC Fredericton
Preliminary Results: Impacts of Fertigation on Potato Growth, Yield, and Quality

8:45 Newton Yorinori, Cavendish Farms
Impact of supplemental irrigation on yield and quality of processing potatoes in PEI

9:00 Monica Everett, McCain Foods
Will an Increase in Water Infiltration Increase Crop Value?

9:15 Kyle Yurkiw, Dalhousie Faculty of Agriculture
Cover crop termination methods for reduced tillage potatoes

9:30 Dengge Qin, Dalhousie Faculty of Agriculture
How Pea–Oilseed Brassica Intercrops Influence the Productivity of Subsequent Potato Crops

9:45 Grace Robertson, UPEI/AAFC
Evaluation of Phosphorous Acid as a Control Strategy for Potato Pink Rot

10:00 Nutrition Break and Poster Session

10:30 **Oral Presentations D**: Pest & Disease Management
Chair: Rick Peters, AAFC Charlottetown

10:30 Rodrigo dos Santos, PEI Department of Agriculture
Integrating Commercial Fields to Enhance Aphid Surveillance in PEI

10:45 Tyler MacKenzie, Agricultural Certification Services
Yield impacts of seed borne and primary infection with PVY: Implications for processing crops in Atlantic Canada

11:00 Dahu Chen, AAFC Fredericton
Pathogenicity to potato tubers of Fusarium species that caused pea root rot in Atlantic Canada

11:15 Claudia Goyer, AAFC Fredericton
Alteration of Potato Gene Expression by 2,4-D Leading to Control of Common Scab

11:30 Rory MacLellan, Cavendish Farms
Suppression of common scab on potatoes using chemical control under PEI field conditions

11:45 Ryan Barrett, Prince Edward Island Potato Board
Evaluation of Minuet® Biopesticide for Control of Common Scab in Processing Potato Varieties

12:00 Presentation of Graduate Student Awards

12:15 Buffet Lunch

The Contribution of Red Clover in Potato Rotations to Nitrate Loading

Yefang Jiang[1*], Mohammad Amir Azimi[2], Fan-rui Meng[2], and Kang Liang[3]

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[2]Faculty of Forestry and Environmental Management, University of New Brunswick, Fredericton, NB
[3]School of Natural Resource Sciences, North Dakota State University, USA

Excessive nitrogen (N) input into the environment is a major contributor to the global contamination of drinking water sources and the eutrophication of aquatic ecosystems. This study investigated the impact of land use on nitrate loading in the Dunk River Watershed in Prince Edward Island, Canada, using the Soil and Water Assessment Tool (SWAT), with a focus on the role of red clover in potato rotation systems. The model domain covered an area of 143 km^2. The SWAT model was developed using land use and weather records, and calibrated and validated using streamflow and water quality observations from 2011 to 2020. Nitrogen uptake and accumulation of the main crops were refined using local measurements. The SWAT model estimated an annual average nitrate loading of 316 Mg N (or 22 kg N/ha) in the watershed. Although the potato–cereal–red clover (PBC) rotation land accounted for 56% of the watershed, it contributed 90% of total nitrate loading, emphasizing the need to improve N-use efficiency. Annual nitrate loading varied with a coefficient of 24.8% but showed no significant long-term trend. Fluctuations were correlated with stream discharge and potato production area, as higher levels of both increased nitrate loading. Groundwater delivered approximately 98% of the total nitrate loading. Red clover was estimated to accumulate N comparable to the total N demand of processing potatoes in the region, contributing significant N to the crop rotation system. Substituting soybean for red clover in the PBC rotation resulted in a significant 16.7% reduction in nitrate loading. This reduction was driven by decreases in nitrate loading from potato (169.7 to 141.4 Mg N/yr), cereal (77.3 to 70.5 Mg N/yr), and red clover lands (36.8 to 0 Mg N/yr), despite an increase from soybean land (5.9 to 26.5 Mg N/yr). These findings highlight the importance of properly accounting for N credits from red clover or substituting it with a crop that recycles less N, such as soybean, to enhance the sustainability of potato production. These findings also underscore the importance of explicitly modeling leguminous forages in nitrate loading estimations.

Integrating crop rotation strategies with optimized nitrogen fertilization lowers greenhouse gas emissions in potato systems without reducing yield

Judith Nyiraneza[1*], Ikechukwu Agomoh[2], Tandra D. Fraser[1], Danielle Murnaghan[1], Jessica Matheson[1], Jennifer Klaus[1], Morteza Mesbah[1]

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This research examined how different crop rotation systems and nitrogen (N) fertilizer strategies influence potato (Solanum tuberosum L.) productivity and greenhouse gas (GHG; N_2O, CO_2, CH_4) emissions during the potato production phase. Three crop sequences were assessed: (i) barley (Hordeum vulgare L.) underseeded with a forage legume followed by a forage legume and potatoes (B–FL–P); (ii) corn (Zea mays L.) followed by sorghum sudangrass (Sorghum bicolor × S. bicolor var. Sudanense) and potatoes (C–SS–P); and (iii) soybean (Glycine max) followed by brown mustard (Brassica juncea L.) and potatoes (S–BM–P). The study was conducted using an experimental design established in 2015 at two neighboring field sites. During the 2024 potato phase, N management treatments were applied. At site A, urea applied at standard rate of 160 kg N ha-1 was compared with Super U applied at a reduced rate of 120 kg N ha-1. At site B, urea applied at a standard rate of 160 kg N ha-1 was compared with urea applied at a reduced rate of 120 kg N ha-1. Across both sites, a 25% reduction in N application did not significantly affect marketable potato yield. At site A, the B–FL–P rotation resulted in significantly greater N_2O emissions compared with the other rotations, whereas the reduced rate Super U treatment produced total N_2O emissions that were 5.7 times lower than those produced by the standard rate urea treatment. At site B, the S–BM–P rotation reduced cumulative N_2O emissions by 66% compared to the B–FL–P rotation and by 50% compared to the C–SS–P rotation. These findings indicate that current nitrogen fertilizer recommendations for potato can be lowered without yield penalties, and that Super U is more effective than conventional urea in reducing N_2O emissions. Relationships between GHG emissions, soil moisture, temperature, and mineral N availability will be discussed.

Bacterial Ring Rot of Potato: Biology, Detection, and Management

Qifan (Evelyn) Yang*[1], Stevan Springer[2], Xiang (Sean) Li[1]

[1]Canadian Food Inspection Agency, 1Charlottetown Laboratory, Prince Edward Island;
[2]Biology Department, University of Prince Edward Island, Charlottetown, Prince Edward Island

Bacterial ring rot, caused by *Clavibacter sepedonicus* (Cs), is one of the most economically significant and strictly regulated bacterial diseases, affecting potato (*Solanum tuberosum*) production worldwide. Despite its relatively narrow host range and strict regulatory control, outbreaks continue to occur. This is partly due to the pathogen's ability to establish latent infections, allowing infected seed lots to evade detection and sustain the disease cycle across multiple growing seasons. This presentation aims to provide an overview of the biology, detection, and management of Cs. The pathogen's systemically invasive nature is examined, including its entry through cut seed surfaces, colonization of the xylem, and the characteristic vascular discoloration and bacterial ooze that define the disease at the tuber level. Although hardly witnessed in field situation, the above-ground symptom expression including wilting, leaf rolling, and interveinal chlorosis is discussed alongside the epidemiological implications of the pathogen's prolonged survival on farm equipment and storage facilities. Current detection methodologies are reviewed and compared ranging from field based visual inspection and ELISA immunodiagnostics to highly sensitive PCR and real time qPCR assays that form the foundation of official certification protocols. The role of each method within national and international seed certification systems is also considered. Finally, it is crucial to consider current management strategies with an integrated approached. Since effective curative treatments are absent, preventive measures becomes crucial: the use of certified disease-free seed, rigorous equipment sanitation, whole-seed planting practices, and regulatory responses to confirmed outbreaks. The status of resistant variety development is considered. Overall, this presentation concluded that the effective control of bacterial ring rot relies on prevention, early detection, and strict regulatory enforcement.

