Manitoba Soil Science Society

62th Annual Manitoba Soil Science Society Conference and Annual General Meeting

February 7-8, 2019

Holiday Inn South
1330 Pembina Highway
Winnipeg, MB

2018-2019 MSSS EXECUTIVE

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CONFERENCE PROGRAM

Thursday, February 7, 2019

7:30 am Registration and Continental Breakfast

8:25 am Conference Commences
Opening Remarks – Laryssa Stevenson, MSSS President

PLENARY SESSION: MANAGEMENT IMPACTS ON SOIL FUNCTIONS AND PRODUCTIVITY
Chairperson: Laryssa Stevenson
CCA CEUs: 1.5 Soil & Water Management

8:30am Keynote Presentation: **Soiled Soil: Counting the Health and Function Costs**
Francis Zvomuya
Department of Soil Science, University of Manitoba, Winnipeg, MB

9:15am Keynote Presentation: **Manure, the Gift that Keeps on Giving: An Overview of the Long-Term Manure and Crop Management Study at Glenlea**
Don Flaten[1], Trevor Fraser[1], and Clay Sawka[2]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*Manitoba Conservation, Winnipeg, MB*

10:00am Nutrition Break and Poster Session
Authors must be present at their posters according to the schedule listed under poster abstracts section of the program

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GENERAL SESSION: WATER MONITORING & MANAGEMENT
Chairperson: Laryssa Stevenson
CCA CEUs: 1.0 Soil & Water Management

10:30am **From a Trickle to a Gush – Provincial Tile Drainage Programming**
Mitchell Timmerman[1] and V. Doan[2]
[1]*Manitoba Agriculture, Carman, MB*
[2]*Manitoba Agriculture, Steinbach, MB*

10:50am **Monitoring Soil Water Content in Manitoba's Seasonally Frozen Soils**
Timi Ojo
Manitoba Agriculture, Winnipeg, MB

11:10am **Evapotranspiration Crop Coefficients for Canola in Manitoba**
Tony Britton[1], [2]*, Aaron Glenn2, Sanjayan Satchithanantham[2], Clayton Jackson[2], Brian Amiro[1], Henry Wilson[2]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*Agriculture and Agri-Food Canada, Brandon, MB*

11:30am **Drinking Water Security in Manitoba First Nation Communities**
Kristy Anderson[1]*, Annemieke Farenhorst[1], Tracey Peter[2], Lalita Bharadwaj[3], Audrey Brass[4]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Departement of Sociology, University of Manitoba, Winnipeg, MB
[3]School of public Health, University of Saskatchewan, Saskatoon, SK
[4]Community Researcher, Pine Creek First Nation

12:00pm Lunch

GENERAL SESSION: NUTRIENT MANAGMENT

Chairperson: Mayowa Adelekun
CCA CEUs: 2.0 Nutrient Management

1:00pm **4R Potassium Management for Soybean Production in Manitoba – Is it A-OK?**
Megan Bourns*[1], Don Flaten[1], John Heard[2] and Greg Bartley[3]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Manitoba Agriculture, Carman, MB
[3]Manitoba Pulse and Soybean Growers, Carman MB

1:20pm **Partial Life-Cycle Analysis of Greenhouse Gas Emissions Comparing Two Long-Term Crop Rotations**
Brian Amiro, Mario Tenuta and Xiaopeng Gao
Department of Soil Science, University of Manitoba, Winnipeg, MB

1:40pm **Corn Hybrid Response to In-Furrow Starter Fertilizer**
Dickson Tran[1],[2]* Don Flaten[2], Paul Bullock[2], Anita Brûlè-Babel[3]
[1]Bayer Crop Science, Headingley, MB
[2]Deptartment of Soil Science, University of Manitoba, Winnipeg, MB
[3]Deptartment of Plant Science, University of Manitoba, Winnipeg, MB

2:00pm **Soybean Soil Fertility in North Central and Northwestern North Dakota**
Chris L. Augustin[1] and David R. Franzen[2]
[1]North Central Research Extension Center, North Dakota State University, Minot, ND
[2]Soil Science Department, North Dakota State University, Fargo, ND

2:20pm Nutrition Break and Poster Session
Authors must be present at their posters according to the schedule listed under poster abstracts section of the program

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2:50pm **Big Data, insights into the variability of canola yield due to fertilizer management, historical yield, soil properties, and terrain attributes**
Alan Moulin and Mohammad Khakbazan
Agriculture and Agri-Food Canada, Brandon, MB

3:10pm **The Impact of DCD and NBPT Concentration on Nitrification and Volatilization**
Rigas Karamanos[1], Chris Holzapfel[2], Bryan Nybo[3], Dick Puurveen[4] and Steve Shirtliffe[5]
[1]Koch Fertilizer Canada, ULC
[2]Indian Head Agricultural Research Association, Indian Head, SK

[3]*Wheatland Conservation Area, Swift Current, SK*
[4]*University of Alberta, Edmonton, AB*
[5]*University of Saskatchewan, Saskatoon, SK*

3:30pm **Using Sediment Properties and Hydrodynamic Behaviour of Lake Winnipeg to Identify Zones for their Potential for Sediment Resuspension**
Masoud Goharrokhi[1], David Lobb[1], Greg McCullough[1], Phil Owens[2], Shawn Clark[1]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*University of Northern British Columbia, Prince George, BC*

3:50pm **Above Ground Residue-Induced Nitrous Oxide (N_2O) Emissions in a Fertilized Spring Wheat Crop in Manitoba**
Mike Runzika* and Mario Tenuta
Department of Soil Science, University of Manitoba, Winnipeg, MB

4:10pm End of Day 1

Friday, February 8, 2019

8:00 am Registration and Continental Breakfast

GENERAL SESSION: SOIL PHYSICAL PROPERTIES AND REMEDIATION

Chairperson: Kristy Anderson
CCA CEUs: 2.0 Soil & Water Management

8:30am **Effectiveness of Gypsum and Alum in Reducing P Release from Soils under Simulated Spring Snowmelt Flooded Conditions**
Chamara Weerasekara[1]*, Wole Akinremi[1] and Darshani Kumaragamage[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Environmental Studies & Sciences, University of Winnipeg, Winnipeg, MB

8:50am **Effect of Biochar Rates on the Sorption and Desorption of Organic Chemical Compounds in Soils**
Fahad Khan*, Annemieke Farenhorst and Sirajum Munira
Department of Soil Science, University of Manitoba, Winnipeg, MB

9:10am **Uptake of ^{14}C labelled Antibiotics from a Hydroponic Solution**
Theresa Adesanya*, Francis Zvomuya, and Annemieke Farenhorst
Department of Soil Science, University of Manitoba, Winnipeg, MB

9:30am **Phenoxy Herbicides' Interactions with River Bottom Sediments**
Mauli Gamhewage[1]*, Annemieke Farenhorst[1], Claudia Sheedy[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Agriculture and Agri-Food Canada, Lethbridge, AB

9:50am Nutrition Break and Poster Session
Authors must be present at their posters according to the schedule listed under poster abstracts section of the program

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10:20am **Spectroscopic Characterizations of Carbon Functional Groups of Biochars**
Sirajum Munira[1], Fahad Khan[1], Theresa Adesanya[1], Mofizul Islam[2], Jay J. Dynes[3], Tom Z. Regier[3], and Annemieke Farenhorst[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Civil Engineering, University of Manitoba, Winnipeg, MB
[3]Canadian Light Source, University of Saskatchewan, Saskatoon, SK

10:40am **Super Absorbent Polymer effects on Soil Physical Properties as Functions of Application Rate and Soil Texture**
Megan Ostrand*, Thomas DeSutter, and Aaron Daigh
Department of Soil Science, North Dakota State University, Fargo, ND

11:00am **Using Soil Morphological Characteristics to Design Onsite Wastewater Management Systems**
Derek Smith
Manitoba Sustainable Development, Environmental Approvals Branch

11:20am MSSS Business Meeting

12:00pm Lunch

GENERAL SESSION: SOIL PRODUCTIVITY

Chairperson: Chamara Weerasekara
CCA CEUs: 1.0 Soil & Water Management

1:00pm **The Dynamics of Crop Production and Value at Nationwide and Provincial levels (1961-2016): Toward Modeling the Cost of Soil Erosion to Food Production in Canada**
Nasem Badreldin[1,2] and David Lobb[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Plant Agriculture, University of Guelph, Guelph, ON

1:20pm **Distribution and Characteristics of Aeolian Deposition in Road-Side Ditches in the Boyne-Morris and La Salle River Watersheds, Manitoba**
Brendan Brooks and David Lobb
Department of Soil Science, University of Manitoba, Winnipeg, MB

1:40pm **Beyond salt chemistry: how the whole soil-plant-insect system responds to salinity and what it means for crop production and management**
Caley Gasch[1], Jason Harmon[2], Tom DeSutter[1], Abbey Wick[1]
[1]Department of Soil Science, North Dakota State University, Fargo, ND
[2]Department of Entomology, North Dakota State University, Fargo, ND

2:00pm **Micromorphology investigations to improve soils understanding**
David Hopkins[1] Anne Dieter[2] Trent Olson[2], Lydia Tackett[2], and Aaron Daigh[1]
[1]Department of Soil Science, North Dakota State University, Fargo, ND
[2]Department of Geosciences, North Dakota State University, Fargo, ND

2:20pm Presentation of Awards and Passing of the Shovel

2:40pm End of Day 2

POSTER PRESENTATIONS

Thursday, February 7, 2019 | 10:00-10:30am

Interdisciplinary Capstone: The Fargo/Moorhead Diversion Project

Nicholas Birkhimer*, Christina Hargiss
School of Natural Resource Sciences, North Dakota State University, Fargo, ND

At North Dakota State University, undergraduate students in the School of Natural Resource Sciences participate in an interdisciplinary capstone class as their culminating graduation experience. Students from the Range Science, Natural Resources Management, and Soil Science majors collaborate in teams of five to six members to work on a complex real world natural resources issue. The spring 2018 capstone course had students look at the proposed Fargo-Moorhead Diversion. The assignment was to have students assess the current FM Diversion design, using it as a base model, and adding additional projects either within the diversion or within one-half mile on either side of the diversion to enhance the design and make it useable beyond simply a diversion channel. Student projects were designed to either make the diversion itself function better or to manage and add functionality to the area surrounding the diversion. Students were divided into three groups, with each group being assigned a 10 mile section of the diversion project to work on. The final products were presented to representatives working on the FM Diversion to ultimately be considered for the project. During the course of preparing these projects, students combined knowledge and experiences from their varied undergraduate experiences to prepare diverse designs and plans that students from the same background would not have been able to prepare. Drawing on knowledge of native prairie grasses, soil types, and environmental permitting, just to name a few, allowed teams to collaborate and create feasible projects that significantly add to the diversion project as a whole.

