3rd biennial

Our Food, Our Future.

Research that Feeds Newfoundland and Labrador

Holiday Inn, St. John's

November 2 - 3

Newfoundland and Labrador

Multidisciplinary Agricultural Research

Building Partnerships

Identifying Knowledge Gaps

Agenda

November 2-3, 2016

Holiday Inn, St. John's, Newfoundland and Labrador

Wednesday, November 2

8:00 a.m. | Continental Breakfast

8:30 a.m. | Welcome and Introductions

Opening Remarks
Agrifoods Development Branch

Greetings from Memorial University of Newfoundland (MUN)
Dr. Gary Kachanoski, President, MUN

Greetings from the Newfoundland and Labrador Federation of Agriculture (NLFA)
Melvin Rideout, President, NLFA

9:00 a.m. | ***A Portrait of Agriculture in Newfoundland and Labrador***
Dave Jennings, Director, Agrifoods Development Branch

9:30 a.m. | ***Newfoundland and Labrador Food Security***
Kristie Jameson, Executive Director, Food First NL

9:45 a.m. | ***Provincial Agriculture Research and Development - Update***
Sabrina Ellsworth, Manager of Agricultural Research, Agrifoods Development Branch

10:00 a.m. | ***Networking Break and Poster Viewing***

Societal Research and Cultural Aspects of Food

10:15 a.m. | ***Home Gardens and Agricultural Policy***
Dr. Lynne Philips, Dean of the Faculty of Humanities and Social Sciences, MUN

10:30 a.m. | ***Exploring Health-Promoting Innovation in the Food System: Healthy Corner Stores to Promote Healthy Eating in Rural Newfoundland and Labrador***
Lisa Woodrow, Registered Dietitian
Stephanie Pomeroy, Project Coordinator, Healthy Corner Stores NL

10:45 a.m. | ***Charting a Course to a Diverse Agriculture Sector in NL: A Survey***
Dr. Ivan Emke, Associate Professor, Social Cultural Studies, MUN-Grenfell Campus and Associate Vice-President of Research (Interim)

11:00 a.m. | Questions and Discussion

Agriculture Means Business – Productivity Growth Opportunities

11:15 a.m. | ***How Does Growing NL's Agricultural Sector Make the Rural Economy Bloom***
Dr. Catherine Keske, Associate Professor, MUN - Grenfell Campus

11:30 a.m. | ***Agricultural Research Investments and their Impacts on Agricultural Productivity***
Dr. Paul Heisey, Agricultural Economist, United States Department of Agriculture

12:00 p.m. | Questions and Discussion

12:15 p.m. | ***Lunch (to be provided) and Poster Viewing***

Sustainable Agriculture Production

1:30 p.m. | ***The Value of Crop Modelling for Comprehensive Agricultural Development and for Identification of Research Priorities***
Dr. Gerrit Hoogenboom, Preeminent Scholar, Institute for Sustainable Food Systems, University of Florida

2:00 p.m. | ***Local Livestock Feeding Opportunities***
Dr. Vanessa Kavanagh, Research Scientist, Agrifoods Development Branch

2:15 p.m. | ***Production and Improvement of Small Fruit Crops Native to Newfoundland and Labrador***
Dr. Samir Debnath, Research Scientist, AAFC

2:30 p.m. | ***Evaluating Biomass Production Potential of Silage Corn (Zea Mays L.) Genotypes under Varying Manure Based Phosphorus Applications in Newfoundland***
Dr. Mumtaz Cheema, Associate Professor, Boreal Ecosystems and Agricultural Sciences, MUN-Grenfell Campus

2:45 p.m. | ***Potential of Mixed Cropping Systems as a Source of High Quality Forage Production in Newfoundland and Labrador***
Dr. Raymond Thomas, Associate Professor, Boreal Ecosystems and Agricultural Sciences, MUN-Grenfell Campus

3:00 p.m. | Questions and Discussion

3:15 p.m. | ***Networking Break and Poster Viewing***

Voices from the Field – Industry Perspectives

3:30 p.m. | ***The Impact of Research on Farms***
Ian Richardson, Larch Grove Farms, Chair, Dairy Farmers of Newfoundland and Labrador

3:45 p.m. | ***The Biggest Tiny Sector in the World. Icelandic Agriculture - Challenges and Opportunities***
Sindri Sigurgeirsson, Chairman of the Icelandic Farmer's Association

4:15 p.m. | Questions and General Discussion

4:30 p.m. | Wrap up

Banquet

7:00 p.m. - November 2

Representative from the Department of Fisheries, Forestry and Agrifoods

Keynote Speaker | Dr. Steve Savage

The Role of Modern Science in Growing a Sustainable Agriculture Industry

Poster Viewing and Networking

*** Dinner (provided) will highlight local Newfoundland and Labrador ingredients | Cash bar will begin at 6:00 p.m. ****

Thursday, November 3

8:00 a.m. | Continental Breakfast

8:30 a.m. | Welcome

Soil and Water Management

8:45 a.m. | ***What is Agriculture?***
Dr. Adrian Unc, Associate Professor, Boreal Ecosystems and Agricultural Sciences, MUN-Grenfell Campus

9:00 a.m. | ***Treatment of Agricultural Tile Drainage Water in a Pilot Scale Woodchip Bioreactor System***
Dr. Lordwin Jeyakumar, NSERC Visiting Scientist, AAFC

9:15 a.m. | ***Soils and Agriculture under Global Geographical Northwards Shift in Climate Properties***
Myron King, Research Associate, Environmental Policy Institute, MUN-Grenfell Campus

9:30 a.m. | Questions and Discussion

Funding Opportunities to Enhance Agricultural Growth

9:45 a.m. | Research and Development Corporation (RDC) - Mark Ploughman, CEO
Growing Forward 2 – Donna Musseau, Manager, Cost Shared Programs
Department of Business, Tourism, Culture and Rural Development – Jim Anstey, Avalon Region Director
Atlantic Canada Opportunities Agency (ACOA) – Lori Kennedy, Account Manager

10:15 a.m. | ***Networking Break and Poster Viewing***

Plant and Animal Health

10:30 a.m. | ***Insect Research in NL Agriculture: the Good, the Bad and the Ugly***
Dr. Peggy Dixon, Research Scientist, AAFC

10:45 a.m. | ***Natural Defenses against Plant Diseases***
Dr. Linda Jewell, Research Scientist, AAFC

11:00 a.m. | ***Studies on Mycobacterium avium subspecies paratuberculosis: The Causative Agent of Johne's Disease in Cattle and Sheep***
Dr. Kapil Tahlan, Assistant Professor, Department of Biology, MUN

11:15 a.m. | Questions and Discussion

Research Success and Opportunities for Growth

11:30 a.m. | ***The Creation and Evolution of the Cranberry Industry in NL***
Fabian Power, President, Cranberry Association of Newfoundland and Labrador

11:45 a.m. | ***Cultivating Connections: Sowing the Seeds of the Supply Chain***
Crystal-Lynn Anderson Baggs, Market Development Officer, Agrifoods Development Branch

12:00 p.m. | Questions and Discussion

12:15 p.m. | ***Lunch (to be provided) and Poster Viewing***

Integrating Knowledge Acquisition and Transfer for Agricultural Development

1:00 p.m. | ***Integration of Research, Knowledge Transfer and Agricultural Education within Teagasc***
Paddy Browne, Head of Crops, Environment and Land Use Program, Teagasc, Ireland

1:30 p.m. | ***Lessons from Vermont: Identifying an Agricultural Niche***
Dr. Deborah Neher, Professor and Chair, Department of Plant and Soil Science, University of Vermont

2:00 p.m. | Questions and Discussion

2:15 p.m. | ***Identifying Knowledge Gaps and Next Steps***

3:45 p.m. | ***Panel Session***
Dave Jennings, Ian Richardson, Dr. Ivan Emke, Paddy Browne and Dr. Paul Heisey

4:30 p.m. | ***Closing Remarks***
Keith Deering, Assistant Deputy Minister, Agrifoods Development Branch
Dr. Ivan Emke, Associate Professor, Social Cultural Studies, MUN-Grenfell Campus and Associate Vice-President of Research (Interim)

Speaker Profiles and Presentation Abstracts

> Dave Jennings, M.Sc. P.Ag.

Director
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Department of Fisheries, Forestry and Agrifoods
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Dave Jennings has worked in the Newfoundland and Labrador Agricultural industry as a part time farmer and employee of Agriculture Canada, the Canadian Food Inspection Agency and the provincial Department of Fisheries, Forestry and Agrifoods. Dave is currently the Director of the Production and Market Development Division of the Agrifoods Branch. In this capacity, Dave is responsible for the Research and Development Program of the Agrifoods Branch and is the Chair of the Provincial Agricultural Research and development Program Implementation Committee. Dave graduated from Memorial University with a B.Sc. in Biology with a concentration in Parasitology and from McGill University with a Master of Science in Plant Pathology.

A Portrait of Agriculture in Newfoundland and Labrador

From very humble beginnings in the second half of the 18th century, agriculture has continued to evolve in the Province of Newfoundland and Labrador. The first permanent European settlers that arrived, primarily in the region surrounding St. John's, created small vegetable and livestock operations that supported their fishing livelihood. This activity increased throughout the first half of the 19th century and peaked with approximately 400 farms on the northeast Avalon. Subsistence agriculture consisting of small mixed crop and livestock production within small and often remote fishing communities continued to define this province's agriculture industry right up to Confederation with Canada in 1949. Since Confederation, the people of the province became largely dependent on imported foods from neighboring provinces. The exception to this was the three supply managed agricultural commodities, milk, chicken, and eggs. Provincial production of these products is guaranteed by a national quota system that ensures that the province gets a per capita share of production. The challenges of world food supply, climate change and transportation issues have recently highlighted the importance of local food production in addressing what is becoming a more apparent food security deficit in the province. Also becoming apparent is the major role that a more efficient and competitive sector could play in growing and sustaining the economy of the province.

> Kristie Jameson

Executive Director
Food First NL
kristie@foodfirstnl.ca

Kristie Jameson is the Executive Director of Food First NL, a non-profit organization which aims to increase access to healthy food in Newfoundland and Labrador. Kristie sits on the Advisory Board for the Leslie Harris Centre for Regional Policy and Development, the Advisory Board for Farm to Cafeteria Canada, and is a founder and co-chair of the St. John's Food Policy Council. Kristie holds a Baccalaureate of Commerce with Honours from the University of Guelph. She is an alumni of the Governor General's Canadian Leadership Conference (2015) and was a nominee for the YWCA's Women of Distinction Award (2016).

Newfoundland and Labrador Food Security

Food Security in Newfoundland & Labrador is complicated. NL relies heavily on outside food sources. Numerous communities lack full grocery stores, leaving residents dependent on convenience stores or transportation to the closest grocery store to buy food.

Many households struggle to afford enough healthy food and depend on food banks to access food. Residents living in remote regions of the province also face barriers accessing healthy wild food. With so many challenges facing the people of this province, it is not surprising that NL has the lowest rate of consumption of vegetables and fruits in Canada, as well as the highest rates of diabetes and obesity. These factors highlight the current food security challenges faced in NL.

In recent years, there has been incredible growth in interest and action on food security in the province. With more community organizations, businesses, governments, researchers, and citizens working on this issue, the time is right for further, collaborated action to further advance this issue.

During this session, Kristie Jameson (Executive Director of Food First NL) will provide an overview of the NL food system, discuss current initiatives underway across NL, and highlight opportunities for further action to advance food security and improve access to healthy food in the province.

> **Sabrina Ellsworth, M.Sc, P.Ag.**
Manager of Agricultural Research
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Sabrina Ellsworth was born and raised in Corner Brook, NL. She received her Bachelor of Science in Agriculture with a major in Animal Science from the Nova Scotia Agricultural College (Dalhousie University, Faculty of Agriculture) in 2002 and a Master of Science (Environmental Science) in 2005 from the same institution. She has since work with the Nova Scotia Department of Agriculture, Atlantic Swine Research Partnership and Nova Scotia Soil and Crop Improvement Association as program coordinator with the Greenhouse Gas Mitigation and Shelterbelt Programs. Since returning to Newfoundland in 2008, Sabrina has held several positions within the Provincial Government; Research Scientist, Crop Specialist, Soil Fertility Specialist, Manager of the Institute of Biodiversity, Ecosystem Science and Sustainability and now for the last 4 years, Manager of Agricultural Research with the Department of Fisheries, Forestry and Agrifoods.

Provincial Agriculture Research and Development - Update

The government of Newfoundland and Labrador invests in research and development activities that enhance the diversification and profitability of the agriculture sector in the province. The applied science being conducted by provincial scientists results in new crop varieties, knowledge of local livestock and crop management practices; the development of best management practices to enhance environmental sustainability on farms; improving competiveness in the market place; and supporting knowledge transfer and outreach. This presentation will provide an overview of the work being carried out by the Province that is enhancing production and sustainability of Newfoundland and Labrador farms.