From Pathotype to Genotype: A Genome-wide Framework for Intraspecies Classification of *Synchytrium endobioticum*

Jiacheng Chuan*, Desmond Hammill, Qifan Yang, Sean Li

Canadian Food Inspection Agency, Charlottetown Laboratory, PE

The unculturable obligate fungus *Synchytrium endobioticum* is the causal agent of potato wart disease, one of the most important quarantine pathogens capable of causing significant economic losses in potato. This soilborne chytrid produces durable resting spores that withstand harsh environmental conditions and remain viable in soil for decades, posing long-term risks to production areas. Currently, over 40 pathotypes have been described, primarily differentiated through bioassays evaluating virulence phenotypes on differential potato varieties. Among these, pathotypes 1(D1), 2(G1), 6(O1), 8(F1), and 18(T1) are particularly well-characterized. However, pathotype assignment depends entirely on time-consuming, resource-intensive bioassays, limiting scalability and rapid diagnostics. Moreover, some studies have reported apparent shifts in pathotype phenotypes across generations during potato wart incubation, potentially influenced by interactions with soil or host microbiomes, complicating reliable phenotype-based classification. To mitigate environmental confounding factors and establish a more stable classification, we developed a robust, genome-wide genotypic framework using high-resolution genomic data from diverse isolates representing key pathotypes. We compiled 187 high-throughput (meta-) genomic datasets of potato wart material from public NCBI repositories and private databases of the Canadian Food Inspection Agency and Agriculture and Agri-Food Canada. Raw reads underwent adapter and low-quality base trimming with the Atria Trimming Program. Clean reads were filtered against the host potato genome and mapped to the *S. endobioticum* reference genome; seven samples with <20% pathogen genome coverage were excluded. The remaining 180 samples were retained for genotyping, comprising 46 pathotype 1(D1), 34 pathotype 6(O1), 11 pathotype 8(F1), 23 pathotype 2(G1), 25 pathotype 18(T1), 22 pathotype 38(Nevşehir), and 19 others. Variants were called using the FASTQ processing pipeline in the Clasnip software. A supervised learning approach was then applied to cluster samples into novel genotypes. This analysis yielded four distinct groups, achieving 100% classification accuracy across 20 replicates of two-fold cross-validation in Clasnip. Groups were designated genotypes 1, 6, 18, and 38 based on the predominant pathotype within each. Only 57.4% of samples aligned with their original pathotype designations, highlighting divergence between phenotype- and genotype-based systems. Notably, the new genotype classification aligned more closely with the mitochondrial DNA haplogroup system previously proposed (van de Vossenberg et al., 2024). The framework incorporates approximately 21,000 variant sites genome-wide, with 75% enriched in around 2,000 genes. This genome-wide framework establishes a molecular foundation for *S. endobioticum* intraspecies classification, offering diagnostic potential for pathotype prediction directly from genomic sequences without bioassays. It facilitates improved quarantine monitoring, epidemiological tracking, and breeding for durable resistance by correlating genotypes with virulence profiles.

Furthermore, the approach supports future functional studies of effector-host interactions and evolutionary dynamics in this persistent pathogen. By bridging pathotype-to-genotype transitions, this work advances precise, rapid, and scalable management strategies against potato wart disease.

Digital Image Analysis for Potato Quality Assessment

David De Koeyer*, Denise Leblanc, Mohammad Islam and Muhammad Fatan Islam

Fredericton Research and Development Centre, Agriculture and Agri-Food Canada, Fredericton, NB

The quality of processed or cooked potatoes is controlled by genetic, environmental, and management factors. Tuber quality is one of the most important aspects of target breeding profiles for each market class. Agriculture and Agri-Food Canada's Potato Breeding Program uses a variety of direct and indirect measures of potato tuber quality. Assessment methods involve both objective colorimetric protocols using specialized tools and visual ratings by trained technical staff. As part of the modernization of the breeding program, standard digital photographs have been captured as part of potato tuber quality evaluation. Custom R scripts were written to quantitatively evaluate after-cooking darkening of steamed tuber samples, as well as colour of chip and fry samples. These analysis pipelines offer significant efficiencies compared to conventional approaches, and additionally allow measurement of colour at the individual tuber, chip, or fry level. Certain quality defects, like sugar-ends in French fries can be identified along with average colour. The presentation will focus on the application of the digital analysis tools for variety trials and genetic experiments. These tools will compliment standard evaluation methods and provide opportunities to improve assessment of quality traits within potato breeding programs.

Unlocking the Potential of Diploid Potatoes for Commercial Production

Bourlaye Fofana[1*], Vanessa Clemis[1], Benoit Bizimungu[2], Sherry Fillmore[3]

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Potato production has traditionally relied on tetraploid cultivars, but this assumption is now being reconsidered, renewing interest in diploid breeding. We evaluated an EMS-mutagenized diploid potato collection of 721 clones for tuber appearance and dormancy, and a subset of 54 clones for marketable yield across multi-year field trials. The collection showed wide phenotypic variation: 86% produced acceptable to excellent tubers, and 80% exhibited good to high dormancy. Market classes included 55% creamer, 41% table/chip, and 4% frying types. Among the 54 yield-tested clones, most creamer (74%) and table/chip (70%) types performed comparably to tetraploid checks, with 17% of creamer clones outperforming them. For Canada No. 1 yield, 20% of creamer and 29% of table/chip clones equaled or exceeded checks. Frying types yielded poorly. Specific gravity was similar across all clones and checks. Overall, these results show that diploid potatoes can match tetraploids in tuber quality, yield, processing traits, and storability in fresh market, supporting their value for breeding and industry use.

Remote Monitoring and Efficient Aeration for Sustainable Potato Storage

T. Seerangurayar* and T. Senthilkumar

Faculty of Sustainable Design Engineering, University of Prince Edward Island, PEI, Canada

Potato (*Solanum tuberosum* L.*)* is an important industrial crop in PEI and is typically stored for up to one year under controlled atmosphere conditions. During storage, potatoes continue to respire, generating heat and CO_2 which accumulate in the store and negatively affect tuber quality. Therefore, it is necessary to reduce respiration by maintaining low storage temperature and high humidity and effectively removing CO_2 through well-designed cooling and ventilation systems. Operating these systems without a complete understanding of storage temperature and humidity profiles can lead to excessive energy consumption and shrinkage/moisture loss. At the experimental site, the fans are controlled by a single temperature-sensor cable with five sensing elements spanning the full storage height, along with an additional five temperature sensors placed randomly. This configuration does not accurately represent the overall temperature distribution within the store and may result in unnecessary energy consumption. To address these limitations, this study aims to develop a multi-sensor remote monitoring system capable of measuring real-time temperature profiles within the potato pile and operating the ventilation system only when required. A custom designed nine flexible temperature sensor cables (17 ft in length), containing eight sensor elements spaced at 2 ft intervals were installed in the pilot site. The nine cables were deployed across three duct lines (three cables per duct line) and monitored continuously, providing a total of 72 sensing points (3 × 3 × 8). The sensor cables were connected directly to the OPI EPIQ remote monitoring system through interconnect wiring, enabling real-time transfer of temperature and humidity data to a cloud-based storage platform. The dashboard displays the collected sensor data and provides a user-friendly graphical interface for quick interpretation. The initial potato temperature was 15.4 ºC and it was gradually reduced to 7.2 ºC. The target temperature is maintained throughout the entire storage period. Continuous monitoring allows for the early detection of hot spots, helping to prevent spoilage. Additionally, monitoring temperature and moisture content at multiple points throughout the storage system assists in managing shrinkage and reducing moisture loss. The second objective of this study is optimizing appropriate airflow rate, duct layout and predicting shrinkage loss through CFD simulation to develop efficient aeration system for sustainable storage. At the end this study, remote monitoring system and robust CFD workflows for potato storage will be developed along with recommendations for the most effective duct configuration and optimal airflow rate to minimize energy consumption and shrinkage losses.