Nitrogen Management Strategies for Modern Corn Hybrids in Manitoba

Lanny Gardiner[1]*, Don Flaten[1], John Heard[2], Mario Tenuta[1] and Yvonne Lawley[3]
[1] Department of Soil Science, University of Manitoba, Winnipeg, MB
[2] Manitoba Agriculture, Carman, MB
[3]Department of Plant Science, University of Manitoba, Winnipeg, MB

Genetic improvements, rising input costs, advancements in technology, and environmental concerns have pushed for the further development of beneficial management practices for nitrogen (N) fertilization. As with most crops in Manitoba, corn has a large requirement for nitrogen, meaning that suboptimal rates will reduce yield. However, excessive application rates are an unnecessary expense for farmers and present risks to the environment. With corn acreage and yields in Manitoba increasing, overall, this research project is targeted towards issues such as appropriate rates of N application at planting through to the use of enhanced efficiency fertilizers or split applications per crop. By conducting two years of replicated small plot research at multiple sites across the province, the project will determine the most appropriate rate of total N supply (from soil and fertilizer) per bushel of grain yield, the most reliable combinations of timing, placement and N source, and the most effective tools to measure in-season N plant status. Results of the first year of trials at 9 sites are still being processed. However, effects of N source, rate, placement and timing on grain yield from the 2018 growing season will be presented.

4R Potassium Management for Soybean Production in Manitoba – Soil and Plant Tissue Response

Megan Bourns[1*], Don Flaten[1], John Heard[2] and Greg Bartley[3]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Manitoba Agriculture, Carman, MB
[3]Manitoba Pulse and Soybean Growers, Carman, MB

In response to expanding soybean production, increased incidence of soybean potassium deficiency symptoms, and a lack of comprehensive historical potassium fertility research for soybean in Manitoba, a two-year study was established to determine soybean response to potassium fertilizer. Conducted in 2017 and 2018, the project investigated both the frequency of yield response to added potassium fertilizer across a range of soil test potassium levels, and the effectiveness of different combinations of potassium fertilizer rates and placements to increase soybean seed yield (30 or 60 lb K_2O/ac sidebanded, and 30, 60 or 120 lb K_2O/ac broadcast and incorporated).

In addition to seed yield at maturity, data collection included spring ammonium acetate exchangeable soil test potassium analyzed on a moist and dry basis, whole plant, uppermost mature trifoliate leaves and stem tissue samples for potassium concentration determination. Potassium concentration of the seed, oil and protein content were also measured. Detailed information on these results will be presented, to complement the oral presentation, "4R Potassium Management for Soybean Production in Manitoba – Is it A-OK" focused largely on yield results from the study.

Preliminary Results of the 2017 Manitoba Soybean Cyst Nematode Survey.

Nazanin Ghavami[1]*, Mario Tenuta[1] and Dennis Lange[2]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*Manitoba Agriculture, Food and Rural Development, Altona, MB*

Soybean Cyst Nematode (SCN), Heterodera glycines Ichinohe, is one of the most devastating disease/pest organisms of soybean worldwide. The nematode is found in all the major soybean growing regions of the world, including Ontario and Quebec in Canada. It is expected to soon be present in Manitoba as the pest has progressed northward in Minnesota and North Dakota to reach the Manitoba border. Early detection of SCN before it establishes in Manitoba is critical to limit yield losses. Therefore, the objective of this on-going study is to survey soybean fields in Manitoba for the presence of SCN. The project continues from surveys conducted from 2012 to 2015 that did not find the nematode. In the current study, 30 commercial soybean fields in Manitoba near the U.S. border with history of soybean and edible bean cultivation were sampled. Three soil samples were collected per field yielding a total of 90 composite samples. A modified Fenwick elutriator (soil washing unit) based on the USDA soil cyst extractor was used to recover nematode cysts. Overall, 17 of the composite samples from 12 fields had nematode cysts. One to a few cysts were recovered from each of these 17 composite samples. In total, 42 cysts were recovered and 23 of the cysts were brown and lemon-shaped as expected of SCN. Cysts that were intact were used for morphological and molecular identification. Three regions of the ribosomal DNA, that is, SCAR, D2/D3 and mitochondrial CoxIII were amplified with PCR using SCNFI-SCNRI, D2A-D3B and CoxIIIF1- CoxIIIR1 primers sets, respectively. PCR products of of DNA extracted from 10 lemon-shaped cysts with bifenestrate vulval cone (characteristics of the genus Heterodera) from 3 fields produced an expected band size of about 252 bp (CoxIIIF1- CoxIIIR1), 477 bp (SCNFI-SCNRI) and 800 bp (D2A-D3B), when visualized on agarose gel. DNA sequencing of multiple regions will be performed to confirm the results obtained from morphological identification and PCR assays. This will help us to answer the question, “is Manitoba still free of the soybean cyst nematode?”

Impact of Mycorrhiza inoculant on Potato productivity

Vikram Bisht and John Heard
Manitoba Agriculture, Carman, MB

Mycorrhizal fungi are known for symbiotically benefitting many host crops, aiding phosphorus uptake and increasing tolerance to moisture deficit stress. On potato crop also mycorrhizal fungi are reported to provide benefits. A commercially marketed endomycorrhiza product in liquid formulation (10,500 viable spores of Glomus intraradices per gram product) was tested in small plot for two years. The potato plots were fertilized at commercially recommended NPKS rates based on soil tests; and the crop was regularly irrigated with lateral pivots. In these trials, there was no significant difference between the untreated and the mycorrhiza treatment plots. There could be a few reasons for the lack of benefit from the mycorrhiza, including sufficient available P supply and soil-moisture to both treatments, and short duration of the crop. It has also been reported that G. intraradices when applied alone to potato, did not increase potato yield (Duffy & Cassells, Appl Soil Ecol 15:137-144).

Anticipating Soybean Response to Potassium Fertilization in Manitoba

Edgar Hammermeister[1] and Eric Bremer[2]
[1]Western Ag Professional Agronomy – LBP1 (SE Saskatchewan and Manitoba)
[2]Western Ag Innovations, Saskatoon, SK

Soybean production in Manitoba has expanded rapidly over the past two decades, with 20% of Manitoba's cropland seeded to soybean in 2017. Potassium (K) removal rates in harvested seed are almost four-fold that of wheat, raising concerns over long-term soil K fertility. To assess the impact of K on soybean yield, nineteen field-scale trials were conducted with farmer cooperators across southern Manitoba in 2017 and 2018 on fields expected to be deficient in K (<150 ppm extractable K). Potassium was either broadcast at 120 lb/ac or banded at 60 lb/ac in the form of potash. Four to six replicates were included for treated and control treatments. Supplemental site characterization was obtained for 14 of these sites using PRS® probe analysis and PRS CropCaster® crop modeling. PRS probes use ion exchange membranes to determine bio-available plant nutrients. The PRS CropCaster utilizes the nutrient supply rate data in a constrained resource model to estimate crop yields under varying growing season scenarios. Soybean yield was unresponsive to potassium fertilization at most locations, despite low extractable K (52 - 155 ppm). Only two fields had a significant yield increase due to K fertilization (10 and 13%). Ammonium acetate extractable K was not correlated with yield response. The PRS CropCaster did not anticipate K fertilizer benefit at 11 of 14 sites. Three sites were anticipated but only two realized. One additional site showed a response. The PRS Backcast® process indicated that low fertilizer yield response at two site-years may be due to in-effective (broadcasted) potash application (SK11 and SK14 in 2017). The below average growing season precipitation may have considerably influenced fertilizer response, particularly for broadcast application.

The Effects of Seed Potato Crop Moisture Management on the Following Year's Potato Crop

Lindsey Andronak and Alison Nelson
Agriculture and Agri-Food Canada, Canada-Manitoba Crop Diversification Centre, Carberry, MB

Growing conditions of a potato seed crop are known to affect the seed physiological age, and the performance of the seed in the following production crop. During seed production, soil moisture, which is affected by irrigation and precipitation, may play an important role on the subsequent performance of a processing potato crop. In 2015, 2016 and 2017, non-replicated plots of E3 Russet Burbank seed were planted at CMCDC-Carberry Onsite with different planting, harvest, moisture and storage treatments. The following years (2016, 2017 and 2018), the seed potatoes produced from these plots were planted at CMCDC-Carberry Offsite. These test plots were all treated the same to determine the impact of seed crop management on processing crop stand, emergence, yield and quality. This poster will focus on the irrigated and dryland seed crop treatments. Results from 2016 and 2017 test plots indicated that dryland seed had slightly lower total emergence (approximately 4% difference) compared to irrigated seed. Irrigated seed had significantly higher gross yield (588 cwt/ac) compared to dryland seed (578 cwt/ac), but had a higher percentage of total defects (6% vs 4%). Results from all three years will be combined, if statistically appropriate, and presented.