> Dr. Lynne Phillips

Dean, Faculty of Humanities and Social Sciences
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Lynne Phillips is the Dean of the Faculty of Humanities and Social Sciences and the convenor of FARM (Food Advocacy Research @ Memorial). She is a proud member of the Portugal Cove-St. Philips' Community Garden.

Home Gardens and Agricultural Policy

This presentation focuses on the policy lessons that can be learned from an examination of the role of the home/kitchen garden in NL rural households. In the pre-1949 period, home gardens were critical to family members' ability to eat a balanced diet, and many organizations, including the Women's Guilds, Home Economists and the Adult Education movement, played a key role in nurturing their use. In the second half of the last century, government policy-makers and agricultural field men, with eyes only for commercial agriculture, virtually ignored home gardens as a source of food. It was also assumed that rural folks found home gardening onerous work, and would willingly abandon gardening as soon as the opportunity arose to access food through other means. Yet, there is plenty of evidence that people took pride in their gardens, to the extent that they were often deeply distraught about leaving their gardens behind during the resettlement years. Today, home gardens – and a permutation of it, the community garden – are alive and well in the province. Yet policy that could support the home garden as a source of good food lags behind. I suggest that, in this time of high dependence on processed and canned food, agricultural policy needs to look more closely at the home garden both as a source of nutrition and as a foundation for establishing greater food literacy in the province.

> Lisa Woodrow, RD

l.woodrow@mun.ca

Lisa Woodrow has been a practicing Registered Dietitian since 2012 and is currently living and working in St. John's, NL. She completed her undergraduate degree in Applied Human Nutrition at Mount Saint Vincent University in Halifax, NS and has recently completed her Master's in Public Health at Memorial University of Newfoundland. Lisa's experience with nutrition and public health have been focused on food security in rural communities and the role that the retail environment can play in healthful eating and access to healthy options. Lisa has a particular interest in connecting with local food producers to increase access and availability of healthy options in the retail setting.

> **Stephanie Pomeroy, MPH**
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Stephanie received a B.Sc. in Biochemistry Nutrition from Memorial University in 2014. She then went on to complete the Master of Public Health program at Memorial in 2015. Stephanie began work as a practicum student at the Food Policy Lab on the Healthy Corner Stores NL pilot project; since then she has moved into the role of Project Coordinator. Her broad research interests include further understanding retail food environments, with an especially keen interest in reducing sugar-sweetened beverage consumption, particularly amongst children.

Exploring Health-Promoting Innovation in the Food System: Healthy Corner Stores to Promote Healthy Eating in Rural Newfoundland and Labrador

> ***Lisa Woodrow[1, 2], Stephanie Pomeroy[1], and Catherine L. Mah[1, 3]***

[1]Division of Community Health and Humanities, Faculty of Medicine, Memorial University of Newfoundland, St. John's, NL
[2]Eastern Health, St. John's, NL
[3]Dalla Lana School of Public Health, University of Toronto, Toronto, ON

The food environments where we live, work, and play are important in shaping dietary behaviors such as purchasing and consumption and have been shown to influence the health of populations in rural and remote communities. Many communities in Newfoundland and Labrador do not have reasonable access to full service grocery stores and therefore rely on corner stores or convenience stores as their main source for food purchasing.

This presentation will discuss the development and implementation of an innovative health-promoting in-store branding campaign and a nutrition education manual with store owners and employees of a rural convenience store, as part of healthy merchandising activities in the Healthy Corner Stores NL project (Food Policy Lab at Memorial University, Food First NL, and Eastern Health). We will discuss the collaborative development process led by Registered Dietitians, store champions, community organizations, and researchers. We will then highlight lessons learned from the campaign as well as related recommendations to strengthen food security in our province. In particular, we will explore opportunities for strengthening local agriculture in this area of the food system.

> **Dr. Ivan Emke**
Associate Professor, Social Cultural Studies/ Associate Vice-President of Research
Memorial University of Newfoundland, Grenfell Campus
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Ivan Emke was born and raised, along with a variety of mixed livestock, on a farm in Bruce County, Ontario. He has fond memories of skipping school to exhibit sheep and cattle at Fall Fairs throughout that region.

He studied at three Universities (Ohio State, Windsor and Carleton), receiving degrees in Anthropology, Communication, Public Relations and Sociology (with a focus on Cultural Studies). Since 1993, he has worked at Grenfell Campus of Memorial University, teaching in Social and Cultural Studies and serving in administrative appointments. He is currently Associate Vice-President of Research and Facilitator for Internationalization.

In terms of research, he has participated in several regional, national and international research groups which are focused on rural issues and community sustainability. And (in a whole different area) he studies the effects of our modern funeral industry on our rituals around death and remembrance.

Charting a Course to a Diverse Agriculture Sector in NL: A Survey

While subsistence agriculture has been part of the pattern of self-provisioning for centuries in Newfoundland and Labrador, more extensive agriculture is a rather new entrant to the province. Currently, about 90-95% of all food consumed in the province is shipped in from elsewhere. This is partly a result of the climate and soil conditions, but also due to cultural patterns, commercial relationships in the food distribution system, economies of scale and transportation links (among others factors).

Thus, agriculture is in a building phase in the province. While this development may seem daunting, it is actually a tremendous opportunity to develop a diverse and resilient industry, and avoid some of the excesses of other areas.

However, a relevant factor in the unfolding of this development relates to the lively interplay of public opinions, from a variety of positions (consumers, producers, government regulators, researchers, industry groups). These groups may differ on questions such as: "what are the appropriate strategies for growth;" "what crops, secondary products, and niche markets should be exploited;" and, "what are the best geographic locations of models that should be used for agriculture in NL' (e.g., other parts of Canada, or places to the north and east of the province, such as Norway or Iceland)?

This research provides a snapshot of public opinion in these matters. It is based on an internet survey of a variety of public groups, presented as a way of enriching the conversation around the development potential of agriculture in this province.

> **Dr. Catherine Keske**
Associate Professor
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Dr. Catherine Keske is an Associate Professor at the Grenfell Campus of Memorial University in the School of Science and the Environment. She holds a Ph.D. in agricultural and resource economics from Colorado State University and a MSc. in mineral economics from the Colorado School of Mines.

As an applied economist, Catherine enjoys interdisciplinary research. She recently edited the 15-chapter book, Food Futures: Growing a Sustainable Food System for Newfoundland and Labrador, which contains contributions from 28 NL authors that specialize in agricultural and food systems research. During the past year she published articles on the connectivity of food security, food sovereignty, and food justice in boreal ecosystems; the relation between population and land use changes and perceived threat to sense of place among agricultural landowners; and, a supply and demand study for conservation easements on agricultural lands.

Catherine is currently the principal investigator on several interdisciplinary projects to evaluate the economic feasibility of expanding agricultural production within the province, and to improve waste management practices in northern regions.

How Does Growing NL's Agricultural Sector Make the Rural Economy Bloom?

This presentation makes the case that increased agricultural production within the province can increase well-being by providing more wealth, income, stability, and local control.

Agriculture is typically viewed by economists as a stabilizing economic sector, particularly when compared to volatile industries like energy. Long term economic benefits are attributed to stable land use and the long term tenure of farm families. Agriculture also provides jobs in rural regions and has the propensity to infuse revenues into several sectors like retail grocers and transportation. The regional economic impact multiplier ranges from 1.3-4.3, meaning that a one dollar increase to the economy generates $0.30-$3.30 to the economy (Haggenblade et al., 1991). Agriculture also facilitates domestic production, thus reducing import reliance.

Keeping these economic indicators in mind, there is opportunity for NL to increase its economic output and decrease import reliance through increased local production. Perhaps more importantly, there is potential to dampen the downside impacts from volatile energy prices and exchange rates, and to improve food security.

This presentation provides an overview of regional economic trends across Canada, and specifically, Atlantic Canada, to identify opportunities and next steps to grow NL's agricultural sector.

> **Dr. Paul W. Heisey**
Agricultural Economist
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Paul Heisey is an Economist in the Structure, Technology and Productivity Branch of the Resource and Rural Economics Division of the Economic Research Service, U.S. Department of Agriculture. His work focuses on agricultural science policy, in particular public and private sector agricultural research and development, intellectual property, and genetic resources.

Paul joined ERS in 1998. From 1985 to 1998, he worked for the International Maize and Wheat Improvement Center (CIMMYT) in Pakistan, Malawi, and Mexico, where his research focused on impact assessment and the economics of technical change in cereals. This included work on varietal development and diffusion, seed systems, and fertilizer use in developing countries.

Paul holds a Ph.D. and M.A. in Agricultural Economics from the University of Wisconsin-Madison; and a B.Sc. in Mathematics from Messiah College, Grantham, Pennsylvania.

Agricultural Research Investments and Their Impacts on Agricultural Productivity

In many countries around the world, both high income and developing, greater productivity arising from innovation and changes in technology has increasingly become the major source of agricultural output growth. Productivity has replaced land expansion and intensification—the application of more inputs to a given unit of land—as the leading factor in growth of agricultural output. Long term investments in agricultural research, public and private, have in turn been identified as the principal source of rising agricultural productivity. In particular, rates of return or cost-benefit ratios to public agricultural research investment have usually been high. In recent years, increases in global public agricultural R&D spending has been driven primarily by increases in large developing countries such as China and India. Public agricultural research investment in high income countries, on the other hand, has entered a time of increasing uncertainty after a number of years of slower growth. On the other hand, private agricultural R&D, particularly in high income countries, has expanded significantly. Public and private agricultural R&D investments are more likely to be complementary than competitive. Around the world, soil fertility, pests and diseases of crops and animals, water scarcity, rising temperatures—some of which are related to climate change—are among the major issues that will require continued attention from agricultural research.

> Dr. Gerrit Hoogenboom

Preeminent Scholar, Institute for Sustainable Food Systems
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Gerrit Hoogenboom has over 25 years of experience in the development and application of crop simulation models and decision support systems. Applications range from freeze forecasting to climate variability and climate change, water resources management, biofuels, economic and environmental sustainability, and food security. He currently coordinates the development of the Decision Support System for Agrotechnology Transfer (DSSAT; www.DSSAT.net), a crop modeling system that is being used world-wide by many scientists and others interested in systems analysis and decision support.

Prior to joining UF, Gerrit Hoogenboom was the Director of the AgWeatherNet Program and Professor of Agrometeorology at Washington State University. AgWeatherNet is one of the largest automated weather monitoring systems that provides near real-time data and associated tools and decision support systems to different stakeholders in the Pacific Northwest (www.weather.wsu.edu). Gerrit Hoogenboom is currently an Editor for Climate Research, the Journal of Agricultural Science (Cambridge), and Scientia Agricola.

He received his Ph.D. from Auburn University, M.S. in Theoretical Production Ecology and M.S. and B.S. from Wageningen University, the Netherlands.

Crop Modeling – A Tool for Improving Agriculture under Climate Uncertainty

During the past 10 years crop simulation models have become an integral part of agricultural systems research, outreach, and education. Crop models have been used for many different applications, ranging from gene-based modeling to climate change impact and adaptation studies. When integrated with decision support systems, the socio-economic components are also very important. In this presentation I will use examples from the AgWeatherNet Program in the state of Washington and based on the international crop modeling platform the Decision Support System for Agrotechnology Transfer (DSSAT). I will also discuss both the strengths and weaknesses of these models and recommendations for improving this technology. Together, the advances in computer technology and the increased interest by industry, funding agencies, and donors provide new opportunities for crop modeling to address the challenges of agriculture under a changing climate.

> **Dr. Vanessa Kavanagh, Ph.D, P.Ag**
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Dr. Vanessa Kavanagh is from Corner Brook, NL and received her BSc from Dalhousie University in Halifax, NS in 2003. In 2007, she completed her MSc at Saint Mary's University in Halifax, NS and assisted in the development of the first soybean inoculants specifically for Western Canadian soils. She obtained her PhD in plant sciences in 2012 from the University of Alberta in Edmonton, AB where she assessed the environmental biosafety of transgenic triticale - concentrating on pollen mediated gene flow. She joined the Department of Fisheries, Forestry and Agrifoods – Agrifoods Development Branch in April 2012 and is currently a Research Scientist and the project lead for the Cereals and Canola programs.

Expanding Livestock Feed Opportunities in Newfoundland and Labrador

Mixed farming (crops and livestock) has been practiced in Newfoundland and Labrador (NL) since settlers first arrived with their animals and grew hay to feed them. This tradition has carried on throughout history for many reasons; however geography has been one of the larger motivators as shipping feed to the Island is costly and intermittent weather stoppages can sometimes make consistent supplies unattainable. While perennial forages are well established, annual high-value feed crops are imported, including all grain and oilseed (i.e. soy and canola) requirements. Importation of these requirements brings a heavy economic and environmental burden with high feed and shipping prices and substantially increased carbon footprints. Cereal grains (wheat, barley, rye and oats) and canola can be successfully cultivated in NL and can contribute to considerable costs savings over importation. In addition, by-products from the feed are highly valuable and provide supplemental income opportunities in the form of straw and food-grade cold-pressed virgin canola oil. These feeds can be used throughout the dairy and other livestock industries as a direct substitution for their imported feed requirements however substantial investment in equipment will be necessary. Costs can be offset by the income potential and improved feed quality from local grain and oilseed cultivation. Carbon footprints can also be greatly minimized by decreasing transportation distances and synthetic inputs when manure and legumes are integrated into the rotations.