An Integrated Classical Vision and Deep Learning Approach for Severity-Based Defect Grading Across Potato Processing Stages

B.K.R. Kaushik Raja[1*], L.G. Divyanth [b], T. Senthilkumar [2*]

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Industrial potato supply chains require rapid, consistent, and auditable grading of defect presence and severity across multiple processing stages, from incoming whole tubers (bruising, greening, sprouting, and mechanical damage) to intermediate and finished products such as French fries, where surface blemishes and color non-uniformity are largely established during blanching and par-frying. Yet, inspection is often batch-based and visually scored, limiting item-level traceability and process feedback. We present an integrated classical computer vision (CV) and deep learning framework that treats defect grading as a measurement problem: (i) region-of-interest isolation, (ii) defect segmentation within the ROI, and (iii) severity assignment using physically interpretable metrics. As a transparent baseline, the classical CV pipeline uses Lab/ΔE and intensity cues with geometric priors to segment the product ROI, then performs inside-ROI anomaly segmentation to extract defect blobs. From the resulting masks, severity descriptors (e.g., defect count, total defect area, maximum defect diameter, and color deviation statistics) are computed per item and mapped to grades using supervised learning. The framework is demonstrated on a controlled RGB imaging dataset of frozen French fries labeled into five categories (minor light, minor dark, major light, major dark, and critical). Using the severity descriptors, a Random Forest baseline achieved approximately 0.85 accuracy, 0.86 F1-score, and 0.80 Cohen's kappa on a held-out validation split, with failure modes observed for coated and skin-on fries due to appearance overlapping with dark defects. To improve robustness under appearance variability and to support transfer across product forms and stages, a two-stage deep segmentation architecture is being developed: U-Net for ROI segmentation followed by DeepLabv3+ for multi-class defect masks aligned to severity labels. Pixel-accurate polygon annotations are being generated to preserve defect geometry required for severity measurement. The expected outcome is a conveyor-compatible, item-level grading pipeline that outputs both defect masks and auditable severity metrics, enabling consistent quality decisions across potato processing stages.

Modeling Greenhouse Gas Emissions Using the DNDC: Long-Term Adaptation and Mitigation Scenarios in Prince Edward Island

Kiana Kiani [1*], Raheleh Malekian [2], Aitazaz A. Farooque [1,2], Xander Wang [2,3], Kuljeet Grewal [1], Ryan Barrett [4]

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[4] Prince Edward Island Potato Board, Charlottetown, PE

In this study, a calibrated DNDC model was used for a long-term (1980-2024) analysis in Prince Edward Island (PEI), Canada, to assess the impact of management scenarios on potato yield and greenhouse gas (GHG) emissions. The analysis examined irrigation as an adaptation strategy and nitrogen fertilizer management as a mitigation strategy within a legume-based potato rotation. A non-legume rotation and varied fertilizer levels were additionally assessed to compare rotational benefits. Irrigation scenarios consisted of full irrigation (IR100), deficit irrigation at 75% (IR75) and 50% (IR50), and no irrigation (IR0). Nitrogen treatments included the conventional rate (150 kg N ha^{-1}; N100) and reduced applications of 90%, 85%, and 80% (N90, N85, N80, respectively). The results support that legume-based rotation enhances soil nitrogen and reduces fertilizer requirements without increasing global warming potential. Results demonstrated that irrigation increased potato yields relative to rainfed conditions, with IR100 raising yields by 12% over 44 years, IR75 achieving nearly the same improvement, and IR50 maintaining 5% gains. However, all irrigation levels increased N_2O and CO_2 emissions, even at IR50, illustrating a trade-off between productivity and emissions. Reducing N fertilizer rates (N90–N80) decreased yields significantly while lowering N_2O emissions; CO_2 emissions showed minimal response. TOPSIS and trustworthiness metrics identified IR50N90, IR50N100, and IR75N90 as management scenarios with relatively balanced performance between yield and emissions. These findings suggest that combining deficit irrigation with standard nitrogen fertilization can support long-term productivity while moderating GHG emissions. Also, compared to non-legume rotations, legume rotations increased potato yield from 34.5 t ha^{-1} to 38.7 t ha^{-1} at the same N rate, implying an N credit of 30 kg N ha^{-1}. Overall, the scenario analysis provides decision-relevant insights for developing sustainable adaptation and mitigation strategies for potato production in PEI under changing environmental conditions.

HYDRA-SE: A Stacked Ensemble Model for Soil-Based Potato Yield Prediction in Atlantic Canada

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[4] School of Computer Science, University of Guelph, Guelph, ON

Accurate crop yield prediction is critical for improving agricultural productivity and supporting sustainable farming systems. In Atlantic Canada, potato production is strongly influenced by spatial variability in soil properties, making yield forecasting challenging. This study presents a machine learning based framework for predicting potato yield using soil analytical, geospatial, and crop productivity data collected from potato fields across Prince Edward Island and New Brunswick during the 2017–2018 growing seasons. A comprehensive dataset containing multiple soil physicochemical parameters was analyzed, and stepwise regression was applied to identify the most influential predictors of yield. Eight key soil features, including moisture content, organic matter, horizontal conduction parameter, iron, phosphate, %Phosphorus/Aluminum ratio, manganese, and copper, were selected from an initial set of 34 variables. Sixteen machine learning algorithms were evaluated, and the top-performing models, CatBoost, LightGBM, Random Forest, Bagged Trees, and XGBoost, were integrated using ensemble and stacked ensemble learning strategies. To further enhance predictive capability, a hybrid stacked ensemble framework called HYDRA-SE was developed to combine the strengths of individual models through a meta-learning approach. The proposed model achieved the highest prediction accuracy (R^2 = 0.88, RMSE = 3.75 t/ha), outperforming individual machine learning models and conventional ensemble methods. The findings highlight the potential of soil-driven machine learning frameworks for reliable field-scale yield prediction. The proposed HYDRA-SE model provides a practical decision-support tool for precision agriculture, enabling data-driven management and improved resource optimization for sustainable potato production in Atlantic Canada.

Soil-Driven Potato Yield Forecasting in Maritime Canada: An Interpretable Hybrid Deep Learning Framework

Masoud Karbasi[1*], Aitazaz A. Farooque[1,2], Raheleh Malekian[1], Fatima Imtiaz[1]

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[2] Faculty of Sustainable Design Engineering, University of Prince Edward Island, Charlottetown, PE

Agricultural planning and food security rely heavily on accurate yield forecasting, particularly in the Maritime provinces of Canada, where significant soil heterogeneity impacts crop productivity. This study introduces a novel, interpretable hybrid machine learning framework for predicting potato tuber yield based solely on physicochemical soil properties, addressing the limitations of traditional linear regression models in capturing complex agricultural variables. Data were collected from eight experimental sites across Prince Edward Island and New Brunswick during the 2017 and 2018 growing seasons, capturing 18 distinct soil characteristics. To optimize model performance, the research employs a rigorous two-stage feature selection architecture. First, the Boruta algorithm filtered relevant predictors, followed by Best Subset Regression (BSR) combined with the Weighted Aggregated Sum Product Assessment (WASPAS) framework to identify the optimal input variables. The core predictive model integrates a Deep Neural Network (DNN) with the Satin Bowerbird Optimization (SBO) algorithm, a bio-inspired metaheuristic that fine-tunes hyperparameters such as learning rate and batch size to achieve superior accuracy and stability. The performance of the proposed DNN-SBO model was evaluated against Kernel Ridge Regression (KRR), Elastic Net, K-Nearest Neighbors (KNN), and Support Vector Regression (SVR) using metrics including Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), and the Correlation Coefficient (R). The results identified a specific input scenario ("Comb2")—comprising Total Base Saturation, Sulfur, Magnesium, Potash, Aluminum, Zinc, Phosphate, Manganese, Organic Matter, Iron, and Copper—as the most effective feature set. Using this combination, the DNN-SBO model demonstrated superior predictive power, with a test correlation coefficient (R) of 0.853, an RMSE of 5.522 t/ha, and a MAPE of 9.707%, outperforming all comparative classical machine learning models. To address the interpretability challenges often associated with deep learning, Shapley Additive exPlanation (SHAP) analysis was applied to quantify the contribution of individual soil features. The analysis revealed that Iron was the most significant predictor of yield (mean SHAP = +5.49), followed by Copper, Zinc, Phosphorus, and Organic Matter, aligning with established agronomic principles regarding micronutrient influence on plant metabolism. This study highlights the efficacy of integrating bio-inspired optimization with deep learning to develop robust, data-driven decision-support tools for precision agriculture and sustainable farming under variable soil conditions.