Proposed Changes to Provincial Soil Fertility Recommendations for Nitrogen and Phosphorus

John Heard
Manitoba Agriculture, Carman MB, Canada

As crop yield potential has increased, soil fertility recommendations have not kept pace with the additional nutrient removals in the crop, especially with phosphorus. Recent nitrogen research has been conducted on high yielding hard red spring wheat and needs to be incorporated in to current fertilization guidelines. Likewise, corn nitrogen studies are in progress.
This poster will contrast the existing fertilizer guidelines and proposed guidelines to be presented for adoption by the Manitoba Soil Fertility Advisory Committee.

Effects of preceding residue management practices on soybean production systems: Soil temperature and crop establishment

Aaron Glenn[1], Ramona Mohr[1], Craig Linde[2], and James Frey[3]
[1]Agriculture and Agri-Food Canada, Brandon, MB
[2]Canada-Manitoba Crop Diversification Centre, Carberry, MB
[3]Parkland Crop Diversification Centre, Roblin, MB

Post-harvest crop residue management practices impact the following growing season soil temperature (T_{SOIL}) which may influence soybean germination, emergence and early development rates. The effects of six residue management treatments were assessed at four sites across Manitoba (Brandon, Carberry, Portage, and Roblin) over three years to determine their impact on soil temperature and soybean establishment. Self-logging temperature sensors were installed 5 cm below the surface in treatment replicates at each site and recorded hourly T_{SOIL} readings. Plant counts were conducted periodically for several weeks after planting, from the first evidence of crop emergence until no further change in plant stand was detected, in order to assess the effect of residue management on early season crop development. Analysis of the hourly T_{SOIL} data indicated that the crop residue management treatments had a significant impact on soil thermal regimes for the majority of site-years. Cumulative soil degree hours greater than 10°C (i.e. the summation of positive values of hourly T_{SOIL}-10°C) for 30 days after planting (DAP) were significantly different between crop residue treatments for 9/12 site-years. Cumulative soil degree hours less than 10°C (i.e. the summation of negative values of hourly T_{SOIL}-10°C, a measure of the degree of cold soil exposure) for 30 DAP were significantly different between crop residue treatments for 5/12 site-years. Overall the soil warmed 16% faster after planting with prior tillage compared to treatments where cereal stubble was retained on the surface. Preceding tillage warmed the soil 3% faster (nominal but not significant) than direct-seeded treatments where preceding cereal residue had been removed post-harvest. The impact of retained canola residue on the subsequent growing season soil thermal environment was found to be more variable. The results from this study provide valuable information regarding the influence that different management practices may have on spring T_{SOIL} in Manitoba cropland.

Thursday, February 7, 2019 | 2:20-2:50pm

Soil Biological Temporal Variability as Functions of Physiochemical States and Soil Management

Zachery R. Leitner[1*], Aaron L.M. Daigh[1], Caley Gasch[1], Jodi DeJong-Hughes[2], and Abbey Wick[1]
[1]North Dakota State University, Fargo, ND
[2]University of Minnesota, Minneapolis, MN

Soil microbial communities and their activities are known to be sensitive to some land management shifts at relatively large time scales, such as years or decades. However, little evidence exists to elucidate if pronounced shifts or cyclical behaviors occur at small time scales, such as weeks or months, under natural weather-driven cyclical states. If such small scale dynamics exists, then the role of soil disturbance on exacerbating or moderating these dynamics is also unknown. In the North Central region of the US, cold soils impede on cropping systems. Therefore, farmers often use tillage to aerate and warm the soil for earlier planting and rapid germination. Although, intensive tillage practices can be detrimental to soil health and leave soils vulnerable to erosion. Therefore, an on-farm study was conducted to monitor small-scale temporal dynamics of the soil microbial community structure and activity, and elucidate if any observed small-scale shifts or cyclical patters were synced with small-scale physiochemical states and temporal patterns. The study was conducted with two tillage practices, a high disturbance (chisel plow) and low disturbance (rotated shallow vertical till and no till), using a randomized complete block design within the growing season of a northern corn-soybean-wheat rotation on a silty-clay vertisol near Mooreton, North Dakota. Phospholipid fatty acid analysis, nitrate reductase, ammonium oxidation, and beta glucosidase were used to determine soil microbial community structures and activity. Soil nutrients, temperature, moisture, and matric potentials were used along with physical state modeling in HYDRUS-1D to describe the physiochemical states. The microbial communities and activities and soil physiochemical states were analyzed for their temporal patterns using temporal autocorrelations and spectral densities. If cyclical temporal patterns were observed among multiple data, then their temporal relationships were described using cospectral and quadrature spectral densities. These data analyses and preliminary results will be presented.

Microbiological Parameters Impacting Drinking Water Quality in a First Nation Community.

Anita Murdock[1*], Sabrin Bashar[1], Ayush Kumar[1], Annemieke Farenhorst[2]
[1]*Department of Microbiology, University of Manitoba, Winnipeg, MB*
[2]*Department of Soil Science, University of Manitoba, Winnipeg, MB*

Currently, there more than 100 short- and long-term drinking water advisories (DWA) in effect for First Nation communities across Canada. Most DWA's are due to microbial contaminants. Many First Nations homes rely on cisterns (water-holding tanks) for home storage of drinking water. Some cisterns have previously been found to be contaminated with coliform bacteria and, in some cases, water samples also tested positive for antibiotic-resistant genes (ARG). We hypothesized that there would be variations in the amount of *E.coli* and total coliforms, as well as in the amount of ARGs, depending on the water distribution system whereby we compared the quality of tap water in homes with a piped versus a cistern water distribution. We also hypothesized that the amount of contamination would vary seasonally between winter and spring. Thus, in collaboration with the community's Chief and Council, this study collected water from various points along the water distribution system in two seasons, including from the source water, water treatment plant, water delivery trucks and taps in homes. Samples were analyzed for the presence of *E. coli* and total coliforms and for the presence of 7 ARGs using qPCR. The results showed more drinking water contamination in cement cisterns than plastic cisterns and with increased frequency in the spring than winter. Although water from piped homes and the water delivery trucks typically tested negative for coliform bacteria, ARGs were detected in these samples. Presence of these genes in drinking water supplies is concerning because ARGs can indicate the presence of bacteria that are difficult to treat with antibiotics, hence elevating the risk for infectious diseases of individuals exposed to these bacteria.

Effect of Land Rolling on Soybean Growth and Grain Yield

Ehsan Zarrinabadi* and David Lobb
Department of Soil Science, University of Manitoba, Winnipeg, MB

A better understanding of the effect of soil management practices on soybean production is essential for the growth of this commodity in Manitoba. Soybean production represents a substantial amount of crop production in the province, and is expected to continue expanding for the near future. Land rolling is a practice that is common in bean production and has become a more widespread soil finishing practice for soybean production. Little information is available about the impacts of land rolling on the performance of soybeans in Manitoba. Therefore, a field experiment was conducted on four soybean fields across the Red River Valley in 2018 to evaluate the response of soybean growth and yield to land rolling. Two treatments consisted of rolled and non-rolled plots. Before field harvest, 10 plants in five different locations for each plot were selected, and average plant height, number of pods per plant, plant density, above ground biomass, and seed yield were measured. Yield data indicated no significant differences between rolled and non-rolled plots.

Assessing the Environmental Impacts of Land Rolling on Soil Loss by Wind

Ehsan Zarrinabadi[1*], David Lobb[1] and Masoud Goharrokhi[1]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*

Soil erosion caused by wind is a major environmental issue that can result in land degradation and threatens crop production. Wind erosion significantly decreases soil fertility by blowing sources of nutrients and organic matter away that can bring about crop production loss, and contribute to air pollution through wind-blown soil particles and chemicals. The dynamics of wind erosion are caused by both natural processes and human activities. Climate, especially near-surface winds, can strongly affect the soil transport rate by displacing or removing the topsoil from the land surface. Human activities can affect wind erosion through changing surface conditions. Land rolling is a practice that is common in bean production, and it is growing in interest and use in Manitoba. The objective of this research was to assess the environmental concerns and effects of land rolling on the potential for wind erosion. The two treatments were rolled and non-rolled plots in soybean fields. In this study, unidirectional sediment traps used to collect wind-blown sediment moving over the soil surface. Particle size analysis and radiochemistry (^{137}Cs) measured on soil and sediment samples to assess the degree of preferential detachment and transport associated with wind erosion.

UAV Acquired Multispectral Imagery and Data Processing Workflow for Agricultural Applications

Matt Gervais, Paul Bullock, Mario Tenuta and Krista Hanis-Gervais
Department of Soil Science, University of Manitoba, Winnipeg, MB

Multispectral sensors are increasingly used as remote sensing tools for determining crop biomass, nutrient and disease status. While satellite and aircraft/UAV mounted sensors are constantly improving, it is important to develop the tools and techniques to process the acquired data. Over the last three crop seasons in southern Manitoba, we have developed a software stack to process and analyze multispectral imagery using a combination of Pix4D, ArcGIS and custom developed software. The software and processes have been specifically tailored for use in agricultural trial plot scaled applications. The limited range of quad-copter style UAVs are not a negative factor in plot scale work, while the high resolution offered by the low altitude flight capabilities make aerial imagery practical even for small plot sizes. Some of our most recent work has shown that vegetation indices using wavelengths within the “red edge” spectral wavelength region are more sensitive to differences and changes in crop morphology/physiology. These indices show good correlation with in-season plant biomass and nitrogen content, as well as harvest biomass and yield.

