Research Day 2024

DALHOUSIE UNIVERSITY

8:30 AM: Registration & set up posters

9:00 AM Welcome Address

Oral Presentation
Session I

9:00 AM Fueling the Future: Biorefinery Innovations for Waste Management and Sustainable Biofuels - *Dr. Sonil Nanda*

9:10 AM Creating cosmeceutical ingredients from upcycled kale: Optimization of a green extraction process using response surface methodology - *Harichandana Valisakkagari*

9:20 AM – Use of algal astaxanthin in Atlantic salmon *(Salmo salar* L*)* diets - *Juan Manriquez-Hernandez*

9:30 AM Optimizing food environments for optimal human, animal, and planetary health - *Kathleen Kevany*

9:40 AM Quality Mapping of Potato Tuber Storage Facility Using Real-Time Location System, Wireless Communication and Machine Vision for Improved Traceability - *Colton Campbell*

9:50 AM Seafood Biostimulant effect on Seed Germination, Plant Growth, and Productivity of Kale *(Brassica oleracea* var. *sabellica) - Anagha Pradeep Kumar*

10.10 AM Buffer Time

10:20 AM Poster Presentation & Networking

Session II

11:00 AM Diversifying Potato Crop Production Systems and it's impacts on the Abundance of Nitrogen Cycling Microorganisms and Nitrous Oxide Emissions - *Leah McIntyre*

11:10 AM A History of Agribusiness: Understanding Influence – *Ashley Jean MacDonald*

11:20 AM Unlocking the potential of protein concentrates from red seaweed *(Palmaria palmata)* as sustainable food ingredients - *Anushi Madushani Wijethunga*

11:30 AM The impact of chemical fungicides and Salicylic acid on the fungal communities of Honeycrisp Apple - *Michael Shayne McLaughlin*

11:40 AM Assessing the sustainability and viability of the pork industry in New Brunswick - *Kingdavid oti*

11:50 AM Empirical Analysis of Factors Influencing Household Food Waste Reduction Behaviour in Nova Scotia, Canada using Structural Equation Modeling - *Prosper Kayelle*

12:00 PM Spray-Induced Gene Silencing (SIGS) as a Potential Tool to Control Wireworms *(Agriotes spp.)* in Potatoes – *Yanxue Zhao*

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12:10 PM Lunch Break

Session III

1:00 PM Poultry Emissions Benchmarking – *Bubacarr Jobarteh*

1:10 PM How does exposure to heat and nutritional stress induce hormetic responses in aphids?- *Iniya Rajan*

1:20 PM Identification and analysis of gaffkemia-responsive genes in the American lobster (Homarus americanus) - *Zohreh Fazelan*

1:30 PM Design and Evaluation of the First Precision Spot Applicator for Granular Herbicides - *Craig MacEachern*

1:40 PM Evaluating the Effects of Enhanced Efficiency Nitrogen Fertilizers on Agronomic and Environmental Performance in Grain Corn - *Baillie Lynds*

1:50 PM Identification of Potential Metabolomic Biomarkers for Early Detection of *Haemonchus contortus* in Sheep - *Hamza Jawad*

2:00 PM Discovering genes controlling ripening time in apple - Tommy Davies

2:10 PM Buffer Time

2:20 PM Poster Presentation & Networking

Session IV

2:50 PM Woodchip residues: A sustainable approach to improve boreal soils in Canada - *Shreemi Prabhakaran*

3:00 PM Preliminary Survey of Wireworms in Potato Fields Adopting Regenerative Agricultural Practices and Examination of Wireworm Life-stage Markers - *Rachel Rix*

3:10 PM Developing decision support tools of growing season N mineralization to inform N management strategies in PEI - *Luke Laurence*

3:20 PM Title - Development of a Cloud-Based IoT System for Livestock Health Monitoring using AWS and Python - *Harini Shree Bhaskaran*

3:30 PM Migration effect of pentachlorophenol wood preservative in soil and its effects on kale and lettuce growth - *Koushika Kumaresan*

3:40 PM Identification and nutritional analysis of phytoplankton species in the Bras d'Or Lakes, Nova Scotia - *Gracie Hanrahan*

3:50 PM Buffer Time

4:00 PM End of Session/Vote of Thanks

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Poster Presentations

1. Optimization and Key Performance Evaluation of Different Drying Technologies for Fruit Pomace Utilization – Feba Thomas

2. Role of *Sinorhizobium meliloti* derived Flavins in Leaf Vegetable Growth Promotion - Nivethika Ajeethan

3. Impactful Social Change: Exploring The Legitimacy of Social Entrepreneurship In Canada Through The Context of School Food Programs - Victoria Dimick

4. Waste-to-Biofuel: Innovations in Thermochemical Valorization of Agro-Food, Forestry and Plastic Residues - Prakhar Talwar

5.AI-Driven Benchmarking Tool for Methane Emissions in Dairy Cows Using Satellite Imaging - Hanqing Bi

6. Decoding Poultry Communication: Time-Series and Semantic Analysis of Vocalizations Under Stress - Venkatraman Manikandan

7. Detecting Lameness in Dairy Cows Using Wearable Accelerometers and Facial Recognition Technology - Yashan Dhaliwal

8. Analyzing Dairy Cow Behavior with Large Language Models and Computer Vision Techniques - Hariesh Sivakumar

9.Enhancing Dairy Cow Biometric Identification with AI and Data Analytics for Precision Livestock Farming - Shubhangi Mahato

10. Assessing Dairy Cow Emotions Through Video and Image Analysis - Christopher Gonzalez

11. Decoding Dairy Cow Vocalizations - Leveraging NLP and WHISPER Models for Non-Invasive Welfare Monitoring – Dr. Suresh Neethirajan

12. Exploring the role of bacterial synthetic communities in alleviating drought stress by shaping trophic interactions and enhancing soil health and plant resilience - Taylar Austin

13. Optimal Temperature Range and Time of Harvest to Optimize Wild Blueberry (*Vaccinium angustifolium* Ait) Fruit Quality for the Fresh Market - Muhammad U. Asif

Abstracts

Oral Presentations

Session I

1. Fueling the Future: Biorefinery Innovations for Waste Management and Sustainable Biofuels - *Dr. Sonil Nanda*

Biofuels are gaining attention as renewable energy sources to address the rising energy demands, fluctuating crude oil prices and greenhouse emissions from fossil fuels. Biofuels can be produced from various renewable feedstocks and biogenic wastes through thermochemical, biological and hybrid conversion technologies. This presentation will highlight the candidacy of a wide variety of waste feedstocks such as lignocellulosic biomass, municipal solid waste, food waste, plastics and biogenic wastes to produce carbon-neutral biofuels and carbon-negative materials. The potential and performance of waste-to-energy technologies such as gasification, pyrolysis, torrefaction and fermentation will be discussed in this talk. The strengths, weaknesses, threats and opportunities of biorefinery technologies to shape the future of energy requirements in the industrial manufacturing and transportation sectors will be reviewed. The current progress, challenges and knowledge gaps in the R&D of biorefining technologies to produce clean hydrocarbon biofuels, biochemicals and bioproducts from agricultural and forestry residues as well as their opportunities for bioeconomy will be discussed in this presentation. The golden circle model of "why, how and what" will be elaborated to demonstrate the value proposition of transforming wastes into valuable resources such as biofuels, biochemicals and biomaterials.

2. Creating Cosmeceutical Ingredients From Upcycled Kale: Optimization of a Green Extraction Process using Response Surface Methodology - *Harichandana Valisakkagari*

Due to short-shelf life a significant amount of harvested Kale *(Brassica oleracea* L.*)* is wasted. The aim of this research is to develop consumer and environment friendly technologies for utilize upcycled kale. The optimum bioactive extraction conditions using ultrasound-assisted extraction (UAE) extraction and application of response surface methodology were established. The results obtained were ultrasonic time of 30 min, temperature of 57 °C, and ethanol concentration of 100% when solid-to-liquid ratio is set for 1:20 g/mL. The resulted extracts consisted of total carotenoid content (TCC) of 550 µg carotenoid/g dry weight (DW). The UAE method was compared with other reported extraction methods. Extraction parameters significantly influenced the estimated yield of TCC (392 µg carotenoid/g DW), total phenolic content (TPC, 11 mg gallic acid equivalents/g DW), and antioxidant capacity (Ferric Reducing Antioxidant Power of 14 µmole Trolox equivalence/g DW and DPPH radical scavenging of IC50 2 mg/mL). The major phytochemicals were quantified using liquid chromatography mass spectrometry. Research is in progress to assess the kale extracts for their ability protect against UVA/UVB-induced DNA damage and inflammation. In conclusion, the bioactive compounds from upcycled kale can be recovered from the green extraction process to use as cosmeceuticals to promote skin health.

