Manitoba Soil Science Society

69th Annual
Manitoba Soil Science Society Conference and Annual General Meeting

SOIL HEALTH STRATEGIES FOR MANITOBA SOILS

February 5-6, 2026

Winnipeg, Manitoba

2025-2026 MSSS EXECUTIVE

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CONFERENCE PROGRAM

Thursday, February 5, 2026

7:45 am Registration

8:25 am Conference Commences
Opening Remarks – Henrique Carvalho, MSSS President

PLENARY SESSION: SOIL HEALTH STRATEGIES FOR MANITOBA SOILS
Chairperson: Henrique Carvalho

KEYNOTE SPEAKERS

8:30 am **Towards understanding soil health: from small plots to farmer fields**
Laura Van Eerd
Chair in Net Zero Soil Management, School of Environmental Sciences, University of Guelph, Guelph, Ontario

9:15 am **The Ins and Outs of Soil Carbon**
Brian Amiro
Professor Emeritus, Department of Soil Science, University of Manitoba, Winnipeg, Manitoba

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10:00 am Nutrition Break and Poster Session

GENERAL SESSION: SOIL HEALTH
Chairperson: Henrique Carvalho

10:30am **Short Term Impacts of Grazing Winter Cereal Cover Crops on Cropping Systems and Profitability**
Katrina Kratzke*[1], Joshua Wianecki[1], Miranda Meehan[1], Kevin Sedivec[1,2], Lindsay Chamberlain Malone[1], Zachary Carlson[3]
[1]School of Natural Resource Sciences, North Dakota State University, Fargo, ND.
[2]Central Grasslands Research Extension Center, North Dakota State University, Streeter, ND
[3]IFF Fargo, North Dakota

10:45 am **Initial Assessment of Carbon Dynamics in Conventional and Diversified Cropping Systems in Manitoba**
Emily Robb*[1] and Henrique Da Ros Carvalho[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

11:00 am **Legacy Effects of Manure Amendments on Aggregate-Associated Particulate, Dissolved, and Mineral-Associated Organic Matter in a Long-Term Integrated Crop-Livestock System**

Charitha Hansima*[1], Inoka Amarakoon[1], Francis Zvomuya[1], Henry Wilson[2], Nora Casson[3], and Mario Tenuta[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada.
[2]Agriculture and Agri-Food Canada, Brandon, Manitoba, Canada
[3]Department of Environmental Studies and Sciences, The University of Winnipeg, Winnipeg, Manitoba, Canada

11:15 am **Improving soil organic carbon prediction using feature selection techniques**

Ehsan Zarrinabadi[1], Zeinab A. Dastgheib[1], Masoud Goharrokhi[1] and David A. Lobb[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Canada

11:30 am **Comparing Full-Range and Portable Visible-Range Spectroscopy for Soil Organic Carbon Determination**

Dinuka Thennakoon*, Masoud Goharrokhi, Tori Maxwell, David Lobb, Annemieke Farenhorst, and Nasem Badreldin
Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

11:45 am **Soil Conservation Strategies for Forest Soils in the Mountain Forest Section of Manitoba**

Paul LeBlanc[1]
[1]District Forester - LP Building Solutions – Forest Resources Division, 558 3rd Ave. S., Swan River, Manitoba, Canada

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12:00 pm Lunch

GENERAL SESSION: NUTRIENT DYNAMICS

Chairperson: Rijwan Sai

1:00 pm **Do Legacy Effects Persist?**
Impacts of Cover Crops and Tillage Practices on Soil Health in a Manitoba Corn Field

Mikhail Maslov[1], Lori Phillips[2], Mario Tenuta[1], Craig Drury[2]
[1] Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada
[2] Agriculture and Agri-Food Canada, Harrow, Ontario, Canada

1:15 pm **Effects of Cover Crops on N2O Emission in Southern Manitoba**

Jose A. Almodovar*[1], Mario Tenuta[1], Yvonne Lawley[2], Navneet Brar[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada
[2]Department of Plant Science, University of Manitoba, Winnipeg, Manitoba, Canada

1:30 pm **Influence of dual inhibitor urea and roots on the taxonomic structure of soil microbial communities**

Rebecca Pagès*[1], Mario Tenuta[2], Stephen Crittenden[3], Matthew Bakker[1]
[1]Department of Microbiology, University of Manitoba, Winnipeg, Manitoba, Canada.
[2] Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada.
[3] Brandon Research and Development Centre, Agriculture and Agri-Food Canada, Brandon, Manitoba, Canada.

1:45 pm **Are All Nitrification Inhibitors Equally Effective to Protect Ammonium and Reduce N_2O Emissions?**
Rida Sabirova* and Mario Tenuta
Department of Soil Science, University of Manitoba, Winnipeg, MB, Canada R3T 2N2

2:00 pm **A Prairie Examination of Nitrogen Stabilizers and Split Application on Yield and Mitigation of N_2O Emissions in Canadian Western Red Spring (CWRS) Wheat**
Sawbhagya L.H.N*[1], Sparling B[1], St.Luce M[2], May B[3], Kubota H[4], Beres B[5], and Tenuta M[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB, Canada.
[2]Agriculture and Agri-Food Canada, Swift Current Research Centre, Swift Current, SK, Canada
[3]Agriculture and Agri-Food Canada, Indian Head Research Centre, Indian Head, SK, Canada
[3]Agriculture and Agri-Food Canada, Lacombe Research Centre, Lacombe, AB, Canada
[3]Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB, Canada

2:15 pm **Genome-Guided Discovery of Soil Bacteria for Sustainable Nitrogen Management in Agriculture**
Raveena Manikku Badu[1], Anna Motnenko[1], George C. diCenzo[1,2], Ivan Oresnik[1], and Matthew G. Bakker[1]
[1] Department of Microbiology, University of Manitoba, Winnipeg, Manitoba, Canada
[2] Department of Microbiology, Queen's University, Kingston, Ontario Canada

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2:30 pm Nutrition Break and Poster Session

3:00 pm **Investigating the link between soil moisture, temperature, and N loss risk in fine- and coarse-textured soils**
Carlie Johnston*[1,2], Xiaopeng Gao[1], Ramona Mohr[2], and Timi Ojo[1,2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada.
[2]Agriculture and Agri-Food Canada, Brandon Research and Development Centre, Brandon, Manitoba, Canada

3:15 pm **Comparison of Extraction-Based and Ion Membrane-Based Soil Fertility Tests in Farm Fields under Contrasting Cropping Systems**
Joanne Thiessen Martens
Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

3:30 pm **Research Applications of Assessing Soil Nutrient Supply Over 30 Years with Plant Root Simulator (PRS®) Probes**

Blake Weiseth[1] and Edgar Hammermeister[2]
[1]Western Ag Innovations, Saskatoon, Saskatchewan
[2]Western Ag Professional Agronomy, Alameda, Saskatchewan

GENERAL SESSION: SOIL AND WATER DYNAMICS

Chairperson: Jamie Wan

3:45 pm **Pedotransfer Functions for Estimating Soil Hydraulic Parameters in Manitoba Vertisols**

Taurai Matengu*[1], Afua Mante[1], Timi Ojo[1,2], Francis Zvomuya[1], Annemieke Farenhorst[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB, Canada.
[2]Agriculture and Agri-Food Canada, London Ontario Research Centre

4:00 pm **Drainmod evaluation of the benefits of controlled drainage and subirrigation of soybean (Glycine max L.) in clay soils in the Canadian Prairies**

Komlan Koudahe* and R. Sri Ranjan
Department of Biosystems Engineering, University of Manitoba, Winnipeg, Canada

4:15 pm **Carbon and Water Balance Dynamics of Converted Perennial and Annually Cropped Fields in St. Claude Manitoba**

Julia Beechinor*[1] and Henrique Carvalho[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

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4:30 pm Closing remarks End of Day 1 – Henrique Carvalho, MSSS President

Friday, February 6, 2026

8:00 am Registration

GENERAL SESSION: ENVIRONMENTAL CONTAMINATION

Chairperson: Charitha Hansima

8:30 am ***Restoring brine-contaminated lands: A controlled study on combined soil washing and amendment strategies.***

Kanishk Kulhari*[1], Francis Zvomuya[1], and Afua Mante[1]
Department of Soil Science, University of Manitoba, Winnipeg, Manitoba

8:45 am **Effects of Soil Amendments on Nitrous Oxide Emission in Brine Contaminated Soils**

Shreeya Aryal*, Francis Zvomuya, and Manushi Henagama Liyanage
Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

9:00 am **Investigating the Effectiveness of Regular and Modified Biochar for Immobilizing Heavy Metals in Acidic Boreal Forest Soil**

Dhulmy Bandara*[1], Srimathie P. Indraratne[1], Inoka Amarakoon[2], Darshani Kumaragamage[1], and Douglas M. Goltz[3]
[1]Department of Environmental Studies and Sciences, The University of Winnipeg
[2]Department of Soil Science, University of Manitoba
[3]Department of Chemistry, The University of Winnipeg

9:15 am **Per- and Polyfluoroalkyl Substances in Biosolid-Amended Soils: Uptake Patterns in Wheat and Alfalfa**

Aaron Ostlund*[1] and Thomas DeSutter[1]
[1]School of Natural Resource Sciences, North Dakota State University, Fargo, ND, USA

9:30 am **Kinetics of Tebuconazole Exposed to Soil and *Pseudomonas Putida* in Microcosm Water Derived from Engineered Wetlands**

Brooke Singbeil*[1], Jose Rodriguez Gil[2], Warren Blunt[1], Alistair Brown[3]
[1]Department of Biosystems Engineering, University of Manitoba, Winnipeg, Manitoba, Canada
[2]Department of Environment and Geography, University of Manitoba, Winnipeg, Manitoba, Canada
[3]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

9:45 am **Determination of pesticide fate and transport in a dual cell on-farm biobed system under field conditions**

Ifeoluwa F. Omotade*[1], Phoenix Nakagawa[2], Ramanathan Sri Ranjan[1], Alistair K. Brown[3], Annemieke Farenhorst[3]
[1]Department of Biosystems Engineering, University of Manitoba, Winnipeg, MB Canada

[2]*School of Environmental Sciences, University of Guelph, Ontario, Canada*
[3]*Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada*

10:00 am	Nutrition Break and Poster Session
10:30am	**Evaluating the phosphorus leaching potential of fall weeds and soybean residue under different water volumes and runoff conditions** Rebecca Agbabiaka*[1], David Lobb[1], Merrin Macrae[2], Joanne Thiessen Martens[1], Kevin Tiessen[1] and Don Flaten[1] [1]*Department of Soil Science, University of Manitoba, Canada*. [2]*Department of Environmental Science and Geography, University of Waterloo, Canada*.
10:45 am	**Seasonal and Event-Driven Atmospheric Deposition of Particulate Matter and Phosphorus over Lake Winnipeg: Evidence from Ship-Based Measurements** Masoud Goharrokhi[1], David Lobb[1], Ehsan Zarrinabadi[1], Greg McCullough[2], Shawn Clark[3], and Alex Koiter[4] [1]*Department of Soil Science, University of Manitoba, Winnipeg, Manitoba. Canada* [2]*Centre for Earth Observations Sciences, Department of Geography and Environment Studies, University of Manitoba, Manitoba, Canada* [3]*Civil Engineering Department, University of Manitoba, Winnipeg, Manitoba, Canada* [4]*Department of Geography and Environment, Brandon University, Brandon, Canada*
11:00 am	**MSSS Business Meeting**
12:00 pm	Lunch

GENERAL SESSION: CROP PRODUCTION CHALLENGES

Chairperson: Nelum Jayarathna

1:00 pm	**Unlocking marginal land potential: Integrated management of salinity and fertility for *Camelina sativa*** Osariemen M. Imafidon*[1], Francis Zvomuya[1], Afua Mante[1], Asfaw Bekele[2] and L. Ruby Carrillo[3] [1]*Department of Soil Science, University of Manitoba, Winnipeg, MB, Canada* [2]*Imperial Oil Resources Limited, Calgary, AB, Canada* [3]*ExxonMobil Technology and Engineering Co., Spring, Texas, United States*
1:15 pm	**Standardizing salinity tolerance research: Lessons from three controlled experiments** Chantel Mertz*[1], Thomas DeSutter[1], Miranda Meehan[1], and Aaron Ostlund[1] [1]*School of Natural Resource Sciences, North Dakota State University, Fargo, North Dakota, United States*

1:30 pm **LIVE VS. LEGACY: RNA VS. DNA DETECTION OF *S. SCABIES* IN SOILS FOR PRE-SEASON DIAGNOSIS OF COMMON SCAB**

Rachel E. Clarkson*[1], Kim Zitnick-Anderson[2], Sage M. Longtin[1], Miranda Vanderhyde[1], Kirsten Butcher[1]
[1]School of Natural Resource Sciences, Soil Science, North Dakota State University, Fargo, ND, United States
[2]Plant Pathology, North Dakota State University, Fargo, ND, United States

GENERAL SESSION: SOIL PHYSICAL PROPERTIES

Chairperson: Aishika Dissanayake

1:45 pm **Assessment of Soil Structural Integrity Across Diverse Cropping Systems**

Sarafina Adanma Emmanuel*, Afua Adobea Mante, Francis Zvomuya, Emmanuel Agyapong, Joanne Thiessen Martens
Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

2:00 pm **Intrinsic susceptibility of sandy and clayey soils to mechanical stress**

Vivian Sename Gomelesio *[1], Robert Heidahl[1], Kanisk Paliwal[1], Afua Adobea Mante[1], and Francis Zvomuya[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

2:15 pm **Effects of Overwintering Cover Crop on Spring Trafficability in Manitoba**

Emmanuel Agyapong[1], Afua Mante[1], Francis Zvomuya[1,] and Yvonne Lawley[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada
[2]Department of Plant Science, University of Manitoba, Winnipeg, Manitoba, Canada

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2:30 pm Nutrition Break and Poster Session

GENERAL SESSION: SOIL SCIENCE EXTENSION AND EDUCATION

Chairperson: Faezeh Parastesh

3:00 pm **mbquartR: An R Package for Working with Manitoba Quarter Sections**

Alexander Koiter[1]
[1]Department of Geography and Environment, Brandon University, Brandon, Manitoba, Canada

3:15 pm **Digging Back In: Reviving Soil Judging Competitions in Canada**

Megan Westphal[1] and Daniel Saurette[2]
[1]Manitoba Agriculture
[2]Ontario Ministry of Agriculture, Food and Agribusiness

3:30 pm **Monoliths in Museums: A Missed Opportunity?**

John Heard

3:45 pm **The Manitoba Agricultural Greenhouse Gas Assessment Tool**

M.D. Timmerman[1] and P. Loro[2]
[1]*Manitoba Agriculture, Box 1149, Carman, Manitoba, Canada*.
[2]*Manitoba Agriculture, 545 University Crescent, Winnipeg, Manitoba, Canada*

4:00 pm **Presentation of Awards and Passing of the Shovel**

Keynote Speakers

Laura Van Eerd

Dr. Laura Van Eerd is the Charlotte Products Chair in Net-Zero Soil Management and Professor at the University of Guelph Ridgetown Campus. She grew up on a cash crop and finishing hog farm, where picking rocks and hoeing beans instilled a life-long love of agriculture. The goal of her internationally-recognized research program is to advance our understanding of how agricultural practices influence soil health and biogeochemical cycling of carbon and nitrogen. This research is aimed at finding solutions for farmers that enhance soil care, crop productivity, and profit margins. Her innovation and foresight led to the establishment of a state-of-the-art long-term experiment that has advanced global knowledge on cover cropping in temperate climates. She has co/authored over 88 peer-reviewed publications, including Best Paper Award 2018 in Canadian Journal of Plant Science and those in top-tier soil science and agronomy journals. Dr. Van Eerd co-led the textbook chapter on soil health for Digging into Canadian soils- An introduction to soil science. In addition to awards acknowledging her significant contributions to teaching, research and extension, Dr. Van Eerd is a Fellow of the Canadian Society of Agronomy, a Soil Champion (Ontario Soil and Crop Improvement Association 2021) and an Influential Women of Canadian Agriculture (2020).