Effects of preceding residue management practices on soybean production systems: Yield and quality

Ramona Mohr[1], Aaron Glenn[1], Craig Linde[2], and James Frey[3]
[1]Agriculture and Agri-Food Canada, Brandon, MB,
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With the introduction of early-maturing soybean cultivars adapted to Manitoba conditions, the industry in this province has grown rapidly over the past decade. Despite this, soybean remains a cold sensitive crop, and current provincial recommendations suggest that soybean be planted when the average soil temperature is ≥10°C, with 18-22°C being ideal. Preceding residue management practices have the potential to alter soil temperature and moisture conditions early in the growing season and, as such, may affect the conditions that soybeans are exposed to during crop establishment. A series of field studies were conducted at four locations across Manitoba (Brandon, Carberry, Portage, Roblin) over four years to determine the effect of preceding crop residue management practices on soybean yield and quality. A randomized complete block design (RCBD) with four replicates was established, comprised of six residue management treatments: a control (wheat residue, tilled), and five stubble treatments (wheat with straw chopped and retained, wheat with straw removed, oat with straw chopped and retained, oat with straw removed, and canola with straw chopped and retained). Residue management frequently affected soil temperature and moisture at time of planting. Practices such as tillage, and straw removal in no-till stubble systems, were effective in increasing soil temperature at planting to varying degrees depending upon the site and year. Despite observed effects on soil temperature, residue management influenced soybean yield in only two of twelve site-years. Residue management also had limited effects on soybean seed quality factors such as seed weight, test weight, percent protein and percent oil. In part, because soybeans in this study were planted during or near to the recommended planting window for Manitoba, and soils at planting were greater than or equal to 15°C, the effects of residue management on the soybean crop may have been limited.

Soil Productivity Training and Fun: the Manitoba Summer Soils Tour

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The Manitoba Soil Science Society features a one-day summer bus tour to different areas of the province to view and study different soils and soil management practices. Attendees consist of graduate students in soils, summer students, extension agronomists and an increasing number of industry Certified Crop Advisers seeking Soil and Water Management credits.

In recent years we have developed a number of exercises to prompt knowledge in soil properties and appropriate production practices while we visit 2-3 farms and exposed soil profiles. The workbook is modelled after the US National Park Service Junior Ranger program that features activity based learning, including use of the web based soil survey to complete fill-in the blank soil descriptions, soil productivity assessment based on texture, structure, drainage and soil nutrient analysis, soil health assessment, soil suitability ratings, detailed soil horizon and landscape drawings, and an en route scavenger hunt of various ag industry, farm type and land uses. Evaluations have scored this learning as effective. Prizes from ag industry are awarded for participation during the homeward trek. Later host farmers receive a soil monolith dug and prepared from the soil pit.

Effect of Tillage Method, Plant Population and Soil Moisture Conditions on Canola Yield

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Many parts of the Canadian Prairies are experiencing extreme weather events that hamper the productivity of conventional cropping systems. In areas that receive excess precipitation and a lack of drying weather conditions, timeliness of operations for crop establishment, addition of inputs and harvest are often made during times of sub-optimal soil conditions for equipment traffic-ability. As a result, soil compaction is an outcome that negatively impacts soil health and reduces the long-term productivity on affected soils. In addition, there is a trend towards lowering seeding rates for canola but the presence of excess soil moisture or soil compaction may further reduce yields, as fewer individual plants may not be able to branch and thus compensate to the same degree.

Since nearly every commercial field in western Canada will have some portion impacted by increased equipment traffic, there should be merit in quantifying the impacts of soil compaction and soil moisture and linking this data with canola performance. By examining novel tillage practices, whose tillage depths range from approximately 2 inches (5 cm) with shallow vertical tillage to 16 inches (40 cm) under deep tillage (subsoiling), as well as the inclusion of raised beds/controlled traffic concepts, we can provide an assessment that may have implications for precision farming systems and alternatives to surface/tile drainage.

In 2018, this project compared the performance of L252 canola and soil penetrometer measurements to 18 inches (45 cm) at two separate sites at AAFC-Portage, both on imperfectly-drained clay loam soil. One site was newly established, while the second site was established in 2017 using flax as the indicator crop. Four plant populations were established in four tillage treatments and two moisture regimes (rain-fed and aggressively irrigated) to determine how to manage canola stands under compacted/excess moisture conditions for best performance.

Achieving Soil Health Objectives with PRS® Technology and Models

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Adoption of management practices for improving soil health is encouraged by tools that integrate knowledge in a way that allows crop producers to easily learn and evaluate how the management practice helps to achieve on-farm soil goals. Important objectives to agricultural producers related to soil health are profitable production, efficient use of nutrients, negligible risk of soil erosion and increased soil organic matter. We utilized measurements of soil nutrient supply using the Plant Root Simulator (PRS®) probe technology (sensitive to biological, chemical and physical soil properties) coupled with a decision support tool (PRS CropCaster®) to deliver nutrient management outcomes that were relevant and testable for agricultural producers. The approach was evaluated using soil measurements and wheat yields determined on plots varying in crop rotation and fertility management during the previous 24 years. Forecasted wheat yields and nitrogen use efficiency showed benefits from prior pulse crops and compost application and were validated by subsequent field measurements. The PRS probe technology and forecasting model approach has considerable potential to increase adoption of profitable soil health management practices.

Quantitative Real-time PCR-based assessment of *Campylobacter coli* and *Campylobacter jejuni* in Drinking Water of First Nation Community

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Access to safe drinking water is basic human right and crucial to health. *Campylobacter* causing infection is a leading cause of food-borne illness in western countries and there are several incidences of *Campylobacter* associated food-borne illness in Manitoba. To our knowledge, there is no report regarding the detection of Campylobacter *sp.* in drinking water of First Nation community in Manitoba. Thus, the focus of our study was to assess the load of *Campylobacter coli* and *C. jejuni* in drinking water of First Nation communities in Manitoba with seasonal variation. In collaboration with the community's Chief and Council, this study collected water from various points along the water distribution system in two seasons, including from the source water, water treatment plant, water delivery trucks, direct lined piped water in homes and water storing cisterns (made of plastic and cement) in homes. To analyze the water samples, DNAs were directly collected from isolated samples and quantitative real-time based PCR was performed to quantify the load of *C. coli* and *C. jejuni* in 100ml of water. The results showed more drinking water contamination in cement cisterns than plastic cisterns and with increased frequency in the spring than winter. As Water Treatment plant and water delivery trucks are cleaned in standard guideline with regular time interval, we didn't expect *Campylobacter* causing contamination. To our surprise, high amount of *Campylobacter coli* has been observed in one water delivery truck (~200 cells/100ml of water) and water treatment plant (~250 cells/100ml of water) during winter and spring, respectively. However, *C. jejuni* has also been observed in one piped home (~230 cells/ml) during spring. This result indicates that necessary steps need to be taken to remove this contamination for public health concern and more analysis is needed to find out the source of contamination.

Urban Soil Taxonomy as it Relates to a Recreational Stormwater Detention Basin

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Urban soils are soils that have been extensively altered through human activities and are unlike their natural counterparts. Currently, there is either minimal or non-existent knowledge on urban soil survey, taxonomy, and characteristics. However, with over 80% of the North America's population living within urban areas, there is a great need for urban soil data. As of 2005, 0.9% of North America was classified as developed land. This relatively low number has great impacts on human health and environmental quality due to its close proximity to the population. Currently, the rate of urbanization for North America is estimated to increase 0.98% between 2015 and 2020. Due to the rapid increase of urbanization and a majority of the population living in these areas, urban soil taxonomy is essential. The objectives of this study were to determine the urban soil taxonomy in an urban, recreational stormwater detention basin within the city of Fargo, ND. Soil cores were obtained inside and outside the basin and described using traditional US soil survey field and laboratory methods and compared to their corresponding taxonomy based on Drs. John Galbraith (Virginia Tech.) and Richard Shaw's (New Jersey State Soil Scientist) urban soil taxonomy proposal. Understanding urban soil taxonomy will give insight for how recreational, stormwater detention basins impact taxonomy in the future and allow for the improvement of urban soil taxonomy.

Host Preference of *Pratylenchus neglectus* to Major Crops Grown in the Prairie Provinces of Canada

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Root lesion nematodes of the genus Pratylenchus Filipjev, 1936 are parasites of economic importance worldwide. Pratylenchus neglectus has recently been identified in the Canadian Prairies and there was an urgent need to determine the hosts preferred by the nematode. In the first study, seven pulse and non-pulse crops (canola, chickpea, lentil, pinto bean, soybean, spring wheat and yellow pea) were screened as hosts for P. neglectus under growth chamber conditions. Host statuses of crops were assessed using the reproductive factor (Rf: final/ initial density) and plant growth parameters (plant height, above and below-ground biomass) were also measured. The suitable hosts for P. neglectus (Rf >1) were canola, chickpea, pinto bean and soybean. The nematode reproduced best on soybean followed by chickpea. Brown lesions were observed on chickpea roots. Lentil was a poor host and yellow pea was a non-host for P. neglectus. P. neglectus populations declined at absence of host in pots without crops (control). In another study, we investigated the effects of selected crops on final population densities of P. neglectus when grown repeatedly in subsequent cycles. Nematode population densities increased in soybean (Rf = 3.7), chickpea (Rf = 2.7), canola (Rf = 1.9), spring wheat (Rf = 2.0) and pinto bean (Rf = 1.8) pots. Lentil was a poor host (Rf = 0.5) and yellow pea inhibited both survival and reproduction of the nematode (Rf < 0.1). Plant growth was not implicated by the nematode. Nematode species identification was performed using morphometrics, PCR with species-specific primers and sequencing of the ribosomal DNA. Growers can include yellow pea as a break crop in their rotational systems to reduce populations of P. neglectus. More work needs to be done to assess the host statuses and performances of different crop cultivars being grown Canada.