Keywords: food waste utilization, innovative products, natural resources, green technology, sustainability.

3. Use of algal astaxanthin in Atlantic salmon *(Salmo salar* L.*)* diets - *Juan Manriquez-Hernandez*

For Atlantic salmon marketing, flesh colour is a particularly important quality criterion. As salmon cannot synthesize the pigments responsible for their characteristic colouration, synthetic astaxanthin must be added to their feeds. The use of synthetic products in raising food animals has generated public concerns; therefore, it is important to develop new sources of natural astaxanthin. Two forms of algal astaxanthin extracted from the green microalga *Haematococcus* lacustris were tested against a conventional synthetic source. Atlantic salmon (initial weight 700 g) were fed for six months with seven experimental diets. Diets contained zero astaxanthin (Ax, control), synthetic astaxanthin included at two concentrations (40 and 80 mg Ax [kg feed]-1, High and Low, respectively), and two forms of algal astaxanthin (oleoresin and powder) both at the same concentrations indicated above. Fish were reared in a freshwater recirculation system; 41 - 45 fish were opportunistically assigned to each tank (2 m3) with two replicates for each treatment. Fish were assessed monthly for production parameters and after six months, ten fish per tank were sampled for further analyses. Fillet colour was visually and instrumentally evaluated, SalmoFan scale and handheld spectrophotometer MiniScan EZ 4500LC, respectively, and astaxanthin concentration in the flesh was determined by High Performance Liquid Chromatography. Response variables were analyzed by ANCOVA with initial weight, coefficient of variation, and number of fish as covariates. The production parameters were not significantly affected by diet, but by the covariates. However, diet significantly affected fillet colouration, but not astaxanthin concentration. Fish fed with Synthetic High astaxanthin had the reddest fillets, but those fed with Oleoresin High were not significantly different. At the Low level of inclusion, both algal astaxanthin pigmented the fillets as well the synthetic one. This demonstrates that synthetic astaxanthin can be successfully replaced by algal oleoresin astaxanthin.

4. Optimizing food environments for optimal human, animal, and planetary health - *Kathleen Kevany*

What opportunities are we failing to seize when our food systems are not optimal (Kevany & Prosperi, 2023)? Food production and consumption practices are significantly altering 75% of the land-based environment and about 66% of the marine environment, and agriculture (worldwide) accounts for 18-30% of all GHG emissions, with 80% of this from animal agriculture (Crippa et al., 2021). Canadians also demonstrate poorer health than expected, with 73% of Canadians are suffering from one or more non-communicable disease (Health Canada, 2020). Thus, Canadian food systems need major reorienting to avert diet-related health crises, environmental destruction, and social destabilization as the health of ecosystems on which we depend is rapidly deteriorating (IPBES, 2019; Venugopal & Sasidharan, 2021) . While the scale of this problem is daunting, researchers across the world have identified promising solutions. This session will discuss relevant research projects underway and opportunities for collaboration and action.

5. Quality Mapping of Potato Tuber Storage Facility Using Real-Time Location System, Wireless Communication and Machine Vision for Improved Traceability - *Colton Campbell*

This thesis proposes a novel post-harvest potato tuber storage traceability system designed to enhance quality monitoring and management. The system leverages a real-time locating system (RTLS), wireless communication, and remote sensors to identify and map the quality characteristics of potato tubers. By creating a detailed 3D map of the storage facility, the system tracks the spatial and temporal placement of each tuber load. Integration with existing traceability systems, such as Greentronics' Ritetrace, allows the acquisition of crucial data including GPS coordinates, time stamps, and mass of each load. This enriched data set supplements the 3D map, which is stored locally for centralized monitoring and analysis. This integrated approach aims to improve traceability, reduce post-harvest losses, and enhance the overall quality management of stored potato tubers.

6. Seafood Biostimulant effect on Seed Germination, Plant Growth, and Productivity of Kale *(Brassica oleracea* var. *sabellica)* - *Anagha Pradeep Kumar*

The use of organic and sustainable agricultural practices has become increasingly important to reduce environmental impact while ensuring food security. The potential use of sea minerals and fish hydrolysate as natural alternative to synthetic biostimulants in sustainable agriculture has not been comprehensively explored. In this study, we investigated the effect of three sea minerals (SM1, SM2 and SM3) and fish hydrolysate (FH) at four different concentrations (0.25, 0.5, 1 and 2%) on seedling and plant growth of kale (*Brassica oleracea* var. sabellica). The results showed that the application of 0.25% SM3 increased seed germination rate by *ca.* 78% while 2% FH increased the mean germination time by *ca.* 35% compared to the control. Root length and surface area were increased with 0.25% SM2 while the shoot length and surface area were increased with 0.25% FH application. Both shoot and root volume of seedlings were increased with 0.25% SM3 and 0.25% SM2, respectively. Plants treated with 2% FH showed an overall increase in plant height and number of leaves, resulting in increased fresh and dry weights of plant tissues. Application of 2% FH increased chlorophyll content, stomatal conductance of CO_2, transpiration and photosynthetic rate. However, maximum photochemical efficiency, and rate of quantum conversion were observed for 1% SM3. In conclusion, 2% FH was the most effective for plant height and weight, but 1% SM3 is recommended for optimal photochemical efficiency. The findings of this study support the potential use of these natural resources in sustainable agriculture.

Keywords: marine waste, sustainable, organic agriculture, germination, crop productivity

Session II

1. Diversifying Potato Crop Production Systems and it's impacts on the Abundance of Nitrogen Cycling Microorganisms and Nitrous Oxide Emissions - *Leah McIntyre*

Increasing plant diversity, soil coverage, and rotation length in potato production systems can improve soil quality and productivity, but may result in increased nitrogen (N) losses as nitrous oxide (N_2O) from nitrification and denitrification. The objective of this study was to compare the effects of four potato crop production systems (CPS) established in 2021 with (N+) and without (N-) N fertilizer that on soil properties, greenhouse gas emissions and the abundance of denitrifiers and nitrifiers measured using N cycling genes. There were no effects of CPS on N_2O emissions, but there were significant effects of CPS in all genes in at least one of the three years, but they were not consistent across years. For instance, nitrite reductases (*nirS* and nirK) had the lowest abundances in the conventional two-year potato-barley rotation, but this was only observed in 2021 and 2022 for *nirS,* and 2023 only for *nirK.* There were significant effects of N regime on N_2O emissions, with cumulative growing-season N_2O emissions from soil under N+ nearly twice that of the soil under N-. Similarly, significant effects of N were reported for all N cycling genes, but the direction of this shift changed between genes and years suggesting the occupation of separate competitive niches under varying environmental conditions or N fertilization. Results show that the CPS may not significantly influence N_2O emissions over the growing season in the short-term, but may influence the functional capacity for N cycling.

2. A History of Agribusiness: Understanding Influence – *Ashley Jean MacDonald*

'Agribusiness' may be thought of as a convenience word, blending together agricultural and business. However, the term was used to describe an American economic concept that was developed in the hopes of finally solving the 'farm problem'. The concept fundamentally changed the nature of farming and the global food system. As is often the case with language, the use and understanding of the word has changed and evolved, but ideals of the original use remain as a non-corporeal actant (NCA). Just as the impacts of the original concept and resulting policies remain evident, the memories and values associated with Agribusiness also remain, enacting influence on the network and the decisions farmers and policymakers continue to make.