Crushing it: Evaluation of the Potato Vine Crusher for Harvest Weed Seed Control in Potatoes

Nicolle MacDonald*[1] and Andrew Mckenzie-Gopsill[2]

Agriculture and Agri-food Canada ([1] Pest Management Centre,[2] Charlottetown Research and Development Centre)

Harvest weed seed control (HWSC) is a suite of tools and tactics that have been shown to be effective at reducing weed seedbank inputs by destroying or removing weed seeds at harvest. However, few studies have explored their use in non-cereal crops. Recently, researchers demonstrated that the Potato Vine Crusher (PVC) - originally designed to crush European corn borer larvae within potato vines - could also devitalize weed seeds at harvest under controlled conditions. However, it is not known how the PVC will function under field conditions or how processing affects seed viability over-winter. Field trials were conducted in Harrington, PE from 2023 to 2025 to determine the PVC's efficacy in reducing weed seed viability and if seeding a cover crop post-potato harvest may influence weed development. Seeds of five weed species were enclosed in fine mesh bags, processed with the PVC during harvest, and retrieved both post-harvest and the following spring for viability testing. Processing with the PVC reduced seed viability of all species, with decreases of 9-32% after harvest and up to 17% in the spring, depending on the species. Despite harvesting with the PVC having no impact on weed biomass, these results demonstrate its potential to destroy weed seeds during potato harvest and contribute to sustainable potato production.

Preliminary Results: Impacts of Fertigation on Potato Growth, Yield, and Quality

Sheng Li[1,], Yulia Kupriyanovich[1], Claudia Goyer[1], Dahu Chen[1], Sheldon Hann[1], Yefang Jiang[1], Michelle D'Souza[3], Leigh Hunter[3], Yves Leclerc[3]*

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Precipitation in the Atlantic Northeast (ANE) has historically been sufficient to support rain-fed potato production. However, with climate change, extreme weather events—including prolonged droughts—have occurred more frequently in recent years. Introducing irrigation to supplement rainfall may therefore be a viable strategy to mitigate drought stress. In commercial potato production, fertilizer is typically applied only once at planting, which can lead to substantial nutrient losses through leaching and greenhouse gas (GHG) emissions. Supplemental irrigation also enables fertilizer to be applied through irrigation (i.e., fertigation), potentially reducing the total fertilization rate while improving nitrogen (N) use efficiency and reducing N losses.

To test these hypothesized benefits of fertigation, a field study was conducted at the McCain Foods Farm of the Future in Florenceville, New Brunswick. Potatoes were grown in a three-year rotation across three fields, with only one field planted with potato each year. Experiments were conducted on the potato field using three treatments: (1) full fertigation (FF), in which fertigation was applied throughout the growing season; (2) critical period fertigation (CPF), in which fertigation was applied only during the vegetative growth and tuber bulking stages; and (3) no irrigation (NI), which served as the control. For the FF and CPF treatments, approximately 70% of the standard N fertilizer rate was applied at planting, with less than 30% supplied through irrigation water, resulting in a reduced total N application rate. Irrigation was applied only when soil moisture fell below 70% of available water capacity.

Results showed that irrigation successfully maintained soil moisture within a desirable range. The NI treatment exhibited higher emergence rates, longer flowering periods, and greener leaves during early growth stages, likely due to the higher initial N application rate. No significant treatment effects were observed for stem density, plant height, or leaf stomatal conductance. Both fertigation treatments produced significantly higher total tuber yields than the control, and a similar trend was observed for marketable yield, although the latter was not statistically significant. In addition, the fertigation treatments reduced the incidence of diseases such as potato early dying and black dot; however, the CPF treatment appeared to increase the risk of hollow heart. Overall, these results suggest that supplemental fertigation can enhance potato productivity in the ANE. Ongoing field experiments are evaluating the effects of these treatments on N leaching and GHG emissions.

Impact of Supplemental Irrigation on Yield and Quality of Processing Potatoes in Prince Edward Island

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Historically, only a small portion of processing potato acreage in Prince Edward Island (PEI) has been grown under irrigation. However, rainfall during the growing season has become increasingly variable, and several recent dry years, including severe drought in 2025 that led to yield losses of up to 30% in some fields, have renewed grower interest in supplemental irrigation. This shift has been reflected in a sharp increase in irrigation-related well applications submitted to the PEI Department of Environment, Energy and Climate Action in the fall of 2025. As irrigated acreage expands, understanding how supplemental irrigation influences yield and quality across common processing varieties is increasingly important for producers.

Since 2020, research at the Cavendish Farms Research Farm has compared dryland and irrigated production systems across major processing varieties to examine irrigation timing relative to potato growth stages and to quantify varietal responsiveness. Six years of field data indicate that the yield benefit of supplemental irrigation is inversely related to total seasonal rainfall. In the driest year (2025), irrigation produced an average yield increase of 140 cwt/ac relative to non-irrigated plots, whereas in the wettest year the irrigated treatment (2021) produced a slight reduction in yield (−2 cwt/ac). Extended dry periods during tuber initiation and bulking were especially impactful on final yields, highlighting the importance of irrigation timing during these stages. Seasonal moisture conditions also influenced tuber quality as well. In 2025, irrigated plots produced a lower specific gravity (1.095) than dryland plots (1.102), while in the wetter 2021 season specific gravity remained nearly identical (1.083 versus 1.082). Together, these results show that both yield and specific gravity responses to irrigation depend strongly on seasonal conditions.

Varietal differences in responsiveness to irrigation were substantial. In very dry years such as 2020, highly responsive varieties like Russet Burbank and Prospect increased yields by 67% and 91%, respectively, under irrigation. Less responsive varieties such as Althea and Dakota Russet increased yields by 37% and 26%. Similar patterns were observed in 2025, where Russet Burbank and Prospect again showed some of the largest yield increases (104% and 61%, respectively), confirming that irrigation efficiency in PEI is strongly variety-specific. These results underscore the importance of matching irrigation investment and scheduling timing to variety and seasonal moisture conditions to maximize water-use efficiency and processing yield potential.

Will an Increase in Water Infiltration Increase Crop Value?

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Why is water infiltration important? If we improve water infiltration, we will have less runoff and soil erosion. Cover crops can store more water and offer greater yield potential and quality (especially in drought years). Vertical tillage helps reduce erosion by leaving more residue on the surface and potentially improving water infiltration. Good water infiltration is an indicator of healthy soil. McCain has completed three years of trials on fifteen commercial potato farms. The presentation will highlight the unpredictable nature of tracking water and how multiple fields help to clarify the impact of water infiltration on marketable yield. The two treatments compared the McCain multimix to grower stand practice of grain underseeded to clover or alfalfa, and a second treatment of vertical tillage using Lemken Karat/Horsch plow/ Rubin Disc compared to the grower standard practice using moldboard plow. Water sensors showed that the moldboard plow had more moisture at 6 inches, but it dried out more quickly during drought conditions than vertical tillage. The multimix species had more moisture at 6 inches compared to oats/underseed and dried at a similar rate as oats. The short answer is yes, water infiltration does increase crop value. Although statistically, there were small differences between treatments, general trends could be found. For the multimix fields, 5/7 fields had an increase in infiltration and a decrease in runoff. Vertical tillage had 5/10 fields with an increase in infiltration and a decrease in runoff. For these fields, 9/15 had a positive increase in marketable yield, with 10/15 having an increase in crop value. On average, there was a net positive of 6.7 cwt/ac with $76.6 increase in marketable yield per farm.

Cover Crop Termination Methods for Reduced Tillage Potatoes

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Potato (*Solanum tuberosum* L.) production in Atlantic Canada is highly vulnerable to weed interference, soil erosion, and constraints on herbicide use. Increasing herbicide-resistant weed populations and public health concerns have raised significant issues regarding the continued reliance on glyphosate. This underscore the need to investigate methods of reducing glyphosate use in production systems. Cover crops offer a promising strategy to enhance weed suppression, soil protection, and moisture regulation in reduced-tillage potato systems; however, their successful integration depends heavily on termination method which has historically relied on glyphosate. Chemical, mechanical and integrated cover crop termination strategies were evaluated for reduced tillage potato production, with emphasis on weed suppression, soil microclimate, and crop yield stability in field experiments at the Harrington Experimental Farm (PE). Fall-seeded cover crops, fall rye (*Secale cereale* L.) and winter barley (*Hordeum vulgare* L., were terminated with either glyphosate, glufosinate, roller-crimping, mowing, undercutting, or the combination of roller-crimping with either glyphosate, glufosinate, or saflufenacil. Prior to termination, mean cover crop biomass production was 670.8 g m^{-2} in fall rye and 524.2 g m^{-2} in winter barley. Termination of cover crops using roller-crimping combined with an herbicide, or by undercutting, were as effective as the use of glyphosate alone. Following termination, fall rye and winter barley effectively suppressed weeds in potato with weed biomass ranging from 8.5 to 11.4 g m^{-2}. Marketable potato yields following rye termination were 49.3% higher than those following winter barley but did not differ by termination method. These results show that there are viable alternatives to glyphosate for fall cover crop termination that fit within a horticulture production system. This research will support more resilient potato production under increasing herbicide-resistance, environmental, and regulatory pressures.