> **Samir Debnath, Ph.D, P.Ag**
Research Scientist
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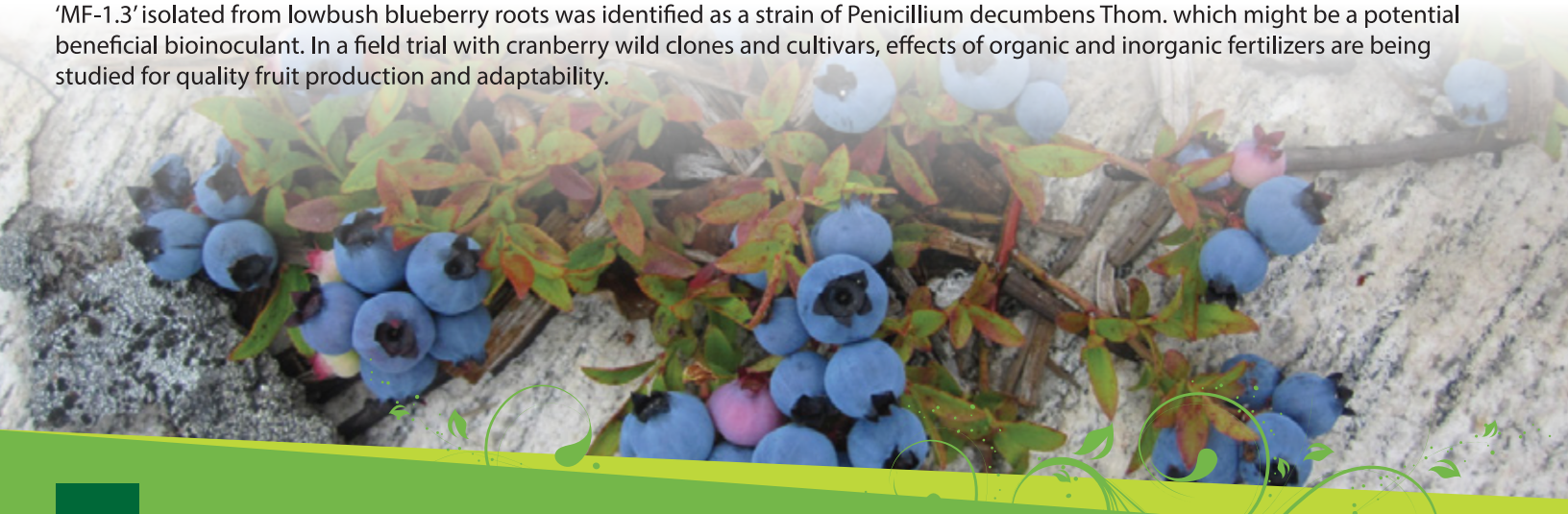
Dr. Samir C. Debnath, P.Ag. is a Research Scientist at the St. John's Research and Development Centre of Agriculture and Agri-Food Canada (AAFC) in Newfoundland and Labrador and an Adjunct Professor of Biology at the Memorial University of Newfoundland. He has authored and co-authored more than 100 publications in peer-reviewed journals including review papers and book chapters. He has been a keynote speaker and an invited speaker at a number of international and national conferences and meetings, was the President of the Newfoundland and Labrador Institute of Agrologists (P.Ag.) and the Canadian Society for Horticultural Science, and the Editor-in-Chief of the journal: Scientia Horticulturae. He is the Country Representative for Canada and the Council Member of the International Society for Horticultural Science. His research concerns biotechnology along with conventional method-based value-added small fruit and medicinal plant production, propagation and genetic enhancement. Much of his current work focuses on wild germplasm, antioxidant activity, biodiversity and micropropagation for berry crop improvement using in vitro and molecular techniques combined with conventional methods.

Production and Improvement of Small Fruit Crops Native to Newfoundland and Labrador

> ***Samir C. Debnath[1], David B. McKenzie[1], Gary A. Bishop[1], Peggy Dixon[1], Yaw L. Siow[2] and Deanne Simms[3]***

[1]St John's Research and Development Centre, Agriculture and Agri-Food Canada, St. John's, NL
[2]Canadian Centre for Agri-Food Research in Health and Medicine, Agriculture and Agri-Food Canada, St. Boniface Hospital Research Centre, Winnipeg, Manitoba
[3]Agrifoods Development Branch, Dept. of Fisheries, Forestry and Agrifoods, Bishop's Falls, NL

Commercially important fruit crops native to Newfoundland and Labrador include lowbush blueberry (Vaccinium spp. L.), cranberry (V. macrocarpon Ait.) and partridgeberry or lingonberry (V. vitis-idaea. L.). Consumption of these fruits is believed to have important therapeutic values, including anti-tumor, anti-ulcer, anti-oxidant and anti-inflammatory activities. Wildberry production systems are changing to a more intensive cultivated system. This leads to an urgent need to develop new techniques for selecting and establishing high-yielding, insect tolerant small fruit crops which are well-adapted to diverse biotic and abiotic conditions in Newfoundland and Labrador. The presentation focuses on: wild berry germplasm collection, characterization, maintenance and their utilization in hybrid development; sustainable crop production systems including the use of bioinoculants and organic fertilizer; and integrated pest management. Bioreactor micropropagation in a liquid medium has been developed/improved for berry crops. The total phenolic and oxygen radical absorbance capacity (ORAC) of blueberry tissue culture plants and of wild clones and cultivars of blueberries and cranberries were estimated. Hybrids obtained through crossing between half-high/highbush and lowbush blueberry genotypes and between Canadian and European lingonberries are being evaluated for frost, drought and pest resistance under greenhouse and field conditions. 'MF-1.3' isolated from lowbush blueberry roots was identified as a strain of Penicillium decumbens Thom. which might be a potential beneficial bioinoculant. In a field trial with cranberry wild clones and cultivars, effects of organic and inorganic fertilizers are being studied for quality fruit production and adaptability.



> **Dr. Mumtaz Cheema**
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Dr. Cheema is an Associate Professor (Agronomy) in the school of science and environment, member of sustainable resource management (SRM) program and the boreal ecosystem research initiative (BERI) at Grenfell Campus Memorial University. The focus of his research program is to develop productive and sustainable cropping systems to combat the challenges of global food security. In recent years, he has studied integrated nutrient management practices that conserve or enhance soil fertility through efficient nutrient cycling and management strategies to maximize nutrient use efficiency and maintain economically sustainable crop productivity with minimize damage to the environment. Abiotic stresses (cold/chilling, drought and salinity) and their management strategies (seed priming and exogenous application of compatible organic solutes) to induce stress tolerance and enhancement of antioxidants in crops. In-situ root monitoring of field crops, identification and quantification of root exudates and their role in nutrients-acquisition, particularly phenomenon of biological nitrification inhibition (BNI) in improving NUE, and suppressing greenhouse gases emission; Waste management. Interactive effects of Biochar and dairy manure application in soil and their impact on leaching and gaseous losses of N in different forage cropping systems is the current focus of research program. Impact of climate change on global food security, particularly rising atmospheric CO2 and its impact on crop growth, yield and produce quality. Dr. Cheema has supervised 36 Master, and 6 PhD theses, and co-supervised 10 Master and 5 PhD theses. Prior to joining the Grenfell Campus Memorial University in 2013, Dr. Cheema worked as Lecturer, Assistant Prof. Associate and Professor in the department of agronomy, and Director Graduate Studies at University of Agriculture, Faisalabad, Pakistan.

Evaluating the Biomass Production Potential of Corn Silage (Zea mays L.) Genotypes under Varying Manure Based Phosphorus Applications in Newfoundland

> ***Mumtaz A. Cheema[1], Muhammad Nadeem [1,3], Adrian Unc[1], Lakshman Galagedara[1], and Vanessa Kavanagh[2]***

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[3]COMSATS Institute of Information Technology, Vehari, Pakistan

Newfoundland and Labrador (NL) dairy and livestock industry faces challenges of insufficient corn silage or forage/fodder production and they have to depend on substantial imports from other provinces. Additionally, transport costs into the province are very high that further increases the cost of imports and eventually the forage/fodder/silage or any other feed ration. On the other side, dairy farm operations across NL produce a large quantity of manure, which is a cheap and abundant source of plant nutrients. For instance, a single dairy cow produces about 10 to 30 kg of phosphorus (P) and 90 to 150 kg of total nitrogen in a year. With these nutrients availability, dairy manure could be considered as a cost effective and alternate source of plant nutrients particularly P to meet the challenges of global food security. Modern agriculture is dependent on P derived from phosphate rock which is a non-renewable resource and current global reserves may be depleted in 50-100 years, while P demand is projected to increase. To evaluate manure as a renewable P source, a two years field research trial has been initiated at Pynn's Brook Research Station (2015-16) to determine the biomass production potential of five silage corn hybrids using dairy manure as P source. Experimental treatments included five silage corn hybrids (Fussion-RR, Yukon-R, A4177G3, DKC-2317, DKC-2628) and four P sources (high and low P dairy manure; inorganic P and control). Data collected on crop growth, root morphology, physiological parameters and biomass yield will provide insight, whether the biomass production potential of corn silage genotypes could be influenced using manure as P source under a very unique soil and climate conditions of Newfoundland and Labrador. This presentation will further enhance our understanding, how the different genotypes respond to climate variations and could be a good fit in the cool growing season of western Newfoundland.

> **Dr. Raymond Thomas**
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Academic qualifications include an ASc in General Agriculture (College Science and Education), BSc in Agriculture (Lincoln University), MSc in Horticulture (University of Minnesota) and PhD in Biology- Plant Biochemistry and Physiology (University of Western Ontario). My research interests are multidisciplinary and involved an integrative approach to answer questions from scales at the cellular to system levels. I use specialize chromatographic and mass spectrometric techniques to elucidate functional, mechanistic and compositional alterations of secondary metabolites (antioxidants and lipids) in environmental stress response in the following systems: plant/animal/insect physiology, microbiology, food science, agriculture, and neurobiology. Most notably, within the last 6 years, I have significantly contributed to the establishment of 3 world class research centers in Canada {Advanced Facility for Avian Research- Western ($9mil - 2009), Boreal Research Institute - NAIT ($5mil- 2012), Boreal Ecosystem Research Facility - Memorial ($4mil – equipment configuration/purchase - 2014)} in the capacity as project manager, research coordinator and faculty respectively. Areas of expertise include lipid biochemistry, mass spectrometry, plant science, horticulture, agriculture, biology, microscopy and microbiology.

Potential of Mixed Cropping System as a Source of High Quality Forage Production in Newfoundland and Labrador

> ***Muhammad Zaeem[1], Thu Huong Pham[1], Muhammad Nadeem[1,5], Waqar Ashiq[1], Vanessa Kavanagh[2],Sathyanarayana Elavarthi[3], Jerry Kaiser[4], Mumtaz Cheema[1], Raymond Thomas[1]***

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Intercropping or mix cropping is the practice of cultivating two or more crops together on the same farmland. Several benefits can be derived from such cropping system. In a forage production system, these benefits include higher biomass production, improved forage quality, enhanced soil nutrient status, and reduced incidences of disease, pest or weed coverage. A major challenge to animal production in the Province is the availability of high quality forage as animal feed. In an effort to overcome this challenge, the proposed work is aimed at exploring the potential of a mixed cropping system of vine soybeans intercropped with silage corn as a high quality forage production system suitable for animal feed production in Newfoundland and Labrador. A collaborative research study between Delaware State University, United States Department of Agriculture, Grenfell Campus Memorial University (Boreal Ecosystem Research Initiative),

and Forestry & Agrifoods Agency (Government of Newfoundland and Labrador) is currently in progress (first year of a 2 year trial) at Pynn's Brook Research Station. The aim of this work is to determine whether intercropping vine soybeans and silage corn confer benefits in terms of increased forage biomass production, enhanced forage nutrient composition and improved soil nutrient or health status under the short and humid growing season in western Newfoundland. Three high biomass and protein producing vine type forage soybean genotypes are intercropped with two high carbohydrate and biomass producing silage corn genotypes. Data will be collected to determine whether this approach would provide any benefits in a high value forage production system suitable for animal feed cultivation in Newfoundland and Labrador.

> **Ian Richardson**

Dairy Farmer, Larch Grove Farms

Chair, Dairy Farmers on Newfoundland and Labrador

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I farm along with my wife Angie, 5 year old daughter Mackenzie and 2 year old son Landon in the beautiful community of Cormack in Western Newfoundland. We moved to Newfoundland 15 years ago from PEI when we purchased a dairy farm in Cormack from a retiring farmer. We have since tripled the number of milking cows to 150 and farm over 700 acres of land. Currently I am the chair of Dairy Farmers of NL and I was previously chair of the Canadian Young Farmers for 3 years.