3. Unlocking the potential of protein concentrates from red seaweed *(Palmaria palmata)* as sustainable food ingredients - *Anushi Madushani Wijethunga*

Red seaweed (*Palmaria palmata*) is a sustainable marine resource that contains 8-35% protein and a complete essential amino acid profile. However, its use as a dietary protein source is limited due to the lack of effective protein extraction methods. This study aims to address this challenge by exploring different pretreatments of *Palmaria palmata* prior to the conventional method known as alkaline solubilization and acidic precipitation (ASAP) to enhance the protein extraction yield and purity. The pretreatment methods used in this work included homogenization, ultrasonication, microwave digestion, surfactants, acid hydrolysis, and viscozyme hydrolysis. The results demonstrated that microwave digestion (500 W, 30 min) and acid hydrolysis (2 M H_2SO_4, 95 ºC, 2 h) are the most effective treatments. Specifically, compared to the negative control, a significant increase in protein extraction yields was observed ($P<0.05$), rising from 10.4% to 47.6% for microwave and to 46.5% for acid hydrolysis. Protein purity reached 89.8% with microwave digestion and 65.3% with acid hydrolysis. The enhanced protein extraction yield was mainly attributed to the disruption of the seaweed's cell wall, as evidenced by the images of Scanning Electron Microscope (SEM) and Confocal Laser Scanning Microscope (CLSM). In addition, the *in vitro* digestibility of proteins resulting from microwave digestion and acid hydrolysis increased significantly ($P<0.05$) from 6.3±0.8 to 11.6±0.8% and 14.4±0.7%, respectively, compared to the control, indicating improved nutritional quality.

Techno-functional properties (e.g., emulsifying capacity and foaming property) of protein ingredients play a vital role in ensuring the sensory attributes of food products, such as texture, stability, and mouthfeel. This study showed that both microwave digestion and acid hydrolysis treatments significantly enhanced the emulsifying capacity, increasing it by approximately three times compared to the control ($p<0.05$). However, contradictory results were observed regarding the effect of these treatments on foaming capacity. Microwave digestion improved foaming capacity by 27.7%, while acid hydrolysis reduced it by 47.0% compared to the control ($p<0.05$).

This study developed sustainable and effective approaches for extracting proteins from *Palmaria palmata* and evaluated their techno-functionalities and nutritional quality, demonstrating significant potential in utilizing red seaweeds as protein alternatives. These findings are crucial in addressing challenges posed by the growing demand for animal proteins and global food insecurity. Future research should prioritize scaling up the extraction processes to facilitate wider applications of red seaweed-based proteins in the food industry

4. **The impact of chemical fungicides and Salicylic acid on the fungal communities of Honeycrisp Apple - *Michael Shayne McLaughlin***

Plant-associated microbial communities exert a profound influence on the physiological traits of their host, including resistance to biotic and abiotic factors. As such, the active maintenance of the microbiome in order to control plant pathogens is a promising avenue for disease control. Unfortunately, the microbiome is highly variable and can be influenced by different environmental conditions, as well as the application of exogenous agents. Thus in order to harness the microbiome to control plant pathogens, a clear understanding of how these factors relate to microbial diversity and community structures is required. In this study, we compared the effects of the application of chemical fungicides and salicylic acid on the fungal communities of "Honeycrisp" apples at harvest over two consecutive growing seasons. We demonstrate significant variations in fungal community structure as a result of growing season and treatment regime, and furthermore that chemical fungicide treatment is associated with a reduction in fungal network complexity.

5. Assessing the sustainability and viability of the pork industry in New Brunswick - *Kingdavid oti*

Access to safe and nutritious food is key to healthy, resilient communities. Recent events such as floods, landslides, and the COVID-19 pandemic have highlighted the vulnerability of Canada's food supply chains, with New Brunswick being no exception. The pork sector in the region faces many challenges, including a shortage of abattoir services, public concerns over production practices, environmental issues, animal welfare concerns, and ethical issues related to feed additives, medicine use, and traceability. These challenges question the sustainability and viability of the industry in the province.

The project aims to optimize the pork value chain to meet this demand while addressing present sustainability issues. The research objectives include understanding why consumers prefer local pork over imported pork, exploring sustainability practices that add value for consumers, and analyzing the implementation of sustainability standards and innovative practices in pork production, handling, storage, and distribution.

Analysis of the consumer survey revealed that consumers believe locally produced pork is higher in quality, tastier, healthier, and safer than imported pork. Consumers are also willing to pay more for pork products with certifications such as animal welfare, free-range, organic, and GMO-free. Value chain analysis identified inefficiencies and provided recommendations to enhance value-adding activities from "farm to fork," focusing on operational misalignments and opportunities for improvement. Producers form contracts with others to ensure a continuous supply of hogs. Wean-to-finish producers set the price for piglets, while butcher shops set prices for finishing sows. Processors operate independently, setting prices based on various factors, whereas retailers work within a more regulated framework. Large-scale processors and butchers significantly influence the distribution of pork products, with retailers being the final link in the chain.

Sustainable challenges for hog producers include limited market access, cost competitiveness, rising input costs, inconsistent customer bases, high feed transportation costs, declining killing plants, and labor shortages. Producers need assistance with market information and adopting standard practices. PigTRACE, a crucial component of the Canadian swine industry's efforts to enhance traceability, biosecurity, and food safety, enables quick responses to disease outbreaks and food safety concerns. Internationally, countries like Australia, South Africa, the USA, and the Netherlands use traceability systems that provide feedback from slaughterhouses, enabling on-farm practices to be adjusted based on outcomes, promoting sustainability and viability.

6. Empirical Analysis of Factors Influencing Household Food Waste Reduction Behaviour in Nova Scotia, Canada using Structural Equation Modeling - *Prosper Kayelle*

Research Problem: Households account for the highest proportion of food waste along the distribution and consumption segment of the food supply chain. Nova Scotia accounts for the highest gross waste management cost in Canada, at $339 tonne^{-1} of waste. Stakeholders in the food distribution and retail sector, and municipal, provincial and national authorities are seeking research-informed strategies to minimize household food waste.

Theoretical Models and Literature Summary: A Structural equations modeling (SEM) approach was applied to investigate household food waste behaviour path relations and causal effects, including direct and indirect food waste behaviour relationships and pathways. We explored pathway relationships associated with a base Theory of Planned Behaviour (TPB) model and extended the base model to include additional predictors such as income, bulk purchasing, price consciousness and food affordability. Primary data analysis was based on responses from a sample of 750 Nova Scotia households.

Key Research Findings: "Fresh fruits and vegetables" accounted for the highest proportion of food waste (16%), followed by "bread and other bakery products" (11%), and "meat and fish" (6%). The lowest proportion of household food waste was for "milk and diary products" (4%). Respondents' attitude towards food waste (b=0.282, SE=0.046, p<0.001), their moral norms (b=0.142, SE=0.033, p<0.001), and perceived behavioural control (PBC) (b=0.099, SE=0.033, p=0.003) significantly predicted respondent's intention to reduce food waste and contributes support to the TPB. In addition, our finding that intention to reduce food waste (b= -1.319, SE=0.526, p=0.012) significantly predicted actual household food waste behaviour contributes to a small body of empirical literature demonstrating that intention is, so far, the most reliable predictor of actual behaviour. Results of the extended TPB model, reveal that households that could afford food (b=-0.073, SE=0.019, p<0.001) were more likely to have decreased intention to reduce food waste. Also, price conscious respondents (b=0.784, SE=0.406, p=0.054) had a greater likelihood of wasting more food. Perceived behavioural control mediated the effect of price consciousness and bulk purchase on intention to reduce food waste and food waste behaviour. Households who buy in bulk and those that were price conscious tended to have stronger PBC, increased intention to reduce food waste and, ultimately reduced food waste.

Policy implications: The study contributes to a better understanding of food waste reduction behaviour in Nova Scotia and offers insights on strategies and interventions to help reduce household food waste.