Towards understanding soil health: from small plots to farmer fields

Laura L. Van Eerd and Charlotte Products
University of Guelph, Ridgetown Campus, School of Environmental Sciences, Ridgetown, ON

In the past decade, soil health research and farmer interest have increased. Soil health is defined as the capacity to function thereby providing services, such as provisioning of food, feed, fuel, and fibre as well as storing carbon, nutrients, and water to name a few. Given these expectations of soil, it is challenging to identify soil health indicators or a suite of indicators (often called frameworks) that reflect these functions. Much of the small plot research focused on identifying how management influenced soil carbon storage and/or nitrogen availability and which soil health indicators or frameworks were responsive to management. This research necessitated long-term experiments that vary in management under specific soil types and climates, but few experiments exist which limits applicability. Hence, soil health research extended to farmer fields that are inherently variable which limits applicability. Research from Ontario will be presented that aims to balance these limitations. Interpreting soil indicators with crop responses in a meaningful way is expected to advance soil knowledge, ideally with a goal to mobilizes management practices that protect soils across the landscape.

Brian Amiro

Dr. Brian Amiro completed B.Sc. and M.Sc. degrees in Biology and Ecology at Laurentian University, and a Ph.D. in Land Resource Science at the University of Guelph. He has worked as an Environmental Scientist for Atomic Energy of Canada Limited; as a Research Scientist with the Canadian Forest Service; and as a Professor, Department Head, and Associate Dean at the University of Manitoba. He is a Fellow of the Canadian Society of Agricultural and Forest Meteorology. He is currently a Professor Emeritus in the Department of Soil Science at the University of Manitoba.

The Ins and Outs of Soil Carbon

Brian Amiro

Professor Emeritus, Department of Soil Science, University of Manitoba, Winnipeg, Manitoba

We have the ability to continuously measure the exchange of carbon between the atmosphere and agricultural systems to examine the dynamics of gains and losses of soil organic matter at the field scale. Here, we will review our understanding of these dynamics using Manitoba data collected over the past two decades. In particular, we will look at the inputs through photosynthesis and losses through ecosystem respiration, where the net gain or loss dictates the dynamics of the soil organic matter pool. We have studied several systems, including annual crops in rotations, perennial crops as continuous hay or in rotation with annual crops, and cover crops to capture carbon in the shoulder seasons. Inter-annual variability in weather affects these dynamics, with soil moisture often controlling the soil carbon sink. We will likely have the potential for greatest gains where we have already lost soil organic matter; but we also need to maintain areas where we still have high organic stocks. Agronomic practices are adapting to technologies and a changing climate, but water limitations to crop growth on the Canadian Prairies will likely be our greatest challenge to increase and maintain soil organic matter.

ORAL PRESENTATION ABSTRACTS

(in alphabetical order; * denotes student presenter)

Evaluating the phosphorus leaching potential of fall weeds and soybean residue under different water volumes and runoff conditions

Rebecca Agbabiaka*[1], David Lobb[1], Merrin Macrae[2], Joanne Thiessen Martens[1], Kevin Tiessen[1] and Don Flaten[1]

[1]*Department of Soil Science, University of Manitoba, Canada*.

[2]*Department of Environmental Science and Geography, University of Waterloo, Canada*.

Corresponding author: agbabiar@myumanitoba.ca

Fall weeds act as significant sources of dissolved reactive phosphorus (DRP) during freezing, thawing and spring snowmelt. However, the influence of meltwater volume and thaw-wash dynamics on P mobilization from these plants remains unclear. This study evaluated DRP release from four fall weeds and soybean residue across five sequential meltwater extractions using four treatments differing in freeze-thaw exposure, meltwater volume, and runoff conditions: 0FTC-AB (1.9L), 1FTC-AB (1.9L), D5FTC-AB (380mL), and D5FTC-MB (100mL). The results show that high meltwater volumes (1.9L) removed 70-90% of total DRP within the first two thaws, indicating a rapid depletion of P consistent with early-snowmelt P pulses observed in agricultural runoff. In contrast, the low-volume D5FTC-MB treatment (100mL) produced gradual DRP release across all five washes, with only 50-80% removed from the plants in the first two thaws, and some weed samples releasing <50% of total DRP by the second wash. Cumulative DRP loads consistently increased with increasing meltwater volume. Temporal patterns showed a significant decline in DRP release after the second extraction (T0 > T1), with no statistical differences among T2, T3, and T4, suggesting rapid early depletion or initial flush of nutrients followed by a low but persistent tail indicating a stabilized low-flux phase. These results indicate that large, rapid snowmelt events can mobilize the majority of soluble residue-derived P, whereas slow, low-flow thaws may contribute prolonged but lower-intensity P loads. We conclude that runoff volume strongly governs the timing and magnitude of residue-derived P release, with weeds likely contributing substantial DRP during early melt events under high-flow conditions.

Effects of Overwintering Cover Crop on Spring Trafficability in Manitoba

Emmanuel Agyapong[1], Afua Mante[1], Francis Zvomuya[1,] and Yvonne Lawley[2]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada*
[2]*Department of Plant Science, University of Manitoba, Winnipeg, Manitoba, Canada*

Manitoba's early spring conditions pose a significant challenge to agricultural productivity. Excess soil moisture from snowmelt and rainfall severely limits soil trafficability, preventing producers from conducting timely seeding and essential field operations, a delay which can negatively impact yield potential. Overwintering cover crops such as fall rye (Secale cereale L.) have been widely advocated as a soil health strategy to reduce spring soil moisture, enhance surface cover, and improve soil resilience under variable climatic conditions. This multi-year study (2022–2024), established near Cartwright, Manitoba, evaluated the effectiveness of fall rye in supporting spring field trafficability. Soil moisture was monitored, and trafficability was assessed using a threshold of 90% of the lower plastic limit for the 0–25 cm layer. Historical climate data (2015–2023) were also analyzed to determine the consistency of fall rye establishment under regional fall temperature regimes. Results showed that soil moisture consistently exceeded the trafficability threshold, suggesting a limited capacity of fall rye to reduce excess moisture in the heavy clay soils typical of the region. The key limitation was identified through historical climate analysis, which revealed that fall temperature regimes did not consistently meet requirements for successful fall rye establishment, including mean daily temperatures above 10°C for a minimum of 4 weeks and ≥309 fall growing degree days. Consequently, the crop produced insufficient biomass (<150 kg ha^{-1}), resulting in minimal evapotranspiration and nullifying the moisture-reduction benefit. The findings suggest that while fall rye is a valuable soil health tool, its effectiveness for improving spring trafficability in Manitoba's heavy soils is constrained by regional fall climatic conditions. To overcome these limitations, producers may need to adopt adaptive management strategies, such as earlier seeding windows, to ensure adequate fall growth and biomass accumulation. This adjustment is necessary to improve trafficability and enhance soil health and productivity.

Effects of Cover Crops on N2O Emission in Southern Manitoba

Jose A. Almodovar[1]*, Mario Tenuta[1], Yvonne Lawley[2], Navneet Brar[2]
[1]Department of Soil Science, [2]Department of Plant Science, University of Manitoba, Winnipeg, Manitoba, Canada

This study evaluates the impact of fall-seeded cover crops on nitrous oxide (N2O) emissions and grain yield in a four-year fully phased crop rotation that included: wheat (*Triticum aestivum L*) , oats (*Avena sativa*) canola, (*Brassica napus*) and soybeans (*Glycine max*) over multiple years on two different sites. The study assessed the effect of cover crops on N2O emissions, compare overwintering versus non-overwintering cover crops, evaluate emissions during thaw periods, and investigate whether terminating overwintering cover crops increases emissions. Additionally, the study examined the effect of cover crop rotations on grain yield. N2O emissions were measured using static vented chambers, and cumulative emissions were quantified. Results showed that overwintering cover crops reduced N_2O emissions (163.15 g N ha^{-1}) compared to non-overwintering cover crops (211.92 g N ha^{-1}), with no significant increase in emissions during thaw periods. Termination of overwintering cover crops did not increase N_2O emissions. Regarding grain yield, Overwintering Cover Crop treatments (OW-CC) consistently produced higher or equal yields compared to non-cover crop treatments, while Non-Overwintering Cover Crop treatments (N/OW-CC) yielded lower or equal to non-cover crop treatments. These findings suggest that cover crops, particularly overwintering types, can effectively reduce N2O emissions without compromising yield, offering a promising strategy for sustainable agriculture and greenhouse gas mitigation.

Effects of Soil Amendments on Nitrous Oxide Emission in Brine Contaminated Soils

Shreeya Aryal*, Francis Zvomuya, and Manushi Henagama Liyanage
Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada

Soil degradation from natural salinization and contamination by oilfield brine spills poses a significant threat to global agriculture, dramatically altering the soil environment and subsequently influencing nutrient cycling. These changes are important because they alter processes such as microbial nitrification and denitrification, the main biological sources of nitrous oxide (N_2O), a potent greenhouse gas. Reclamation of these stressed soils often employs amendments like biochar, gypsum, and organic manure, but their interactive effects with the chemical stressors (high EC and SAR) on N_2O flux remain poorly understood, especially in brine-contaminated soils. This laboratory incubation study examined the effects of factorial combinations of biochar, gypsum, and nitrogen (N) source (composted manure, synthetic N fertilizer) on N_2O emissions from brine-contaminated soils using a randomized complete block design. Results on N_2O flux and cumulative losses will be reported in this presentation. This research will inform the development of effective, sustainable N management and remediation strategies for brine-contaminated agricultural lands.

Genome-Guided Discovery of Soil Bacteria for Sustainable Nitrogen Management in Agriculture

Raveena Manikku Badu[1], Anna Motnenko[1], George C. diCenzo[1,2], Ivan Oresnik[1], and Matthew G. Bakker[1]

[1] *Department of Microbiology, University of Manitoba, Winnipeg, Manitoba, Canada*

[2] *Department of Microbiology, Queen's University, Kingston, Ontario Canada*

Inefficient fertilizer uptake by crops contributes to environmental harm, with only 40–50% of applied nitrogen being assimilated by plants. Enhancing nutrient availability through microbial management could reduce dependence on synthetic fertilizers and mitigate emissions of greenhouse gases like nitrous oxide. We hypothesized that by analyzing patterns in the whole genomes of bacteria associated with agricultural soils, we could develop a model to rapidly evaluate the efficacy of novel strains for plant growth promotion and nitrogen assimilation. To support this goal, the Canadian Collection of Agricultural Soil Microbes (CCASM) is being established, including whole-genome data for hundreds of bacterial strains. Microbial isolates were obtained from agricultural soils, deliberately picking strains based on distinct colony morphologies and phenotypic traits. The collection currently includes 1,034 isolates from the Prairies, of which we have whole genome sequenced 768 isolates. Of these, 744 genome sequences are of high-quality, and are distributed among the phyla Actinomycetota (348), Bacillota (207), Pseudomonadota (165), and Bacteroidota (24). Current screens on the annotated high quality whole genomes for the ability to produce 1-aminocyclopropane-1-carboxylate deaminase (ACCD) protein, responsible for plant growth promotion during salt stress conditions, has shown 153 isolates from across 14 genera to be strong candidates for possession of this trait. We have also identified 8 isolates from across 5 different genera that carry the nitrogenase iron protein, a core protein responsible for nitrogen fixation. Out of the 8 candidate isolates for nitrogen fixation two isolates are novel species according to the Genome Taxonomy Database classification. We will be continuing to explore this microbial culture collection for additional traits related to plant growth and fertilizer uptake.