The Impact of Research on Farms

Farming in Newfoundland and Labrador has always been a challenge. The weather is cold; the seasons are short and everything we do costs more money than if we were to try to do the same thing on the mainland. And then there are rocks, rocks and more rocks wrapped in a blanket of highly acidic soil. For those of us who farm livestock and crops, these challenges have been hard to address, especially when our farm is isolated and we're not able to take advantage of all the opportunities and programs that are available elsewhere. On my farm, we have been able to see a real benefit from participating in agricultural research. The research that we participate in gives us the opportunity to try some of the latest equipment and seed technology at low risk and cost to our operation. It is a win-win situation because the researchers need somewhere to carry out their trials and we get to keep the end product. Results from large research trials has given us a better idea of how crops and their inputs will perform on our own farm. Being part of this research, we have a sense of ownership because these trials are close to home, on our farm, in our town in our Province for all the agriculture community to learn from. In the past 4 years our farm has been able to replace very expensive purchased grains with grain grown right on our own farm. This year will be the first year that we will have grown enough of our own grain to feed it all year round. We have also redirected our operations to include grain as one of our annual crops. We have also incorporated no-till technology over the entire farm which when you're dealing with rocks like we do has been invaluable. The combination of better forage stands because of the rotation and our own grain has been a game changer at Larch Grove. Most importantly, the work that we do gets redirected to the Newfoundland farming community so they can learn from our mistakes and benefit from our successes and become less reliant on purchased grains.

> Mr. Sindri Sigurgeirsson

Chair
Icelandic Farmer's Association
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Mr. Sindri Sigurgeirsson is the Chairman of the Icelandic Farmer's Association since 2013.

He was born in Reykjavik, the capital of Iceland, but has strong rural roots. He studied farming at the Agricultural University of Iceland and has been farming for himself for over 20 years. He has also studied business at the University of Bifrost. He now runs a sheep farm at Bakkakot in the western part of Iceland.

He has been a farming leader for a number of years. Firstly in the local farming association in western Iceland, then the Icelandic Sheep Farmer's Association, serving there as chairman 2009-2012. He was elected Chairman of the Icelandic Farmer's Association in 2013, and re-elected in 2016.

Sindri is 42 years old, married to Mrs. Kristin Kristjansdottir. They have two children born in 1996 and 1999.

The Biggest Tiny Sector in the world. Icelandic Agriculture - Challenges and Opportunities

Mr. Sigurgeirsson will attempt to describe the situation of farmers in Iceland. What they farm and how they farm. They are, as farmers everywhere in the world, dependent on nature, and it can be quite rough in Iceland. They are heavily regulated as elsewhere and depend also on various agricultural policy measures in their business. He will talk about government policy and the general business environment. How farming has changed and how he thinks it will evolve.

He will also touch on Iceland's relationship with consumers (and taxpayers) and what he sees as the main challenges and opportunities for them in the coming years.

> Dr. Adrian Unc

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Dr. Adrian Unc has training in Agronomy (BSc, Romania), Soil Science (MSc and PhD, Univ. of Guelph, Canada), and Molecular Biology & Microbiology (Postdoctoral, Univ. of Ottawa, Canada), and has carried out research in Canada, USA, UK, Jordan and Israel for private and public granting agencies (provincial, state, federal, and international governmental agencies). Currently he is also Overseeing Editor for Algal Research (a journal established by the Los Alamos National Laboratory at Elsevier, and Associate & Deputy Editor for Soil Use and Management, a journal of the British Soil Science Society.

His main interests are in the area of environmental microbiology as relevant to and rural and urban economic and environmental sustainability of managed biological systems that include fertility and health of agriculture and rangelands, and soil-plant relationships.

He has chaired advisory committees for 16 graduate students (MSc and PhD level) and was an external advisor for other graduate students in agriculture, engineering and biology in Canada, USA, Romania, Mexico, and Iran.

What is Agriculture?

Agriculture is the art and science of growing crops and rearing animals for food. To best manage the resources required for agricultural production one must understand the underlying processes and mechanisms. Agriculture can be carried out under natural conditions by modifying the land to best meet the needs of a certain agricultural system. At the other extreme agriculture can also be carried out under absolutely controlled conditions in enclosed spaces where nutrient delivery and climatic parameters are fully controlled. Much of agriculture is carried out either in the field or under variably controlled conditions in greenhouses or hoop-houses where growth parameters are controlled to variable extents.

A natural ecosystem eventually reaches an equilibrium that satisfies the needs of a given biological community. Agriculture modifies such equilibrium to favour the agricultural ecosystem of interest. Needless to say that the ecosystem will consistently drift towards a natural equilibrium. Sustainable practice of agriculture aims to induce a stable equilibrium that satisfies the requirements of the agricultural system of interest while minimizing impacts on the farm economics or environmental health.

Land-use change is the extreme example of an ecosystem brought out of an equilibrium state and tending towards a new equilibrium, the latter being strongly dependent on the farming practices

This presentation will review the current scientific understanding of agricultural systems and the role of such understanding in shaping the management of newer or older land conversions.

> **Dr. Lordwin Jeyakumar**
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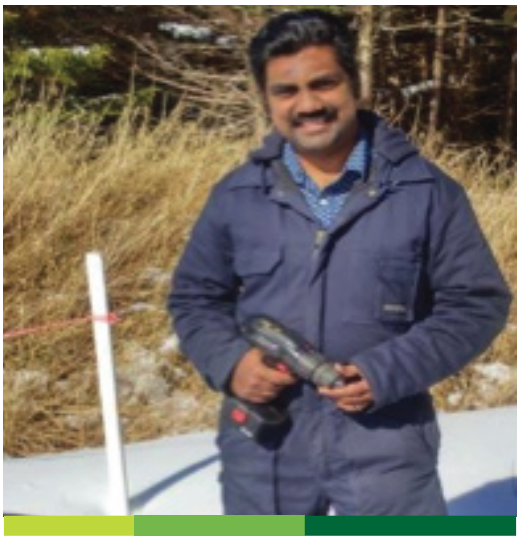

Dr Lordwin Jeyakumar is a NSERC Visiting Scientist and agricultural systems engineering specialist at the Agriculture and Agri-Food Canada (AAFC), St. John's, NL. Prior to his appointments at AAFC, Lordwin was an Associate Professor of Soil and Water Engineering at the Sam Higginbottom Institute of Agriculture Technology and Sciences. Lordwin's primary research goal is to develop, adapt and evaluate technologies and practices that support water conservation and mitigate impacts of limited and declining water quality and quantity in agricultural systems. Lordwin is the author or coauthor of 28 refereed journal articles, over 50 other technical publications including book chapters, conference proceeding papers and a book on "Process based modeling in constructed wetland". Throughout his career, Lordwin has been the recipient of numerous professional, research and educational awards, including the prestigious UCD Research Scholarship, Ireland and NSERC Visiting Fellowship, Canada. Lordwin holds B.Tech, M.Tech degrees from the Sam Higginbottom Institute of Agriculture Technology and Sciences and a PhD from the University College Dublin, Ireland.

Treatment of Agricultural Tile Drainage Water in a Pilot-Scale Woodchip Bioreactor System

Loss of nitrate in sub-surface tile drainage from agricultural fields is an important issue in Newfoundland and Labrador and the Atlantic provinces. One possible strategy for reducing nitrate export is the use of denitrification bioreactors. Woodchip denitrification beds can reduce nitrate load in agricultural tile drainage water to alleviate the adverse environmental effects associated with nitrate pollution. Four woodchip bioreactors have been installed at the St. John's Research and Development Centre which treats 12 drainage plots. Each plot is 22 m x 60 m for a total tile drainage area of 1.6 ha. The four bioreactors are of equal size, with the woodchip beds measuring 24.38 m long, 3.04 m wide and 1.06 m deep. Individual drainage plot tile lines are routed into a drainage hut, where they can be piped into 1 of 4 pump pits. Each pump pit is fitted with a submersible water pump, which pumps the collected drainage water to 1 of 4 dedicated bioreactors. Each pump has an outflow capacity of 1.5 l/s, which is equal to the treatment capacity of the constructed bioreactors assuming an 8 h retention time. Studies are on-going to optimize the development of the system.

> **Myron King**
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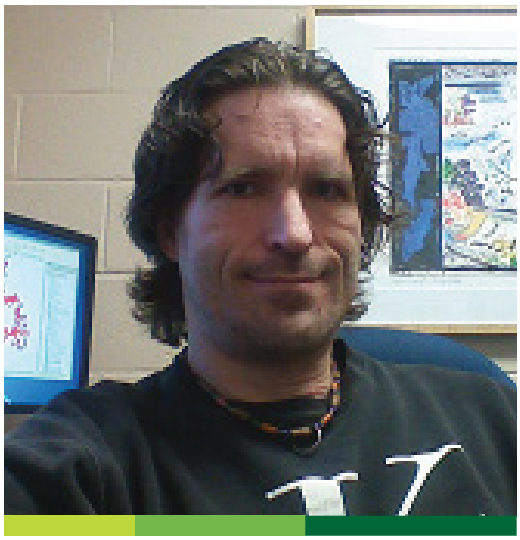

Myron has been involved with several environmental research projects since completing the Master of Science in Coastal Zone Management, University of Ulster. His thesis research concentrated on the Ecological Knowledge of Newfoundland and Labrador Fishers highlighting their expertise on the water and associated mapping cognizance incorporating a geographical information systems (GIS) approach. Myron has been involved with watershed research, examining Northeast Avalon watershed and wetland areas slated for development and their associated conservation value attributes. Recently he has contributed as a research team member and mapper investigating the connectivity of food security, food sovereignty and food justice in a boreal ecosystem. Myron has extensive experience in the Information Technology industry where he worked several years as a senior incident manager. Myron is an active volunteer with the Canadian Cystic Fibrosis Foundation and with the Salmon & Trout Association of Conception Bay Central.

The Effects of Climate Change on Soils and the Future of Boreal Agriculture

> ***Myron King, Adrian Unc, Lakshman Galagedara, Daniel Aldorff***

Memorial University of Newfoundland, Grenfell Campus, Corner Brook, NL

Climate change (CC) combined with temperature increases and extreme weather events affect current agricultural areas. This issue may be nevertheless somewhat relieved by increase of suitable agricultural areas in boreal regions on the whole. This results in a 'northwards shift' in climate properties when compared to current conditions. Thus to effectively inform agricultural management policy decisions specific to boreal regions, we must understand to what extent are we willing to pursue agriculture versus other land uses. For example, what will agricultural areas in the near north region, the first region affected by a shift due to CC, need to consider for adaptation?

It is not yet fully understood where or how the interplay between CC and soil localization will define future agricultural lands. Newfoundland and Labrador is a prime boreal example where conversion of natural lands to agricultural use occurs, and as such could easily be an area of high impact.

To help determine the volume and area of the expected changes relevant to the different boreal soils, location-specific climate predictions are needed in combination with a detailed localized soil mapping. Here, we combined high resolution climate predictions using the spatial climate scenario generator "CLIMGEN" to explore the uncertainties of future CC with GIS soil mapping data. This combination, along with related analyses, can allow a generalized assessment of global and regional scenarios applicable to land–use changes and associated management requirements.

> **Crystal-Lynn Anderson Baggs**
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Crystal Anderson-Baggs was born and raised in Port aux Basques, NL. Having been raised in rural Newfoundland, she is passionate about economic development especially within the agricultural industry and the potential to become more self-sufficient and provide a sustainable food system for all residents.

She is a graduate of the Bachelor of Commerce (Co-op) program with a concentration in Marketing and is currently completing her Master of Business Administration studies with the University of Leicester.

During her career, she has worked with such organizations as the PJ Gardiner Institute, Community Business Development Corporations (CBDCs), and the Kittiwake Economic Development Corporation.

In 2008, Crystal joined the Department of Fisheries, Forestry and Agrifoods as the Market Development Officer. Some of her projects include the development and implementation of the "From This Rock" Culinary Tour and the "Farm Guide". These projects help bring exposure to the variety and quality of products grown and produced here and create better market access to our producers and processors. She continues to work with industry and community groups daily to facilitate community capacity and economic development as it relates to the agrifoods industry.

Cultivating Connections: Sowing the Seeds of the Supply Chain

The consumer's interest in local agricultural and overall food security has grown significantly in the last number of years. However, distribution and access is still a major roadblock to the growth of the industry. While the conversation is occurring around local food, the quantitative and qualitative data on the potential market is unknown. In addition, the proper linkages that need to exist to create a provincial distribution channel has to be identified, developed and nurtured and the roles of interested stakeholders defined.