Identification of Erosional Features in Wetlands using Digital Terrain Analysis

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Within the predominantly agricultural Broughton's Creek Watershed, small topographic depressions referred as potholes have been subject to numerous erosional landscape processes since breaking the prairies. These processes include: (1) wind erosion, where sediments from the cultivated field are deposited in the wetland area; (2) water erosion, where agricultural runoff concentrates along flow paths; and (3) tillage erosion, where agricultural activities displace soil into the vegetated boundary. Each erosional process generates different types of depositional land surface features, and may potentially be detected by digital elevation models and/or remote sensing techniques. A LiDAR dataset, paired with satellite imagery and aerial photography interpretation, was used to choose intact, natural wetlands likely to experience wind, water and tillage erosion based on land surface characteristics. Important land surface characteristics, for each type of erosion, included land cover and use for wind erosion, inflow and outflow presence for water erosion, and slope for tillage erosion. Field visits were then conducted to confirm DEM outputs. It was found that water and wind erosion depositional landforms were difficult to detect in the terrain analysis and in field, due to their gradual, gentle slopes. Tillage erosion depositional landforms, such as tillage steps or ridges, were much easier to locate due to their significant elevation differences and steeper slopes. It was concluded that digital terrain analysis can be a powerful tool to understand erosional landscape processes, in turn, will inform appropriate restoration and/or agricultural management practices to adopt. While higher resolution elevation data or soil properties is required to further quantify land surface features, the methods used in this study accommodates exploratory investigations.

Quantifying Vegetation Water Content with Remote Sensing to Improve Satellite-based Estimates of Soil Moisture

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Remote sensing of soil moisture from satellites must take into consideration the overlying vegetation layer. Vegetation water content (VWC) affects the signals received by both passive and active microwave sensors on satellite platforms and a quantified value for VWC is an essential component of the algorithms that derive soil moisture content from their signals. However, agricultural regions have a large seasonal variation in crop biomass and VWC. Methods are required to quickly and accurately assess the changing VWC over agricultural areas in order to extract timely and reliable estimates of the moisture level in the underlying soil. The Soil Moisture Active-Passive Validation Experiment in 2016 (SMAPVEX16) provided an opportunity to assess the extent to which passive reflectance levels in optical and near-infrared wavelengths can accurately quantify vegetation water content. The water content of physical vegetation samples from several different crops (canola, corn, oats, wheat. soybean) in several different fields in the Carman-Elm Creek area were matched up with images of the same fields from a drone-mounted Micasense Red Edge 3 camera taken within 24 hours of the vegetation sampling. Seventy different vegetation indices that had been previously published in peer-reviewed literature were assessed. Among the ten indices most highly correlated to VWC (r^2 values from 0.88 to 0.89), nine used the red-edge wavelength and only 1 used the red wavelength. Five of the ten indices used the green wavelength. The index versus VWC relationship was crop independent. Mean reflectance values from 5, 10 and 20 m radii around each sample point were assessed independently but the radius of the reflectance sample made no difference in the r^2 values. The next step is to upscale the method using reflectance data in similar wavelengths available from the Sentinel-2 passive sensor.

Using Soil and Sediment Colour to Identify the Sources of Sediment in the LaSalle Watershed

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The La Salle River watershed is a primarily agricultural watershed located in southern Manitoba. There are concerns over declining water quality and accelerated soil and streambank erosion in this watershed. The development and targeting of cost-effective soil and water conservation practices within the watershed requires identifying the primary sources of sediment. However, the large spatial and temporal variability of watershed processes make the identification of sediment sources difficult. Sediment fingerprinting is a technique that is increasingly being used to provide information on the sources of sediment at the watershed scale. This technique uses natural soil and sediment properties as fingerprints (tracers) to link in-steam suspended sediment back to its origins. Furthermore, soil and sediment colour is increasingly being used as a fingerprint to identify the sources within sediment fingerprinting studies as it provides a rapid, inexpensive, and non-destructive method to characterize soil and sediment samples. Within the La Salle River watershed suspended sediments were sampled using paired time-integrated samplers fixed to the stream bed. Suspended sediment samples were collected at five locations at a range of spatial scales (headwaters through to the watershed outlet) between 2015 and 2018. The colour of the sediment samples was measured using spectral readings over a 350–2500 nm wavelength range using a spectroradiometer and these values were compared to those measured within field, riparian ditch and streambank source samples. Using this information, the relative contribution from each of the sediment sources to the in-stream suspended sediment can then be estimated.

Distribution and Characteristics of Animal Burrows Along Field Edges in the Boyne-Morris and La Salle River Watersheds, Manitoba

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The sedimentary processes active in road-side ditches are largely unexplored, with prior research focussing primarily on maintaining ditch geometry for the purpose of promoting hydrologic conductivity. Little attention has been paid to their role as intermediate conduits for eroded soil, as it makes its journey from field to stream. This is problematic in the Canadian Prairies, where the stream network consists overwhelmingly of road-side ditches. If one is to have a holistic understanding of sedimentary processes in such a landscape, it stands to reason ditch sedimentary processes should be understood.

Bioturbation by small burrowing mammals is a conspicuous erosional process in road-side ditches that is largely under-studied. A survey of such burrows was conducted in the Boyne-Morris and La Salle River watersheds in the fall of 2018 to better understand the characteristics of such features, their distribution throughout the prairie landscape, and their contribution to soil erosion as a whole. Transects were run across lengths of road that spanned clayey, fine loamy, coarse loamy, and sandy soils with counts recorded on a per mile basis. Dimensions were recorded for 44 burrows and bulk density measured for 16 to infer soil loss associated with each. On average, 28 kg of soil was lost per burrow with burrows being preferentially distributed in coarse loamy and sandy soils. In total 2200 and 1400 t yr^{-1} of soil was lost via burrowing in the road-side ditches of the Boyne-Morris and La Salle River watersheds respectively. To constrain these values, watershed sediment yields were calculated using integrated SoilERI values, cultivated area, and the assumption that 50% of cultivated land was actively eroding. The result was sediment yields of $1.2*10^6$ and $4.5*10^5$ t yr^{-1} for the Boyne-Morris and La Salle watersheds respectively. This suggests mammalian bioturbation can be deemed a minor sedimentary process in the watersheds.

Functional Genes Abundances Linked with Nitrous Oxide Emissions from Manure in A Drip-Irrigated Cotton Field in Arid Xinjiang of China

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Application of synthetic nitrogen (N) fertilizer and manure can increase nitrous oxide (N_2O) emissions from cropland. However, the linkage between N_2O emissions and the abundance of nitrifier and denitrifer genes in response to fertilizer and manure additions remains unclear. A field experiment was conducted in 2016 to investigate how fertilizer and manure additions affect the abundance of the *amoA* gene involved in nitrification, and *narG, nirS, nirK* and *nosZ* genes involved in denitrification. The study site was in the Xinjiang Uygur autonomous region in northwestern China which has an arid climate. Nitrous oxide emissions were monitored from trial plots planted to drip-irrigated cotton (*Gossypium hirsutum*). Treatments included plots not amended (Control), and plots amended with urea (Urea), animal manure (Manure) and a 50/50 mix of urea and manure (U+M). Manure were broadcast-incorporated into soil before seeding while urea was split-applied with drip irrigation (fertigation) over the growing season. Results showed the addition treatments did not affect Operational Taxonomic Unit (OTU) richness or Shannon diversity index. Nitrifying enzyme activities (NEA) were unaffected by the addition treatments, whereas denitrifying enzyme activities (DEA) were 39-59 times greater in manure (U+M and Manure) than non-manure amended (Control and Urea) treatments. Real-time quantitative PCR revealed that increased DEA with manure application was highly correlated (r=0.70-0.84, P<0.01) with increased abundance of nitrate reducer (*narG)* and denitrifies of *nirK* and *nosZ*. Increase in abundance of these functional genes were further correlated with soil NO_3^-, dissolved organic carbon, total C, total N and C:N ratio. Manure application also increased cumulative N_2O emissions and applied-N scaled emission factors, although emissions and emission factors were generally low in the drip irrigation system. In contrast with manure, urea application had no impact on abundances of nitrifier and denitrifier gene, DEA, NEA, and N_2O emissions, likely due to a limitation of C availability. These results demonstrated that enhanced N_2O emissions by manure application under drip-irrigated condition was due to increased denitrification involving functional genes of *narG*, *nirK* and *nosZ*.

ORAL PRESENTATION ABSTRACTS

Manure, the Gift that Keeps on Giving:
An Overview of the Long Term Manure and Crop Management Study at Glenlea

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The NCLE (National Centre for Livestock and the Environment) Long Term Manure and Crop Management Field Laboratory at the University of Manitoba's Glenlea Research Station was established in the fall of 2007. For the first eight years (Phase 1, from 2007 to 2015), treatments and measurements were focused on the availability and uptake of N and P from annual and intermittent applications of liquid pig manure, solid pig manure and solid dairy cattle manure compared to annual applications of synthetic fertilizer, in two long term crop rotations (annual crops and perennial grass forage). Generally, N availability from liquid pig manure was excellent and similar to that predicted by standard formulas used for manure management in Manitoba. However, N availability from solid manures was much less than predicted by those formulas, especially in perennial forage. As expected, annual applications of manure at rates calculated to meet crop N requirements resulted in substantial increases in soil test P.

For Phase 2 (from 2015 to 2017) the focus shifted to measuring the effects of long term applications of manure N on release of N from soil to crops, the effect of suspending manure application for several years on the drawdown of soil test P, and the availability of N and P from liquid and solid manures applied intermittently to cropland. During the two years after annual applications of manure were discontinued, treatments with a history of manure application out-yielded the treatments with a history of synthetic fertilizer application. The large amount of N mineralization in historically manured treatments resulted in no benefit of synthetic N fertilization for accelerating drawdown of soil test P. Effects of intermittent applications of manure in Phase 2 were generally similar to those for Phase 1, with liquid pig manure producing yields similar to those for synthetic fertilizer in both cropping systems. However, solid manures achieved yields similar to synthetic fertilizer only in the annual cropping system.