7. Spray-Induced Gene Silencing (SIGS) as a Potential Tool to Control Wireworms *(Agriotes spp.)* in Potatoes – Yanxue Zhao

Spray-induced gene silencing (SIGS) is an emerging technique as a potential strategy for pest management. This approach is achieved by exogenously applying double-stranded RNA (dsRNA) molecules to plants to suppress pest target gene expression using endogenous RNA interference (RNAi) machinery. SIGS is more acceptable and efficient as compared to developing transgenic crops, which has been controversial among consumers, as well as costly and time-consuming. Additionally, SIGS is more sustainable and environmentally friendly than chemical pesticides, as they can cause profound threats to soil health and the ecosystem of the agricultural land. In recent years, wireworms have become increasingly destructive to many vegetable crops worldwide. Wireworms are the soil-dwelling larvae of click beetles and they feed underground part of plants such as seeds, roots and tubers. More common damage is seen as shallow to deep holes in the potatoes, caused by wireworms burrowing into the tubers while feeding. This damage leads to a severe reduction in tuber quality and, as a result, affected potatoes become unmarketable. In this research, SIGS strategy is tested in potato tissue culture plants, to qualify and quantify the translocation of exogenous treated double-stranded (ds)-DNA or RNA molecules, aiming to provide a proof of concept in its possibility in wireworm control. Plasmid DNA molecules have been used to qualify and quantify the translocation of DNA in potato tissue culture plants. Two different treatment methods have been developed, including root dipping and leaf smear. The samples were collected from three different plant parts (upper, middle and lower plant part) at 4 different time intervals (3 hours; 1 day; 3 days and 7 days). Then, the quantification of translocated DNA was measured using RT-qPCR. It has been found that the plasmid DNA can be systematically delivered into the plants through the root dipping method, while leaf smear method shows a low translocation, only 2 detected plant samples have translocation out of 16. Both treatments are going to be performed using dsRNA in the future to test the potential of dsRNA translocation within the potato tissue culture plants. This SIGS strategy can be applied for pest control as well as for gene silencing by studying the function of target genes.

Session III

1. Poultry Emissions Benchmarking – *Bubacarr Jobarteh*

This project aims to develop predictive models for methane from poultry farms and processors across Canada, leveraging new technologies and data-driven methods. We investigate the temporal and spatial patterns of these emissions, including the variability within and between farms and processors, and forecast emissions using satellite imagery and advanced machine learning models. We utilized satellite data, machine learning techniques, and spatial data to examine the temporal and spatial variability of methane emissions. Predictive models such as ARIMA, LSTM, and XGBoost (XGB) were developed to enhance emission forecasts. These models employ ensemble methods and regularization techniques to improve their predictive performance. Our results indicate diverse emission profiles among poultry farms and processors, with the models demonstrating high accuracy in predicting methane emissions. These findings provide valuable insights for benchmarking purposes, helping policymakers and government officials manage the environmental impact of the poultry industry in Canada more effectively.

2. How does exposure to heat and nutritional stress induce hormetic responses in aphids?**? - *Iniya Rajan***

Hormesis is a biphasic stress response characterized by high dose inhibition and low dose stimulation. We examined whether exposure to mild heat shock and nutritional stress hormetically affects reproduction and survival of green peach aphid, *Myzus persicae*. Aphids were exposed to 25 (control), 30, 34, and 38 ^{0}C for 2, 4, and 6 h. No significant (P>0.05) stimulatory effects on reproduction and survival were observed, except for notable reductions at 38 ^{0}C. In the nutritional stress experiments, aphids were deprived of food source in treatment groups while control groups were provided with cabbage leaf discs. In a second set of experiments, aphids subjected to food stress produced 97% fewer nymphs than control aphids, and after 48 h survival was only 60% that of controls. Ongoing experiments will measure effects on aphids of concurrent mild heat stress and nutritional stress, including RNA-seq transcriptome analysis to identify differentially expressed genes and pathways associated with these responses.

Keywords: Hormesis, *Myzus persicae*, Mild heat shock, Nutritional stress, RNA-sequencing

3. Identification and analysis of gaffkemia-responsive genes in the American lobster *(Homarus americanus)* - *Zohreh Fazelan*

Aerococcus viridans var*. homri* is the cause of mortalities in natural populations and impounded *Homarus americanus*. However, there is limited research on the American lobster's immune response mechanisms against *A. viridans*. In the present study, RNA-seq was used to examine the expression of more than 29,000 hepatopancreatic genes in *H. americanus* during an *A. viridans* infection challenge to determine how lobster immune responses are regulated at a molecular level. Both DESeq2 and edgeR analyses were used to find differentially expressed genes. DEseq2 uncovered 1803 differentially expressed genes over infection comparisons of interest; infected at 6 h vs. control at 6 h, infected at end timepoint vs. control at end timepoint, and infected at 24 h vs. control at 6 h. We highlight 90 genes involved in the *H. americanus* immune response comprised of innate immunity-related genes. These include anti-lipopolysaccharide factors (ALF-L1, ALF-L2, ALF-L4, and other isoforms), serum amyloid protein A, hyperglycemic hormone, thioredoxin, interferon regulatory factor, tumor necrosis factor, MyD88, Flightless-1, relish, NF-kappa-B inhibitor, phenoloxidase-activating factors, melanization protease, coagulation factor isoforms, clotting factors, C-type lectins, and other immunity-related proteins. Previous research has connected a few of these immune genes to the immune response of American lobster to *A. viridans*. These findings provide compelling evidence that ALFs are likely critical players in the immune defense of American lobsters against a threatening infectious bacterial disease: gaffkemia. This, along with the differential expression of other immune genes, illustrates the molecular regulation of the hepatopancreatic response to *A. viridans* infection in *H. americanus*, advancing our knowledge of complex and efficient innate immunity.

4. Design and Evaluation of the First Precision Spot Applicator for Granular Herbicides - *Craig MacEachern*

The objective of this research was to develop the worlds first spot applicator for granular agrochemical. Despite rapid developments in spot spraying, currently there is no commercially available equipment for spot application of granules. Therefore, the goal of this study was to design, build, and evaluate a precision applicator for spot applying granular agrochemicals with a focus on the wild blueberry cropping system. The design incorporated a John Deere RC2000 with a custom control box, recirculation system, and electrically actuated valves, all modified to fit a Valmar 1255 Twin-Roller. The system uses inputs from a predeveloped prescription map and can actuate each of the twelve valves independently for precise agrochemical application with a 0.61 m resolution over a 7.32 m application width. In field evaluations the applicator demonstrated high accuracy (95%), precision (91%), sensitivity (99%), and specificity (91%) when targeting hair fescue in wild blueberry fields. Further, there were no significant differences ($p = 0.875$) in terms of reduction in living tuft count when dichlobenil was applied both conventionally (broadcast) and spot specifically. Finally, when used on hair fescue in wild blueberry, the spot applicator reduces per hectare costs by 62.5% and increases implement uptime by 24.13%. In all, the system represents the first successfully designed and implemented spot applicator for granular agrochemical. Moving forward, components of the applicator will need to be ruggedized however, the basis of the system has significant commercialization potential and can provide considerable economic and temporal benefits to producers.

5. Evaluating the Effects of Enhanced Efficiency Nitrogen Fertilizers on Agronomic and Environmental Performance in Grain Corn - *Baillie Lynds*

Enhanced-efficiency nitrogen fertilizers (EENFs) have the potential to improve crop yield and nitrogen (N) use efficiency while reducing N loss and protecting the environment. There are different types of EENFs, including slow-release, control-release, and stabilized N fertilizers. Previous research showed that the impact of EENFs on greenhouse gas (GHG) emissions and grain yield is inconsistent, as the efficacy of EENFs is variable depending on the soil type, temperature, humidity, microbial activity, availability of water, and crop species. The efficacy of EENFs in cereals in Maritime Canada has not been well-documented. The objective of this project is to evaluate the effects of different types, rates, and split applications of EENFs on environmental and agronomic performance in grain corn at two sites in Maritime Canada over two years. Our preliminary results from the 2023 field trial conducted in Truro, Nova Scotia showed that (1) fertilizer treatments increased grain yield compared to no fertilizer control; (2) EENF reduced environmental impact without yield penalty; (3) reduced N rate did not impact grain yield; and (4) single application at planting did not affect grain yield and residual soil nitrate concentrations immediately after harvest compared to split applications. Our findings will provide recommendations to growers regarding the best type, and the optimum rate and N split application timings of EENFs in grain corn, and help improve food security and the sustainability of the agricultural industry overall.