How Pea–Oilseed Brassica Intercrops Influence the Productivity of Subsequent Potato Crops

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Sustaining potato productivity in Atlantic Canada requires diversified rotations that enhance soil health, nutrient cycling, and weed management. Legume–oilseed brassica intercrops have demonstrated agronomic and ecological benefits; however, their carryover effects on subsequent potato crops remain poorly quantified under regional conditions. This study integrates on-farm trials in Prince Edward Island and small-plot research in Nova Scotia to evaluate how pea–brassica intercrops influence subsequent potato yield. On-farm trials conducted in 2024 compared pea, mustard, camelina, and pea–oilseed intercrops prior to a 2025 processing potato crop. Intercrops generally reduced mid-season weed pressure relative to oilseed monocultures and produced competitive combined biomass and grain yields; however, potato yields in 2025 did not differ significantly among treatments. In complementary small-plot rotation trials, pea–camelina and pea–brown mustard treatments in 2024 marginally increased potato yield in 2025 compared with monocultures ($P = 0.08$), indicating a positive but moderate legacy effect consistent with potential residue interactions. Collectively, these findings suggest that pea–oilseed brassica intercrops can contribute to improved rotational performance of potatoes, with benefits likely mediated through residue quality interactions and weed suppression. Ongoing analyses will further elucidate the mechanisms underpinning these yield responses and refine recommendations for potato-based rotations in the Northeast.

Evaluation of Phosphorous Acid as a Control Strategy for Potato Pink Rot (*Phytophthora erythroseptica*).

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Potato pink rot, caused by the fungus-like oomycete, *Phytophthora erythroseptica*, is a significant soilborne disease that leads to substantial losses in both field and storage environments. Non-chemical management practices are useful in reducing the incidence of pink rot, but are most commonly supplemented with chemical treatments for effective disease suppression. The phenylamide fungicide Metalaxyl-m (Ridomil Gold ®), has historically been used for pink rot control, but due to the emergence of resistant strains of *P. erythroseptica*, alternative methods of chemical control need to be evaluated. This study assessed the efficacy of the phosphorous acid fungicide Confine® Extra, as a component of a control strategy for potato pink rot. A field trial (cv. Red Norland) was established at the Harrington Research Farm according to a randomized complete block design with four replications per treatment. Nine treatments were evaluated, including one to six foliar applications of Confine® Extra at 250 L ha^{-1},and three- and five-applications delivered at 60 L ha^{-1} to simulate concentrations that would occur during aerial application. Inoculated and non-inoculated controls were also included in the trial. Plots were inoculated in-furrow at planting (except for non-inoculated controls) with a mycelium/oospore slurry of a local isolate of *P. erythroseptica* growing on V8 agar medium and blended prior to inoculation. The proportion of infected tubers following harvest was used to assess field-level disease incidence. Additionally, post-harvest wound and zoospore inoculations were conducted to further evaluate the pink rot susceptibility of treated tubers. Incidence of pink rot infection was recorded, and disease severity was quantified as percent surface infection and internal depth of rot development. Data from these assessments will be analyzed to determine the influence of application timing, frequency, and spray volume on pink rot incidence and severity. Results from this study will provide direction for incorporating phosphorous acid into pink rot management strategies.

Integrating Commercial Fields to Enhance Aphid Surveillance in PEI

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Effective monitoring of aphid vectors is essential for maintaining the high phytosanitary standards required in seed potato production. Prince Edward Island's Aphid Alert Program has been in operation for over 30 years, serving as a strategic tool to safeguard seed potato quality by enabling early detection of virus-vectoring aphid species and supporting timely, informed management decisions. In recent years, the program has renewed its focus on identifying the five aphid species most critical to potato virus transmission—Green Peach Aphid, Potato Aphid, Buckthorn Aphid, Bird-Cherry Oat Aphid, and Foxglove Aphid—while grouping non-vector species under the category "Other Aphids". Until 2024, monitoring was limited to seed potato fields. To improve early detection of virus-vectoring species and evaluate potential benefits of broader landscape surveillance, six commercial potato fields were added to the program in 2025, each paired with a corresponding seed field from the same grower (with one exception). One commercial field with insufficient sampling—and its associated seed field—was excluded from analysis. Across the remaining five field pairs, commercial fields exhibited consistently higher total aphid counts compared to seed fields. Mean total aphids per sample were 5.63 in commercial fields versus 3.81 in seed fields, a statistically significant difference ($p = 0.00043$). "Other Aphids" were also significantly more abundant in commercial fields, averaging 4.88 per sample compared to 2.76 in seed fields ($p = 0.00025$). These findings indicate that commercial fields may serve as earlier or more abundant reservoirs of non-priority aphid species. In contrast, none of the five priority aphid species showed statistically significant differences between commercial and seed fields. For example, Green Peach Aphid counts averaged 0.01 in commercial fields and 0.06 in seed fields ($p = 0.27$), while Buckthorn Aphid averaged 0.20 and 0.52, respectively ($p = 0.94$). Median values for all five species were zero in both field types, reflecting very low populations overall during the 2025 season. Low population pressure may have limited the ability to detect meaningful differences between field types this year. Analysis at the individual grower level revealed significant differences for only two of the five participating growers, both showing higher total aphids and "Other Aphids" in commercial fields ($p \leq 0.00025$ for Client 2; ≤ 0.038 for Client 3). This suggests that field-level management differences, localized aphid pressure, or landscape characteristics may influence aphid dynamics more strongly than field designation alone. The addition of commercial fields has demonstrated promise for improving the sensitivity and breadth of aphid surveillance in PEI. Continued monitoring during future seasons—with potentially higher aphid pressure—will help clarify whether commercial fields can serve as effective early-warning sites for vector species of concern, supporting more proactive virus-management strategies for the PEI seed potato industry.

Yield Impacts of Seed-Borne and Primary Infection with PVY: Implications for Processing Crops in Atlantic Canada

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Potato virus Y (PVY) remains a persistent challenge in Atlantic Canadian potato production. While research attention has traditionally focused on PVY management in seed crops, the economic impact of PVY on processing yield and tuber size distribution is less well quantified. A replicated field trial in cv. Russet Burbank was conducted under industry-standard processing-crop management to quantify yield losses associated with varying levels of seed-borne PVY (0% to 20%) and to examine in-season PVY spread and quantify the relative contribution of infections acquired at different times. In 2025, marketable yield declined by 1.66 cwt/acre for each 1% increase in PVY, corresponding to 6.5–17% marketable yield reductions across treatment levels. Total yield declined only modestly (~7%), while total tuber number increased (+20%), indicating that PVY primarily altered tuber size fractioning rather than reducing tuber initiation. Specifically, higher PVY was associated with a ~60% reduction in large tuber yield but a ~40% increase in small tuber yield, demonstrating substantial size reallocation that directly impacts processing value. These values are similar, though more pronounced, than those observed in the 2024 replicate trial, likely reflecting additive drought stress in 2025 and lower aphid-mediated PVY spread between treatments. In 2024, extreme aphid pressure resulted in near-saturation of PVY across plots, reducing separation among treatments and flattening the incremental yield response to PVY. At typical processing contract volumes, even moderate PVY levels translated into economically meaningful losses, though management responses to these impacts will depend on individual farmer's risk tolerance and cost structure.

Mid-season leaf testing allowed individual plants to be classified by infection timing, enabling analysis of yield reduction as a function of when infection occurred. Yield losses were strongly timing-dependent, with 61% marketable yield reduction in plants with seed-borne infection, 43% reduction from early (July) primary infection, and 25% reduction from late (August) primary infection relative to healthy plants. These data confirm that early infection disproportionately drives economic loss. Daughter-tuber testing from these individually tracked plants to assess vertical (generational) transmission as a function of infection timing and tuber size will also be discussed. PVY spread was also quantified from treatment plots into initially PVY-free neighbouring plots separated from the main trial. This spread increased through the season and was markedly greater (7-fold) to downwind rather than upwind plots, demonstrating strongly directional transmission risk from processing fields to adjacent sensitive crops. This provides a clear and actionable basis for strategic field orientation and planning for growers to reduce PVY transmission risk.