Beyond Salt Chemistry: How the Whole Soil-Plant-Insect System Responds to Salinity and What it Means for Crop Production and Management

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Soils in the Northern Great Plains can host high salt concentrations, resulting from geologic origin, and strongly tied to landscape climate and hydrology patterns. Salt concentrations in topsoil can be elevated with intensive management for row crop production, and salinity is a significant factor that limits cash crop production in the region. We know that high salt concentrations in topsoil directly impact plant productivity and crop yield. However, our field and greenhouse studies have also revealed that salinity alters additional ecosystem properties that challenge crop production. Specifically, soils within saline patches tend to have reduced structural development, higher water content, and elevated soil nutrient concentrations. Thus, salt-affected soils provide poor plant growing conditions and provide habitat for soil organisms that is physically and chemically different than nearby non-saline soils. These changes are associated with our observations of shifts in soil biological communities (broad taxonomic microbial groups and earthworms), and we are investigating how these saline soil communities participate in plant-soil feedbacks. Salinity causes additional changes aboveground, including helping herbivorous insect pests develop and maintain healthier populations on plant hosts (Zea mays and Glycine max) when grown in increasingly saline soils. Moreover, herbivorous pests like soybean aphids (Aphis glycines) prefer plants grown in highly-saline soils. Given that soil salinity occurs within a suite of soil conditions that influence soil function, and that plant salt stress can be exacerbated by insect pests, saline patches are a good candidate for zone soil management and targeted pest management. We expect that efforts to improve general soil health in saline soils will alleviate biotic and abiotic threats to crop production.

Super Absorbent Polymer effects on Soil Physical Properties as Functions of Application Rate and Soil Texture

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Super absorbent polymers (SAPs) are materials that can absorb significantly more water or aqueous solution than their mass. The nature and properties of SAPs make them a widely utilized material across many disciplines such as engineering, medicine and agriculture. The objectives of this study were to determine the physical effects of a SAP application rates across various five soil textures, namely water retention and liquid limits. To each texture, SAP application rates were 0, 0.4%, 0.8% and 2% by soil mass. For water retention, matric potentials of -0.1, -0.3, and -15 bar were used and for determining the liquid limits the table-top penetrometer method was used. Gravimetric water content increased with application rate across all soil textures with the increase being greatest in soils with higher sand concentrations. There was a 218% increase in water content for the Williams (Fine-loamy), and a 114% increase for the Fargo (Clay). Liquid limit study is in progress but preliminary results suggest that SAP application increases the water content at the liquid limit. Early trends have shown that as SAP application rate increases so does the water content of the liquid limit. Understanding the physical properties and SAP behavior will give us insight into potential field applications.

4R Potassium Management for Soybean Production in Manitoba – Is it A-OK?

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Soybean acres now occupy more than 25% of Manitoba's annual cropland. Coupled with this expansion in acres, soybeans remove potassium at a much higher rate than most other crops (1.1 – 1.4 lb K_2O/bu). These factors, along with increases in genetic yield potentials, likely explain the increase in incidence of soybean potassium deficiency symptoms in recent years. Despite the increase in acreage and the high demand for potassium from soybean crops, there has been little comprehensive historical research in the province.

In response to these challenges, two sets of potassium fertilizer rate and placement trials for soybean production in Manitoba were initiated: one set in small plot trials and one set in field scale, on-farm trials. The frequency of soybean yield response to added potassium fertilizer and the effectiveness of different potassium fertilizer rate and placement combinations to increase seed yield (30 or 60 lb K_2O/ac sidebanded, and 30, 60 or 120 lb K_2O/ac broadcast and incorporated) were investigated.

Results from the two-year study indicate that conventional soil testing using ammonium acetate exchangeable potassium may not be a reliable predictor of soybean yield response to added potassium fertilizer in Manitoba. There were no significant responses to added potassium fertilizer at any small plot site in 2017 or 2018, regardless of rate/placement combination and despite low background soil potassium levels (49 -117 ppm). Two of twenty on-farm trial sites responded statistically significantly to potassium fertilizer addition, one in each of 2017 and 2018, but the frequency of response across all sites was not as predicted by background ammonium acetate potassium levels (52 – 457 ppm). Additional measurements include Plant Root Simulator® (PRS) probe potassium supply rates, differences in potassium concentration of the soybean tissue midseason, potassium concentration, oil/protein content of the seed at harvest, and differences in soybean and barley responsiveness to potassium fertilizer addition.

Micromorphology Investigations to Improve Soils Understanding

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Micromorphology capacity has increased at North Dakota State University in terms of thin section production and quality since June, 2015. More importantly, digital image capture and analysis have improved significantly. Initial digitization was accomplished using a precision Zeiss confocal microscope with an attached camera. Since 2017, a digital scanner primarily used in histology research has been used for scanning thin sections and the quality is remarkable. Biotic features in the scanned thin sections reveal levels of physiologic complexity and morphologic patterns that cannot be appreciated outside of this micromorphologic milieu. Two graduate student case studies from a soil genesis course will be examined that have high potential to generate sets of thin sections that could help undergraduates appreciate the complexity of the living soil. This presentation will highlight both the technical journey of our research team and applications of thin section analysis for both teaching and research.

Partial Life-Cycle Analysis of Greenhouse Gas Emissions: Comparing Two Long-Term Crop Rotations

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An important question is whether a period of perennial crops can help decrease greenhouse gas emissions from agricultural production when included in a broader annual cropping system. Greenhouse gas exchange has been measured continuously at the Trace-Gas Manitoba Site near Glenlea since 2006. Two treatments were compared: one with a continuous annual crop rotation, and the other where 4 years of the rotation had a perennial (alfalfa/grass) crop. The net exchange of CO_2 and N_2O was measured as a half-hour mean over the 2006 to 2016 period using the flux-gradient micrometeorological technique. This technique measures the concentration difference between two vertical heights, and estimates the flux as the product of the difference and a transfer coefficient based on known relationships with measured atmospheric turbulence. The annual field exchange was based on summing the half-hour fluxes and converted to CO_2 equivalents for each gas. Greenhouse gas emissions from nitrogen fertilizer input manufacturing was calculated from industry averages. End use of products assumed full respiration as CO_2, but the alfalfa/grass crop was also fed to cattle to generate enteric methane. Nitrogen fertilizer manufacturing represented only about 2% of total emissions. N_2O (upward) and CO_2 (downward) field emissions were of the same magnitude. Harvested product end use represented the largest emissions. Over 11 years, the rotation with the 4 years of perennial crop was not significantly different from the continuous annual crop system, with a net emission of about 5 Mg CO_2 equivalents ha^{-1} y^{-1}. Large inter-annual variability because of environmental conditions, different crops, and management indicates that a long-term focus needs to be considered when comparing potential differential emissions from crop systems.

Corn Hybrid Response to In-Furrow Starter Fertilizer

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Results for the first and second year of a research project on hybrid response to starter fertilizer in Manitoba are presented. The objectives of the study are to evaluate starter fertilizer impacts on grain yield, plant growth and plant development of corn hybrids, both within and between relative maturity groups. In the first year, 8 Dekalb hybrids, with two treatments, a control (no SF) and one in-furrow treatment SF in the form of APP (10-34-0, 5 US gallons per acre) were planted at 4 locations. In the second year, the study focused specifically on hybrid response to starter phosphorus. The treatments for year 2 was 19.8 lbs P2O5 ac-1 in the form of APP and a control with no in-furrow fertilizer but 5.8 lbs N ac-1 in the form of UAN applied pre-emergence to equalize the N applied in APP. Preliminary results show that grain yield for only one of the hybrids, DKC 26-28, was significantly greater for treatments with starter fertilizer, compared to treatments without starter fertilizer over the entire 4 site years. None of the other hybrids responded consistently to starter fertilizer. These results represent only 4 site years of yield data total. Another 4 locations looking at both hybrid response to SF and hybrid response to starter P will be established in 2019.

Soybean Soil Fertility in North Central and Northwestern North Dakota

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Soybean (Glycine max L.) is a new cash crop for north central and northwestern North Dakota (ND) producers. Soils and climate in these new soybean areas differ from current fertilizer guidelines. North central and northwestern ND is more undulating, arid, cooler, and has differencing soil pH. A three year study to evaluate soybean best management practices was initiated in the spring of 2016 and concluded in 2018. Each year had two sites and twelve treatments. One site was acidic (pH < 6) and the other was alkaline (pH > 7.3). Both site treatments were: untreated check, inoculated with rhizobia (Bradyrhizobium japonicum L.), broadcast urea (55 kg ha-1), broadcast MAP (110 kg ha-1), In-furrow 10-34-0 (28 L ha-1), in-furrow 6-24-6 (28 L ha-1), foliar 9-18-9 (28 L ha-1) at V5 and R2, and foliar 9-18-9 (28 L ha-1) with sulfate (1.1 kg ha-1) at V5 and R2. The acidic site had two treatments of sugar beet (Beta vulgaris L.) waste lime (4,411 kg ha-1 and 8,821 kg ha-1). The alkaline site received treatments of iron ortho-ortho-EDDHA (28 L ha-1), and naked ortho-ortho-EDDHA (28 L ha-1). Treatments were to found to not affect soybean yield, protein, or oil content.

Big Data, Insights into the Variability of Canola Yield Due to Fertilizer Management, Historical Yield, Soil Properties, and Terrain Attributes

Alan Moulin and Mohammad Khakbazan
Agriculture and Agri-Food Canada, Brandon, MB

Canola production in the Canadian Prairies varies considerably within and between producer's fields. This study describes the variability of crop yield in producer's fields in the context of terrain attributes, and in relation to fertilizer rates in management zones determined from historical yield. Canola yield data were collected for 27 fields in Alberta, Saskatchewan and Manitoba Canada in 2014, 2015, 2016 and 2017. Statistical methods associated with big data analysis, such as gradient boosted tree analysis and artificial neural networks, were used in combination with variable importance analysis, to assess the variability or canola yield as affected by fertilizer management, historical yield, soil properties, and terrain attributes. Data were also assessed with analysis of variance and contrasts. Several terrain attributes accounted for a considerable proportion of canola yield, in combined analyses of all fields. Terrain attributes, such as elevation, accounted for more variability in canola yield, relative to management zones and fertilizer treatments. Analyses of management zones for fertilizer management of crop yield within zones had the best statistical fit when conducted with fields as a factor in statistical analyses. In analyses with fields included as a factor in the linear mixed model, significant differences were observed for canola production between historically low and high yielding zones, and in contrasts between the control with no N fertilizer and treatments with 50, 100 and 150 % of fertilizer applied based on soil test recommendations. The combination of big data methods and analysis of variance provided valuable information regarding the effects of management and environmental factors which influence canola yield.