Investigating the Effectiveness of Regular and Modified Biochar for Immobilizing Heavy Metals in Acidic Boreal Forest Soil

Dhulmy Bandara[1*], Srimathie P. Indraratne[1], Inoka Amarakoon[2], Darshani Kumaragamage[1] and Douglas M. Goltz[3]

[1]Department of Environmental Studies and Sciences, The University of Winnipeg
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Soil heavy metal contamination threatens ecosystems and human health due to accumulation through the food chain. This study evaluated one regular biochar (RBC) and three modified biochar (MBC) (4 M NaOH, NBC; 10% H_2O_2, HBC; 5% $KMnO_4$, KBC) for immobilizing cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) from contaminated acidic boreal forest soil. Mono-metal adsorption was studied to compare RBC and MBC capacities; surface morphology, composition, and functional groups were spectroscopically analyzed. A two-month laboratory incubation study was conducted with RBC and MBC amended at a rate of 5% (w/w) along with an unamended control. Soil columns were maintained at field capacity and leachate was collected biweekly for metal and pH analysis. At the end of incubation, available and total metal concentrations were determined. The stability of metal-amendment complexes was evaluated using toxicity characteristic leaching procedure (TCLP) and synthetic precipitation leaching procedure (SPLP). Among the four biochar, Zn adsorption showed superior performance in RBC (109,184 mg kg^{-1}) and KBC (140,171 mg kg^{-1}). Cu exhibited the highest adsorption capacity in RBC (72,228 mg kg^{-1}), followed by NBC (55,425 mg kg^{-1}), while Cd adsorption was highest in KBC, reaching 82,457 mg kg^{-1}. Compared to the control, all amended soils reduced Cd, Pb, and Zn by >96%, while Cu reductions ranged from 23% (KBC) to 94% (NBC), in TCLP. Similarly, Cd, Pb, and Zn were reduced by >95%, and Cu by 12% (KBC) to 91% (NBC) by SPLP. Available Cd and Pb remained ≤0.02 mg L^{-1} in all amended soils while Cu and Zn remained ≤0.1 mg L^{-1}. These results confirm that regular biochar and modified biochar effectively immobilize Cd, Cu, Pb, and Zn in acidic boreal forest soils.

Carbon and Water Balance Dynamics of Converted Perennial and Annually Cropped Fields in St. Claude Manitoba

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Inclusion of perennials in annual crop rotations is a beneficial and popular practice in the Canadian prairies. Perennial rotations are used by grain, mixed, and livestock farmers for a multitude of benefits. However, termination of perennial phases often emits carbon dioxide (CO_2) to the atmosphere and can counteract the carbon sequestered by the pervious perennial crop depending on environmental conditions (e.g., soil and climate) and management practices. At present, there is uncertainty about the effects of perennial conversion in agricultural systems in sandy loam soils in MB. Here we report on the first 6 months of measurements of a study designed to evaluate the carbon (C) and water balances of a perennial hay field converted to grain corn in comparison to a conventionally managed field using micrometeorological techniques. We hypothesize that the magnitude of C losses due to the perennial conversion is, in part, dependent on the water balance of the field. Carbon losses are amplified when soil water is available due to enhanced respiration. Identical eddy covariance flux towers were deployed in two neighboring sites in May of 2025 following a paired-system approach. The converted perennial field is an alfalfa (*Medicago sativa*) grass (sp. unknown) mix and was cut for hay 3 times. Termination of the perennial phase occurred in the fall with herbicide application and tillage. The annual field was seeded to spring wheat (*Triticum aestivum L.*) and harvested at the end of August. This data is preliminary but will explore the initial effects of termination on the carbon and water balances of these fields.

LIVE VS. LEGACY: RNA VS. DNA DETECTION OF *S. SCABIES* IN SOILS FOR PRE-SEASON DIAGNOSIS OF COMMON SCAB

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Pre-season diagnosis of common scab, caused by *Streptomyces scabies*, is essential for mitigating economic losses before tuber infection occurs. Current diagnostic methods rely on DNA-based assays, which cannot distinguish between viable and relic *S. scabies*. Because RNA is synthesized by metabolically active cells and degrades rapidly, RNA-based assays may provide a more reliable indication of pathogen activity and virulence potential in soil. This experiment evaluated whether RNA-based detection of *S. scabies* serves as a more reliable pre-season predictor of disease severity compared to DNA-based assays. Soils were artificially infested with a gradient of *S. scabies* inoculum and seeded to radish (*Raphanus sativa* var. Champion). Soil subsamples collected prior to radish transplant were extracted for both DNA and RNA. Quantitative PCR (qPCR) and reverse-transcriptase qPCR (rt-qPCR) were used to quantify abundances of two genes: 1) 16S, which is constitutively expressed, and 2) *txtAB*, which encodes a suite of proteins facilitating infection when a tuber is present (facultative expression). Following the five-week incubation, disease severity was evaluated and regressed against initial gene abundances of both gene targets. A clear gradient in *S. scabies* density was detectable using *txtAB* amplification from DNA but not from RNA (cDNA). However, *txtAB* abundance in DNA did not predict disease severity. Our results suggest that while DNA-based assays capture pathogen presence, *txtAB* is unsuitable for pre-season diagnostics due to its facultative expression. Preliminary results for the 16S assay demonstrated that increases in transcribed 16S abundance resulted in increases in disease severity, and this relationship was approaching significance. Together, these results highlight that RNA-based assays may be more suitable for pre-season diagnostics when targeting a constitutively expressed gene.

Assessment of Soil Structural Integrity Across Diverse Cropping Systems

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Soil structural integrity is crucial to enhancing crop productivity, promoting soil resilience, and mitigating the impacts of climate change. This study compared the soil structural integrity of three cropping systems (perennial, annual, and intermediate) at the beginning of the growing season in May 2025. Fields in these cropping systems were selected based on their > 10-year cropping histories. Penetration resistance (a measure of structural integrity) was measured in the 0 – 20-cm and 20 - 40-cm soil layers using a penetrologger. The penetration resistance values in the 0 – 20-cm and 20 – 40-cm layers were, respectively, 2.08 and 3.19 MPa in the perennial cropping system, 1.5 and 2.67 MPa in the annual cropping system and 1.64 and 2.2 MPa in the intermediate cropping system. While the penetration resistance values were not statistically different ($p > 0.05$), the higher penetration resistance in the perennial cropping system suggests a more compromised soil structural integrity, which may lead to reduced seedling emergence and poor root development, nutrient cycling and water distribution.

Seasonal and Event-Driven Atmospheric Deposition of Particulate Matter and Phosphorus over Lake Winnipeg: Evidence from Ship-Based Measurements

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Atmospheric deposition is not well understood pathway for nutrient delivery to large freshwater lakes, particularly under episodic conditions such as wildfire smoke events. This study investigates the magnitude, composition, and seasonal variability of atmospheric particulate matter and bulk deposition over Lake Winnipeg using ship-based measurements conducted during spring, summer, and fall 2025. Atmospheric sampling was carried out during research cruises to capture spatial gradients across the lake. Airborne particulate matter was collected on filters, with pre- and post-sampling weights used to quantify particulate mass loading. Continuous measurements of $PM_{2.5}$ and PM_{10} concentrations were obtained concurrently to characterize fine and coarse aerosol conditions during each sampling period. To directly assess atmospheric delivery to the lake surface, a bulk deposition funnel sampler was deployed onboard to collect combined wet and dry deposition, enabling evaluation of deposition magnitude under contrasting seasonal and meteorological conditions. A pollen sensor operated throughout the cruises provided independent characterization of biogenic particle influence and aided interpretation of seasonal changes in particle assemblages. Collected filters and deposited materials were analyzed using scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM–EDX) to identify dominant particle types and to assess surface elemental composition at the particle and area-averaged scale. SEM imaging revealed clear seasonal shifts in particle assemblages, including increased biogenic particles during non-smoking periods and the presence of ash-like particles during summer wildfire influence. EDX analyses indicated relative enrichment of phosphorus associated with ash and selected particle types, while mineral-rich particles were characterized by elevated silicon signatures. By integrating particulate mass loading, $PM_{2.5}/PM_{10}$ concentrations, bulk deposition measurements, pollen monitoring, and SEM–EDX characterization, this study provides a process-based assessment of atmospheric particulate deposition to Lake Winnipeg. The results demonstrate that episodic events, particularly wildfire smoke, can substantially alter both the quantity and composition of

atmospheric deposition, highlighting the importance of atmospheric pathways in lake-scale nutrient budgets and the value of ship-based, multi-instrument observational strategies

Intrinsic susceptibility of sandy and clayey soils to mechanical stress

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Mechanical stress on soils leads to soil structural degradation, which impacts soil health and resilience. In the present study, the lower plastic limit (LPL) of sandy (<35% clay) and clayey (≥35% clay) soils was assessed to determine the soil's intrinsic susceptibility to mechanical stress. Soil samples were collected from the 0 – 20 cm layer across nine fields between Carman North and Elm Creek, with fields serving as replicates (sand = 5, clay = 4). A completely randomized design was used, with soil texture class as the main factor and LPL as the response variable. Sandy soils had a mean LPL of 5.52% with a range of 0 to 20%, while clayey soils had a mean LPL of 22.99% with a range of 17 to 27%. The LPL determined for the sandy soils indicate that sandy soils reach their mechanical failure point at much lower moisture contents and therefore operate closer to their mechanical strength limit under typical field conditions. The high permeability and rapid drainage of sandy soils, while facilitating quicker field access usually after rainfall, does not offset their inherently low mechanical strength, as indicated by their low LPL. As a result, they compact and densify readily under repeated machinery traffic, whereas the higher LPL of clay soils provides greater intrinsic resilience to mechanical stress.

Legacy Effects of Manure Amendments on Aggregate-Associated Particulate, Dissolved, and Mineral-Associated Organic Matter in a Long-Term Integrated Crop-Livestock System

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Emerging soil organic matter (SOM) continuum models view SOM as a spectrum linking particulate, dissolved, and mineral-associated pools. Within soil aggregates, dissolved organic matter (DOM) forms a mobile interface in this continuum, yet agronomic controls on aggregate-scale DOM remain poorly resolved. We sampled surface soil aggregates from the long-term NCLE crop-livestock trial at the Glenlea research station, Manitoba (est. 2007), arranged as an RCBD split-split plot with two cropping systems (annual vs perennial), four manure treatments (no manure, liquid pig, solid pig, solid dairy), and two soil managements (no-till with cover crops vs conventional tillage). Large aggregates (<8 mm) were wet-sieved into macroaggregates (250-2000 µm), microaggregates (53-250 µm), and silt+clay (<53 µm). Macro- and microaggregates were water-extracted for aggregate-derived DOM and further fractionated into associated particulate (POM) and mineral-associated (MAOM) organic matter fractions. DOM was characterized using UV-visible indices and fluorescence components from excitation-emission matrix spectroscopy with parallel factor analysis (EEM-PARAFAC). Permutational ANOVA (PERMANOVA; α = 0.05) tested treatment effects, non-metric multidimensional scaling (NMDS) ordinated DOM composition, and *envfit* related the ordination axes to POM and MAOM mass fractions and C:N ratios. Manure form was the dominant driver of DOM composition, whereas cropping system and soil management had no effects. NMDS revealed an aggregate-DOM continuum in macro- and microaggregates, with DOM shifting from more plant-like, aromatic signatures toward more N-rich, microbially processed components that closely tracked underlying POM and MAOM quantity and stoichiometry. Solid manures, especially solid pig, most strongly diversified this DOM continuum. Preliminary $\delta^{13}C$–$\delta^{15}N$ biplots for macroaggregate cPOM and free MAOM showed that solid pig plots occupied the most ^{15}N-enriched region of C–N space, indicating efficient transfer of manure-derived N into both particulate and mineral-associated pools. Together, these results demonstrate a strong legacy of solid pig manure, even nine years after applications ceased, it is still imprints aggregate-associated particulate, dissolved, and mineral-associated organic matter along the SOM continuum.

Monoliths in Museums: A Missed Opportunity?

John Heard

The Manitoba Soil Science Society plays a vital role as platform for presenting research findings and for soils education and outreach. Many of our activities attest to this tradition: our AGM focused on oral and poster presentation of research, summer soils tours, soil judging and an annual soil calendar. One of the venues providing public education and knowledge on science, and soil, is the museum. Worldwide there are 38 museums specifically dedicated to soils and 66 permanent soil collections available for viewing. Many other agricultural related museums have some focus or depiction of local soils. A global review of soil museums found nearly all display soil monoliths to visually depict the unique characteristics of structure, colour, horizon development, etc. The role of our productive Prairie soils in stoking agricultural development cannot be understated. Many pioneers and settlers became successful because of this incredible natural resource. In Manitoba there are some 52 museums with a stated focus on pioneers and early settlement, often displaying farming tools, implements and artifacts. I conducted visits and reviews of 3 interpretative centres and 5 rural agriculturally related museums in Manitoba to assess their portrayal of soil. As a comparison, I've toured the World Soil Museum, the Smithsonian Soil Display and several state museums. Many selected photos will be shown. The 3 interpretive centres in Manitoba provided excellent visual descriptions of the soil with monoliths and some interactive displays featuring cropping systems, crops and soil life. But rural agricultural museums tended to lack such a soil component, with no agricultural monoliths on display and a lack of soil description and its importance to the pioneers. I propose that as an outreach and educational project, the Manitoba Soil Science Society offer to provide monoliths with appropriate description to selected agricultural museums. Some museums have already eagerly agreed to participate, should we move forward with this venture.

Unlocking marginal land potential: Integrated management of salinity and fertility for *Camelina sativa*

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Soil degradation is accelerating due to human-induced salinization, resulting in vast areas of marginal land unsuitable for conventional food crops. These marginal lands offer opportunities for production of biofuel crops like Camelina (*Camelina sativa*), a moderately salt-tolerant oilseed crop. However, poor soil conditions still limit its productivity, necessitating the evaluation of soil amendments to improve seed establishment and growth. This growth room bioassay examined the impact of the combined application of soil amendments on camelina seedling emergence and biomass yield in a saline soil across two crop cycles. The experimental layout was a completely randomized design with a 2^5 factorial treatment structure consisting of two levels each of biochar, biostimulant, fertilizer type, gypsum and moisture regime. Treatments were evaluated for their effects on seed emergence and biomass, and compared against two controls: unamended saline soil and fertile non-saline soil. Preliminary results showed that the combined biochar and composted manure treatment significantly increased ($p < 0.05$) seedling emergence and biomass yield compared to the untreated control. A significant moisture effect was observed in the first growth cycle, where adequate moisture was critical to increased emergence. However, in the second growth cycle, the moisture effect was non-significant ($p > 0.05$), as both moisture levels produced similarly high emergence which was not significantly different from the controls. The findings suggest that these amendments may enhance crop productivity and resilience in degraded or saline soils, offering a viable management strategy for marginal land utilization.