Pathogenicity to Potato Tubers of *Fusarium* Species That Caused Pea Root Rot in Atlantic Canada

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Over ten Fusarium species are known to cause potato tuber dry rot worldwide. Field peas were recently grown as rotation and fall cover crops in Atlantic Canada and pea root rots were observed in some pea fields. In a field survey of field pea root rot in New Brunswick and Prince Edward Island in 2018, seven Fusarium species were identified from the pea root rot samples, which accounted for 85.7% of the total isolates. *F. vanettenii* (formerly *F. solani f. sp. pisi*) and *F. oxysporum* were dominated in majority of the fields, accounting for 37.6% and 33.9% of isolates, respectively, followed by *F. avenaceum* 7.4%, *F. solani* 3.7%, *F. commune* 1.6%, *F. equiseti* 0.8% and *F. flagelliforme* 0.4%. The objective of this study was to determine if Fusarium species isolated from field peas could cause potato tuber dry rot in storage. Storage trials were conducted from 2019 to 2025. Tubers of the cultivars 'Shepody', 'Yukon Gold', 'Chieftain', 'Atlantic' and 'Russet Burbank' were inoculated by inserting a plastic screw with active mycelia and spores of the tested isolates into tubers, with F. sambucinum used as a positive control and plastic screw without culture used as negative control. Inoculated tubers were then incubated in a room at 13°C with 70-80% relative humidity. After 3 weeks of incubation tubers were cut at the point of inoculation and the disease severity was scored following a 1-9 scale. Among the five Fusarium species tested including *F. vanettenii, F. oxysporum, F. avenaceum, F. commune*, and *F. equiseti*, only *F. avenaceum* was moderately to highly pathogenic to potatoes, causing dry rot, while the rest four species were either non-pathogenic or weakly pathogenic to potato tubers. Results showed that growing field peas as rotation or fall cover crops would not significantly increase Fusarium dry rot pressure in Atlantic Canada.

Alteration of Potato Gene Expression by 2,4-D Leading to Control of Common Scab

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Common scab causes significant economic losses in potato production across Canada, particularly in the rain-fed systems of Eastern Canada. Although 2,4-D is widely known as a synthetic auxin herbicide at high application rates, at low rates it functions as a plant hormone. Previous field studies in Manitoba and New Brunswick have shown that low-dose 2,4-D applications can effectively reduce common scab severity. While the early gene expression responses to 2,4-D have been characterized in several plant species, the longer-term transcriptional changes to low 2,4-D doses and the mechanisms underlying disease suppression remain poorly understood. The objective of this study was to elucidate the mode of action of 2,4-D by identifying the cascade of genes regulated in the foliage, roots, and tubers of *Solanum tuberosum* cv. Yukon Gold under controlled conditions. Plants were grown in soil naturally infested with common scab. After four weeks in the greenhouse, plants were sprayed with either water (control) or 2,4-D (equivalent of 79 g of active ingredient ha^{-1}). Each treatment consisted of four replicates, with two plants per replicate. Leaves and roots were sampled at 1 day and 5 weeks after treatment, while tubers were collected at 5 and 8 weeks. Common scab severity was assessed, and RNA was extracted and sent to Genome Québec for cDNA synthesis, library preparation, and sequencing. Tuber common scab severity was significantly lower in 2,4-D–treated plants compared with untreated controls. Transcriptomic analyses revealed that 2,4-D substantially altered potato gene expression, acting as a natural auxin mimic, inducing auxin-responsive pathways and affecting synergistic and antagonistic interactions with other phytohormones, including those involved in defence responses.

Suppression of Common Scab on Potatoes Using Chemical Control under PEI Field Conditions

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Common scab (*Streptomyces scabiei*) is a highly prevalent disease in Prince Edward Island (PEI) potatoes. Lesions caused by the disease can reduce the quality and marketability of tubers, resulting in economic losses for growers. Although some reports have indicated reductions in scab severity are possible using chemical controls, PEI-specific research is required to evaluate their effectiveness under local field conditions.

To address this need, a two-year study (2024–2025) was conducted at the Cavendish Farms Research Farm to assess the efficacy of potential commercial products for suppressing common scab in two processing potato varieties with scab susceptibility, (Alverstone Russet and Prospect). The products included the biological fungicide Minuet, previously reported to reduce scab symptoms, and the plant growth regulator **daminozide**, which showed some suppression of scab in earlier trials at the Cavendish Farms Research Farm.

Four treatments were evaluated

1. untreated control
2. pre-emergence drench of Minuet (379 mL/ac)
3. foliar application of **daminozide** (0.25%) thirty days after emergence
4. split foliar application of **daminozide** (0.125%) at thirty and forty-five days after emergence

In 2024, all Minuet and **daminozide** treatments produced a reduction in pitted scab and total scab incidence compared with the control in both varieties. However, in 2025, no treatments differed from the control in Alverstone Russet, and in Prospect, both Minuet and the split **daminozide** application resulted in increased pitted scab incidence.

These findings suggest that, under PEI conditions, the evaluated commercial products may not consistently suppress common scab and may, in some cases, exacerbate disease symptoms. Additional research is needed to identify more reliable control strategies for growers.

Evaluation of Minuet® Biopesticide for Control of Common Scab in Processing Potato Varieties

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Common scab, caused primarily by *Streptomyces spp.* bacteria, continues to be a significant source of loss in marketable yield for Prince Edward Island potato producers. Recent research indicates that the use of the in-furrow biopesticide Minuet® may help suppress common scab symptoms. Minuet® is a biological fungicide labelled in Canada for suppression of Rhizoctonia root rot, black scurf and other tuber skin quality diseases. Positive results in field trials on PEI in 2023 and 2024 led to four additional trial fields being added in 2024 to further investigate the potential for Minuet® to suppress common scab symptoms under commercial conditions. At planting, approximately 10 acres (4 ha) of potatoes were planted per field with Minuet® applied in-furrow at the label rate, with the rest of the field planted without Minuet® (grower standard practice). At harvest, ten-foot yield samples were collected in both treatment and control sections of each field and stored for subsequent grading. Following grading for yield and size, a random subset of 25 tubers from each sample were graded for scab incidence and severity. There was no difference in total yield observed across three years of results. A significant reduction ($p<0.001$) in common scab incidence in the Minuet® treatment (5.9%) compared with the control (11.1%) was observed when pooling samples from all fields. There was also a corresponding reduction in scab severity, but this reduction was lower (0.93 versus 0.84 on 0-3 scale, $p=0.023$). There was also a significant reduction ($p<0.001$) in Rhizoctonia black scurf symptoms in the Minuet® treatment compared to the control. Based on three years of field trials using susceptible varieties, there appears to be a trend toward a reduction in common scab symptoms through use of Minuet®.

POSTER PRESENTATIONS:

Abiotic Stress Responses and Biotechnological Advances in Potato (*Solanum tuberosum* L.)

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Potato (*Solanum tuberosum* L.) is a major global food crop, yet highly vulnerable to abiotic stresses, including drought, salinity, heat, cold, and flooding, which become more intense under climate change. These stresses can severely impair several crop processes, including photosynthesis, water-use efficiency, redox homeostasis, and ultimately suppress tuber growth. However, in response to abiotic stresses, potato plants trigger some characteristic physiological, biochemical, and molecular responses to protect plant functioning which determines their stress tolerance and susceptibility. Conventional breeding methods have been widely used to enhance the stress tolerance in plants, but they are inherently slow, more time-consuming, and their effectiveness is constrained by genetic complexities of potato - autotetraploidy, high heterozygosity, vegetative propagation, and polygenic stress traits. Recent advances in biotechnological strategies have transformed the aspect of potato improvement. Overexpression of key regulatory genes, omics-driven gene discoveries, genome-wide and functional analyses, microbial and nanobiotechnology-based approaches and CRISPR/Cas-mediated gene editing have now enabled precise manipulation of stress-responsive pathways. Although CRISPR applications for abiotic stress-responsive genes in potato are limited and still emerging, improvement in gene editing efficiency and identification of promising targets underscore its potential. Integration of physiological understanding with advanced functional genomics represents a future path towards the development of climate-resilient potato cultivars. This review synthesizes existing studies and advances on stress responses and biotechnological mitigation pathways to enhance tolerance in potato plants while critically identifying research gaps and outlining future directions for enhancing abiotic stress tolerance in potato.