> Dr. Kapil Tahlan

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Dr. Kapil Tahlan obtained his Ph.D. in Microbiology and Biotechnology from the University of Alberta (Edmonton, Canada) in 2005, following which he was a Natural Sciences and Engineering Research Council of Canada postdoctoral fellow at the Department of Biochemistry and Biomedical Sciences at McMaster University (Hamilton, Canada). In 2007 he moved to the National Institutes of Health (Bethesda, USA) to work on tuberculosis. In 2010 he was appointed as a full time faculty member in the Department of Biology at Memorial University. His current research group works on antibiotic production/resistance and specific bacterial pathogens of concern to human and veterinary medicine.

Studies on Mycobacterium avium Subspecies paratuberculosis: The Causative Agent of Johne's Disease in Cattle and Sheep

Mycobacterium avium subspecies paratuberculosis (Map) is the causative agent of Johne's disease (JD) - a chronic wasting disease affecting farmed animals such as cattle and sheep. JD is responsible for significant economic losses in the dairy and beef industries due to reduced milk yields, reduced slaughter value and premature culling of infected animals. Due to the lack of treatment options or effective vaccines, mitigating losses can be difficult. In addition, the early stages of Map infection may occur in asymptomatic animal hosts that continue to shed viable bacteria in their feces, leading to the infection of other healthy farm animals. There is also some controversy regarding the association of Map and Crohn's (CD) disease in humans, as both JD and CD have similar symptoms and in some cases Map has also been isolated from patients with CD. Map is an extremely slow growing bacterium and is hard to culture and manipulate in the laboratory. Our research group has established infrastructure and capacity at Memorial University to isolate and study Map from different sources. Initially our work was focused on studying Map from dairy animals, but we are currently expanding our research to include farmed sheep from Newfoundland. To the best of our knowledge, these are some of the first studies on this important pathogen form the province of NL.

> Dr. Linda Elizabeth Jewell, M.Sc, Ph.D

Plant Pathologist
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Linda grew up in Ottawa and obtained her BSc and MSc from the University of Ottawa, specializing in organic and natural product chemistry, where she identified and synthesized plant-derived and inspired chemicals with potential health benefits.

She then completed a PhD in plant pathology at the University of Guelph, studying low-temperature plant pathogens of grasses and cereals. Next, Linda completed a postdoctoral fellowship at the National Agriculture and Food Research Organization of Japan's Hokkaido Agricultural Research Center.

Linda joined Agriculture and AgriFood Canada at the St. John's Research and Development Centre as a Plant Pathologist in October of 2015. She is currently performing a survey of the diseases that occur on blueberries and other native berries of Newfoundland, and is also working with diseases on forage grasses and cereals. Outside of the lab, she enjoys reading, hiking, running, and snowboarding.

Natural Defenses against Plant Diseases

What do the Salem Witch Trials, the Irish Potato Famine, and the problem of disappearing oak trees have in common? They were all caused by plant diseases! Just like animals, plants can suffer from diseases caused by viruses, bacteria, and fungi. Many of us have seen the damage caused by plant disease in our own yards or gardens: fuzzy grey mould on blueberries, misshapen club roots on turnips, and chocolate brown spots on grasses are just some examples of common disease symptoms. But also like animals, plants have an immune system that is switched on when invaders are detected. What happens when a plant is challenged by a potential pathogen? How does the plant immune system work, and how are scientists using this information to help plants fight off disease? How can beneficial bacteria and fungi boost plant immunity or fight off harmful invaders? Learn more about the wars raging inside and on the surface of plants all around us, and how these dramatic battles can threaten our access to safe and plentiful food.

> Dr. Peggy Dixon

Entomologist
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Dr. Dixon has been the Entomologist at the St. John's Research and Development Centre, Agriculture and Agri-Food Canada, since 1992. She grew up in Baie Verte, where she developed a fascination for insects, particularly beetles, and put together her first insect collection in elementary school. Currently she works with farmers, universities, research partners and governments, including the provincial agrifoods branch, to find economically sustainable and environmentally friendly ways to manage insect pests and conserve beneficial species. Peggy has a BSc (Honours) in Biology from Memorial University and a PhD in Agricultural Entomology from the University of Edinburgh in Scotland. She is a Past President of the Entomological Society of Canada, and a lifetime "Honorary Member" of the Acadian Entomological Society, as well as an adjunct Professor at both Memorial and Acadia Universities. Peggy lives in CBS with her husband Mike and children Caleigh and James.

Insect Research in Newfoundland and Labrador Agriculture: The Good, The Bad and The Ugly

> *Peggy Dixon, Carolyn Parsons, Todd Power*

St John's Research and Development Centre, Agriculture and Agri-Food Canada, St. John's, NL

The majority of the world's insects are not pests, although those that are have the potential to cause devastating damage and loss. Entomology research has been underway at Agriculture and Agri-Food Canada's St. John's Research and Development Centre for the past 60 years, but this presentation will focus on current projects at the "Experimental Farm". Most of the insects in our current research program are pests of horticultural crops, but others, such as pollinators, are beneficial. Three studies relate to the cabbage maggot, one of Newfoundland and Labrador horticulture's most notorious pests; these studies focus on reducing the damage caused by the cabbage maggot and include research on insect netting, insecticide resistance and resistant rutabaga cultivars. Another insect pest which has come into focus in the last 3 years is the spotted wing drosophila. This invasive fruit fly was first introduced to North America in California, and has spread to Newfoundland in just 5 years! Spotted wing drosophila has been found across most of Newfoundland, but not in large enough numbers to cause concern. Another project has the entomology team in St. John's working with scientists across Canada to assess the distribution of aphid species which spread virus diseases in strawberry. Our other projects will be described briefly, and our insect collection, comprised of more than 50,000 specimens, also will be introduced. This collection of mostly Newfoundland and Labrador insects is useful for checking insect identifications and changes in species occurrence across the province.

> **Paddy Browne**
Head of Crops, Environment and Land Use Programme
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As Head of the Crops, Environment and Land Use Programme, I am responsible for the Research and Knowledge Transfer functions in the areas of Crops, Environment, Horticulture and Forestry. The aim of the Teagasc Crops, Environment and Land Use Programme is to develop and transfer cost-effective crop production systems along with evidence based knowledge to support and underpin the development of a profitable, competitive and environmentally sustainable agri-food sector.

Crops research is mainly carried out at Oak Park, Carlow and Environmental Research is principally carried out at Johnstown Castle in Wexford. Forestry and Horticultural research are concentrated at the Ashtown campus in Dublin. In addition, on farm research is carried out at locations right around Ireland while the Agricultural Catchments Programme is located in six specific river catchments around the country. Knowledge Transfer activities are also carried on right around the country.

Integration of Research, Knowledge transfer and Agricultural Education within Teagasc

Teagasc is the Irish Agriculture and Food Development Authority. It is an autonomous state agency. It was established under legislation in 1988 as an amalgamation of two separate bodies embracing agricultural research, education and advisory/extension. The advisory/extension and education components each had a legacy of state-control stretching over 100 years at the time of the establishment of Teagasc. The research component has a shorter history going back to the foundation of The Agricultural Institute in 1958 with the financial assistance of Marshall Aid. The Agricultural Institute was also established as a quasi-autonomous semi-state organization with its own board of directors and hence operated at arm's length from day-to-day government control.

Teagasc's mission is "To support science-based innovation in the agri-food sector and broader bio economy so as to underpin profitability, competitiveness, and sustainability"

The achievement of effective integration of the three services of research, education and extension has been a challenge since the setting up of Teagasc, not least because of the difference governance legacies of the component services.

Since our establishment we have striven to deliver on our mandate in accordance with the well-known concept of the Agriculture Knowledge Innovation System (AKIS). Stakeholders are at the core of the system and are involved through a variety of formal channels (Stakeholder Consultation Groups) in influencing the work programmes of the three operational pillars of research, education and extension. As an organization we face a constant challenge to achieve integration between these pillars. Where this succeeds well there is no doubt that the quality of the resulting outcomes is substantially enhanced. Stakeholders are exposed to knowledge from a variety of external (that is, to the Teagasc system) sources. This presents a challenge for ourselves to ensure that we provide a knowledge innovation support service that adds value within a wider knowledge system.

Long experience has underlined for us the importance of two key over-arching requirements for an effective AKIS, namely, (1) the absolute necessity of ensuring a central role for stakeholders that enables them to have a real input into our activities and (2) effective integration between the pillars of that system.

> **Dr. Deborah Neher**

Professor and Chair, Department of Plant and Soil Science
University of Vermont
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Deborah A. Neher is Professor and chair of the Department of Plant and Soil Science at University of Vermont. Dr. Neher brings over 25 years of experience as a researcher, educator, and graduate student mentor. She is a soil ecologist and agroecologist with primary research interests in development of invertebrate bioindicators for environmental monitoring of terrestrial soils. In 2009, she was awarded the UVM College of Agriculture and Life Science Hubert W. Vogelmann Award for Excellence in Research and Scholarship. She earned her B.S. from McPherson College in environmental science, M.S. from University of Illinois-Urbana in plant biology, Ph.D. from the University of California-Davis in plant pathology, and then spent five years as a member of the Agricultural Lands group of the Environmental Monitoring and Assessment Program (EMAP-AL) served as a member of the Farmlands Work Group for the State of the Nation's Ecosystem 2002 and 2008 Reports and was a member of the Farmlands Contact Group for the 2008 Report. These reports are coordinated by the H. John Heinz III Center for Science, Economics and the Environment in Washington, D.C. She spent eight years on the faculty at University of Toledo before joining University of Vermont in 2004.

Lessons from Vermont: Identifying an Agricultural Niche

Northeastern regions of North America offer unique challenges to agriculture with their short seasons, cold winters, small fields and wet soils. Nonetheless, there are unique opportunities for diversified agricultural systems, providing coupled nutrient loops and recipes for sustainability. Global climate change will change geographic ranges and phenology of crops, pests and pathogens. Relatively small populations offer opportunities for partnerships among educational institutions, community, and government. Fortunately, interdisciplinary is more attainable at relatively small scales and a key to solving problems. For example, season extension methods can benefit not only dairy and meat production, but also availability of fresh local produce for longer periods. Any new crops produced in the region also require venues for processing and markets. Identifying and filling gaps in the regional food chain can generate new jobs and allow greater re-investment locally. Reliable solutions must be based on data-driven research.

> Fabian Power

President

Cranberry Association of Newfoundland and Labrador

Fabian Power was born and raised in Bishop's Falls, Newfoundland, where he now resides with his wife of 19 years, Susan, and their two children Rachel, 15 and Sam, 13.

After completing the electrical engineering program at the Marine Institute in St. John's, Fabian worked with his father's business until 1996, at which time he decided to go intobusiness for himself in the form of a building supply franchise which would open in Botwood, only 20 minutes from his hometown. This year Fabian and his dedicated staff celebrate the 20th anniversary of Botwood Home Hardware Building Centre.

Fabian's interest in the cranberry industry came in 2009, when the opportunity for new farms in Newfoundland and Labrador became apparent. He quickly became very intrigued with cranberry farming and found the more information he collected, the stronger his desire became to advocate for other farmers and to see Newfoundland and Labrador not only grow the cranberry industry, but watch it thrive.

Fabian began clearing fields for his own cranberry farm in the winter of 2010, and hasn't looked back since, adding more acres each season. Since being elected president of The Cranberry Association of Newfoundland and Labrador, Fabian has represented Newfoundland cranberry farmers on many issues, most recently negotiating the prospects of a processing plant for the cranberry cooperative. His mission is to partner with other farmers to ensure cranberry farming in Newfoundland and Labrador is here to stay!

Keynote Speaker

> Dr. Steve Savage

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Steve Savage has been working in agricultural technology for more than 35 years. Originally trained in Biology at Stanford, he then went to the University of California Davis for a Ph.D. in Plant Pathology. He then worked for Colorado State University, DuPont, and then Mycogen – a bio-control company. Since 1996 Steve has been an independent consultant working with a wide range of large and small technology companies, grower organizations, venture capital groups and sustainability consortia. In 2007 Steve began blogging about food and agricultural issues posting >350 pieces on a variety of platforms. Since 2015 he has been a contributor on Forbes. He speaks frequently to diverse audiences throughout the US and Canada.

The Role of Modern Science in Growing an Agriculture Industry

The ongoing campaign to enhance this region's food resilience represents a unique and exciting opportunity to encourage farming systems that embody the state-of-the-art in terms of sustainability. It is important to inform this discussion with science-driven learnings from other regions. It is also important to thoughtfully consider what flexibility, support and understanding is needed to give prospective farmers what they need to justify investing their time, efforts and money in this ambitious food expansion endeavor. This presentation will seek to provide perspective on the opportunity along with a balanced look at potentially controversial topics such as crop protection chemicals, biotechnology, and organic.