Investigating the link between soil moisture, temperature, and N loss risk in fine- and coarse-textured soils

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Maximizing the efficiency of nitrogen (N) fertilizer used in agricultural production has long been a priority for researchers, producers, and industry professionals. Extensive research has been done across the prairies to provide producers with relative efficiency estimates of different N management strategies. However, the efficiency of a given N management strategy can vary depending on soil moisture and temperature conditions throughout the growing season. With the goal of determining the effect of soil moisture, soil texture, and temperature on the transformation and movement of banded urea-based fertilizers over time, a controlled environment study was established. Fine- or coarse-textured soil was moistened to 20, 40, 60 or 80% water-filled pore space (WFPS), packed into pans, and incubated at 5, 10 or 15 °C for 56 days. Urea or SuperU was inserted into the center of fertilized pans in a vertical column at a rate of 150 kg N ha^{-1}. Unfertilized pans were included to measure the background N transformation at each soil moisture. Pans were destructively sampled at day 7, 14, 28 and 56 by inserting steel rings into soil in concentric circles around the fertilizer band. Soil nitrate and ammonium concentrations in each sample were measured to assess N transformation and movement. Preliminary results showed that at 5 °C, nitrate and ammonium concentrations were greater in urea pans than SuperU pans, and they generally increased with soil moisture. Controlled environment study data will be used to link and validate the efficiency of various N management strategies observed in related field trials.

mbquartR: An R Package for Working with Manitoba Quarter Sections

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A quarter section in Manitoba is a land unit measuring 160 acres (~64.8 ha), representing a quarter of a square mile. It originates from the Dominion Land Survey system, introduced in the late 19th century to organize the European settlement and colonization of Western Canada. The grid system covers most of the province of Manitoba and organizes land into a hierarchy of quarter sections, sections, townships, and ranges. These legal land descriptions (e.g., NE-11-33-29W1) are often used to identify rural or farm parcels of land, and prior to widespread adoption of GPS technology were used to georeference soil samples. While there are a few web-based tools that allow users to locate land parcels based on the legal land descriptions, they do not allow for batch processing, do not return coordinates, and/or are fee based. The free and open-source R package *mbquartR* provides several tools to simplify working with Manitoba quarter sections. It integrates directly into R workflows, supports batch conversion of legal land descriptions to coordinates (and vice versa), and has a convenient mapping function. Developed as the author's first software project this presentation will also offer insights into learning R package development, documentation, and coding best practices. Submission to rOpenSci for software peer review played an important role in enhancing the package's reliability, documentation, and adherence to open software standards through a transparent, collaborative, and constructive process.

Drainmod evaluation of the benefits of controlled drainage and subirrigation of soybean (*Glycine max* L.) in clay soils in the Canadian Prairies

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Farm water management is difficult in heavy clay soils due to poor drainage. Field studies were conducted in 2023 and 2024 growing seasons to evaluate the benefits of controlled drainage and subirrigation through tile drains in soybean (*Glycine max* L.) in poorly drained heavy clay soils of the Canadian Prairies. Field data was used to develop a Drainmod model for growing soybeans under controlled drainage and subirrigation in heavy clay soils. Results showed the Drainmod as a reliable model in predicting water table variation under controlled drainage and subirrigation management practices with an overall coefficient of determination (R^2) of 0.95, index of agreement (D) of 0.98, root mean square error (RMSE) of 0.11 m, and mean bias error (MBE) of -0.03 m. Standardized Precipitation Index (SPI) was used to identify wet and dry growing seasons from 2010 to 2024. This information was used to assess the effect of controlled drainage and subirrigation on soybean relative yield in multi-year simulations using Drainmod model. On average, controlled drainage in wetter growing seasons resulted in 11.25% higher relative yield compared to no tile, while the relative yield under subirrigation was 20.5% higher than the one on no tile. Based on these findings, water management strategies i.e. controlled drainage in wetter growing seasons and subirrigation in drier periods have been found to increase soybean yield.

Keywords*:* Controlled drainage, Subirrigation, Standardized precipitation index, Soybean.

Short Term Impacts of Grazing Winter Cereal Cover Crops on Cropping Systems and Profitability

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Cover crops (CC) as part of integrated crop livestock systems may extend the grazing season in the Northern Great Plains and offset costs of CC establishment. The objective of this study was to determine the effects of grazing CC on crop performance, soil health, and profitability. At Central Grasslands Research Extension Center near Streeter, ND, nine 1.8 ha plots were established and assigned: dual (fall and spring) grazing (DG), spring grazing, or no grazing (NG), which was divided into no graze and no CC. Fall 2022 and 2023, winter rye was planted as a CC. Fall 2024 and 2025 winter rye, winter wheat, and winter triticale strips were planted in each CC plot. In fall 2022, and spring 2023, 2024, and 2025, CCs were grazed at 0.6 animal unit months (AUMs), 3.36 AUMs, 0.98 AUMs, and 0.56 AUMs, respectively. Grazing was deferred fall 2023 and 2024 due to low biomass. Winter cereal biomass production was evaluated pre- and post-grazing. Fall grazing did not impact spring CC biomass. Winter rye produced the greatest spring biomass, followed by winter wheat. Winter triticale biomass was low due to winter kill. Grazing did not alter soil chemical or physical properties. Cover crops significantly reduced weed cover. Weed suppression was unaffected by grazing. In 2025, corn grain yield was significantly lower in triticale CC strips. Soil volumetric water was highest in NG plots throughout the growing season. A partial budget estimated the economic effect of CC establishment, cash crop yield, and livestock production. Grazing either resulted in a net income or provided a return on CC investment across all years. Grazing CC is heavily dependent on planting date, temperature, and precipitation, but can extend the grazing season in the spring, reducing feeding costs without negatively impacting soil health or crop performance.

***Restoring brine-contaminated lands: A controlled study on combined soil washing and amendment strategies*.**

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Brine-impacted lands, resulting from the release of highly concentrated oil and gas flowback and produced waters, are characterized by extreme salinity and sodicity. The resulting high concentrations of sodium and dissolved salts degrade soil structure, reduce water infiltration, and collectively cause osmotic stress and ion toxicity, severely limiting crop establishment and productivity. Soil washing is a promising in-situ remediation strategy that directly removes soluble salts, reducing the need for costly excavation and replacement. A controlled growth room study examined how soil washing affects plant performance on brine-impacted soils and assessed whether adding amendments can further improve recovery. A completely randomized factorial experiment was established using barley (*Hordeum vulgare*) to assess the efficacy of soil washing in combination with biochar, composted manure, and clean soil mixing treatments. All treatments were replicated three times. Results for seed emergence, tillering, plant height, and biomass will be presented to show how treatments influence early barley establishment and growth on brine-impacted soils. These controlled-environment findings will complement ongoing field research by revealing the interactions between soil washing and amendments and how they influence soil properties and early crop establishment. The results will also indicate the feasibility of soil washing as a remediation approach for brine-impacted agricultural soils.

Soil Conservation Strategies for Forest Soils in the Mountain Forest Section of Manitoba

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The Duck and Porcupine Mountains have the most productive forest soil in Manitoba. Conserving the organic matter, mineral soil and its' inherent productivity are part of LP Swan River's standard operating guidelines. The Sustainable Forestry Initiative (SFI) 2022 Forest Management Standard has program participants adhere to a wide variety of Objectives, Performance Measures, and Indicators. Specific to soils, Performance Measure 2.3 states that "Certified Organizations shall implement practices to protect and maintain forest and soil productivity and soil health". LP maintains documented evidence of soil protection and maintenance for all SFI indicators under Performance Measure 2.3. Furthermore, LP Swan River is audited by 3rd-party independent SFI auditors both on the soil protection evidence and soil protection in the forest operations. The auditor chooses a subset of roads, crossings, and harvest blocks to field audit. A summary of forest soil protection measures will be showcased, including pre-harvest soil survey and protection measures during forest management activities. Planners utilize Pre-Harvest soil information and soil mapping of the forest to set season of harvest to winter or frozen only on moist and wet sites, especially wet clays. Proactive rutting and compaction avoidance are practiced during felling and skidding phases of harvest. Proactive erosion control is practiced on all roads and water crossings. Once harvest is complete, roads organic matter, any Ah horizon soil, as well as stumps and slash are 'rolled back' to restore the forest soils and their productive capacity.

Comparison of Extraction-Based and Ion Membrane-Based Soil Fertility Tests in Farm Fields under Contrasting Cropping Systems

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The nutrient status of agricultural soils is most commonly assessed with extraction-based tests but other alternatives, such as ion membrane-based tests, are also available. Both methods aim to predict soil nutrient supply to a subsequent crop. Extraction-based tests quantify the nutrient concentration obtained from a soil sample using weak chemical extractants and typically do not quantify nutrients released through mineralization of organic matter. Ion membrane tests quantify a nutrient flux rate representing the release of nutrients from the soil to the soil solution over time, including from mineralization. Cropping systems with a history of perennial crops may have greater reserves of nutrients in organic form that may not be detected in an extraction-based test but could be detected in a membrane-based test. The objective of this study is to compare the results of these soil testing methods on soil samples from 40 farm fields (13 clusters of 3-4 fields) with differing cropping systems in the Black soil zone of Manitoba and Saskatchewan. Each cluster of fields included contrasting cropping systems history (>7 years) ranging from only annual crops to long-term perennial crops. “Intermediate” cropping systems in each cluster included practices such as cover cropping, short phases of perennials in rotation, and/or crop-livestock integration. Soil samples were collected in spring or fall 2025 using the recommended methods of two commercial soil labs, AGVISE Laboratories (soil probe with 0-15 and 15-60 cm depths; extraction-based test) and Western Ag Innovations (soil slice to 10 cm; membrane-based test conducted under controlled conditions), and submitted to the labs for analysis. Analysis of covariance will be used to characterize relationships between the soil tests and the influence of cropping system history. Future work will examine relationships between each test and the observed crop biomass and yield, as well as other soil, plant, and agroecosystems properties.

Standardizing salinity tolerance research: Lessons from three controlled experiments

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Soil salinization is a growing threat to soil health. Identifying plant species capable of establishing and functioning under elevated salinity is essential for long-term recovery of these soils. Although plant salinity tolerance has been studied for decades, many past experiments do not report critical methodological details such as growth media used, growth stage at exposure, duration of exposure, or measured electrical conductivity. In other cases, the varieties evaluated are no longer relevant, or the salt types or methods of salt addition used do not reflect conditions found in nature. As a result, it is difficult to utilize much of the past salinity tolerance work in a modern context. This lack of standardization highlights the need for greenhouse screening approaches that are repeatable, comparable, and relevant for research and land management. To begin addressing this need, a series of greenhouse and growth-chamber experiments were conducted to evaluate practical time-efficient strategies for determining plant salt tolerance. Three controlled studies assessed a diverse group of species including black bean, einkorn, Kernza®, lambsquarters, oats, orach, Swiss chard, and wheat. These experiments captured plant responses at multiple developmental stages, ranging from early vegetative screenings to longer studies that followed plants through maturity. Methods differed across experiments, including approaches for inducing salinity, watering systems, and the range of sodium chloride concentrations applied. Across studies, variables such as germination percentage and rate, biomass, yield, and soil $EC_{1:1}$ were measured. Data was analyzed using the modified discount response function to estimate C50 values and response-curve steepness. Collectively, these experiments represent an important step toward developing consistent and repeatable approaches for evaluating plant salinity tolerance. However, additional work is still needed to refine these methods to better capture plant responses under conditions that reflect the variability found in salt-affected soils worldwide.

Do Legacy Effects Persist?
Impacts of Cover Crops and Tillage Practices on Soil Health in a Manitoba Corn Field

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Soil health and microbial resilience are enhanced by maintaining continuous soil cover and minimizing tillage disturbances. The understanding of how cover cropping (CC) and tillage practices affect soil microbial dynamics, such as biomass, functional genes abundance or GHG emissions, provides insight into whether the soil health and microbial improvements gained through the CC phase persist into the cash crop season and how management practices influence soil microbial status. That knowledge is beneficial in examining the temporal soil health stability under contrasting management systems and identifying BMPs for sustainable corn production in the Prairies. This study evaluates the combined impact of CC, tillage strategies, and 4R Nutrient Stewardship on N_2O emissions, microbial N cycling functional genes abundance, and corn yield. Field trials were conducted over two growing seasons in Manitoba, Canada, under contrasting weather conditions – drought in 2023 and a wet summer in 2024. Treatments included conventional and no-till systems with and without CC (fall rye), receiving split nitrogen (N) fertilizer with and without the nitrification inhibitor Centuro (pronitridine) or the dual urease-nitrification inhibitor Tribune (pronitridine + NBPT). In 2024, Tribune-CC interactions suppressed nitrification functional capacity by up to 32% compared to Tribune alone. Tribune treatments also had a generally higher complete denitrification potential. Inhibitors consistently reduced N_2O emissions by up to 54%. CC increased emissions in 2023 but reduced them in 2024. Conventional tillage increased N2O emissions in 2023, but had no significant effects in 2024. Cover cropping slightly decreased corn grain yield compared to no CC treatments. Inhibitors had no direct effect on corn yields, suggesting their primary role is in environmental benefits rather than yield improvement. These findings demonstrate the potential of integrating BMPs to mitigate N_2O emissions while maintaining productivity, providing valuable insights for sustainable N fertilizer management in Prairie corn production.