Developing the DNDC Model for Long-Term Assessment of Potato Production and Greenhouse Gas Emissions in Prince Edward Island

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In this study, the DNDC model was calibrated and validated to simulate potato yield and greenhouse gas (GHG) emissions using field measurements collected over two growing seasons (2023–2024) at three sites in Prince Edward Island (PEI), Canada. Model performance was evaluated using soil moisture (SM), soil temperature (ST), potato yield, and N_2O and CO_2 flux measurements. A One-At-A-Time sensitivity analysis (±30%) was conducted to identify the most influential input parameters and to assess uncertainty in simulated potato yield and GHG emissions. Also, long-term trends in yield, soil carbon and nitrogen, and GHG emissions were evaluated using historical climate data (1981–2024) under a legume-based potato rotation. Results showed that biomass fraction, crop water demand, and soil physical properties were the most influential parameters for yield, accounting for up to 40% of the variation. Simulated N_2O emissions were highly sensitive to soil pH (up to 70%), followed by bulk density, while CO_2 emissions were less sensitive (<10% change). Overall, the DNDC model performed well in simulating soil moisture, soil temperature, and potato yield across the three sites, capturing interannual differences between irrigated and rainfed conditions. Although the model showed weaker performance in simulating daily N_2O and CO_2 flux magnitudes, cumulative N_2O and CO_2 emissions showed much stronger agreement with measurements, indicating higher reliability for seasonal GHG budgets than for short-term flux dynamics. Long-term simulations indicated increasing trends in organic carbon soil (1%) and soil organic nitrogen (approximately 10%), while potato yield variability was primarily controlled by water availability rather than nitrogen stress. Over these 44 years, N_2O emissions varied strongly from year to year and were partly linked to precipitation. CO_2 emissions followed a similar long-term pattern but were weakly related to rainfall. Overall, the results demonstrate that the DNDC model can reliably simulate short-term field dynamics and long-term trends in potato yield and GHG emissions in PEI, supporting its use for sustainable management and climate impact assessments.

Nitrogen Management Strategies for Sustainable Potato Production

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Efficient nitrogen (N) management is critical for improving potato productivity while minimizing environmental impacts. This study evaluated four nitrogen management strategies: check (no liquid N) (C), variable-rate N via SWAT maps (S), variable-rate N via DJI Farm software (D), and grower standard practice (G) under field conditions near Souris, Prince Edward Island. Yield, soil properties, plant nitrogen status, and greenhouse gas (GHG) emissions were assessed. Results showed that soil properties, including organic matter and pH, remained largely unchanged over the growing season, suggesting limited short-term treatment effects. Total and marketable yield were significantly higher under G and S compared with the control, while D showed intermediate performance. Tuber nitrogen uptake followed similar trends, whereas vine and tuber nitrogen concentrations did not differ significantly among treatments. Cumulative CO_2 emissions were highest under G, reflecting increased biological activity associated with greater biomass production. In contrast, N_2O emissions were highest under D, likely due to localized nitrogen surplus, while S maintained relatively lower emissions, indicating more efficient nitrogen placement. The CH_4 sink was not affected by nitrogen management strategies. Overall, the SWAT-based variable-rate nitrogen approach (S) achieved comparable yields to conventional practices while potentially reducing excess nitrogen application and associated emissions. These findings highlight the potential of precision agriculture tools to enhance nitrogen use efficiency and support more sustainable potato production systems.

Development of the AquaCrop Model for Irrigation Management in Potato Production in Prince Edward Island

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Climate change is affecting water availability and sectoral demands worldwide, including the irrigation needs of rainfed agriculture. Providing supplemental irrigation to rainfed crops is an effective strategy to ensure sustainable production. Crop growth models allow researchers to explore various management options at low cost, facilitating the evaluation of multiple strategies. The AquaCrop model is a user-friendly, practitioner-oriented tool that balances accuracy, robustness, and simplicity, while requiring relatively few input parameters. In this study, AquaCrop was calibrated for the potato production system in PEI using data from two irrigation management strategies implemented at the Cavendish Farms Research farm during the summer of 2025: soil sensor–based irrigation management (Field A) and expert-based irrigation management (Field B). Aquaspy soil moisture sensors were installed in each field to measure soil moisture in real time. Soil moisture and yield data from Field A were used for model calibration, while data from Field B were used for model validation. The calibrated parameters under full irrigation included canopy growth and canopy decline coefficients (CDC), crop coefficient for transpiration (Tr) at full canopy, normalized water productivity for biomass (WP*), soil water depletion thresholds for inhibition of leaf growth and stomatal conductance, thresholds for acceleration of canopy senescence, reference harvest index (HI_0), and coefficients adjusting HI_0, in response to leaf growth and stomatal inhibition. For soil moisture under full irrigation, calibration statistics were: RMSE = 0.7 mm, Pearson correlation coefficient (r) = 0.75, CV(RMSE) = 8%, and Willmott's Index of Agreement (d) = 0.85. The model simulated a yield of 42.3 t ha^{-1}, while the measured yield was 46 t ha^{-1}, representing an 8% difference between simulated and observed values. Validation statistics for soil moisture under the alternative irrigation management were RMSE = 0.72 mm, r = 0.80, CV(RMSE) = 8.1%, and d = 0.72. Under these conditions, the model simulated a yield of 44.9 t ha^{-1}, while the measured yield was 40 t ha^{-1}, resulting in a 12% difference between simulated and measured values. Overall, the results indicate that the AquaCrop model can satisfactorily simulate soil moisture dynamics and potato yield under Prince Edward Island conditions.

Effects of Irrigation Management on Greenhouse Gas Emissions from Potato Cropping Systems in Prince Edward Island

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In recent years, climate change has led to longer drought periods during the growing season and shifts in seasonal precipitation. Declining rainfall, rising temperatures, and high evapotranspiration rates pose serious threats to the potato sector in Prince Edward Island (PEI). Consequently, the use of supplemental irrigation to meet crop water requirements is required to sustain potato production in PEI. To evaluate the effects of irrigation on greenhouse gas (GHG) emissions, a study was conducted at the Cavendish Farms Research farm during the summer of 2025. In this experiment, three large blocks were assigned to different irrigation management strategies: AQUASPY soil sensor (A), water schedule (W), and dryland (rainfed) (D). Emissions of CO_2, N_2O, and CH_4 were measured biweekly throughout the growing season using LI-COR Trace Gas Analyzer (TGA). The total yields for Fields A, W, and D were 36.8, 38.8, and 20.9 t/ha, respectively, indicating a significantly higher total potato yield in irrigated fields than in rainfed fields. CO_2 emissions from Fields A, W, and D were 13,018, 13,774, and 10,858 kg/ha, respectively, and were significantly higher in irrigated fields compared to the rainfed field. N_2O emissions were 1.37, 1.37, and 1.06 kg/ha for Fields A, W, and D, respectively, with no significant difference between irrigated and rainfed fields. CH_4 fluxes (sink) for Fields A, W, and D were -0.20, -0.25, and -0.31 kg/ha, respectively, showing significantly lower CH_4 absorption in irrigated fields compared to the rainfed field. Although irrigated fields exhibited higher CO_2 emissions and lower CH_4 uptake, direct comparison of raw emissions alone does not fully capture the environmental impact of the cropping system. To provide a more comprehensive, system-level perspective, the yield-scaled Global Warming Potential ($GWP_{(crop)}$) was calculated. The $GWP_{(crop)}$ values for Fields A, W, and D were 363.02, 364.07, and 532.74 kg CO_2-eq per ton, respectively. These results demonstrate that, despite higher absolute emissions in irrigated fields, the greater total yield substantially reduced the climate impact per unit of crop. Overall, these findings suggest that irrigation can enhance the sustainability of potato production by increasing yield efficiency while mitigating per-unit GHG emissions.