1 | ICO-MS for Analysis of Food and Agricultural Products

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Inductively coupled plasma mass spectrometry (ICP-MS) is a technique for elemental analysis, including various metals, non-metals, and their isotopes. It has very high sensitivity with element detection limits down to part per trillion (ppt) levels. Agricultural products are our main food sources providing more than 30 elements, critical to our nutrition and health maintenance. However, some elements can be both nutritional or hazardous to human and animals, mainly a function of their concentration. Besides the 4 main elements, H, O, C and N, all major components in proteins, carbohydrates, and lipids, there is a long list of primary macroelements such as Ca, Mg, Na, K, P, S, Fe, Cu, Zn, and secondary microelements such as Ge, Cr, B, Sn, F, I, Co, Si, Mn, Li, Mn, Mo, Ni, Se, V, which constitute either over 0.01% or less than 0.001%, respectively, of the animal body, including humans. All these elements are essential to life playing important roles in metabolic processes. However, frequently, toxic elements such as Be, Sb, Bi, Ba, U, Al, Tl, Hg, Cd and Pb are also found in our foods. ICP-MS, with its high precision and sensitivity in detection and a rapid sample turnaround time, has become the most powerful tool in the analysis of all elements in agricultural and food products; it also has widespread applications in forensics, mining industry, environmental monitoring and pharmaceuticals.

This poster presentation will demonstrate the routine elemental analysis for certain food and agricultural products. It aims to promote the understanding of its applicability to Food and Agricultural industry for ensuring food safety and monitoring of the nutritional content of the diet for both humans and animals.

2 | The Cabbage Maggot - A Difficult Pest to Manage

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The cabbage maggot is one of the most serious and challenging insect pests of broccoli, cabbage, cauliflower, turnip and related vegetables, not only in NL but in all of Canada. It is a major pest of canola in western Canada as well. Management of the cabbage maggot in Canada relies heavily on the use of one insecticide, chlorpyrifos, and cabbage maggot resistance to chlorpyrifos has been documented. Alternative methods to manage this pest have been studied for decades, yet we still rely almost entirely on chemical control. In 2006 a project was initiated at the St. John's Research and Development Centre, to review scientific publications and current strategies used for cabbage maggot management around the world. The goal was to identify any control options that could be adopted in NL and Canada. This poster outlines the research projects that arose as a direct result of the 2006 review, including development of cabbage-maggot resistant rutabaga, biopesticides, insect exclusion fencing and insect netting.

3 | The Spotted Wing Drosophilia, an Invasive Pest of Small Fruits

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The spotted wing drosophila is an invasive pest from Asia which threatens production of small fruit crops, including berries, in North America (NA). This tiny fruit fly was first detected in California in 2008 and since then has spread across NA to Newfoundland. It is related to the fruit flies in your kitchen, but unlike those, it does not need over-ripe or rotting fruit to lay its eggs. Female spotted wing drosophila flies have a structure like a saw which they use to penetrate fruit while it is still on the plant, and subsequently lay their eggs in that fruit. This is important because this fly can lay eggs in fruit before it's ripe, thus the maggot stage of the spotted wing drosophila can be in the fruit at harvest and then end up in produce in stores. The first spotted wing drosophila were found in Newfoundland in 2013. Since that time, with the help of the Agrifoods Agency, we have been monitoring it in various commercial crops across the island: lowbush and half-high blueberry, raspberry, strawberry, sea buckthorn, haskap, blackberry, red currant, black currant and lingonberry (partridgeberry). The spotted wing drosophila has been found across the island but so far, not in large enough numbers to cause concern.

4 | Transition to a Sustainable Food System in Newfoundland and Labrador

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This research aims to assess the chances of organic agriculture in Newfoundland and Labrador (NL) by using a comprehensive literature search and a case study approach. The working hypothesis of this research is that a strong organic agriculture sector is an important component of the transition to a sustainable food system in the province of NL. Sustainable food security entails not only that all people at all times have access to adequate and nutritious food, but also that this food be produced with minimal environmental impact (FAO, 2010). Organic agriculture is a growing field whose success has been driven mainly by consumer demand and dedication of farmers. Its future depends on its ability to compete favorably and sustainably with conventional agriculture in terms of crop and land productivity. With its scarce cropping land and a big number of small and medium scale farms, NL is best positioned for growing its small-scale organic farming sector, which can provide both food and income security for NL inhabitants.

5 | Overview of Development of Novel Woodchip Bioreactor System to Reduce Pollution Effects of Agricultural Drainage Water

> ***Lordwin Jeyakumar[1], David McKenzie[1], Erin Smith[2], Evan Derdall[3], Helen Zhang[4], Adrian Unc[5], Lakshman Galagedara[5], Sandy Todd[1] and Gary Bishop[1]***
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Tile drainage systems are used to remove excess water from agricultural lands thereby, lengthening the growing season, and increasing the ability to produce higher value crops. However nitrate-nitrogen exports from agricultural fields through subsurface (tile) drainage system contribute to the eutrophication of natural aquatic ecosystems. On the other hand, economic pressures confronting farmers and lack of conventional water treatment facilities could potentially create significant problems in pollution control which may need to be addressed through an effective and affordable treatment system. Considering these issues, the St. John's Research and Development Centre constructed four bioreactors of equal size, with the woodchip beds measuring 24.38 m long, 3.04 m wide and 1.06 m deep to treat the tile drainage water for 1.6 ha of land. These bioreactors are filled with wood by-products that serve as a carbon and energy source to denitrifiers, which reduce nitrate (NO3-) to non-reactive dinitrogen (N2) gas via microbial denitrification. Using "wood by-products" for tile drainage water treatment is a "win - win" technique which contributes to sustainable development and has substantial benefits for both the economy and the environment.



6 | Impact of Surface Mulch Type on New Plantings of Half-High Blueberry Cultivars

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New plantings of half-high blueberry (Vaccinium corymbosum L. x Vaccinium angustifolium Ait.) on undrained loam soils have suffered losses due to frost heaving and waterlogging on the Avalon Peninsula. These typically high silt soils are prone to compaction and often

have intermittent perched water tables caused by a shallow hard pan. To prevent blueberry root waterlogging damage, a field site at the St. John's Research and Development Centre was deep tilled, tile drained, and 30 cm high raised beds were prepared for a 2012 experimental planting. Commercial half-high cultivars from four maturity classes (Bluetta – early, Reka – early to midseason, Chippewa – midseason, Bonus – mid to late season) were planted for assessment of plant establishment characteristics under three surface mulch types (sawdust, wood chips, and five year black plastic). Twin drip irrigation lines were installed in the root zone on each side of the plants for scheduled fertigation and any required irrigation. Due to intermittent snow cover, winter damage each year was moderately severe on upper stem flower buds and leaf buds. Plant flower occurrence was used as an indicator for plant growth. In the first two growing seasons flower occurrence was near zero for Bluetta and Bonus, low for Reka (12 %) and moderate for Chippewa (55 %). Blueberry plant flower occurrence on sawdust (12 %) and wood chip mulch (12 %) was less than half of flower occurrence under black plastic mulch (28 %). Flower occurrence and berry yield will be assessed through the 2017 production season.

7 | Alternative Crops Initiative

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The Alternative Crops Initiative investigates opportunities to expand the Agrifoods fruit crop industry. Newfoundland and Labrador has a climate that is very favorable for growth and production of berry crops such as half-high blueberry (V. corymbosum / V. angustifolium), lingonberry (V. vitisidaea) and cranberries (V. macrocarpon). A berry species that may be commercially produced in this province will have the ideal traits including: high yield, ideal color, disease/insect resistance, and winter hardiness. Thirty one cultivars of half high blueberry and thirty two cultivars of lingonberry were provided by AAFC- St. John's to conduct field trials. New Lingonberry hybrids are currently being tested against two European lingonberry varieties Sussi and Sanna. Information will be collected on yield, color, disease/insect resistance and winter hardiness. With a growing cranberry industry it is important to evaluate new high yielding cultivars. Through a partnership with Rutgers University; cranberry varieties Mullica Queen, Crimson Queen and Demoranville were propagated and are presently being evaluated during a multiyear project. First yield collection of both the lingonberry and cranberry will begin in the 2017 field season. The half-high blueberry variety AD30 showed 86.67% of plants bearing fruit, and the AD17 half-high blueberry yielded an average of 413.70 g/plant. It is important to continue research of new and more competitive varieties. Preliminary results are showing favorable yields, this research is the first step to NL becoming a leader in the cranberry, blueberry and lingonberry, industries while preserving the quality of the local wild berry.

8 | Cold-Hardy Wine Grape Production in Newfoundland and Labrador

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In 2013, the first experimental vineyard was constructed at the Pynn's Brook Research Station in Pynn's Brook, NL. This project was put forth to determine if grapevines will grow, mature grapes to the appropriate brix levels, and survive in various Newfoundland climates. The first vineyard began modestly with 11 red varietals and 5 white varietals, for a total of 140 cold-hardy vines. Since the initiation of this project, there are now 6 commercial vineyards on the Island to contribute to the viticulture industry.

Vegetative vigour, timing of the bloom, frost-free days and date of last frost were significantly affected by site location. Rootstock had a significant effect on vegetative vigour when compared to own-rooted plants. The red varietal, Marechal Foch was the first variety to bloom. Frontenac, Marechal Foch, L'Acadie Blanc, and Giesen were the four varieties that bore fruit, reaching a high of 14o Brix for the summer of 2015.

9 | The Newfoundland and Labrador Seed Potato Program

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Several of the most commercially devastating potato pests are found in the province of Newfoundland and Labrador including potato wart and round worm species. To combat the risks associated with these pests the government of Newfoundland and Labrador works to develop potato varieties which exhibit novel traits that protect them from these risks while maintaining commercial productivity levels. Potato wart and round worm infestations can lower tuber yields and increase disease susceptibility even destroy an entire crop. We are working to develop and evaluate selected potato varieties with resistance / immunities to these specific pests while increasing their productivity through artificial selection. New variety tubers are produced from tissue culture as nuclear class seed at the Nuclear Seed

Potato Production Facility in St. John's and are then moved to the Glenwood Seed Potato farm for further multiplication and evaluation. Varieties are then given a final assessment for suitability and production capabilities. Since 2013 as a result of the research done through the provincial seed potato production program there have been two new varieties, AAC Fortune and AAC Madam Blue, that have entered or are about to enter the commercial seed market in Newfoundland. With the ever evolving nature of agricultural pests and diseases it is critical to the provincial potato industry to have new varieties available to ensure maximum return on investment and to help minimize crop impact of these commercially significant risks.

10 | Survey of Antibiotic Resistome in Agriculture Soils and Mixed Use Water shed in Western Newfoundland

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Antibiotic production is a naturally employed by microorganisms to control their environment in stress situations. Antibiotic resistance has evolved in parallel to counteract antibiotic effects. This arms race led to a wide range of antibiotic resistances to develop naturally in the environment. However, excessive use of antibiotics for human or animal health, may induce unnaturally high antibiotic stresses leading to enhanced antibiotic resistance, i.e. acquired resistance. Wastewater treatment plants integrate multiple waste-streams and harbour multiple antibiotic resistances. Insufficient treatment can lead to environmental discharge of waste streams carrying antibiotic resistant organisms. Land application of livestock manures from farms might also lead to high antibiotic resistances in soils.

We present here an initial exploration into the distribution of antibiotic resistance, i.e. resistome, in soils and waters, in Western Newfoundland. Water has been sampled from the Humber river along a gradient of increased human impact, mainly associated with the discharge municipal wastewaters. Cormack soil samples were collected from a control farm site, that does not receive human waste. Total DNA was extracted and has undergone shotgun sequencing on an Illumina HiSeq platform. Search for antibiotic resistance markers in the metagenomic data thus obtained was carried out by employing the Shortbred pipeline (Kaminsky et al., 2015). About 400 antibiotic resistance genes, of variable abundance, were identified, distributed across the tested systems, an indication of the wide distribution of antibiotic resistance in the environment. The analysis is currently focusing on the identification of markers for acquired resistance, and their relationship with the sample location.

11 | Soil Microbial Diversity and Function Around and Within a Long Term Agricultural Plot in Newfoundland

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Microorganisms carry out functions relevant to nutrient and carbon cycling in soil. Chemical and biochemical cycles in soils of undisturbed, or minimally disturbed ecosystems tend to have seasonally induced variability but they may be generally considered to be under steady state from year to year. Agricultural management of soil affects directly and indirectly both diversity and functionality of soil microbial communities.

Literature indicates that soil pH is the main governing parameter for microbial diversity. In Newfoundland most cultivation occurs on podzols. Upon conversion from forest soils are limed to increase the pH from 4.5-5.0, and occasionally drained.
We explored the genetic diversity of the fungal and bacterial communities, and estimated the putative functional profile of the bacterial community in a long-term cultivated plot in comparison with the non-managed surrounding area. The test plot, in Cormack, Newfoundland and Labrador, has been farmed for about 60 years.

Both horizontal and depth gradients were sampled in a fully replicated approach. Paired-end community sequencing was carried on an Illumina MiSeq platform. For bacterial/archaeal 16s rDNA marker primers for the V4-V6 hypervariable region were used. The ITS1f and ITS2 primers were employed to estimate fungal diversity via the ITS ribosomal DNA marker. Data was analyzed in QIIME™. Metagenome functional prediction, an estimation of functions as known to be associated with the identified bacterial species, was carried out with PICRUSt.