Drinking Water Security in Manitoba First Nation Communities

Kristy Anderson[1*], Annemieke Farenhorst[1], Tracey Peter[2], Lalita Bharadwaj[3], Audrey Brass[4]
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[3]School of public Health, University of Saskatchewan, Saskatoon, SK
[4]Community Researcher, Pine Creek First Nation

In Canada, water is recognized as a human right and is protected as a public service under Canada's *Constitution Act* of 1982. Those living off reserve receive drinking water that is regulated by legally binding provincial regulations. The federal government developed the *Indian Act* in 1876, which gave the federal government authority to legislate the affairs of First Nations people and their lands. Reserve drinking water falls under the federal government's fiduciary responsibility as a result of the *Indian Act*. The federal government has yet to provide any legally binding regulations for water on reserve.

As December, 2018 there were 113 drinking water advisories in First Nations communities in Canada, not including those within the Saskatoon Tribal Council. Our research aims to quantify the level of water insecurity that First Nations families living on reserves are currently experiencing. Drinking water security is defined as having access to drinking water as described by the Human Right to Drinking Water.
We hypothesize that there will differences in drinking water security in First Nations communities between homes that have different methods of water distribution (eg. piped water, cistern water).

We distributed surveys in three different First Nations communities in Manitoba. Surveys were done door-to-door utilizing a questionnaire with both quantitative and qualitative questions. The results show some homes having unsafe, unacceptable, unaffordable, and inadequate amounts of clean safe water. 54.5% of homes have run out of water completely, and 33.7% of homes have had times where they do not have enough water to take care of their hygiene needs. Some families report that their children have been bullied from having unclean clothes at school due to the lack of water at home.

Research was done in collaboration with the community's Chief and Council, and it was approved by the University of Manitoba Ethics Board.

Spectroscopic Characterizations of Carbon Functional Groups of Biochars

Sirajum Munira[1], Fahad Khan[1], Theresa Adesanya[1], Mofizul Islam[2], Jay J. Dynes[3], Tom Z. Regier[3], and Annemieke Farenhorst[1]
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[2]Department of Civil Engineering, University of Manitoba, Winnipeg, MB
[3]Canadian Light Source, University of Saskatchewan, Saskatoon, SK

Biochar is defined as solid carbon-rich residues produced by the pyrolysis of biomass. Biochar in soil exerts potential agri-environmental benefits such as enhancing nutrient management, reducing contaminant movement to groundwater. Biochars are also considered potential tools for the removal of contaminants in water and wastewater treatment applications. Characterization of organic carbon (C) functional groups is important for understanding the interactions of chemicals with biochars, and hence biochar practical applications. The objective of this study was to characterize organic C functional groups of 15 biochars produced from different feedstocks and under a range of pyrolysis temperatures (400-1500^{o}C). Three techniques were used and compared for the information they generated: Synchrotron based X-ray Absorption Near-Edge Structure (XANES) spectroscopy, solid-state ^{13}C Nuclear Magnetic Resonance (NMR) spectroscopy and Attenuated Total Reflection-Fourier Transform Infrared (ATR-FTIR) spectroscopy. XANES and ATR-FTIR techniques were successful in characterizing the organic C functional groups in all biochars. However, NMR was not successful for some biochars possibly because of interferences induced by magnetic particles in these biochars. Both XANES and NMR demonstrated that aromatic C is often the dominant organic C functional groups in biochars. In estimating the relative proportions of organic C functional groups in biochars, deconvolution and integration techniques produced relatively similar results for NMR but less so for XANES. This suggests that further improvements to the deconvolution technique used in XANES is likely to strengthen confidence in the quantification of the relative proportions of organic C functional groups by this technique.

Monitoring Soil Water Content in Manitoba's Seasonally Frozen Soils

Timi Ojo
Manitoba Agriculture, Winnipeg, MB

The total soil water content of soils below 0°C contains unfrozen water and ice. As soil temperature decreases, the proportion of unfrozen water in a frozen soil decreases with corresponding increase in the proportion of ice. The Manitoba Agriculture Weather Program operates a network of 109 weather stations that provides near-real time weather information, including soil moisture monitoring. Each station has four sensors installed at 5, 20, 50 and 100 cm depths. The soil surface experiences diurnal freeze-thaw cycles in October/November, often completely frozen from December through early March and diurnal freeze-thaw cycles again in late March/April. However, the impacts of multiple freeze-thaw cycles on the sensor calibration is unknown. An experiment was conducted to test two soil moisture sensors- ML3 Theta Probe and Campbell Scientific CS565 in three different soil textures- sand, loam and heavy clay to determine the impact of freeze-thaw and wet-dry cycles on the calibration of each sensor. The preliminary results showed negligible impacts of the freeze-thaw cycle but wet-dry cycles had significant impact on the calibration, especially, in heavy clay soil.

Phenoxy Herbicides' Interactions with River Bottom Sediments

Mauli Gamhewage[1*], Annemieke Farenhorst[1], Claudia Sheedy[2]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*Agriculture and Agri-Food Canada, Lethbridge, AB*

The objective of this study was to examine the effects of sediment particle size distribution (PSD) and organic carbon (OC) content on the sorption and desorption of the auxin herbicides 2-methyl-4-chlorophenoxy acetic acid (MCPA) and 2,4-dichlorophenoxy acetic acid (2,4-D) by sediments, and to what extent the variations observed for environmental detections of MCPA and 2,4-D in these sediments could be explained by these measured laboratory parameters. Sixty surface bottom sediments samples ($15cm^3$) and water-column samples (1L) were collected from twelve sampling sites distributed across selected rivers in a Prairie province of Canada, with each site being sampled four to seven times during the summer 2016. Sediments with larger OC contents had relatively larger sorption and smaller desorption when their unimodal PSD had a narrow range (1 to 60µm), but relatively smaller sorption and larger desorption when their unimodal PSD had a broader range (1 to 1,000µm) thus coarser particle sizes. Sediments with smaller OC contents always had relatively smaller sorption and larger desorption. Neither MCPA nor 2,4-D concentrations detected in sediments were significantly correlated with sediment properties or their sorption-desorption characteristics. The water-column loadings of MCPA and 2,4-D, and not sediment characteristics, are the driving force for determining their concentrations in sediments. Relatively to 2,4-D, MCPA was more frequently detected in the sediments and in greater concentrations because the more frequent presence of MCPA in the water-column allowed for greater opportunities for MCPA to partition to sediments.

Uptake of ^{14}C labelled Antibiotics from a Hydroponic Solution

Theresa Adesanya[1*], Francis Zvomuya[1], and Annemieke Farenhorst[1]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, Manitoba*

Cattail and switchgrass can remove inorganic contaminants from soils and biosolids, but their role in the attenuation of organic contaminants, such as antibiotics, is poorly understood. Uptake by plants is one of the several mechanisms by which plant-assisted attenuation of antibiotics can be achieved. The objectives of this study were to (1) evaluate the uptake of ^{14}C labelled sulfamethoxazole and ciprofloxacin in a hydroponic system (2) determine the partitioning of these antibiotics between plant roots and aboveground biomass. A growth chamber study was conducted to evaluate the uptake of the two antibiotics at two environmentally relevant concentrations (5 and 10 $\mu g\ L^{-1}$). Plants were destructively sampled every 3-4 days during the 24-day growth period. Harvested plants were separated into roots and aboveground biomass and combusted using a PerkinElmer Model 307 Sample Oxidizer with the evolved $^{14}CO_2$ being trapped and quantified using a liquid scintillation counter. The amount of antibiotic taken up ($\mu g\ g^{-1}$) was calculated for each plant species and over time. Results on the kinetics of uptake, bioaccumulation and translocation factors of the two plants species will be presented and discussed. Overall, both cattail and switchgrass continued to accumulate sulfamethoxazole and ciprofloxacin over time, and antibiotics accumulation was greater in roots than in aboveground biomass.

Evapotranspiration Crop Coefficients for Canola in Manitoba

Tony Britton[1, 2*], Aaron Glenn[2], Sanjayan Satchithanantham[2], Clayton Jackson[2], Brian Amiro[1], Henry Wilson[2]
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The FAO-56 Penman-Monteith equation can be used to estimate evapotranspiration (ET) for an idealized reference vegetation (alfalfa or short grass) from common weather data, which can then be adjusted to represent a crop of interest using the appropriate crop coefficient (Kc) for different stages of development. Time-averaged Kc values were published in FAO-56 for canola but these coefficients may not represent modern varieties grown under Manitoba conditions. Comparisons between measured canola ET and reference ET were done at 3 sites in southern Manitoba (Carberry, Glenlea and Miami) in the 2018 growing season. The eddy-covariance micrometeorological method was used to measure ET directly and supporting meteorological parameters (air temperature, relative humidity, wind speed, and incoming solar radiation) were collected to estimate reference ET through the PM FAO-56 equation. Actual cumulative growing season ET measured at Carberry, Miami, and Glenlea was 337, 332, and 328 mm, respectively. Estimated cumulative growing season ET using the FAO-56 canola Kc values at the same three sites was 354, 408, and 326 mm, respectively. The FAO-56 Kc values of canola for initial, mid, and end of season development are 0.35, 1.15 and 0.35. Based on the ratio of measured ET to reference ET, Kc initial values were represented adequately by the FAO-56 values (0.33 to 0.53, n = 3), but the measured Kc mid-season values tended to be lower (0.95 to 0.98). The measured Kc values for end of season development varied between 0.27 to 0.72 for the 3 sites and reasons for these discrepancies will be discussed. These measured Kc values may be used to estimate canola ET on the eastern Canadian Prairies with greater confidence.