Pedotransfer Functions for Estimating Soil Hydraulic Parameters in Manitoba Vertisols

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Modeling soil water dynamics requires accurate estimation of soil hydraulic parameters for the Mualem–van Genuchten (VGM) model, yet direct measurement of these properties at field scale is difficult, costly, and constrained by strong spatial variability. Pedotransfer functions (PTFs) developed elsewhere often perform inconsistently under Manitoba's pedological and climatic conditions, leading to inaccurate estimates of hydraulic parameters and soil moisture states. Therefore, the objective of this study was to develop a hierarchical set of PTFs for estimating the VGM parameters for Vertisolic soils in Manitoba. Three modelling frameworks (multiple linear regression, artificial neural networks, and K-nearest neighbour) were used to develop the PTFs. For each framework, four hierarchical PTFs were constructed using progressively richer predictor sets: (i) texture (% sand, % silt, % clay); (ii) texture + bulk density; (iii) texture, bulk density, and soil depth; and (iv) texture, bulk density, soil depth, and environmental/chemical attributes (drainage class, precipitation, soil temperature, pH, $CaCO_3$, and organic matter content). Predictor data were obtained from national and provincial sources. Residual and saturated water contents, shape parameters, and saturated hydraulic conductivity were determined using inverse modelling with HYDRUS coupled with PEST (Parameter ESTimation), based on data collected in 2018 through 2022 from 15 Vertisolic sites in Manitoba, including soil moisture observations at three depths (5, 20 and 50 cm). Model performance evaluated using R^2 (70 to 95%), root mean square error (RMSE = 0.07 to 1.88), Nash–Sutcliffe efficiency (NSE = 0.81 to 0.99), and information criteria indicated that the PTFs developed in this study had high predictive capability. Relative to texture-only models, the fourth-level hierarchical PTFs that incorporated the full set of physical, environmental, and chemical predictors reduced the RMSE of water content predictions by up to 40% and increased R^2 by 35%. The PTFs developed in this study will provide a low-cost, practical tool for estimating soil hydraulic properties and enhancing water management efficiency in Vertisols.

Determination of pesticide fate and transport in a dual cell on-farm biobed system under field conditions

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Rinsing of spraying equipment following pest management practices can create point-source pollution without efficient rinsate disposal practices. Biobeds are systems made up of cells that contain biomixture composed of a 2:1:1 (v/v) mixture of straw, soil and peat, to capture and degrade pesticides by microorganisms. This study assessed the dissipation of 2,4-D, bentazon, boscalid, clopyralid, dicamba, glyphosate and tebuconazole in biomixtures of an operational dual-cell on-farm biobed system in Manitoba, Canada. Stainless steel cores (100 cm^3) were filled with biomixtures that were spiked at 0.2 mg/g per pesticide or left blank. Cores were installed at 10 cm below the biobed surface, either vertically or horizontally, and collected at 0, 2, 4, 8, 14, and 28 days after installation. Pesticide concentrations quantified in the vertical cores were used to estimate pesticide dissipation (leaching + degradation) and the horizontal cores were used to estimate pesticide degradation rates only. Biomixtures were freeze-dried and extracted using the already validated potassium hydroxide method (KOH) for glyphosate, and the Quick Polar Pesticides Method (QuPPe) for all other pesticides. Pesticides were quantified using ultra-high performance liquid chromatography – tandem mass spectrometry. The results showed that 2,4-D, bentazon, clopyralid and dicamba were dissipated to concentrations close to or below their limits of quantification, with faster dissipation in the vertical cores. However, boscalid, glyphosate and tebuconazole showed little dissipation and remained persistent at day 28. Out of five kinetic models applied, the half-order model provided the best fit for 2,4-D, clopyralid and dicamba; the single first order model for bentazon, glyphosate and tebuconazole; and the first order multi compartment for boscalid. The results provide valuable insights into the effectiveness of biobeds in degrading various pesticides and their efficiency in reducing environmental contamination.

Per- and Polyfluoroalkyl Substances in Biosolid-Amended Soils: Uptake Patterns in Wheat and Alfalfa

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Per- and polyfluoroalkyl substances (PFAS) have emerged as an environmental consideration for agricultural systems where municipal biosolids are used to supply organic matter and plant nutrients. While biosolids remain an important amendment for improving soil fertility and supporting soil health strategies, PFAS introduce an additional dimension of chemical behavior that is not well understood in soil–plant systems. This study evaluated PFAS bioaccumulation in hard red spring wheat and alfalfa grown in a controlled greenhouse experiment using soils amended with two municipal biosolid sources applied at agronomic nitrogen rates. All soil, biosolid, and plant samples were analyzed using EPA Method 1633 and interpreted with respect to soil properties known to influence PFAS mobility. Short-chain PFAS were the dominant compounds detected in plant tissue, despite being present at low or non-detectable concentrations in the biosolids themselves. In contrast, long-chain PFAS present in the biosolids exhibited limited mobility and were rarely detected in aboveground biomass. These results are consistent with PFAS behavior governed by molecular structure and soil interactions rather than total PFAS inputs alone. Differences between biosolid sources influenced the PFAS profiles measured in plant tissue, although overall uptake remained low across all treatments. A supplementary evaluation of background greenhouse inputs indicated that non-biosolid sources can introduce PFAS at trace levels, underscoring the importance of accounting for environmental background when interpreting PFAS uptake. Overall, this study provides a soil-focused assessment of PFAS behavior in biosolid-amended systems and demonstrates that PFAS bioaccumulation is driven primarily by PFAS chemistry and soil interactions. These findings contribute to a growing understanding of PFAS dynamics in agricultural soils where organic amendments are used to support soil health and productivity.

Influence of dual inhibitor urea and roots on the taxonomic structure of soil microbial communities

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With the growing global population, nitrogen fertilizers are critical to meet the rising demand for food. However, nitrogen (N) fertilizer that is not assimilated by plants, whether due to NH_3 volatilization, NO_3^- leaching, or N_2O emissions, represents a loss to farmers and contributes to environmental degradation. To mitigate N losses, urease- and nitrification enzyme inhibitors are used by some farmers to slow nitrogen transformation rates and improving plant nitrogen uptake. However, our understanding of how these inhibitors impact soil microbial communities is incomplete. We hypothesize that nitrogen-transformation inhibitors may reorganize the taxonomic structure of soil microbial communities, as well as impacting microbial functional potential. To explore this possibility, a field-based metagenomic study was conducted at two experimental sites in Manitoba: the TGAS-MAN site for the long-term monitoring of greenhouse gas dynamics from agricultural soils (Glenlea, MB) and at AAFC's Phillips Farm (Portage la Prairie, MB). At each location, replicated wheat plots received either untreated urea 46-0-0, or an enhanced fertilizer consisting of urea plus N-(n-butyl)thiophosphoric triamide (urease inhibitor) and dicyandiamide (nitrification inhibitor) (SUPERU, Koch Agronomic Services). DNA was extracted from rhizosphere and bulk soil samples and sequenced to a depth of $1.2x10^7 \pm 5.0x10^7$ reads per sample (NovaSeq X, Illumina). Data processing and analysis followed a standard pipeline of tools for quality control, trimming, *de novo* assembly, and annotation. We detected $1.4x10^5$ taxa overall, with up to 1,600 showing significant treatment-specific responses. Soil compartments (rhizosphere vs. bulk soil) differed significantly at both sites, indicating strong plant-driven effects on rhizosphere microbial composition. Multiple plant growth promoting microorganisms were more abundant in the rhizosphere. Sampling time had a major influence on microbial community structure, while the fertilizer treatment had limited impacts. We conclude that microbial communities are primarily shaped by soil fraction and time, with the rhizosphere selectively enriched in plant-beneficial taxa.

Initial Assessment of Carbon Dynamics in Conventional and Diversified Cropping Systems in Manitoba

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Accurately quantifying the capacity of agricultural soils to sequester carbon (C) is critical for developing management strategies that mitigate C emissions while sustaining soil health. Among proposed climate-smart practices, integrating cover crops into annual cropping systems has received increasing attention in recent years, but their capacity to enhance C sequestration under Manitoban conditions remains uncertain. Here, we report on the first six months of measurements of a study designed to evaluate the C sequestration potential and water use efficiency (WUE) of a diversified cropping system that includes cover crops in comparison to a conventionally managed field using micrometeorological techniques. Our hypothesis is that, under favourable environmental conditions, the diversified cropping system will have greater cumulative net ecosystem productivity (NEP) than the conventional field. Two identical eddy covariance towers were deployed in commercial fields in southern Manitoba in 2025. The conventional field produced canola (*Brassica napus* L.) and the diversified cropping system canola with intercropped clover (*Trifolium pratense*). Carbon fluxes were measured over the growing season and were partitioned into gross ecosystem productivity (GEP), ecosystem respiration (ER), and NEP. Daily and cumulative C fluxes were calculated to assess the C balance after data was screened and gap filled following quality control criteria and algorithms adopted by the Fluxnet-Canada Research Network (FCRN). During the active portion of the growing season, May to September, the diversified and conventional fields sequestered 276.4 and 317.4 g C m^{-2}, respectively. Preliminary data suggests that cover crop production in the fall shoulder season (October to December) provided additional C uptake while the conventional field mostly lost C to the atmosphere due to respiration. Continued monitoring of these fields will provide field-scale quantification of the carbon dynamics associated with these practices and contribute to our understanding of how management and environmental factors influence carbon balances of agricultural fields.

Are All Nitrification Inhibitors Equally Effective to Protect Ammonium and Reduce N_2O Emissions?

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Farmers have various commercial options for nitrification inhibitors, yet little information is available on the efficacy of the active ingredient, concentration, and application across soil types. A 28-day microcosm study was conducted at 20°C and 65% water-filled pore space to examine the effects of these factors on nitrification and nitrous oxide (N_2O) emissions. The treatments included a control of no nitrogen, N source (UAN or urea), and N source combined with nitrification inhibitors: DCD (in Nitrolizer Dart), Pronitridine (in Centuro), Nitrapyrin (in eNtrench) or DMPP (in ARM U Advanced), applied at standard (1x), half (0.5x), and double (2x) commercial rates. Further treatments were applied to sand, loam and clay soil. The progress of nitrification was assessed by concentrations of NH_4^+, NO_3^-, and NO_2^-, and N_2O emissions throughout the experiment. All inhibitors delayed the conversion of ammonium to nitrite and nitrate, with DCD consistently outperforming all others in all soil types. Nitrapyrin was less effective, and Pronitridine and DMPP were not very effective. The inhibitors worked best in sand and least in clay. The higher rate (2x) of all inhibitors tended to inhibit nitrification and reduce N_2O emissions most effectively, although in many cases the differences between rates were not statistically significant. Most inhibitors (except Pronitridine) significantly reduced N_2O emissions, regardless of texture. There was a tendency toward reduced nitrite accumulation and lower N_2O emissions with most inhibitors across all textures. The results highlight the importance of nitrification inhibition in reducing nitrite accumulation and, consequently, N_2O production. They also show the critical role of soil texture and inhibitor rate in optimizing nitrogen fertilizer use and minimizing N_2O emissions. Lastly, nitrification inhibitors at commercial and double rates were not equally effective in protecting ammonium and reducing N_2O emissions.

A Prairie Examination of Nitrogen Stabilizers and Split Application on Yield and Mitigation of N_2O Emissions in Canadian Western Red Spring (CWRS) Wheat

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Canadian Western Red Spring (CWRS) wheat is a popular export commodity valued for its consistently high protein content and superior milling and baking qualities. This study evaluates how nitrogen (N) stabilizers, split application, and reduced N rates influence agronomic performance and nitrous oxide (N_2O) emission reductions in CWRS Wheat. A three-factor factorial RCBD was used at five locations across the Canadian Prairies: Notre Dame-MB, Indian Head-SK, Swift Current-SK, Lacombe-AB, and Lethbridge-AB. The treatments included N application timing (single and split), N stabilizers (with/without the nitrification inhibitor (nitrification inhibitor, eNtrench, at planting and with/without the urease inhibitor, Anvol, at the split application), and N rates: 70%, 90%, and 100% of recommended. A 0 N Control was also included. All sites had four blocks, and urea (planting) and UAN (split) were N sources. N_2O emissions for 0% and 100% N treatments were done using the static vented chamber method and data processing with the HMR R package. According to preliminary results, single N application produced higher cumulative growing-season emissions at Lacombe, Notre Dame, Lethbridge, and Swift Current, with values of 2.131, 1.498, 0.900, and 0.09 kg N_2O-N/ha, respectively, compared to the split application. eNtrench treated urea was effective in reducing N_2O emissions compared to urea alone at all the sites. The split application of eNtrench and ANVOL reduced cumulative growing season emissions by 62%, 26%, 20%, 16%, and 15% at Lacombe, Lethbridge, Indian Head, Notre Dame, and Swift Current, respectively, compared to the split application without inhibitors. At Lacombe, Lethbridge, and Indian Head, the 70 % N rate produced a lower average grain yield than 100% N; however, these differences were not statistically significant ($p>0.05$). Single N application resulted in significantly ($p<0.05$) higher grain protein content, compared with split application at Lacombe and Swift Current. The study continues with three more field seasons.

Kinetics of Tebuconazole Exposed to Soil and *Pseudomonas Putida* in Microcosm Water Derived from Engineered Wetlands

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Tebuconazole is a fungicide that is used globally in the agricultural industry for crop preservation and seed treatment, as well as in landscape maintenance for turf and horticultural plants. Due to the widespread use, non-target organisms are at risk of exposure to its toxic effects. Thus, *in vivo* dissipation kinetics of tebuconazole were calculated in a previous 14-week mesocosm experiment (engineered wetland) at the Prairie Wetland Research Facility at the University of Manitoba over the summer and fall 2025. This study herein sought to determine the impacts of the addition of soil and the microbe *Pseudomonas putida* on the final time-point samples of the mesocosm study treatment initially spiked at 700 μg L^{-1}. This microcosm study herein had three treatments in triplicate applied to the mesocosm water samples over 840h: 1) *P. putida* (biotransformation), 2) soil (sorption), and 3) *P. putida* and soil combined. Ultra-high performance liquid chromatography-tandem mass spectrometry and isotope dilution was used to quantify tebuconazole concentrations. Tebuconazole indicated strong initial sorption (<48h) to soil under the treatment conditions tested. When comparing the soil-only and combined microbe-and-soil treatments, they followed very similar dissipation trends; suggesting that sorption is a major fate mechanism for tebuconazole. The *P. putida* alone treatment did not demonstrate the ability to significantly degrade tebuconazole. However, an observed significant increase in tebuconazole concentration over 96h (means 118 to 184 μg L^{-1}) suggested that the microbe had the potential to convert the previous study's tebuconazole transformation products (TPs) back to the parent compound. This suggests that tebuconazole TPs can exist at levels that rival the parent compound in aqueous environments, and thus current literature can underreport the total inventory of available fungicide.