Stage-Specific Evaluation of Multi-Source Data Integration for Potato Yield Prediction Using Sentinel-2 and Soil Sensing

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Reliable in-season potato yield forecasting remains difficult because soil conditions, crop growth, and weather patterns interact in complex and changing ways throughout the season. Satellite-derived vegetation indices are widely used for crop monitoring; however, the added benefit of combining them with soil and environmental data has not been clearly quantified. To address this gap, we developed a multi-source machine learning framework that integrates proximal soil sensing measurements, laboratory-based soil chemistry, Sentinel-2 vegetation indices, and weather observations collected from commercial potato fields in Prince Edward Island during the 2017 and 2018 growing seasons. In this study, we evaluated how yield prediction accuracy changes as additional data sources are progressively incorporated across key growth stages. Model performance was assessed using independent test datasets from three commercial fields per year. During the early growth stage, models based solely on vegetation indices and weather data showed limited predictive power (Test $R^2 \approx 0.29$). However, when proximal soil sensing measurements were included, prediction accuracy increased substantially (Test $R^2 \approx 0.77$). Adding laboratory soil chemistry and further data layers provided only modest improvement at this stage, indicating diminishing returns from increasing data complexity early in the season. Prediction accuracy improved during the tuber bulking stage, where full integration of vegetation, soil, and weather data achieved the highest performance (Test R^2 up to 0.82). These results suggest that the relative importance of different data sources shifts as the crop develops, with integrated information becoming more valuable later in the growing cycle. Overall, the findings show that effective yield forecasting strategies should be stage-specific. Proximal soil sensing delivers strong early-season predictive value, while broader data integration offers incremental gains during mid-season development. This work provides practical guidance for designing cost-effective, data-driven decision systems in commercial potato production.

Emulating DNDC with Machine Learning: A Machine-Guided Approach to Simplify Simulations

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Accurate prediction of greenhouse gas fluxes is essential for sustainable agroecosystem management. Process-based models (PBMs) like DNDC provide detailed mechanistic insights but are computationally intensive and require extensive input data, limiting rapid or large-scale analyses. Machine learning (ML) offers a fast and flexible alternative, capable of emulating PBM outputs while capturing complex nonlinear relationships. This study develops an ML-based emulator for DNDC, identifies key predictors, and evaluates how reduced input sets affect predictive performance. Key predictors were first identified from DNDC outputs using Boruta feature selection, followed by correlation filtering. Predictor combinations were then evaluated using WASPAS multi-criteria ranking to define both a top-ranked feature set and a minimum-efficient feature subset. For N_2O, the best feature set included irrigation (Irr), total precipitation (P), number of heavy rainfall days (>15 mm, HRD15), heavy rain events preceded by a dry spell ≥5 days (HRE_D5), mean air temperature (MeanT), soil temperature (ST), days with water-filled pore space >70% FC (WFPS70_Days), substrate nitrogen (Substrate_N), and soil organic matter (SON), with a minimum-efficient set of Irr, P, HRD15, ST, and Substrate_N. For CO_2, the best model included HRD15, MeanT, ST, WFPS70_Days, Substrate_N, N fertilizer (Fert_N), and SON, with a minimum-efficient set of ST, WFPS70_Days, Substrate_N, Fert_N, and SON. Multiple regression and ML algorithms, including linear, tree-based, kernel-based, boosting, neural network, and hybrid peak-sensitive models, were trained using 5-fold cross-validation on log-transformed targets, and performance was evaluated using R^2, RMSE, MAE, normalized RMSE, and MASE using both feature sets. For CO_2 fluxes, the Decision Tree with the top-ranked set achieved the highest accuracy (R^2 = 0.960, RMSE = 59.5, nRMSE = 4.44%), while CatBoost with the minimum-efficient set maintained strong performance (R^2 = 0.953, RMSE = 64.6, nRMSE = 4.82%). For N_2O, XGBoost with the top-ranked set provided the best predictions (R^2 = 0.888, RMSE = 0.159, nRMSE = 6.15%), whereas the Hybrid Peak Specialist model using the minimum-efficient set achieved reasonable accuracy (R^2 = 0.832, RMSE = 0.194, nRMSE = 7.54%). These results show that although full-feature sets maximize accuracy, surrogate models with reduced inputs retain most predictive skill, supporting rapid, large-scale DNDC emulation.

Tracking Agro-Meteorological Extremes from Space Using Cloud-Powered Satellite Indices in Prince Edward Island

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Drought is an intricate natural phenomenon that has intensified and spread across regions due to climate change and shifts in precipitation patterns. As a result, identifying its occurrence and drought-prone locations is critical for successful drought management. This study assessed long-term (2000–2025) agro-meteorological drought conditions in Prince Edward Island (PEI), Canada. The study used several drought indices, including the Vegetation Condition Index (VCI), Temperature Condition Index (TCI), and Vegetation Health Index (VHI) derived from MODIS products, as well as the Standardized Precipitation Index (SPI) derived from CHIRPS using the Google Earth Engine (GEE) platform. Furthermore, spatial drought frequency (SDF) and average drought frequency (ADF) were determined, and a statistical analysis was carried out to construct time series for both metrics. The trend was then assessed using the Moving-average test. The findings suggest that, according to VHI, the most severe droughts occurred in 2001 and 2020, affecting 85-90% of the research region. Drought conditions increased again dramatically in 2025. Furthermore, 65.67% of PEI had very low drought frequency, whereas 15.81% had extremely high drought frequency. As a result, both SDF and ADF consistently identified drought regions. Long-term analyses of precipitation and the SPI show a statistically significant drop, with drought conditions becoming more frequent and severe since 2018. These findings offer actionable insights into improving drought readiness and dynamic agricultural management in PEI.

A Review of Irrigation Scheduling Techniques for Potato and Their Impacts on Yield and Water Productivity

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Potatoes benefit from irrigation management due to their major impact on both yield and tuber quality. Irrigation management is challenging due to fluctuating weather conditions, shallow root zone, and soil moisture vulnerability. These factors make it difficult to maintain water availability without causing water stress. Inadequate irrigation can cause a maximum 50% yield decline under extreme drought conditions and the outbreak of various diseases, making the potatoes non-marketable. Irrigation scheduling is a beneficial strategy for managing crop water needs throughout the growing season. This study was conducted to review studies of more accurate and precise irrigation scheduling techniques and their effects on yield and water productivity across different soil types, cultivars, and environmental conditions. This systematic review selected 40 recent studies spanning 2013 to 2026, analysing using keywords such as potato, irrigation scheduling, yield, water-saving, and water-use efficiency, and focuses on irrigation scheduling techniques such as soil sensor-based, evapotranspiration-based, and plant-based, and their impact on potato yield and water productivity. Soil-based approaches advise maintaining 80-90% field capacity to maximise yield and increase water productivity. ET-based recommendations, irrigation at 80-100% of ET. Plant-based scheduling uses the crop water stress index (CWSI) to advise irrigation when CWSI is less than 0.4. This review emphasises irrigation scheduling to maximise yield and water productivity and demonstrates its role in achieving groundwater sustainability in potato production.

Context-Dependent Thresholds Govern Synergistic and Antagonistic Greenhouse Gas Outcomes in Integrated Cover Crop–Bio-Waste Amendment Systems

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Most studies examine soil management practices in isolation rather than as a part of an interconnected system, obscuring when and why their combined application produces unexpected greenhouse gas (GHG) and soil health outcomes. The review addresses that gap by developing a threshold-based intervention framework that explains when integrating cover crop with biowaste-based amendments (BBAs) yields synergistic benefits, additive effects, or antagonistic trade-offs, distinct from previous single-practice or qualitative syntheses. Unlike prior reviews that describe combined practice qualitatively, that framework identifies and quantifies key pedoclimatic and operational thresholds governing non-additive response, thereby providing a predictive rather than descriptive lens on integrated soil management. A systematic scoping review with mechanistic synthesis identified 242 studies. Across these studies, synergistic outcomes emerged when cover-crop-driven processes complemented amendment effects, for instance, root-driven aggregation aligned with amendment-based structural or chemical stabilisation and when plant nitrogen uptake matched the amendment's moderate nutrient release. However, synergies were conditional and dependent on minimum cover crop biomass (~0.8–1.0 Mg ha^{-1}), sufficient soil mineral protection (≥ ~20% clay), and soil moisture below denitrification-dominated thresholds (~60% water-filled pore space). These thresholds consistently governed whether integrated systems enhanced carbon stabilisation and reduced N_2O emissions. When thresholds were not met, the same practices often generated antagonistic trade-offs, including pollution swapping between gaseous pathways, for e.g. lowering ammonia volatilisation while increasing N_2O emissions or between GHG mitigation and nutrient loss risks. Biochar most reliably suppressed residue-driven N_2O pulses by adsorbing ammonium and enhancing N_2O reduction, whereas digestate posed the greatest risk of antagonistic outcomes under moist, fine-textured conditions with insufficient vegetative demand. Overall, the synthesis demonstrates that interactional outcomes in the cover crops and BBA system are emergent properties constrained by quantifiable thresholds rather than practice identity alone. This highlights the need to move beyond generalised best practices toward threshold-based decision frameworks and regionally calibrated, predictive management for robust climate mitigation and soil health gains.