6. Identification of Potential Metabolomic Biomarkers for Early Detection of *Haemonchus contortus* in Sheep **- *Hamza Jawad***

Haemonchus contortus, a highly pathogenic gastrointestinal nematode, poses a significant economic threat to the global sheep industry. Early detection is crucial for effective control, as current methods like fecal egg count often detect infections too late, leading to blind treatment and drug resistance. This study aims to identify potential biomarkers for early detection of subclinical H. contortus infection using Liquid Chromatography Mass Spectrometry metabolomics. Sixty Rideau Arcott ewe lambs (7-8 months old) were divided into four treatment groups using a 2 x 2 factorial design: Control Non-Drench (CT-ND, n=15), Control Drench (CT-D, n=15), Inoculated Non-Drench (IN-ND, n=15), and Inoculated Drench (IN-D, n=15). Inoculated groups received 5,000 L3 strain of H. contortus on day 0. Drenched groups were treated with ivermectin and fenbendazole on day 28 post-inoculation, while control and non-drenched groups received a water solution as sham treatment. Blood samples were collected on days -1, 7, 21, 28, 35, 42, and 57 from each individual animal for metabolite profiling at TMIC, University of Alberta (UofA). Fecal samples were also collected after each blood collection for identifying infection status. Metabolomic analysis revealed distinct blood metabolite profiles at different time points. At day 28 post-inoculation, 14 metabolites potentially involved in infection were identified by Partial Least Squares Discriminant Analysis and Random Forest Analysis, including PC ae C40:6, serotonin, kynurenine, trans-hydroxyproline, IAA, LysoPC a C18:2, tryptophan, C16:1, HPHPA, C4, C2, LysoPC a C24:0, methionine-sul, and LysoPC a C20:4. Notably, PC ae C40:6, serotonin, kynurenine, and trans-hydroxyproline showed significant p-values in t-tests ($p \leq 0.05$). By day 42 (2 weeks post-drench), analysis across treatments identified 9 differential metabolites (PC ae C40:6, SM(OH) C24:1, SM(OH) C14:1, LysoPC a C16:0, LysoPC a C14:0, methionine-sulfoxide, PC aa C32:2, PC aa C40:1, and C16:1). Comparing drench vs. non-drench groups at day 42 revealed 10 differential metabolites (SM(OH) C24:1, LysoPC a C20:4, LysoPC a C24:0, carnosine, SM(OH) C22:1, LysoPC a C14:0, HPHPA, PC aa C40:2, SM C18:1, and PC aa C38:0). These findings reveal dynamic changes in lipid metabolism and amino acid pathways during infection and treatment, with identified metabolites showing promise as potential biomarkers for infection status and drenching responses. Future analyses, along with logistic regression modeling, aim to identify top contributing metabolites, determine their functions, and discover potential biomarker candidates. This comprehensive approach seeks to develop a metabolite biomarker panel for early detection of subclinical gastrointestinal nematode infections, enabling targeted selective treatment and ultimately reducing expenses and production losses in sheep farming.

Keywords: Haemonchus contortus; Metabolomics; Potential Biomarkers; Anthelmintic resistance; Sheep parasitology

7. Discovering genes controlling ripening time in apple - Tommy Davies

The apple is an economically and culturally important fruit crop grown in temperate regions around the world. The apple stands to benefit greatly from modern genomics, including the application of genomics informed breeding and gene editing technologies. However, the discovery of the DNA sequences, or causal alleles, that control apple phenotypes remains as a key barrier to the rapid advancement of genomics informed breeding and gene editing in apple. The objective of this experiement is to advance the current state of knowledge in the areas of apple phenomics and genomics by leveraging the wealth of phenotypic and genetic diversity in Canada's Apple Biodiversity Collection (ABC). In this presentation, I outline the recent findings from a genome wide association study conducted using high depth DNA sequence data from 97 diverse samples from the ABC with the aim of discovering the causal allele for ripening time in apple. The results delimit a narrow region of the genome on chromosome 3 probable to harbour the causal allele for ripening time, and suggests that regulatory variants impact ripening time. Evidence of a regulatory variant impacting ripening time in apple at this locus is novel and represents a significant step for understanding the genetic control of ripening time in apple, which was previously thought to be controlled by a coding sequence

Session IV

1. Woodchip residues: A sustainable approach to improve boreal soils in Canada - *Shreemi Prabhakaran*

In response to climate changes, the application of manure with organic materials rich in carbon (C) content could be a sustainable approach to rapidly improve and maintaining healthy soils in the boreal region of Canada. However, there is limited information available on the effect of ramial chipped wood (RCW) residues with manure, a source of nitrogen (N), on soil health properties, such as the soil organic C, aggregate stability and microbial activity. A field study was conducted in Normandin (Quebec) comparing five treatments: unamended (control), inorganic fertilizer, liquid dairy manure (LDM), LDM combined with 24 t C ha-1 as RCW, and LDM combined with 48 t C ha-1 as RCW. Each treatment, applied in 2021 only, was replicated four times in a randomized complete block design. Barley undersown to a grass-legume forage mixture was sown in spring 2021. Soil samples were collected at 0-15 cm depth four times per growing season between 2021 and 2023, evaluating active C, soil pH, C:N ratio, aggregate stability, soil respiration (SR), and easily-extractable glomalin-related soil protein (EE-GRSP). Results indicate that treatments combining RCW with LDM significantly improved aggregate stability, pH, SR, and EE-GRSP by fall 2021. Notably, LDM plus 48 t C ha-1 as RCW resulted in significant enhancement across all soil health parameters by fall 2022 and 2023, demonstrating its effectiveness. Moreover, EE-GRSP exhibited a strong positive correlation with active C, pH, and C:N ratio. These findings highlight the potential of RCW as a sustainable soil amendments, offering insights for enhancing soil health in the boreal region soils of Canada.

2. Preliminary Survey of Wireworms in Potato Fields Adopting Regenerative Agricultural Practices and Examination of Wireworm Life-stage Markers - *Rachel Rix*

Wireworms, larvae of the click beetle (Coleoptera: Elateridae), are among the most serious and challenging pests to manage in agriculture, causing significant economic damage to a variety of high value crops. Wireworms are of particular concern in potato causing damage by creating small holes and tunnels in tubers, scarring the periderm. This reduces tuber yield, quality, and marketability, even at 10-15% damage. The subterranean distribution of wireworms makes detection and damage prediction challenging, and unlike above-ground pests that often immigrate to crops, wireworms may already be established in the soil at the time of planting. Larvae require several years to complete their development, where compounding generations may overwhelm a field. Modern agriculture is moving toward more sustainable farming approaches that improve crop quality and yields, reduce inputs with high carbon footprints, and improve farm biodiversity and farm resiliency in the face of climate change. These include regenerative agricultural approaches which aim to increase agricultural biodiversity by diversifying and increasing crop rotations and cover crops, improve soil health by reducing soil disruption and degradation through reducing or eliminating tilling, and reduce or alter the use of agrochemical inputs including fertilizers and pesticides. Movement away from traditional pest management practices can result in pest resurgence. It is thus imperative to monitor pest populations so proactive measures can be taken to prevent considerable crop damage. Furthermore, improved understanding of insect developmental stages and processes may help inform future pest management strategies. We present findings of our work focused on these two areas of wireworm study. We conducted a preliminary survey of click beetle/wireworm populations in 12 regenerative potato fields in NB. Sampling methods included light trapping for adults, and bait traps and soil coring for larval stages. We expected to find click beetles from the prolific Agriotes genus. Interestingly, we instead found click beetles from the Hypnoidus genus which are found to be in NB, and prolific in Quebec and the Prairies and known pests of agricultural crops. We also examined gene expression data generated from a transcriptome analysis of the most prolific wireworm species in the Maritimes, Agriotes sputator, to identify potential molecular signatures for early, middle, and late-stage larvae. We have identified marker genes involved in developmental processes including lipid synthesis, cytoskeletal and nervous system development, moulting and stage transition processes, and

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3. Developing decision support tools of growing season N mineralization to inform N management strategies in PEI - *Luke Laurence*

Producers on Prince Edward Island face multiple challenges with respect to applying soil-based nitrogen (N) credits to assist with supplemental N fertilizer recommendations. Challenges due to the lack of direct soil analysis, topographical and bioclimatic variability inherent with N mineralization, and the means to extrapolate predictions across their fields, all contribute to a producer's overall uncertainty when putting growing season nitrogen (GSN) mineralization estimates into practice. By strengthening predictions via machine learning, incorporating pedotransfer functions (PTFs) to address data gaps, and applying digital soil mapping (DSM) techniques to support spatial variabilities across a landscape, reliable estimates of GSN can be made accessible to producers to inform "right rate" N fertilizer recommendations.
Recently developed pedotransfer functions for nitrogen indices will be discussed as a possible solution for point-specific predictions based on a producers existing soil analysis. Transitioning from point estimates to spatial predictions (in-field or regional) via digital soil mapping techniques, the inclusion of particular data layers for climate, landscape, and soil management, etc. will be presented in the context of increasing the predictive strength of GSN estimates across a landscape. Finally, various strategies to make this information available to producers, and possible methods for implementing these estimates into N fertilizer prescriptions will be discussed with the concept of a tiered approach to N management