The Manitoba Agricultural Greenhouse Gas Assessment Tool

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This presentation will reveal the purpose of the **Manitoba Agricultural Greenhouse Gas Assessment** Tool, its user-friendly features, functionality with soil management practice examples, limitations and, finally, its most compelling power – the user's ability to choose alternative management scenarios, producing emissions estimates for comparison against baseline (business-as-usual) estimates. Methane (CH_4) and nitrous oxide (N_2O) are potent greenhouse gases (GhGs) emitted by agriculture. The provincial agriculture department has developed an educational GhG calculator that enables farmers to generate estimates of annual emissions of these gases based on their particular practices and then explore the impact of changing practices. The first phase of the GhG Assessment Tool consists of annual estimates of N_2O and CH_4 emissions from soil and crop management practices, livestock and livestock manure. These contributions are converted to CO_2-equivalents so that they can be properly presented and compared. Carbon dioxide (CO_2) is also absorbed by agriculture through carbon (C) sequestration, which occurs over a long period of time. Because the GhG Assessment Tool provides annual estimates of N_2O and CH_4, and C sequestration occurs on a different time-scale, the Tool does not include C sequestration. The calculations in the tool are based primarily on the National Inventory Report 1990-2020: Greenhouse Gas Sources and Sinks in Canada (2022). As available, Manitoba data were applied to particular practices, making the estimation capability as locally accurate as possible.The annual emissions of N_2O and CH_4 generated by the tool are ballpark estimates. Management changes should not be made based solely on GhG estimates generated by this tool. Other important factors, such as economics and animal welfare, as well as soil, air and water quality, should also be considered.

Comparing Full-Range and Portable Visible-Range Spectroscopy for Soil Organic Carbon Determination

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Soil organic carbon (SOC) is a key indicator of soil health, influencing nutrient availability, soil structure, water dynamics, and climate mitigation potential. Accurate, efficient assessment of SOC is critical for monitoring soil conditions under changing land use and climate. Traditional laboratory methods such as loss on ignition (LOI) are time-consuming, destructive, and often costly for broad-scale monitoring. In contrast, reflectance spectroscopy offers a rapid, nondestructive alternative. However, its effectiveness depends heavily on sensor configuration, spectral range, and repeatability. This ongoing study evaluates the performance of three spectral devices in estimating SOC under controlled laboratory conditions: a full-range ASD FieldSpec 4 spectroradiometer (Malvern Panalytical Ltd., Boulder, CO, USA) and two low-cost portable devices, Nix Spectro L and Nix Spectro 2 (Nix Sensor Ltd., Hamilton, ON, Canada). The FiledSpec 4 collects reflectance across the full visible to shortwave-infrared (VIS–SWIR; 350–2500 nm), using an external halogen light source and a calibrated white reference panel. In contrast, the Nix devices operate within the visible range (about 400–700 nm) using an internal light source in direct contact with the soil, minimizing ambient light interference and generating color metrics derived from reflectance. This study evaluates the comparability of devices through both spectral analyses (e.g., reflectance trends and shape alignment) across the visible range and color space models (e.g., CIELAB values and ΔE2000 differences) using 120 soil samples from Manitoba's agricultural landscape. Additionally, this study investigates measurement consistency across devices to determine whether low-cost sensors can offer reliable SOC screening performance relative to a research-grade spectroradiometer. This study aims to support the validation and broader adaptation of accessible, portable sensing technologies for soil monitoring by clarifying their strengths and limitations across both spectral and colorimetric domains.

Keywords: soil organic carbon, visible-near infrared spectroscopy, nix sensor, soil health

Research Applications of Assessing Soil Nutrient Supply Over 30 Years with Plant Root Simulator (PRS®) Probes

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Ion-exchange resins have been used since the 1950s to measure soil nutrient supply in research labs. However, ion-exchange resins were not used routinely for soil analysis in North America until 1994, when Western Ag commercialized a resin membrane technology developed at the University of Saskatchewan, known as Plant Root Simulator (PRS®) Technology. PRS® probes are ion exchange resin membranes held in plastic supports that are easily inserted into soil to measure ion supply *in situ* with minimal disturbance. When buried, soil ions displace the counter-ions at a rate that depends on their activity and diffusion rate in soil solution. The quantity of soil ions adsorbed during a burial period is a function of all soil properties (physical, chemical, and biological) controlling nutrient availability in soil. Since 1994, PRS® probes have been referenced in over 600 peer-reviewed journal articles, with a cumulative impact factor over 2400. This presentation will provide an overview of research applications of PRS® Technology from the fields of agronomy, forestry, and ecology, highlighting significant findings over the past 30 years.

Digging Back In: Reviving Soil Judging Competitions in Canada

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Soil judging contests provide valuable hands-on learning experiences where students describe soil profiles, assess landscapes, and interpret these observations for land use and management decisions. Working individually or in teams with a coach, participants develop practical technical skills and compete with peers from other institutions. While these contests are common in the United States and many other countries, they are rarely offered in Canada, limiting opportunities for students to gain technical and experiential soils training. The last Canadian soil judging event took place during the Canadian Soil Science Society conference in 2010. In July 2025, as part of the *Soils for Our Future* international conference, the Manitoba Soil Science Society hosted its first soil judging competition. Fourteen students from across Canada took part in a full day of training, which included a demonstration pit for guided instruction, three competitive judging pits, and a station focused on landscape interpretation. Despite extreme heat, the event was highly successful - engaging, educational, and technically rigorous. Establishing soil judging contests as annual events in Canada would significantly strengthen students' ability to accurately read soils and landscapes - skills essential for informed land use planning and sustainable land management.

Improving soil organic carbon prediction using feature selection techniques

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Land management practices, topography, and erosion processes influence soil organic carbon dynamics in topographically complex landscapes by redistributing carbon-rich soil from eroding areas to downslope depositional areas. Declines in Soil Organic Carbon (SOC), a key indicator of both agricultural and environmental conditions, can adversely impact soil quality by degrading soil structure and fertility, and ultimately limiting crop growth and productivity. Understanding spatial distribution of SOC through time- and cost-efficient techniques, such as visible and near-infrared (vis-NIR) diffuse reflectance spectroscopy, could support large-scale monitoring, identify SOC-depleted hotspots, and guide site-specific management practices that mitigate land degradation. However, high redundancy and non-informative information common in soil spectral datasets can compromise the accuracy and stability of SOC prediction models. This study investigates the application of minimum Redundancy-Maximum Relevance (mRMR) feature selection to derive an informative, low-redundancy subset of colour coefficients for improved SOC prediction. The results showed that the best-performing feature sets did not require all 15 coefficients and adding variables beyond the optimal subset produced no statistically significant improvement. The mRMR technique identified L, x, y, u, and Z as the most informative colour-coefficient subset, providing an optimal balance between simplicity and accuracy. Non-linear algorithms outperformed the linear approach, with the best-performing predictor sets including (L, x, y, u, Z) for linear regression (R^2 = 0.6), (L, x, y, u) for random forest (R^2 = 0.7), and (L, x, y, Z) for support vector machine (R^2 = 0.7). Notably, incorporating sampling depth, as an environmental covariate, further improved SOC prediction performance, indicating that SOC depth distribution adds predictive information beyond colour coefficients alone.

POSTER PRESENTATION ABSTRACTS

(in alphabetical order; * denotes student presenter)

Pesticide Impacts on Microbial Community Composition in Cropping and Biobed Systems

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Pesticides are chemical formulations that protect crops from harmful pests. As a result, millions of tonnes of pesticides are applied globally each year. With increasing access to genomic tools, growing attention is being directed toward understanding how these pesticide applications influence the soil microbial composition and functional capacity, and the extent to which current regulatory frameworks would need to consider these potential impacts on soil health. In this study, we plan to characterize the microbial community composition in (1) biomixtures exposed to large doses of pesticides because of rinsate disposal in biobed systems, (2) soils exposed to low doses of pesticides through conventional annual crop production, and (3) biomixtures and soils not purposefully exposed to pesticides. Specifically, samples include: (a) biomixture samples (0-15 and 15-30 cm) from a dual-cell biobed system and from an adjacent pile of uncontaminated biomixture, and (b) soil samples (0-15 cm) from Canada's oldest organic systems study, which includes organic, conventional ,and native grasses plots. The poster presents preliminary results and outlines planned approaches for additional measurements in this graduate study, which seeks to understand the effects of current-use pesticides on the relatively abundance of diverse bacteria and fungi common to Prairie soils. Shotgun metagenomic sequencing will be used to characterize microbial communities and identify metabolic pathways associated with pesticide degradation. Ultra-High-Performance Liquid Chromatography Mass Spectrometry (UHPLC-MS/MS) will be applied to estimate pesticides types and quantify their concentrations in samples.

Long-Term Soil Carbon and Morphological Evolution in Paired Land-Uses across Southwestern North Dakota.

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Assessing long-term soil carbon dynamics and morphological changes is critical for understanding the sustainability of agricultural practices in the Northern Great Plains. This study analyzes the storage of total carbon (TC), inorganic carbon (IC), and organic carbon (OC) in paired cropland and native grassland sites within Major Land Resource Area 54 (Rolling Shale Plain) in southwest North Dakota. Initial sampling was conducted in 1992, followed by resampling in 2010 and 2023. The initial sampling indicated a noticeable decline in OC stocks within the top 30 cm of long-term cropland compared to grassland, with a trend of increased IC in the subsoil of the cropped sites. Along with the resampling in 2023, we examined changes in soil profile morphology and classification over the three periods, observing apparent deepening of Ap and Bk horizons, and shifts in diagnostic horizons across the main soil series (Amor, Shambo, and Stady). These findings suggest that land use and management intensity have caused changes in both soil carbon pools and physical soil characteristics over three decades. We will discuss the quantified data on C stock changes and detailed horizon comparisons from 11 paired sites representing the region's primary soil series over the time period. This research aims to inform future land-use and carbon management strategies in North Dakota's agricultural landscapes.

Measuring to manage: Spectroscopy can serve the industry

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NRC Winnipeg is fostering a healthy, resilient and sustainable future of agri-food production, by promoting measurement:

- Spectroscopy is a measurement modality that uses optical energy to analyse the composition of matter.
- It provides a means for quantitative and qualitative analysis of agricultural and agri-food products across the supply chain, including soil.
- It is particularly useful for making routine measurements and enabling instant, on-the-spot decisions in the lab or at a process line.
- Digital spectroscopic repositories can support longer-term tracking (e.g. condition of soil) and production history, be it on-farm or in a processing environment.
- NRC Winnipeg is focused on the priorities of the Canadian ag-tech communities, from researchers to producers and processors, and is set up to de-risk the adoption of this measurement technology where it will create business and economic benefit.

“Imagine: A healthy and holistic agri-food production system, one in which all important points along the supply chain involve simple measurement, thus creating a traceable, information- and value-based system of our products and processes”.

Composted wastewater sludge as an alternative to commercial phosphorus fertilizer: impacts on crop yield and phosphorus uptake

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The increasing demand for phosphorus (P) in agriculture, coupled with the environmental challenges of eutrophication and the depletion of finite phosphate rock reserves, underscores the urgent need for sustainable P sources. This study evaluated the capacity of composted wastewater sludge to serve as a sole and sustainable alternative to commercial monoammonium phosphate (MAP) fertilizer for crop production under field conditions in southern Manitoba. Three treatments (composted sludge, MAP, and control) were tested in a randomized complete block design with four blocks. Wheat and canola were grown over the 2025 field season with supplemental nitrogen, potassium, and sulphur applied uniformly to ensure P was the limiting factor. For wheat, biomass samples were collected at both flowering and maturity, and grain yield was recorded at harvest. For canola, only flowering-stage biomass was collected due to pest damage that impacted grain yield. Plant tissue and grain samples will be analyzed to determine P efficiency indices. These, along with wheat grain and biomass yield results, will be presented. Results from this study will provide insight into the potential of composted wastewater sludge to support crop productivity while contributing to sustainable nutrient recycling in agricultural systems.

Crop yield and plant performance in a two-year legume cover crop system for annual cropping in the Canadian prairies

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Cover cropping with legumes can improve soil health, boost organic matter, and increase N availability, but it requires a creative approach for the short growing season of the Canadian Prairies. This trial tested the performance of a single-pass seeding system with one non-legume and four legume cover crops together with wheat at six site-years (utilizing early season heat and moisture), maintaining the established cover crops after harvest and overwintering them into a living mulch system. Canola was seeded into the chemically suppressed living mulch the following spring at three site-years. Trails were established at four Manitoba locations (Arborg, Carberry, Melita, and Roblin) in 2023, though cover crops failed at Melita. The trial was repeated in 2024 at Carberry and Roblin. All variables tested differed significantly among site-years. No significant treatment difference or interaction between site and cover crop was observed at any site-year for wheat biomass, grain yield, protein, or N yield, indicating that cover crops did not compromise wheat performance. At all site-years, cover crop biomass was low during the wheat phase, but was difficult to control during the canola phase. Canola was grown successfully in the living mulch at one of three sites, with yields in treatments with low mulch biomass being similar to the canola-only control and the regional 10-year average. These results indicate that a wheat cash crop with cover crops succeeded at 5 out of 6 site-years, but a canola crop succeeded at only one out of three site-years tested and strongly depended on effective control of living mulch biomass.

Resolving the Potassium Puzzle Using Plant Root Simulator (PRS®) Technology

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Potassium (K) fertilizer requirements are difficult to predict due to the interaction between soil K supply, root systems, and drought stress. Plants require almost as much K as nitrogen, requiring a large flux of K to roots that in turn depends on the intensity and quantity of soil K supply and on root surface area. Crop requirements for K also vary with drought stress due to impacts on water use efficiency. We determined the relationship of plant K uptake to soil K supply using Plant Root Simulator (PRS®) probes. The flux of K to a modeled root system can be integrated, thus predicting season-long uptake. Our PRS® CropCaster® method then uses a "dynamic K response" to account for the interaction of evapotranspiration stress, plant K sufficiency and K fertilizer response.