We therefore present the variability of both genetic diversity and associated functions along a management gradient that compares natural and cultivated soils.

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12 | Mapping Spatio-Temporal Variability of Apparent Electrical Conductivity under Different Land Uses

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Understanding the natural variability of soil properties is a key to effective soil management for improving soil functions and soil health. In Newfoundland and Labrador, not much information is available about the variability of these soil properties, soil physical and hydrological properties in particular over the agricultural landscape. Reliable, timely and cost effective soil surveys to establish the spatial distribution of fundamental soil properties and to evaluate the temporal changes of these properties are highly desired. This research focuses on utilizing apparent electrical conductivity (ECa) recorded by electromagnetic induction (EMI) surveys in characterizing the spatial and temporal variability of soil physical properties in Western Newfoundland (WNL). This involves the use of ECa survey data to direct soil sampling to provide a comparative soil physical properties information and to demonstrate the effectiveness of EMI survey protocols in characterizing spatial and temporal variability of target properties, such as moisture content, porosity, texture etc. A study

has been started at Pynn's Brook Research Station, Pasadena using two different non-invasive EMI sensors to collect ECa data under different nutrient management and land use systems. Results of this study will help to develop relationships between ECa and target soil properties. Once these relationships are established, the EMI results can be used for extrapolation of spatially and temporally variable point information into the field scale.

13 | Does Biochar Mitigate Greenhouse Gases Emission and Nitrogen Losses in Dairy Manure Based Corn Silage Production System?

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Agriculture contributes 14% of anthropogenic greenhouse gas emissions (GHG) to the atmosphere. Canada and US accounts for 8% and 10% of total GHG emissions, respectively. Globally, agricultural systems contribute nearly 70% of N2O emissions to the atmosphere, which is a powerful GHG with 300 times global warming potential than CO2. By 2100, the global N2O emissions are projected to be four times greater than the current emissions, largely due to an increase in N-fertilizers use. The net emission of GHGs from farming activities can potentially be decreased by changing crop management practices to increase soil organic carbon (SOC) content and decrease N2O emissions. Dairy manure application in agricultural fields increases SOC mineralization and consequently stimulates nitrification and denitrification processes leading to N2O emissions. Biochar, a stable carbon rich product obtained by pyrolyzing biomass has been observed to; increase biomass production in many crop plants, decrease litter decomposition rates in the soil, decrease N2O emission in the soil, increase NH4 uptake and increase long term longevity storage in the soil. However, these mitigation effects are not constant across all soil types and conditions, cropping systems and biochar types. A field experiment has been initiated at Pynn's Brook Research Station, Pasadena, NL to investigate the impact of biochar application on GHGs emission and nitrogen losses in dairy manure based corn silage production systems. Treatments include; i) dairy manure with high nitrogen (DM1) (0.37%), ii) dairy manure with low nitrogen (DM2) (0.14%), iii) inorganic nitrogen (IN), iv) IN + Biochar v) DM1 + Biochar, vi) DM2 + Biochar vii) control (No nitrogen) and viii) control (No crop). GHGs and soil sampling are being carried out fortnightly throughout the crop growing season to estimate the gaseous and leaching losses from dairy manure based cropping systems. Data on soil temperature, soil volumetric moisture contents and EC are also being recorded from each treatment at sampling time. It is expected significant changes is GHG losses, N leaching and crop growth among treatments.

14 | Spatial and Temporal Profiling of Corn Silage Root Traits under Manure and Phosphorus Fertilizer Supplies in Field Conditions

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To enhance the phosphorus use efficiency in cereal crops is an important task for agriculture sustainability and global food security. Roots dynamics and limited phosphorus availability is the major cause of low biomass production. Roots provide essential functions including the uptake of water and nutrients for plant growth, acclimate to abiotic and biotic stressors in the root zone, serve as storage organs, anchor the plants to the soil and are the sites of interactions with both pathogenic and beneficial organisms in the rhizosphere. Water and nutrients uptake by crops depends on root branching in the soil. It is known that higher root length density increase water and nutrient uptake. As such, efficient nutrients uptake depends on root-shoot ratio (R/S), root size, and root distribution in the soil profile, which not only maximize interception and uptake of nutrients, but also reduces N and P losses to deeper soil layers and groundwater, thereby enhancing nutrient use efficiency. Root associated factors such as root morphology, architecture, root hair density, nutrient absorption rate, ability to modify the rhizosphere and mychorrhizal symbiosis can strongly influence P acquisition. Roots morphological traits and root exudates are crucial for nutrients acquisition and increase crop adaptability under a wide range of environmental conditions. A field experiment is being conducted at Pynn's Brook Research Station to investigate the spatial and temporal variations in root morphological traits and root exudates of five silage corn genotypes, and to determine their role in P acquisition in the unique soils of western Newfoundland. This project will enhance our understanding of the spatiotemporal development of roots system architecture, and biochemical processes operating in the rhizosphere under various phosphorus fertilizer applications.

15 | Improving Soil Hydrology and Soil Health through Cover Crops

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Globally, land productivity has continually decreased due to degradation of soil structure, depletion of nutrients, and reduction in soil water holding capacity, all these affecting soil health. This led to significant increases in agricultural inputs causing high costs of

production and increased environmental degradation. Extensive tillage damages soil structure often leading to formation of soil crust which in turn lowers infiltration and water holding capacity, and increases runoff accelerating erosion and nutrient loss. On the other hand, higher rain intensities and shorter rainfall periods, a result of climate change, further impose severe stresses by altering the agriculturally relevant hydrology. Consequently, plants survival is affected by the reduced water holding capacity and reduced infiltration rates associated with the ever-longer dry periods. Growing cover crops after the harvest of cash crops, such as cereals, is a well-known, widely employed practice that helps with the soil recovery towards more natural conditions by protecting the soil surface from rainfall splashing and reducing the surface sealing effect. Thus, soil health could be improved with the added benefits of increased land productivity and enhanced environmental quality. These benefits can be summarised as improved water holding capacity, higher nutrient retention, improved soil biological functions, reduction in soil erosion, and reduction of eutrophication in surface waters. Some legume cover crops such as clover, peas and alfa-alfa can fix as much as 20-120 kg of atmospheric nitrogen per acre. Therefore, it might be worth considering testing cover crops, for different cropping systems relevant for the agriculture in NL, to assess their potential role for enhancing soil health and hydrology.

16 | Somatic Embryogenesis in Blueberries using Semi-Solid and Liquid Media in a Bioreactor System

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Blueberry (Vaccinium spp. L., family: Ericaceae) is a widely accepted economically important health-promoting small fruit crop. In Newfoundland and Labrador, blueberry wild germplasm managed and harvested commercially to meet the increasing demand of high quality blueberries. Being genetically heterozygous in nature, blueberry plants grown from the seeds are not true-to-type to the donor plants. Although the species is successfully propagated by conventional methods, it is labour-intensive and time consuming. With the advent of plant tissue culture techniques, it is extensively employed to multiply plants rapidly which provides year around production. Moreover, the use of liquid medium in a bioreactor system will minimize the labour and cost at various point of time compared to in vitro conventional propagation using semi-solid gelled media. In plant tissue culture isolated plant parts from the intact and healthy plant are used as explants; which kept on the suitable semi-solid (agar gelled) or liquid nutrient media with or without growth hormone. This nutrient media nurture and work as the conductive elements those surrounds the plant parts. The growth regulators in the culture media helps the explants to dedifferentiate and redifferentiate, which eventually helps in callus formation, elongation and proliferation. An attempt has been made in order to develop a protocol for somatic embryogenesis in blueberries in semi-solid and liquid media in a bioreactor system. Results obtained from this study are to identify an improved cost-effective method of blueberry propagation via somatic embryogenesis using semi-solid medium and liquid medium in a bioreactor system.

17 | A Priori Evaluating the Role of E Horizon on Hydrological Processes in Podsolic Soils

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Climate change and its corresponding effects of increasing of surface temperature, highly variable rain intensities resulting droughts and floods and other extreme events will potentially diminish global agricultural areas by end of this century. Yet, the loss of glaciers and increase in growing days in regions of the northern hemisphere offer new prospects of expanding agricultural areas into formerly unsuitable lands. However, these lands are covered by Boreal forest that are repositories of huge amounts of organic carbon and support a broad range of exceptional ecological habitats. Moreover, predominant soils are Podzols, commonly not considered suitable for crops. Although the likelihood of converting Podzols is high, it is yet mainly unknown how the predicted more intense and irregular rain pattern will affect and control Podzol qualities. Central for the estimation of water, carbon and nutrient fluxes within Podzol is the knowledge about its hydrological properties, e. g. variation of water residual time and drainable water content (qd) after rain. Here, we simulated the vertical hydrologic response for a Podzol and a Brunisol to various intense rain events: 5, 10, 15, 25, and 50 mm h-1 using a Hydrus 1-D. We analyzed; i) soil water contents (qt), ii) drainable water content (qd), and iii) unsaturated hydraulic conductivity K. Results showed that Boreal Podzol, in comparison to Brunisol, is characterized by; i) low drainage rates in the A-horizon and higher qd, particularly towards the lower boundary, ii) higher drainage rates in the E-horizon and thus leading to higher qd values and iii) faster wetting of the bottom B-horizon. The potential increase in the soil solution concentration due to water-soluble substances in the A-horizon combined with quick discharge and higher solute transport rates of the E-horizon can lead to accelerated leaching of natural soil minerals as well as artificial substances (e.g. fertilizers and pesticides). These hydrological properties potentially diminish nutrient availability for crops while causing water pollution problems in connected water bodies. Hence, every planned conversion of Boreal Podzol into agricultural lands requires careful consideration of its peculiarities and agronomic practices should be altered accordingly.

18 | Root Exudates Profile in Five Silage Corn Genotypes Grown in Western Newfoundland

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Root exudates play important roles in the modulation of nutrient availability, enhanced plant tolerance to abiotic or biotic stresses as well as the attraction of different bacterial populations in the rhizosphere. Root exudates are also involved in plant signaling mechanisms, and plant adaptation processes. A research trial was conducted at Pynn's Brook Research Station to determine the root exudate profile in five silage corn genotypes (Fussion-RR, Yukon-R, A4177G3, DKC-2317, DKC-2628) during 2015. Soil and corn roots sampling were done at the black layer stage in each silage corn genotypes. Samples were analyzed with GC-MS to characterize the root exudate profiles of the silage corn genotypes. Preliminary results indicate that silage corn genotypes varied significantly ($P < 0.01$) in terms of root exudates. Quantitatively, the five corn genotypes differed in the levels of the following root exudates: sugars (ribofuranose, D-xylopyranose), amino acids (glycine, pryoglutamic acid), phenolic acids (p-hydroxybenzoic, p-coumaric and, ferulic acids), organic acid (cis-aconitic acid) and fatty acids (alpha linolenic and pentanoic acids). In all the variety tested, p-coumaric was the major phenolic acid, D-xylopyranose the major sugar, pryoglutamic acid the main amino acids and pentanoic acids the major fatty acids in the roots exudates.

Fussion-RR exhibited higher levels of phenolic acids (p-coumaric acid: 76 nmol %) and fatty acids (pentanoic acid: 5.8 nmol %; α-linolenic acid: 0.195 nmol %) compared to other genotypes. However, DKC-2628 expressed higher levels of sugars (D-xylopyranose: 85 nmol %) and amino acids (pryoglutamic acid: 91 nmol %) compared to the other genotypes. Cis-aconitic acid is the only root exudate found consistently in the soil from the root zone of all corn genotypes. Further studies are underway to quantify the root exudates in corn root and soil samples at different growth stages in each silage corn genotypes, to determine their possible role in enhancing nutrient acquisition and crop growth performance in the cool growing seasons of western Newfoundland.

19 | Food, Fish and Farming in the NL K-12 Curriculum

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This poster will present the results of a scan of the Newfoundland and Labrador K-12 English Curriculum. The purpose is to identify both the presence of food systems related curriculum and potential places where the current curriculum links with food systems education. Across the country, there are increasing trends to promote food systems thinking by integrating food literacy into the curriculum and also to make curriculum connections with innovations that are occurring in sustainable food system planning. For example, New Brunswick's Local Food Security Act stipulates the provision of food, agriculture, and garden-based education in schools. This scan includes the documentation of what courses and in what grades food, fish and/ or farming are being taught and to understand in what context these subjects are being taught. Some suggestions will be made for critical synergies between the current curriculum and current innovations in food systems curriculum. It is hoped that this scan can be used as a tool for teachers, community groups and curriculum planners in order to strengthen food and place-based curriculum in NL.