4. Development of a Cloud-Based IoT System for Livestock Health Monitoring using AWS and Python - *Harini Shree Bhaskaran*

This study develops a cloud based IoT system for monitoring the health of livestock using Amazon Web Services (AWS) and Python, addressing the increasing demands of digital agriculture. As the number of IoT devices in agriculture proliferates, issues of scalability and computational load have become prominent, necessitating efficient and scalable solutions. This research introduces a cloud-based architecture aimed at enhancing livestock health monitoring. This system is designed to track critical health indicators such as movement patterns, body temperature, and heart rate, utilizing AWS for robust data handling and Python for data processing and real-time analytics. The proposed system incorporates Narrow Band IoT (Nb IoT) technology, which is optimized for low-bandwidth, long-range communication, making it suitable for rural and remote farming locations. The architecture's scalability allows for effective management of varying numbers of IoT devices, which is essential for adapting to changing herd sizes and farm scales. Preliminary experiments conducted to assess the system's performance have demonstrated its durability and effectiveness, indicating a successful integration of AWS IoT Cloud services with the deployed IoT devices. Furthermore, the study explores the implementation of predictive analytics to facilitate proactive health management in livestock. By predicting potential health issues before they become apparent, the system can offer significant improvements in animal welfare and farm efficiency. The integration of cloud computing and IoT not only meets the growing technological needs of modern agriculture but also sets a new benchmark in the development of sustainable farming practices. The findings from this research could have broad implications for the future of livestock management, potentially leading to widespread adoption of technology-driven health monitoring systems in agriculture. This would help in optimizing the health management of livestock globally, thereby enhancing productivity and sustainability in the agricultural sector.

Keywords: Cloud Computing; Internet of Things (IoT); Livestock Health Monitoring; Predictive Analytics; Amazon Web Services (AWS)

5. Migration effect of pentachlorophenol wood preservative in soil and its effects on kale and lettuce growth - *Koushika Kumaresan*

Pentachlorophenol (PCP) is an oil-based preservative widely used to preserve wood in North America. However, Due to PCP's dangerous nature, it was included in the list of persistent organic pollutants (POPs) under the Stockholm Convention and phased out of the industry in 2023. This study evaluates the effect of PCP on crops such as kale, lettuce, and sunflower germination. This study has seven treatments, each with three replications: control, west coast oil (WCO) a combination of diesel (70%) and biodiesel (30%) the preservative carrier, and PCP treating solutions made using WCO with concentrations of 1.58%, 1.85%, 2.7%, 3.1%, and 4.6%. The seeds were soaked in each treatment for 24, 18, 12, 6, hours, and 1 minute and were placed in Petri plates, watered every two days once, and kept in the dark to germinate. When compared to control and WCO treatments, PCP substantially impacted the germination of all three plants. The germination % of kale, lettuce, and sunflower were 0.8%, 0.889%, and 0.267% respectively at 1.58% of PCP where control and WCO had more than 80% of germination in all three crops. The soaking time did not affect the germination, however, the concentrations such as 2.7%, 3.1%, and 4.6% had zero germination%. Other germination indices included mean germination time (MGT), mean germination rate (MGR), germination velocity (GV), germination rate index (GRI), and Germination index (GI) were also determined. The results compile with the previous studies where PCP has impacted the germination of different crops. Further studies need to be conducted to see the other growth and yield parameters and physiological and biochemical impact. The study will provide a basis for assessing the environmental impact of new wood preservatives, offer insights into their comparison with PCP, and guide future phytoremediation research.

Keywords: Pentachlorophenol, wood preservative, germination%, germination indices, soaking time.

6. Identification and nutritional analysis of phytoplankton species in the Bras d'Or Lakes, Nova Scotia - *Gracie Hanrahan*

Phytoplankton is the base of most marine food webs and almost all marine life depends on it for survival (Winder and Sommer, 2012). Knowledge of the phytoplankton community in an ecosystem is critical for understanding the natural diet of organisms that live there, including the American oyster (*Crassostrea virginica*). The Bras d'Or Lake, located in Nova Scotia, was previously the source of a thriving oyster industry before approximately 90% of the oyster population died from the oyster parasite, *Haplosporidium nelsoni* (Stephenson and Petrie, 2005). Understanding the natural diet of oysters in the area is key to restoring the population to help revive the industry. Dietary information will help local hatcheries develop feeding protocols for brood stock and larvae to try to restore the population. The purpose of this study was to identify phytoplankton species found in the Bras d'Or Lake using DNA sequencing as well as determining which would be a valuable food source for oysters through nutritional analysis. This research included extraction of DNA from phytoplankton in water and oyster digestive tract along with comparing nutritional composition of the isolated species. Three different locations were sampled across the Bras d'Or Lake each month for a total of 7 months to investigate differences in phytoplankton composition among different areas. Continued monitoring of phytoplankton in the Bras d'Or Lake and its nutritional composition is essential for a better understanding of the environment and the phytoplankton resources being used by oysters in these locations

Poster Presentations

1. Optimization and Key Performance Evaluation of Different Drying Technologies for Fruit Pomace Utilization – *Feba Thomas*

Fruit pomace is an underutilized by-product of fruit industries generated during juice or wine processing. Fruit pomace contains various valuable bioactive compounds such as dietary fiber, carbohydrates, phenolic compounds, polysaccharides, phytochemicals, peptides, vitamins, minerals, and other health-promoting nutrients. This gives improved cellular and metabolic activities in human health due to their anti-inflammation, antioxidant, anti-allergenic, and anti-carcinogenic properties. Numerous drying treatments can be employed to valorize these by-products into nutritional ingredients in a sustainable manner. There are numerous drying methods available, selecting the optimal method for by-product valorization depends on its nature and composition. From a quality perspective, drying must retain the taste, aroma, color, appearance, and nutritional value of the initial material. Apart from quality considerations, drying efficiency is another key factor for evaluating drying performance. Therefore, optimizing the drying technique for each category of fruit processing by-products should be based on key performance indicators such as economics, environmental, and social impact. The high perishable nature of fruit pomaces is the major challenge facing its efficient utilization. Therefore, immediate drying at the production site would be a key solution. In recent years, non-thermal drying technologies have become an emerging area of research. Based on numerous studies, non-thermal technologies have advantages over thermal technologies because of their energy efficiency and lower impact on nutritional quality. However, no comprehensive study of the key performance evaluation of different drying techniques for fruit pomace valorization is available. Therefore, this project aims to evaluate the key performance indicators of three different thermal and non-thermal drying techniques (freeze-drying, hot-air, and EHD drying). The drying kinetics, energy consumption, environmental impact, cost-benefit analysis, and product quality are considered as variables for key performance evaluation. This study would be essential in the decision-making process of different stakeholders to select a proper dryer based on performance matrices evaluation and opportunity cost.

2. Role of *Sinorhizobium meliloti* derived Flavins in Leaf Vegetable Growth Promotion - *Nivethika Ajeethan*

Riboflavin, commonly known as vitamin B2, is an essential element of living organisms and the precursor of flavin (FLs) cofactors. *Sinorhizobium meliloti* 1021 strain secretes FLs and was implicated in plant growth promotion. However, the mechanism of its plant growth promotion is not well understood. In this study, we tested the hypothesis that bacteria derived FLs are involved in the ability of *S. meliloti* 1021 to promote host-plant growth. We evaluated the growth and development of lettuce (*Lactuca sativa*) and kale (*Brassica oleracea* var. sabellica) plants inoculated with *S. meliloti* 1021 (FL^+) and its mutant 1021Δ*ribBA* (FL^-) with limited ability to secrete FLs. The results indicated that inoculation with FL^+significantly ($p < 0.05$) increased the length and surface areas of root and hypocotyl of the seedlings compared to inoculation with FL^-. We observed that there was 19% and 14% significant ($p < 0.05$) increase in total root lengths of kale and lettuce seedlings, respectively, following the inoculation with FL^+ and compared to that of FL^-. Total phenolics and flavonoids contents of the leaf tissues were significantly ($p < 0.05$) increased with bacterial FLs secretion. Moreover, the inoculation with FL^+ apparently improved plant growth compared to the inoculation with FL^- plants. Overall, we demonstrated that the secretion of FLs contributes to bacterial plant growth promoting functions. Future investigation will use proteomic and metabolomnic approaches combined with plant physiological responses to better understand host-plant responses to bacteria-derived FLs.