Assessing the Relationships Between Soil Test Phosphorus and Soil Phosphorus Release Under Snowmelt Induced Flooding

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Soil test phosphorus (STP) is widely used to estimate soil phosphorus (P) availability and the risk of P loss to downstream water sources. In cold climatic regions such as the Canadian Prairies, snowmelt-induced flooding is a major pathway for P export from agricultural fields. However, the relationship between STP levels and P release under these unique snowmelt conditions remains poorly understood. This study investigates how STP influences P release during simulated snowmelt flooding to facilitate P-loss risk assessment for cold-climatic regions. Intact soil columns were collected from four different agricultural fields with low Olsen P values. Monoammonium phosphate was added to columns to make a wide range of Olsen P and flooded under simulated snowmelt conditions. The P release into overlying water was quantified after 14 days after flooding. For the pooled dataset, split-line regression analysis was conducted. A change point of 64 ppm was identified for Olsen P (R^2=0.6475) and 96 ppm for Mehlich-3 P (R^2=0.7104). These findings suggest that soil P release during snowmelt flooding exhibits threshold responses rather than simple linear increases, highlighting the importance of managing STP below critical levels to reduce P loss risk from agricultural landscapes. Further analyses will be conducted to evaluate additional P indices, including water-extractable P, oxalate-extractable P, degree of P saturation and P sorption capacity, to strengthen mechanistic understanding.

Sulfur fertilizers for optimizing canola production in North Dakota

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North Dakota accounts for approximately 85% of total U.S. domestic canola production, and canola acreage continues to expand across the state. Sulfur is a critical nutrient for canola oil synthesis and overall productivity. Current sulfur fertilizer recommendations for canola in North Dakota (20–30 lb S/ac) are primarily based on research conducted in the cooler and wetter northern Red River Valley. These conditions differ substantially from other regions of the state, such as western North Dakota, which is generally drier and warmer. Consequently, regionally representative and statewide research is needed to refine sulfur fertilizer recommendations for canola production in North Dakota. The objectives of this study were to evaluate the effects of sulfur fertilizer rate and sulfur fertilizer source on canola yield and quality. Field experiments were conducted at three locations (Dickinson, Hettinger, and Minot) to identify appropriate sulfur fertilization strategies for canola production across the state. Three sulfur fertilizer sources (ammonium sulfate, gypsum, and elemental sulfur) were applied at four rates (0, 10, 20, and 30 lb S/ac), in combination with three nitrogen rates (0, 100, and 150 lb N/ac), immediately after planting canola under a no-till system. Results from the study (2025) indicate that optimal sulfur application rate of 20 lb/ac with appropriate sulfur source and nitrogen management can maximize canola yield and quality across western North Dakota.

Sequential Inverse Modeling with HYDRUS-1D Coupled with PEST for Estimation of Soil Hydraulic Parameters in Fine-Textured soils

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Accurate estimation of soil hydraulic parameters is critical for modeling water flow and developing soil health strategies in fine-textured agroecosystems of Manitoba. This study used HYDRUS-1D coupled with Parameter ESTimation (PEST) software to estimate van Genuchten-Mualem parameters for a Vertisolic soil at Carman-Elm Creek over 4 growing seasons (2016-2019). Field-measured volumetric water contents within 0 – 10 cm, 10 – 30 cm, 30 – 70 cm, and 70 – 130 cm layers were used for sequential inverse calibration by generating 100 randomized initial parameter sets annually to address solution's non uniqueness. Sequential calibrations using randomized initial parameter sets and performance-based filtering were conducted to isolate maximum likelihood ranges. The HYDRUS-PEST coupling achieved satisfactory model performance (Nash-Sutcliffe efficiency coefficient (0.65 – 0.92), percent bias (-9.31 % - 1.48 %), ratio of root mean square error to standard deviation (0.29–0.59), and the coefficient of determination (0.68 – 0.96). However, validation for 2018 performed poorly due to pronounced variability in rainfall and temperature, reflecting the influence of extreme weather on soil hydraulic behavior. The surface (0 – 10 cm) saturated hydraulic conductivity (K_s) exhibited strong interannual variability (120, 10, 21, and 120 cm day^{-1} for 2016 – 2019), while deeper layers remained relatively stable (< 20 cm day^{-1}). This contrast illustrates combined impact of soil structure and seasonal dynamics on water transport in clay-rich systems. The findings emphasize the importance of multi-year calibration and probabilistic parameterization for fine-textured soils under variable climatic conditions. By identifying consistent parameter ranges, this work advances modelling approaches that can enhance soil water management strategies and guide soil-health assessments in Manitoba's cold-climate agroecosystems.

Evaluating the Potential for Phosphorus Release to Floodwater from Soils Amended with Struvite-Enriched Compost

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Novel recycled P fertilisers that maintain crop productivity while reducing P runoff losses offer the potential to improve sustainability of production in regions impacted by eutrophication of aquatic systems. Struvite and struvite-enriched composts—produced by incorporating struvite into organic materials such as yard waste, household waste, and cattle manure during the composting process—may be suitable for supplying plant-available P while minimizing P loss due to slow-release P characteristics. This study assesses the effectiveness of struvite-enriched compost in reducing dissolved reactive phosphorus (DRP) losses during flooding and snowmelt events from Prairie soils, relative to the soluble fertiliser monoammonium phosphate and the slow-release ammoniated P fertiliser struvite (NH_4MgPO_4). Here we present the results of an experiment conducted at one field site near Libau in 2025, using a randomised complete block design (13 treatments of differing combinations of P source x 4 replicates) in both annual and perennial cropping systems. Presented are the results of a flooding experiment completed in October of 2025 at the end of the growing season. A PVC ring (30 cm length, 25 cm diameter) was installed in each plot of the experiment with 15 cm of the ring protruding above the soil surface. In the flooding experiment, water samples were collected at 3 and 15 minutes after rings being flooded with 4 L of reverse-osmosis water, to quantify potential for release of DRP to overlying floodwater. Supporting soil measurements include water-extractable P and Olsen P in the 0-5 cm soil depth and plant tissue P concentration. Preliminary results indicate higher potential for release of P to floodwater where P sources were surface applied rather than incorporated in combination with higher rates of P application. Future research is planned to evaluate the potential for release to snowmelt at these same experimental sites. Overall, this study will examine the environmental implications of using struvite-enriched compost as a soil fertility amendment under the hydrological conditions of southern Manitoba.

Field Evaluation of Gypsum and Ferric Chloride Co-Application: Impacts on Available Phosphorus in Soil and potential losses to snowmelt

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Eutrophication is a major environmental concern in Canadian freshwater bodies. Phosphorus (P) loss from agricultural soils through snowmelt runoff is a driver of this eutrophication. Co-application of gypsum and ferric chloride is a promising strategy to mitigate P losses, which has not yet been evaluated in field conditions. The objective is to investigate the co-application of gypsum and ferric chloride on soil P status. It is hypothesized that the co-application of gypsum and ferric chloride will significantly reduce the soil labile P than in unamended soil. A field experiment was conducted at two sites in southern Manitoba using a randomized complete block design with three treatments and four replicates. Gypsum and ferric chloride were co-applied in the fall at 2.5 Mg ha^{-1}:2.5 Mg ha^{-1} (T1=1:1) and 2.5 Mg ha^{-1}:1.25 Mg ha^{-1} (T2=2:1) ratios with an unamended control (T3) to 1 m × 1 m plots in each site. Then, soil samples (0-20 cm depth) were collected immediately from each plot, air-dried, sieved through a 2 mm mesh and analysed for Olsen P and pH. Data were statistically analysed in a two-way ANOVA using R. Mean Olsen P concentrations for T1, T2, and T3 were 25.80, 27.55, and 32.18 mg kg^{-1}, respectively, at site 1 and 56.74, 60.55, and 60.65 mg kg^{-1}, respectively, at site 2. Although the Olsen P at the two sites were significantly different ($p < 0.05$), no significant differences were observed among treatments within each site ($p > 0.05$). At both sites, amended treatments (T1 and T2) significantly ($p < 0.05$) reduced soil pH than T3. Findings suggest that while amendments influenced soil pH, they did not alter the extractable P immediately after application. The next phase of this project will quantify water extractable soil P and P loss to snowmelt during spring from each plot.

Near-Infrared Technology for Manitoba Soil Physical and Chemical Properties Determinations

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Soil testing and characterization is integral in the agricultural industry as it assists in estimating soil health, and in making more informed decisions about crop selection and management. The current standardized soil testing methods are time-consuming, labour-intensive, destructive, and costly. The aim of this study is to evaluate the use of Near-Infrared Spectrometry (NIRS) technology as a methodical approach for rapid and simultaneous quantification of selected soil properties for Manitoba soils. A total of 2038 soil samples were collected across Manitoba as follows: 1) by soil horizon in a range of soil-landscapes and 2) from 0-5 cm, 5-20 cm, 20-50 cm
and 50-100 cm soil layers near weather stations that are part of the Manitoba Ag-Weather Network. The soil properties quantified include organic carbon content, % sand, silt and clay via pipette method, particle size distribution via laser diffraction, pH, and electrical conductivity. Near Infrared spectral data (800 to 2,500 nm) was collected using the Bruker FT-NIR Multi- Purpose Analyzer (MPA II) with two sample presentation modes: a rotating sample cup (diameter 97 mm) and a glass vial (diameter 22 mm). Models are being developed to predict soil properties, including particle size distribution parameters (D10, D50, D90). Calibration and validation analyses are being completed to compare the prediction accuracy across models that differ by (a) field sampling method (horizon-based vs. fixed depth samples), (b) soil color class (dark versus light soils), (c) analytical method (e.g., % clay via pipette vs. laser diffraction), (d) laboratory (university versus commercial laboratory), (e) the FT-NIR sample presentation mode, and (f) the number of samples considered. By optimizing and evaluating these model options, we aim to advise Manitoba stakeholders on how best to apply FT-NIR to maximize the benefits of this cost-effective, efficient, and non-destructive soil testing method.

Kinetic Study of Cd, Cu, and Zn Adsorption onto Biochar and Limestone under Simulated Boreal Temperatures

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Heavy metal contamination of soils poses serious ecological and public health risks, particularly in boreal forest regions affected by mining and smelting activities. Toxic metals such as cadmium (Cd), copper (Cu), and zinc (Zn) are commonly released into the environment, where they accumulate in soils and enter the food chain, threatening plant health, wildlife, and human populations. Among various remediation strategies, the use of soil amendments like biochar and limestone offers a sustainable approach to immobilize heavy metals and restore soil functionality. Biochar enhances nutrient retention and microbial activity, while limestone aids in pH regulation and metal stabilization. This study investigates the adsorption kinetics of Cd, Cu, and Zn onto biochar, limestone, and their combinations under temperatures relevant to boreal ecosystems (25 °C and 4 °C). Batch experiments were conducted by adding each amendment to a buffered metal solution (20 mg L^{-1}, pH 5.0) and agitating the mixture at 150 rpm. Time-resolved sampling was performed over 5 minutes to 24 hours, followed by filtration (0.45 µm), acid preservation, and metal quantification via atomic absorption spectroscopy (AAS). Kinetic data were fitted to pseudo-first-order and pseudo-second-order models to determine adsorption rates and mechanisms. The results will support the development of optimized amendment strategies for cold-region soil remediation and provide insight into the temperature-dependent behavior of metal–amendment interactions. This study serves as a foundation for future in-soil applications under boreal environmental conditions.

Towards Net Zero: Nitrous Oxide Emissions from Cropping Systems with Varying Degrees of Perennialization in Manitoba

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Agricultural soils are a dominant global source of nitrous oxide (N_2O), a potent and long-lived greenhouse gas. This study, part of the Leveraging Ecosystems to Transform Agriculture on the Prairies (LEAP) project, quantifies how cropping system perenniality and soil texture interact to control N_2O emissions and in-situ production. We will employ a three-year field sampling across six sites in southern Manitoba, pairing static chamber flux measurements with soil gas profiling (5, 15, 30, 60 cm depths) using silicon diffusive equilibrium samplers. This design directly tests three hypotheses: (1) perennial systems will generate lower cumulative N_2O emissions than annual or intermediate systems; (2) finer-textured clay soils will exhibit higher peak fluxes but lower diffusivity than coarser sandy soils; and (3) the vertical distribution of N_2O within the soil profile will be a key indicator of predominant production pathways and emission potential. Our results will provide a framework to guide the development of low-emission, climate-smart cropping systems adopted to Prairie landscapes.

Incubation study to assess the impact of swine manure from different diet treatments on greenhouse gas emission

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Swine manure provides nutrients, particularly nitrogen (N) and phosphorus (P), to Canadian croplands, but its improper management can result in significant environmental problems, such as greenhouse gas emissions. This study examines how swine slurry from different dietary treatments influence N_2O, CH_4 and CO_2 emissions and soil inorganic-N concentrations. To test that, two swine feeding trials were conducted, first trial with four diet N-P levels (Low-N-Low-P, Low-N-Normal-P, Normal-N-Low-P, Normal-N-Normal-P), and the second trial with six enzyme-additive diets (positive control with normal soybean meal, fat and protein; negative control (NC) with their reduced levels; NC+protease; NC+xylanase; NC+protease+xylanase; and NC+encapsulated protease+xylanase). An incubation experiment was performed using the generated manure alongside an unamended control. Soil was incubated for 6-week period at 20^0C after adding manure treatments according to Manitoba Agriculture recommendations. During the incubation, headspace gas was collected at 12 time points (0, 1, 3, 5, 7, 10, 15, 20, 25, 30, 35, 42 days) and analyzed for N_2O, CH_4, and CO_2 concentrations. On each sampling day, soil was analyzed for inorganic-N (NO_3^-+NH_4^+), pH and EC contents. Preliminary manure analysis showed significantly higher phosphate concentrations in manures from normal-P diets (0.63%, 0.56%) compared to low-P diets (0.34%, 0.33%). Enzyme-additive treatments had no significant effect on phosphate concentration, ranging from 0.26% to 0.39%. Manure inorganic-N levels ranged from 0.42% to 0.5% in the first trial, and from 0.25% to 0.39% in the second trial, showing no diet effects. Early incubation results (0-15 days) showed significantly lower inorganic-N level in Low-N-Normal-P (250 mg/kg) treatment than other manure treatments, with the highest of 313 mg/kg in Normal-N-Low-P. The unamended control had the lowest (154 mg/kg). At day 15 (218 mg/kg), inorganic-N concentration was significantly lower compared to 0-7 days, with the highest at day 1 (300 mg/kg). Gas and remaining soil analyses are ongoing and will be presented at the meeting. Finally, results will contribute to develop sustainable manure management strategies which reduce environmental risks in Canadian cropping systems.