20 | Influence of Micropropagation on Vegetable Growth and Antioxidant Properties of Lowbush Blueberry

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Lowbush blueberry is one of the best sources of natural dietary antioxidants, and there is the possibility to increase the antioxidant properties further through advance propagation technology. Bare areas of naturally grown native lowbush blueberry fields cause low yield, and filling in those bare areas rapidly by conventional stem cutting propagation is a constraint in blueberry production. The morphological characteristics of matured plants of two blueberry genotypes grown in greenhouse and propagated from stem or softwood cutting and by tissue culture were studied in 2013. Antioxidant metabolites and activities in fruits and leaves at different maturity stages were investigated. Plant derived through micropropagation grew more vigorously and produced higher number of rhizomes and branches per plant compared with stem cutting plants of both genotypes. Whereas, conventionally propagated plants had thicker stem and higher number of branches per rhizome than micropropagated counterparts. Although the tissue culture originated plants bore larger leaves than the plants propagated from softwood cutting, those characteristics were genotype specific. In vitro propagation enhanced total phenolic and flavonoid content as well as antioxidant activities of blueberries. The extract from green fruits had higher content of phenolics and flavonoids and exhibited higher antioxidant activities than those of in extract from half-ripen and fully ripen berries. Total phenolic and flavonoid content, DPPH radical scavenging activity and reducing power of ferric ions of blueberry fruit and leaf extracts were ranked in the order red leaves > green leaves > green fruits > half-ripen fruits > fully-ripen fruits.

21 | Agricultural Drainage Effect on the Photosynthetic Capacity of Boreal Peatland

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Natural peatlands are known to sink or accumulate atmospheric carbon – since the rate of biomass production through photosynthesis exceeds the rate of decomposition. Hence peatlands are known to be an important link to the global carbon cycle. However, human disturbance (e.g. agricultural drainage), via changes in hydrology and vegetation composition, has potentially caused a decrease in soil carbon storage and in some cases, has converted wetlands into carbon source instead of a sink.

Photosynthetic capacity, a key indicator of ecosystem production and biomass production, is considered to playing a pivotal role in determining an ecosystem functioning as a carbon sink or source. Talking of biomass production, peatland drainage to improve soil aeration conditions has been known to lower the water table, thereby keeping the soil dry and improving plant growth and production. However, how the drainage directly affects the photosynthetic capacity on a plot scale with certain dominated plant functional type (PFT) is unknown, although a few research has been conducted to examine the photosynthetic capacity at ecosystem scale based on eddy covariance measurement. Therefore, we designed a pilot study to examine the photosynthetic capacity and its changes at the plot scale based on a pair of clear and opaque chamber measurement.

Here we presented our data on net ecosystem exchange (NEE) of carbon dioxide and thus gross primary production (GPP) (i.e. photosynthetic capacity) of the plot scale at our drained boreal peatland-pasture site and natural peatland site. Both spatial and temporal variability will be presented. Our data showed the agricultural drainage has caused a significant change in NEE and GPP during the growing season. Specifically, we found that the pasture had a much higher GPP and NEE than the natural site. Our data will provide the peatland carbon modeling with the key parameter of simulating photosynthesis and biomass production for each PFT affected by agricultural drainage.

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22 | Diurnal and Seasonal Variation in Methane Fluxes from an Abandoned Boreal Peatland Pasture Based on Eddy Covariance Measurements

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Although there are a few estimates of the annual methane (CH4) flux from agriculturally managed peatlands, knowledge of controls over the variation of CH4 in different time-scales is limited by the lack of high temporal-resolution data. Here we measured CH4 fluxes continually from May, 2014 to April, 2016 using the eddy covariance technique at an abandoned peatland pasture in western Newfoundland, Canada. The goals of the study were to identify the controls over the diurnal and seasonal variations in CH4 flux, as well as to quantify the annual CH4 flux. The diurnal pattern of CH4 flux and its controls shifted among different periods during our studied period. CH4 flux increased from nighttime to daytime and peaked at around midday during the early and late growing season, consistent with the diurnal pattern of solar radiation, air temperature, VPD and u*, though highly variable nighttime CH4 emission occurred during early growing season. In contrast, CH4 fluxes decreased from nighttime to daytime, with small emissions or uptakes of CH4 at midday during peak growing season. It is hypothesized that this unique diurnal pattern of CH4 flux was probably related to CH4 oxidation process corresponding with the surface soil temperature and oxygen input associated with daytime plant photosynthesis.

The seasonal variation in daily CH4 flux was weak in the first study year (from May, 2014 to April, 2015), but it was more pronounced in the second year with low CH4 emissions and uptakes in the early and middle growing season and larger fluxes and high variability in the late growing season. The daily average CH4 flux ranged from -9.3 to 10.0 nmol m-2 s-1 in 2014-15 and from -9.8 to 12.1 nmol m-2 s-1 in 2015-16.

Path analysis results indicated that water table was the only significant control over CH4 flux variation in the dry 2014 growing season, but subsurface soil temperature was the main control in the wet 2015 growing season. The combined effects of surface and subsurface soil temperature, water table depth, solar radiation, vapor pressure deficit, and friction velocity explained more than 80% of the seasonal variability in CH4 flux. The annual CH4 emission was similar in both years, with ~ 0.3 - 0.5 g CH4 m-2 based on different gap-filling methods, falling within the range of CH4 emissions reported for pastures elsewhere. This study is the first report of long-term landscape CH4 flux of agriculturally managed peatlands in Canada and updates our knowledge of controls over CH4 flux in these ecosystems at different temporal-scales.

23 | Spatial Variability of CH4 Emission at a Drained Boreal Peat Pasture during the Growing Season

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Peatlands are regarded as the global storages of soil carbon and the source of atmospheric methane. The ecosystems of these lands consist of the carbon–water complex. Therefore, peat soils are most likely to have greater than 95% of soil water content which slows down the mineralization of soil organic matter. Methane (CH4) flux in peatlands is a combined result of CH4 production in anaerobic zone, CH4 consumption in aerobic zone, and CH4 transportation, which are all affected by hydrology and vegetation composition. Agricultural drainage in peatlands, via changes in hydrology and vegetation composition, has a significant impact on all the three relevant processes with CH4 emission. However, how exactly agricultural drainage changes CH4 emission in boreal peatlands is not well known.

Here we carried out a field study, using a static chamber technique, to examine the spatial and temporal variation of CH4 emission from a drained boreal peat pasture during the growing season of 2016. We hypothesized that drainage ditches function as a hot-spot of CH4 emission with a significant spatial variability associated with dominated vegetation type, and the overall CH4 emission would be significantly lower than natural site.

Our data implied that CH4 emission in the drained pasture site was regulated by dominant vegetation type, soil temperature and water table depth. Specifically, the subplots with shrubs as dominant vegetation had a small CH4 emission, and even a small CH4 sink during

the peak growing season. The subplots with grasses and sedges as dominant vegetation had a much higher CH4 emission and the drainage ditches had the highest methane emission at the drained pasture site. The CH4 emission from the natural peatland site was significantly higher than drainage peat pasture site. Our studies suggest the importance of considering the spatial variability of CH4 emission and the significant contribution from drainage ditches when assessing the effects of agricultural drainage on CH4 emission in boreal peatlands.

24 | The Effect of Agricultural Drainage on Dissolved Organic Carbon in Boreal Peatlands

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Peatlands are an important terrestrial carbon store which can hold approximately 200-450 Pg C. Actually peatlands with the carbon-rich soils are a principal source of dissolved organic carbon (DOC) to the fluvial environment, the transportation of which constitutes a significant link in the global carbon cycle. DOC consists of a variety of molecules that range in size and structure from simple non-humic acids and sugars to complex humic substances, and therefore contains both biologically available (labile) and more recalcitrant components, so concentration and composition of DOC can be varied in soil water according to changing conditions.

Agricultural drainage of peatland has led to changes in both concentration and composition of DOC. The full effects of drainage on DOC are difficult to assess and are likely to be extremely complex. A reduction or loss of natural carbon sinks represents a significant problem from the standpoint of global climate change, so such study is therefore imperative that we improve our understanding of how peatlands respond to drainage.

Our study investigated the principal differences in DOC concentrations between drained boreal peatland-pasture site and natural peatland site to have a qualitative assessment of DOC along with the initial assessment of aromaticity of DOC by using Specific UV absorbance (SUVA), which gives an "average" molar absorptivity for all the molecules contributing to the DOC in a sample. DOC concentration was measured using TOC-V analyzer. Samples were analyzed for UV–Vis absorption using a spectrophotometer. SUVA was determined by dividing UV–Vis absorbance at $\lambda = 254$ nm by the sample DOC concentration multiplied by 100.

Our results showed that DOC concentration was higher in drainage site than natural one. By drainage, and lowering water table, more aerobic decomposition is occurred and likely increases organic matter biodegradation, so higher SUVA in drained peatland was seen in comparison to the intact one. So, drainage can effect both on DOC concentration and aromaticity, and therefore alter the stability of the carbon storage in boreal peatlands.

25 | Northern Cereals - New Markets for a Changing Environment

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New opportunities for greater cereal production in northern areas have been realized as a result of warmer growing conditions, improved varieties and technologies, and concerns about sustainability. In a few areas, it has already been possible to produce higher value cereals for milling and malting which has allowed SMEs (small/medium enterprises) to develop new "local" products to meet a growing demand from tourists and residents.

The project objectives are to increase cereal growing in the partner areas of Iceland, Orkney, Northern Norway, the Faroe Islands and Newfoundland and Labrador and to increase the growing of higher value cereals for local food and drink products. The main outputs from the project will be increased numbers of farmers growing cereals for feed, malting or milling and the production of higher value cereal products like seed, malt, food and beverages. These changes will increase employment, income and consumer choice in rural areas. The main beneficiaries will be growers and their local communities, SMEs and consumers.

Individually, none of the project partners have the skills or resources to carry out the project alone and therefore the novel approach being adopted is to pool the experiences and specializations of the partners together with their associates to collectively address constraints and knowledge transfer across the supply chain – from planting the crop to the development of new food and drink products. Results from this project will contribute to increased sustainability among dairy farmers who can use grain for feed and reducing imports of grain/concentrates leading to more economical farms and creating a market for domestic grain for feed and food.

A Northern Periphery and Arctic Programme (NPA) Project -
European Regional Development Fund
A Collaboration in Knowledge Transfer Between:
Iceland, Orkney, Northern Norway, the Faroe Islands and Newfoundland and Labrador

26 | A Fly in the Ointment: Liquid Manure's Impacts on the Lesser House Fly Population in Cavendish, NL

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In response to long-term community complaints regarding the smell of mink feces and the annoyance of lesser house flies that breed in this feces, Viking fur farm installed feces removal and liquification equipment. This effort, undoubtedly, has lowered both the smell and fly numbers. Concerns quickly shifted to the application of the resulting liquid manure to the fields surrounding the farm. Our aims were to assess the impact of liquid manure on the lesser house flies in these fields. Our study had two hypotheses: i) does liquid manure attract lesser house flies to the field? ii) does liquid manure enable the lesser housefly to breed in the field? To assess attraction, we placed sticky traps in a field: one part was treated with liquid manure, one part with compost (normal practice), and one part untreated. We used two malaise traps to also assess fly diversity in the field. To assess breeding, we took 210 soil samples, throughout the summer of 2015, and surveyed the soil and plant roots for evidence of fly larvae. There were 22 lesser house flies captured on cards, and one specimen was captured in a malaise trap, incredibly low numbers, especially compared to the most abundant fly families that we trapped: > 1500 Anthomyiidae (flower flies) and > 500 Muscidae (house flies). The low number strongly suggests that the application of liquid manure is not a concern regarding these flies, although, the low number negates any formal analysis. However, we were able to assess interesting patterns for the Anthomyiidae and Muscidae. Both of these families increased significantly in number immediately after the application of liquid manure and then dissipated in the weeks following. The liquid manure, when first applied, was significantly more attractive to the Anthomyiidae and Muscidae then the compost or untreated parts of the field. Despite some evidence of liquid manure attraction (two families), our soil sampling did not find any evidence of larvae. Our research suggests that the application of liquid mink manure will not play a role in the abundance of flies in Cavendish.

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27 | Functional Foods: A Potential Niche for Newfoundland and Labrador Agriculture and Food Industry

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Functional foods refers to food ingredients that confer demonstrated health benefits beyond basic nutritional needs. These include components such as omega 3 fatty acids, vitamins, mineral elements, plant sterols, fibers, phenolics, amino acids among others. Examples of functional foods include blueberries high in antioxidants and polyphenolics, eggs enhanced with omega 3 fatty acids and vitamin E, wheat high in lutein, tomatoes high in lycopene, and yogurts enhanced with probiotics. The interest in these ingredients in agricultural and food products is based on their biological activities and demonstrated effects in enhancing health or reducing the risks of developing serious diseases. The functional foods market is growing at a rate of 15% per annum and is predicted to become the fastest growing sector in the agriculture and food industry over the next 25 years. This growth is driven by a more health conscious consumer base who recognize the benefits between healthy diets and enhanced health. As we move towards growing and improving the Agriculture and food sectors in Newfoundland and Labrador, opportunities exist to also enhance the production of functional foods unique to the province. Newfoundland and Labrador have a unique climate and growing season that shape the synthesis of the biomolecules present in animal and plant products grown in the Province.


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