Keywords: bacteria-derived flavins; plant growth regulation; riboflavin; lettuce; kale

3. Impactful Social Change: Exploring The Legitimacy of Social Entrepreneurship In Canada Through The Context of School Food Programs - *Victoria Dimick*

Evidence shows that school food programs are one of the smartest long-term investments a government can make (Fraser & Ruetz, 2019; Ruetz et al., 2022; World Food Programme, 2020). Until April 2024, Canada was one of the only industrialized countries without a national school food program. Instead the landscape of SFPs in Canada was fragmented and heavily reliant on non for profits and limited funding sources, resulting in inequitable access and compromised sustainability and effectiveness. Canada is facing a growing demand for NPO services and subsequent social deficits, resulting in a pressing need to develop alternative solutions to address its complex social issues. Social entrepreneurship's ability to bridge the gap between the for-profit and non-profit sectors, while simultaneously generating social impact and economic value, positions it as a valuable agent of change in advancing the cause of SFPs in Canada. This research investigates the perceived legitimacy of social entrepreneurship as a viable approach to addressing social issues, specifically in the context of delivering of school food programs in Canada. The study aims to understand how this perceived legitimacy impacts the effectiveness and sustainability of social entrepreneurship in contributing to social issues. The methodology involves qualitative semi-structured interviews with stakeholders in the Canadian food industry, including social entrepreneurs. Narrative analysis will be used to examine the interview transcripts, providing insights into the factors influencing the perceived legitimacy of social entrepreneurship. By exploring the role of social entrepreneurship in school food programs, this research aims to highlight its potential to address food security and develop sustainable solutions. Understanding these dynamics is crucial for enhancing the legitimacy of social entrepreneurship initiatives, ultimately fostering positive social change on a broader scale.

4. Waste-to-Biofuel: Innovations in Thermochemical Valorization of Agro-Food, Forestry and Plastic Residues - *Prakhar Talwar*

An increase in the global population has led to an unparalleled rise in energy demands and municipal solid waste generation. Meanwhile, the escalating usage of fossil fuels leads to massive greenhouse gas emissions leading to global warming and environmental degradation. A shift towards renewable resources for energy generation can offer a sustainable approach to reducing the demands for fossil fuels, reducing greenhouse gas emissions and effectively managing municipal solid waste. This poster will highlight the geographical abundance and physicochemical properties of agricultural biomass, forestry residues and plastic wastes in Canada and the world. This poster will also showcase different thermochemical technologies such as torrefaction, pyrolysis, gasification and liquefaction capable of transforming agro-food and plastic residues into solid, liquid and gaseous biofuels. Recent innovations, challenges and opportunities for scale-up and commercialization of these technologies will also be presented. The effects of process parameters such as temperature, heating rate, reaction time and feedstock composition on biofuel yields and properties will be presented. Finally, the relevance of biofuels to the United Nations Sustainable Development Goals and Canada's Net-Zero Goals, their broad industrial applications as well as environmental and socio-economic benefits will be emphasized in this work.

5. AI-Driven Benchmarking Tool for Methane Emissions in Dairy Cows Using Satellite Imaging - *Hanqing Bi*

This project aims to establish a benchmark for the dairy industry by analyzing methane emissions from both farms and processors. The dataset used includes methane data from the Sentinel-5P satellite, spanning from 2016 to 2023, and covers 575 farms and 385 processors. Our analysis reveals that the total methane emissions are highest in the autumn, followed by summer, with winter having the lowest emissions. Separate analyses for farms and processors show similar trends; however, during the summer, farm emissions are below average while processor emissions are above average. We also compared emissions before and after the COVID-19 pandemic, finding that post-COVID emissions are significantly higher than pre-COVID levels. Finally, we used an LSTM model to predict methane emissions for both farms and processors, using a sliding window approach to construct the dataset. This study provides a scientific basis for assessing the environmental impact of the dairy industry and helps in formulating more effective emission reduction strategies.

6. Decoding Poultry Communication: Time-Series and Semantic Analysis of Vocalizations Under Stress - *Venkatraman Manikandan*

Our study delves deeply into the realm of poultry vocalization, a field often underestimated for its complexity and communicative richness. Beyond mere sounds, these vocalizations encompass a spectrum of calls expressing emotions, warnings, and social dynamics within flocks. Employing advanced deep learning techniques, we decode the intricate sounds of poultry, ranging from clucks to cackles, to understand their emotional and social contexts. Our methodology transforms auditory data into spectrograms, segments these into analytical windows, and applies deep learning combined with semantic and natural language processing techniques. This includes sentimental analysis, a critical tool for interpreting the underlying emotions expressed in these vocalizations, thus offering a profound understanding of poultry psychological states. This research provides valuable insights into poultry welfare, revealing stress levels and social dynamics within flocks. Recognizing these vocal cues opens pathways to enhance farming practices, aimed at reducing stress and anxiety among poultry. Our non-invasive approach promotes humane and sustainable farming practices, prioritizing animal welfare without compromising environmental health. The implications of this research are far-reaching, marking a significant advancement in our understanding of poultry behavior. It paves the way for improved living conditions in agricultural settings, aligning animal husbandry with ethical and sustainable principles. Our findings also suggest potential applications in automated monitoring systems, where continuous vocalization analysis could provide real-time indicators of flock health and well-being. This technological integration could revolutionize poultry farming, making it more responsive and adaptive to the needs of the animals. Such advancements underscore the importance of interdisciplinary research in enhancing animal welfare and agricultural sustainability.

7. Detecting Lameness in Dairy Cows Using Wearable Accelerometers and Facial Recognition Technology - *Yashan Dhaliwal*

Lameness is a painful condition that causes dairy cows to alter their gait to minimize weight on the affected limbs. As the third most economically significant health issue in dairy herds after fertility and mastitis, lameness affects 35% of dairy cattle in Canada. This study leverages artificial intelligence (AI) to analyze bimodal data—visual (images and videos) and accelerometer data—for the early detection and prediction of lameness in dairy cows. In the first phase, facial biometric data from six Holstein cows was collected over 21 days at the Ruminant Animal Centre (RAC) at Dalhousie Agricultural Campus in Truro, Nova Scotia. Data was gathered tri-daily—morning, afternoon, and evening—to capture natural variations in facial expressions and movements. The tri-daily schedule encompassed capturing cow images and videos under various contextual settings: before and after exercise in the morning, before and after feeding at noon, and during rest in the evening. This phase resulted in a dataset comprising 7000 images and 1000 videos. Concurrently, accelerometer data from four cows was collected using Fibion Sens motion sensors.

We conducted a correlation analysis between the accelerometer data and images to identify patterns indicative of lameness. A DenseNet AI model was developed to process and analyze this bimodal data. Our results clearly show that integrating bimodal data—visual and accelerometer—enhances the early detection of lameness by revealing new features. These new features include:

Facial Tension Indicators - Changes in facial muscle tension and expressions that correlate with pain and discomfort.
Gait Abnormalities - Detailed analysis of walking patterns, including step length and symmetry.
Activity Variations - Differences in daily activity patterns, such as resting and movement times.
Behavioral Changes - Indicators of altered behavior, such as reluctance to move or changes in standing postures.

These features, not observable through a single data modality, enable more accurate and early detection of lameness. Our AI model allows for timely veterinary intervention and management adjustments, ultimately improving cow welfare and reducing economic losses in dairy farming.

Keywords: Lameness; Dairy Cows; AI; Facial Expression Analysis; Accelerometer Data; Early Detection; Bimodal Data; Predictive Model

8. Analyzing Dairy Cow Behavior with Large Language Models and Computer Vision Techniques - *Hariesh Sivakumar*

In our study, we harness Large Language Models (LLMs) to explore dairy cow behavior, introducing an innovative approach to farm management rooted in computer science and advanced algorithms. This study holds significant importance as it seeks to revolutionize traditional farm management. LLMs outperform in interpreting human-language prompts, enabling seamless interaction for users without technical expertise.