Effect of Zinc Formulation and Application Rate on Zinc Uptake and Seed Zinc Concentration in Dry Beans

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Zinc (Zn) deficiency is a widespread nutritional constraint, and biofortification of dry beans (*Phaseolus vulgaris* L.) represents a promising strategy to improve dietary Zn intake. This study integrates field and greenhouse experiments to evaluate how Zn fertilizer formulation, application rate, and environmental conditions influence Zn uptake, yield, and seed Zn concentration in dry beans. Field experiments conducted in 2025 examined the effects of foliar-applied $ZnSO_4$ under contrasting soil drainage conditions (tile-drained vs. non-drained) across multiple dry bean varieties. Preliminary findings from the Grand Farm site indicate that Zn application interacts with drainage and genotype to influence agronomic performance, including total seed yield and 100-seed weight, while yield components from the Mandan site, are currently being processed and will be reported. Seed samples collected from these trials are being analyzed using acid digestion and inductively coupled plasma–optical emission spectrometry (ICP-OES) to quantify treatment effects on Zn accumulation. To complement field observations, a controlled greenhouse experiment is underway to assess the effects of Zn formulation and application rate on Zn uptake and mobilization into seeds. The greenhouse study follows a randomized complete block design with ten treatments, including an untreated control and nine combinations of three Zn formulations ($ZnSO_4$, Zn-EDTA, and $ZnCl_2$) applied at three rates (1, 2, and 4 mg Zn per plant). Zn applications are conducted at early pod set using standardized solutions to ensure equivalent elemental Zn across formulations. Data collection includes plant growth, pod number, total seed weight, 100-seed weight, and seed Zn concentration, with seeds from upper and lower pods analyzed separately. Statistical analysis will use two-way ANOVA to assess the main effects of formulation and rate and their interaction. Collectively, these experiments aim to identify Zn management strategies that enhance seed Zn concentration without compromising yield, thereby supporting agronomic biofortification in dry bean production systems.

Precision 4R Management: Improving Nitrogen Use Efficiency, Greenhouse Gas Emissions and Production Economics of Canola

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Nitrogen (N) fertilizer, essential for canola production, is a major source of nitrous oxide (N_2O) emissions. Although studies show that 4R nutrient stewardship and nitrification-inhibited fertilizers can lower N_2O, most treat fields as uniform areas, receiving a single rate. Differences in landscape position create within-field differences in yield potential. A single N rate oversupplies low-yielding areas, increases N losses, and reduces fertilizer N use efficiency. Precision agriculture tools like SWAT MAPS delineate areas into management zones that receive tailored prescriptions based on soil property, water regime, and topography. This project evaluates whether Precision 4R Nitrogen Management based on SWAT MAPS management zones can improve N fertilizer use efficiency, reduce N_2O emissions, and support profitable canola production. Experiments were established on canola fields in Manitoba (one-site) and Saskatchewan (two-sites), with replicated commercial-farm-scale strips comparing: a) flat N rate with urea, b) variable-rate (VR) urea, c) VR urea plus nitrification-inhibited urea (SuperU) in high-loss zones, d) VR urea plus SuperU with a 10% N rate reduction, and e) zero-N control. Treatments were applied across SWAT MAPS zones 1-2 (top), 5-6 (mid-slope), and 9-10 (low-lying). Growing-season N_2O fluxes were done using static vented chambers and data were processed using the HMR R package. In-season and post-harvest soil mineral N and yield were monitored to quantify N uptake and grain yield. First-year results indicated that N_2O emissions were greatest in zones 9-10 under the flat N treatment, while emissions from zero-N controls were negligible. VR urea with SuperU showed reduced N_2O emissions in low-lying areas at some sites. Yield responses sometimes favoured flat N rate application. Residual nitrate was highest under flat N application for Brandon and Indian Head with Saskatoon showing highest among the sites. Multi-year measurements will determine how far this Precision 4R approach can contribute to research objectives.

Field-Scale Evalua□on of Biochar for Improving Soil Health and Reducing Greenhouse Gas Emissions in Manitoba

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Biochar is a promising farm waste management product with strong potential to improve soil health while supporting net-zero greenhouse gas emissions in agricultural systems. Although biochar has been widely studied and applied in soil science, most research has focused on laboratory, greenhouse, or small-scale trials. Field-based studies remain limited, particularly in the Canadian Prairies, where unique soils, climate, and management practices require region specific evaluation. Biochar is a charcoal-like material produced by heating high-carbon biomass under low-oxygen conditions. Its stable structure allows it to persist in soil for several hundred years, making it an effective tool for long-term carbon sequestration. Biochar can retain up to five times its weight in water, improving soil moisture availability, and it enhances soil porosity and nutrient-holding capacity, increasing nutrient availability to crops. These properties contribute to improved soil fertility, structure, and overall soil health. Incorporating biochar into agricultural soils provides multiple environmental benefits, including converting waste materials into valuable soil amendments, reducing nutrient losses, improving air and water quality, and mitigating the impacts of hazardous compounds. When applied appropriately, biochar can enhance crop productivity while reducing greenhouse gas emissions. To address the lack of field-scale data in Manitoba, research trials are underway at the Russ Edwards School of Agriculture and Environment at Assiniboine Community College, in collaboration with Jonique Farms Ltd. in St. Laurent, Manitoba, and Manitoba Beef and Forage Initiative (MBFI), Brandon, Manitoba. These studies evaluate biochar product types, application rates, and incorporation methods while measuring carbon dioxide emissions to better understand biochar's role in improving soil health, crop yields, and carbon storage in Manitoba agroecosystems.

Characterization of Dissolved Organic Matter in Boreal Forest Riparian Zones

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Dissolved organic matter (DOM) is composed of soluble organic compounds and is a vector for carbon transport from terrestrial to aquatic environments in the boreal forest. Riparian zones are transition zones between land and water where a high degree of processing of DOM occurs. Recent studies have found that a high degree of processing occurs in riparian zones, but it is unknown how characteristics of the riparian zones influence this processing and ultimately determine the chemical composition of DOM exported to streams and lakes. Filling this critical knowledge gap will help predict the effect of climate change on carbon cycling in the boreal forest, particularly the impacts on aquatic ecosystems where changes to DOM may alter chemical, physical and biological processes. The objective of this research is to determine how initial soil water characteristics and riparian zone topography and traits influence the composition of the DOM that leaches into streams . The proposed research will be conducted within the Lake 239 catchment at the Experimental Lakes Area (ELA) in Northwestern Ontario. Soil samples will be collected from three distinct catchments and account for different soil types, depth, and moisture content. Riparian zones will be analyzed for the width, slope, and depth to the water table, and soil characteristics such as organic matter and soil texture will be measured in lab. An initial soil water solution will be produced from these samples and drained through the sampled soil cores to produce riparian soil leachate. For both the initial soil water solutions and soil leachate, DOC concentration analysis will be performed using a Shimadzu TOC-L CSN + TNM-L analyzer, with an ASI-L auto-sampler. Fluorescence will be analyzed using a Cary Eclipse Fluorescence Spectrometer, with a 3-dimensional excitation-emission matrices (EEMs) and absorbance will be measured using a Shimadzu UV-2501PC UV-VIS Recording Spectrophotometer.

Partitioning Behaviour and Dissipation Kinetics of Ultraviolet Filters in Mesocosm Water and Sediment

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Ultraviolet filters (UVFs) absorb UV-A and -B radiations, making those important components in sun protectants and other commercial liquid and solid materials vulnerable to photodegradation. UVFs can be introduced into the environment directly from humans via personal care products and sunscreen during recreational activities, and indirectly through insufficient removal by wastewater treatment plants. Their physiochemical properties (e.g. $\log K_{ow}$) can contribute to their environmental persistence, toxicity and bioaccumulation in non-target organisms. We hypothesize that UVFs will partition to sediments in proportion to their hydrophobicity. Triplicates of two mesocosm treatments (water-only and water with sediment and plants) were spiked at 50 µg L^{-1} with four UVF standards: octocrylene, octisalate, oxybenzone, and sulisobenzone. Water and sediment samples from the mesocosms were collected weekly for nine weeks from July to September 2024. Water samples were quantified by direct injection and isotope dilution via ultra-high performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS). Half-lives from the water data were calculated to be 30 and 17 days for sulisobenzone and 3.6 and 2.9 for oxybenzone in the water-only and water with sediment and plants treatments, respectively. Octocrylene persisted near it's solubility limit and octisalate remained below the method limit of quantification in both treatments throughout the season. Sediment samples were freeze dried for future analysis. To complete this work, we are currently validating a sediment extraction method to quantify the suite of four UVFs using the aforementioned UHPLC-MS/MS analytical method. Kinetic dissipation constants, half-lives, and solids-water distribution coefficients (k_d) will be calculated. These characteristics will give predictive capabilities for real-life distribution and fate of UVFs in fresh water environments.

Characterizing Sediment Phosphorus in the FortWhyte Alive Lakes

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Urban lakes are vulnerable to eutrophication because they receive continuous nutrient inputs from surrounding watersheds and often experience restricted hydrologic exchange This is a particular problem at FortWhyte Alive, an environmental education centre in Winnipeg, Manitoba where long term monitoring has documented substantial differences in phosphorus concentrations among five lakes. These lakes are endorheic and were formed from clay quarry pits, creating closed basins where nutrients accumulate. Despite sharing a common watershed, the processes driving their differing phosphorus levels remain poorly understood. One potential explanation is that sediment phosphorus reservoirs differ among lakes, influencing the mobility of phosphorus and its availability in the water column. To begin investigating this more closely, we conducted a preliminary survey of sediment phosphorus during the summer of 2025. Three sediment samples were collected from each lake with an Ekman grab to capture spatial variability and were analyzed for water extractable and Olsen phosphorus. We compared concentrations of these sediment fractions with existing surface water phosphorus data from FortWhyte Alive's long-term monitoring program. Water extractable phosphorus was consistently low in all lake sediments, but there was substantial variation in Olsen phosphorus among lakes. In general, lakes with higher sediment Olsen phosphorus also had higher water column phosphorus concentrations, although this relationship was mediated by the presence of aerators in some lakes. This suggests that sediment-associated phosphorus may be contributing to spatial differences in nutrient conditions at FortWhyte Alive. Overall, these findings indicate that sediment phosphorus reservoirs may influence lake specific nutrient dynamics at this site. This work provides a foundation for future research aimed at investigating environmental drivers of internal phosphorus release and examining how water level changes influence water quality in these shallow, nutrient rich lakes.

Microbes Unchained: Freeing Soil Microbes from Their Dirt Prison for Better Science

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The soil microbiome plays a crucial role in ecosystem function, yet many phylogenetic groups remain poorly studied due to their close associations with soil particles, biofilms, and organic matter. Traditional media often fails to culture the full diversity of soil microbial communities, introducing compositional and structural biases. While DNA-based methods have facilitated an improved understanding of soil microbial communities, molecular methods do not facilitate separation of viable cells. The inability to separate microbes from the soil matrix while maintaining structural and compositional integrity restricts our ability to assess the ecological roles of different phylogenetic groups. Further, the ability to extract viable microbial cells from soil enables new possibilities for community manipulation using synthetic communities through genetic modification, a promising step for linking microbial identity with function. To this end, we evaluated two methods for separating viable cells from the soil matrix: 1) a soil extract derived broth (low in concentration to better mimic resource-poor conditions of soil) and 2) a Nycodenz density gradient separation, which physically isolates intact cells without requiring cultivation. Amplicon sequencing of the 16S rRNA (V3–V4) and 18S rRNA (V4) regions for bacteria and fungi, respectively, was conducted on cDNA synthesized from RNA using the Illumina NextSeq1000 to compare microbial community composition and structure across extraction methods. Direct soil RNA extraction served as a reference. Based on preliminary results, Nycodenz separation provided the most representative bacterial profile. However, lack of successful 18S sequencing suggested that Nycodenz may not recover fungal cells efficiently. Results of this experiment are intended to improve viable cell separation from complex media, facilitating future research on microbial identity-function relationships.

Influence of Soil Dissolved Organic Matter Quality on Phosphorus Mobilization from Agricultural Soils during Snowmelt Runoff in the Red River Basin, Canada

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Eutrophication of aquatic ecosystems has become a significant water quality concern across the Canadian Prairies, particularly in Lake Winnipeg. Over-enrichment of surface water with phosphorus (P) mobilized through spring snowmelt runoff from agricultural soils in the Red River Basin is a major driver of Lake Winnipeg eutrophication. The Red River Basin contributes a disproportionately large proportion of total P loading to Lake Winnipeg, having been classified as a P hotspot with high vulnerability to flooding during snowmelt. Soil dissolved organic matter (DOM) directly influences soil P availability through competition for mineral sorption sites and modification of soil physicochemical properties. The dynamics of DOM are influenced by source quality, land use and management practices, and environmental factors. This research explores how variability in DOM quality in soil, with respect to land use, cropping systems, manure application practices, topography, soil type, texture, pH, and organic matter content influences P mobilization from agricultural fields during snowmelt in the Red River Basin, south of Winnipeg. Absorbance and fluorescence indices of DOM and dissolved reactive phosphorus (DRP) will be analysed in soils collected from 117 agricultural fields across this region. Landscape and soil properties of each site will be documented through landowner interviews and provincial databases. Statistical analyses will characterize relationships between landscape variables, DRP concentrations, and DOM quality indices. The research outcomes will help us understand interactions between soil organic matter properties and the risk of P loss during snowmelt. Furthermore, it will help to identify high-risk areas within the Red River Basin where management interventions could most effectively reduce P export during snowmelt.