The research methodology integrates the training of LLMs with sophisticated deep learning algorithms. These algorithms meticulously process diverse datasets, including audio recordings, video footage, and sensor data. By identifying nuanced behavior patterns, we establish baseline metrics for early issue detection, utilizing anomaly detection algorithms. Furthermore, a user-friendly interface facilitates dynamic interaction, enabling users not only to query but also to instruct LLMs for further analysis.

Compared to conventional observation techniques, our algorithm-driven approach significantly enhances precision and efficiency in farm management. This research pioneers the fusion of humane treatment and computational efficiency at the technology-agriculture intersection. Continuous advancements in data monitoring will offer real-time insights into dairy cow behavior. Leveraging machine learning algorithms for anomaly detection and predictive modeling creates a perpetual feedback loop, enabling prompt interventions when potential issues arise. This approach mitigates health risks and optimizes farming practices by leveraging computational insights. As we explore the synergy of computer science and agriculture further, we envision a landscape where dairy farming prioritizes animal welfare, maximizes productivity, and sustains a new industry standard.

9.Enhancing Dairy Cow Biometric Identification with AI and Data Analytics for Precision Livestock Farming - *Shubhangi Mahato*

Earlier, farmers relied on methods like tattoos, ear notching, and hot iron branding to identify their animals. These methods, while traditional, brought pain to the cattle and weren't foolproof. In places like Alberta, branding is used on about 20% of beef cattle but is banned across Europe. The search for a better way has led us to a crossroads between farming and artificial intelligence. Nowadays, we're using fancy technology called artificial intelligence (AI) to help farmers out. Computers are learning to recognize cows based on their unique facial features. Instead of physical tags, each cow gets a digital tag based on unique patterns and shapes of bovine faces, such as ear shape, eyes, muzzle pattern, ear veins connecting to brain, breath in and breath out thermal signatures and more. We can provide a non-invasive, real-time identification system for categorizing cattle into groups such as pregnant, two years old or younger, dry cow, and high milking cow. But no journey is without its challenges. The cows don't always face the camera, additionally, the farm's varying lighting, weather, and obstructions further complicate the picture. With the advancement in technology, we can train our AI models to become precise and efficient by giving dataset of several thousand cattle images. The data sets used for training the model come from local farms of Nova Scotia, Canada. Images and Videos of around 250 cows, which including Holstein and Jersey breads will be used for the same. This isn't just about technology; it's about building decision support for farmers. It's about turning a farm into a nurturing community where every cow is known, understood, and cared for.

10. Assessing Dairy Cow Emotions Through Video and Image Analysis - *Christopher Gonzalez*

Our research aims to leverage AI to enhance dairy cow welfare by detecting their emotional states, which directly affect their health and productivity. To identify these states, we utilize a comprehensive multimodal dataset. This dataset includes audio recordings of various call types, including stress-related ones, captured by high-sensitivity microphones. Additionally, we gather images using high-resolution cameras that provide detailed insights into facial expressions, ear positions, and body postures. Wearable sensors further augment our data by monitoring physiological parameters such as heart rate variability, respiratory patterns, and body temperature.

We employ machine learning techniques, including deep learning with convolutional and recurrent neural networks, to train our model to recognize and classify cows' emotional states. These models analyze the nature and intensity of emotions using the multimodal dataset and physiological indicators like ear postures and eye white visibility. Our system offers continuous real-time monitoring, displaying data and issuing alerts for stress or negative emotional states, thus enhancing animal welfare.

To ensure the highest accuracy, we validate our AI findings against traditional observational methods and veterinary assessments. Ethical considerations are integral to our research, including secure data storage and adherence to relevant standards. We also provide farmer training to ensure effective system use and accurate data interpretation. This innovative approach reduces animal stress, minimizes the need for human intervention, and facilitates continuous welfare assessment, leading to more precise dairy farming.

11. Decoding Dairy Cow Vocalizations - Leveraging NLP and WHISPER Models for Non-Invasive Welfare Monitoring – D*r. Suresh Neethirajan*

Our groundbreaking research employs advanced AI to enhance dairy cow welfare by decoding their vocalizations. We isolated 20 cows for four hours post-milking, capturing extensive vocal recordings with high-sensitivity microphones. These recordings, analyzed for frequency, duration, and intensity, revealed distinct categories reflecting specific emotional states, such as frustration and stress. Using the WHISPER model and sophisticated NLP techniques, including the BERT model, we effectively classified these vocalizations. This non-invasive approach provides detailed insights into the cows' emotional well-being, surpassing traditional welfare assessments that rely on direct human observation, which can often induce stress. By implementing real-time monitoring with these AI techniques, we significantly improve the responsiveness and precision of welfare interventions, minimizing the need for human interaction and thus reducing animal stress. Our research highlights the potential of NLP tools to recognize and interpret complex animal vocalizations, paving the way for advancements in automated animal welfare monitoring systems. Decoding the language of dairy cows not only enhances their welfare but also equips farmers with actionable insights. This methodology aligns with the trend towards more humane and scientifically informed agricultural practices, particularly within the smart farming paradigm. By integrating these advanced technologies, we aim to foster a more sustainable and empathetic approach to dairy farming.

12. Exploring the role of bacterial synthetic communities in alleviating drought stress by shaping trophic interactions and enhancing soil health and plant resilience - *Taylar Austin*

As Canada aims to meet stringent emission and carbon targets by 2030, sustainable agricultural practices are essential. This research explores the potential of bacterial synthetic communities (SynComs), isolated from the rhizosphere of forage plants in drought-prone fields, to alleviate drought stress in forage plants under greenhouse conditions. The study investigates how these SynComs shape trophic interactions among nematodes, bacteria, and fungi and whether these interactions can be linked to improvements in soil health and plant resilience. By inoculating forage plants with SynComs, we aim to observe changes in plant stress responses and identify patterns in microbial community interactions. This study includes higher trophic-level organisms, such as nematodes, which are highly sensitive to soil moisture levels due to their reliance on water films in soil for mobility and survival. The impact of drought on nematodes and their subsequent effect on bacteria, archaea, and fungi is largely unknown. Microscopic and molecular techniques will be employed to identify nematode communities. Soil samples will be analyzed for physicochemical properties, including soil organic matter turnover, nutrient cycling, microbial diversity, and community structure. The expected outcomes include identifying key microbial interactions that enhance plant growth and stress tolerance and providing a scientific basis for sustainable agricultural practices that mitigate the impacts of climate change. This approach aims to validate the efficacy of SynComs in promoting soil health and plant resilience, ultimately supporting the development of innovative ecosystem management and conservation strategies. By focusing on the resilience and stability of these microbial communities, the research seeks to uncover critical insights into how SynComs contribute to soil health, plant growth, and ecosystem sustainability.

13. Optimal Temperature Range and Time of Harvest to Optimize Wild Blueberry (*Vaccinium angustifolium* Ait) Fruit Quality for the Fresh Market - *Muhammad U. Asif*

Considering temperature conditions plays a crucial role in maximizing the fruit quality during wild blueberry (*Vaccinium angustifolium* Ait.) harvesting. This study explores the optimal temperature ranges for harvesting wild blueberries using three harvesting methods: Hand rake (HR), Walk-behind (WH), and Mechanical harvester (MH). The study was conducted in commercial wild blueberry fields in central Nova Scotia. The daytime temperature was categorized into four ranges TH-1 (10-15°C), TH-2 (16-21°C), TH-3 (22-27°C), and TH-4 (28-33°C) for harvesting wild blueberries using HR, WH, and MH. The harvested berries were categorized into four categories including undamaged berries, bruised berries, cut or split berries, and debris, and the impact of temperature on berries quality for each harvesting method was investigated. One-way ANOVA analysis identified that the temperature range TH-1 and TH-2 was most conducive to achieving high-quality berries across all harvesting methods. Based on the results, the maximum (80%) yield of good quality berries was achieved within the temperature range of 15-25°C, especially during early morning and early afternoon. This study proved that early morning and early afternoon harvesting is best for optimizing fruit quality and farm profitability. To enhance results will play a pivotal role for blueberry growers, offering sustainable practices for enhancing fruit quality. This research bridges the knowledge gap related to the implications of temperature during harvest on the blueberry quality.

Keywords: Wild blueberry quality, temperature, harvesting methods, bruising, fruit quality, farm profitability