The Impact of DCD and NBPT Concentration on Nitrification and Volatilization

Rigas Karamanos[1], Chris Holzapfel[2], Bryan Nybo[3], Dick Puurveen[4] and Steve Shirtliffe[5]
[1]Koch Fertilizer Canada, ULC
[2]Indian Head Agricultural Research Association, Indian Head, SK
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[4]University of Alberta, Edmonton, AB
[5]University of Saskatchewan, Saskatoon, SK

Nitrification inhibitors are used in agriculture to slow the conversion of ammonium to nitrate by inhibiting ammonia monoxygenace (AMO), which is found within the *Nitrosomonas* bacteria. There are two ways to inhibit nitrification of the AMO enzyme, namely, (a) competitive inhibition: The inhibitor will compete to occupy AMO's active site; by blocking the active site, it slows the conversion of ammonium to nitrate preventing loss of nitrates, and, (b) non-competitive inhibition: The inhibitor can temporarily inactivate the AMO enzyme by altering the active site. Dicyandiamide (DCD) is a competitive inhibitor. The amount of DCD delivered by a product has a direct impact on how well a product will inhibit loss of nitrogen through nitrification. Research shows the concentration of DCD in the soil has a direct influence on the percent of nitrification. Higher concentrations of DCD equate to higher percentage of nitrification inhibition. The results of a two-year program that compares two products, one containing 8500 ppm and one 870ppm of DCD and approximately equal concentration of a volatilization inhibitor will be presented.

Effect of Biochar Rates on the Sorption and Desorption of Organic Chemical Compounds in Soils

Fahad Khan*, Annemieke Farenhorst and Sirajum Munira
Department of Soil Science, University of Manitoba, Winnipeg, MB

Biochars are carbon-rich porous materials typically produced under limited oxygen from a variety of different feedstocks exposed to pyrolysis temperatures ranging from 250 to 1500°C. Depending on the feedstock type and pyrolysis temperature, biochars can have vastly different physiochemical properties. We hypothesize that with the increase of biochar rates, sorption of organic chemical compounds in soils will increase, while desorption will decrease. The study design used three different biochars (Wood Ash 1, Wood Ash 2 and Corn Stover) that were individually mixed at 0, 0.05, 2, 4 and 8% rate (w/w) into a sandy clay loam soil rich in iron oxides (SCL-Fe_2O_3), and a clay loam soil rich in calcium carbonates (CL-$CaCO_3$). A series of batch equilibrium experiments were conducted to determine the amount of sulfamethazine (an antimicrobial), and the amount of glyphosate and 2,4-D (both herbicides) that was sorbed (%) and desorbed (%) in biochar amended soils. These compounds were applied at 1, 5, 10, 15, 20 and 40 mg/L concentrations. Results indicated that the response of biochar rates on chemical sorption and desorption was different for glyphosate than for the other two chemicals. Sorption of glyphosate decreased, and desorption increased with increasing biochar rates, and with increasing glyphosate concentrations in both soils. Sulfamethazine and 2,4-D showed the same trends for sorption and desorption. Wood Ash 1 significantly increased 2,4-D and sulfamethazine sorption, when applied at 0.05% and sorbed almost all the chemicals at 2, 4 and 8% rates in both soils possibly due to the high specific surface area and C/N ratio. In the case of desorption, the results were opposite to sorption results. For Wood Ash 2 sorption of both chemicals increases, and desorption decreases with the increase in the rate of Wood Ash 2 in both soils. Corn stover had almost no impact on the sorption of either chemical when different rates were applied but sometimes it caused desorption to decrease as its rate was increased. Therefore, we concluded that Wood Ash 1 has highest sorptive capability which can make sulfamethazine and 2,4-D completely immobile in soil. Sorption of all three chemicals were always found higher in SCL-Fe_2O_3 than CL-$CaCO_3$.

Effectiveness of Gypsum and Alum in Reducing P Release from Soils under Simulated Spring Snowmelt Flooded Conditions

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[2]Department of Environmental Studies and Sciences, University of Winnipeg, Winnipeg, MB

Phosphorous is a crucial nutrient in agricultural production systems. Enrichment of agricultural landscapes with P leads to globally significant environmental issues including eutrophication of surface waterbodies. Increased frequency and the intensity of spring floods in the Red River basin has contributed to increased P loadings to Lake Winnipeg. Chemical amendments are often used to reduce the release of environmental contaminants including P from the soils to waterbodies through mechanisms such as precipitation, ionic exchange, and surface complexation. However, knowledge on the effectiveness of these amendments in reducing soil P release to floodwater under spring flooded conditions is limited. Therefore, the objective of this study was to quantify and compare the effectiveness of gypsum (CaSO4) and alum (Al2(SO4)3) in reducing P release from soil to floodwater under simulated spring flooded conditions. Undisturbed soil columns collected from eight agricultural fields located in the Red River valley of Manitoba were used in this experiment. Two amendments were applied at the rate of 5000 kg ha-1, one week prior to the flooding. Unamended and amended soils were flooded with deionized water and incubated at 4 0C for eight weeks. Pore water and floodwater samples were collected on weekly basis and analyzed for dissolved reactive P (DRP) concentrations. Floodwater and pore water DRP concentrations varied among the soils. Both amendments were effective in reducing DRP concentrations in floodwater and pore water in most of the soils, while the decrease in DRP was often greater with alum than gypsum amendment. More information on concentrations of cations and anions in flood and porewater are being collected to describe the differences in the effectiveness and mechanisms of these two amendments in immobilizing P in these soils.

From a Trickle to a Gush – Provincial Tile Drainage Programming

M.D. Timmerman[1] and V. Doan[2]
[1]*Manitoba Agriculture, Carman, MB.*
[2] *Manitoba Agriculture, Steinbach, MB*

Soil plus water equals mud.
– Ancient childhood proverb

The Society's 2018 field expedition to the Interlake (periodically dubbed by locals as the Unilake) included a visit to a site west of Arborg where the crop production limitation of soil excess moisture is being managed both at and beneath the surface. As a follow-up, this update from the provinical agriculture ministry will further engage Society members on the vital role of soil science in water management in the Northern Great Plains Region. In the land of muddy waters, much has been learned and should be further shared.

In Manitoba, water management has played a major role in the establishment of urban and rural communities as well as a thriving agriculture industry. Drainage is expected to remain vital to maintaining the productivity of farms and the protection of rural and urban infrastructure. Effectively and sustainably managing drainage is a complex challenge that spans provincial and municipal governments, landowners, industries and the public.

To varying degrees, most agricultural soils must be artificially drained to optimize crop production. Historically, the most commonly used method to remove excess water from Manitoba fields has been surface drainage. Tile drainage is the proven sub-surface drainage practice of placing perforated pipes below ground level to remove excess water from the soil profile. While adopted on a modest number of acres to date in agri-Manitoba, this practice has become a subject of rising interest among growers, regulators and stakeholders.

Manitoba Agriculture's role is multi-faceted: 1) regulatory support (the STICK), 2) support for knowledge generation and lead in extension (the CHALKBOARD) and 3) offering of incentives for practice change (the CARROT). Developments pertaining to all three aspects will be addressed.

The Dynamics of Crop Production and Value at Nationwide and Provincial levels (1961-2016): Toward Modeling the Cost of Soil Erosion to Food Production in Canada

Nasem Badreldin[1,2] and David A. Lobb[1]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*Department of Plant Agriculture, University of Guelph, Guelph, ON*

Crop cultivation, yield, and crop values have been changed during the past 55 years in Canada. The spatiotemporal bigdata in agricultural sciences is the first step to an accurate comprehensive understanding of soil health development. Seeded areas in Canada have been increasing dramatically since 1961 from 23.5 million of hectares (ha) to about 37.5 million ha in the year 2016. The overall national summer-fallow areas have decreased -10.4 million ha between 1961 and 2016. Oilseeds, Pulses, and Cereals are the three major crop commodities in Canada. In 1961, the Cereals were the dominant crops in Canada with about 16.32 million ha (69.25%). 4.95% of the agricultural lands were seeded with Tam Hay, 1.25 million ha were seeded with Oilseed crops (5.43%), Potatoes (0.52%), and Pulses (0.23%). In the year 2016, Cereals has dropped about -30% to become 40.5% of the total seeded area in Canada. Oilseeds have increased + 24.7% to become 30.1% (11.3 million ha). 11.1% was seeded with Pulses (4.2 million ha). The year 1970 was the lowest recorded for the seeded areas by Cereals, which was obviously observed in the national scale, and the Oilseeds doubled its numbers from 7.85% in 1969 to become 14.03% in 1970. In 2016, Canola become the major seeded crop in the Oilseeds group with 74.5%, the Soybeans become 20.1%, and Flaxseeds 3.4%, which decreased -63% in the past 55 years. Wheat is the major crop Cereals. In 1961, 62.7% of seeded Cereals were Wheat, 21.2% for Oats, 13.7% Barley, 1.4% Rye, and about 1% Corn (grains). Bigdata in agriculture has the potential for several uses such as agricultural sustainability modeling, agricultural market sensitivity analysis, and commodity-based spatiotemporal dynamics.

Using Soil Morphological Characteristics to Design Onsite Wastewater Management Systems

Derek Smith
Manitoba Sustainable Development, Environmental Approvals Branch, Winnipeg, MB

Onsite wastewater management systems (OWMS) play an integral role in rural land development and must be properly designed to ensure adequate protection of the environment and public health. One of the most important factors influencing the design and performance of the soil treatment system is the long-term acceptance rate (LTAR) of the soil. The LTAR is defined as the volume of wastewater that can be continuously applied to a given area of soil per day and is dependent on the hydraulic and treatment capabilities of the soil and the impact of soil pore clogging on soil permeability. For decades, the percolation test has been used as the main tool for predicting the LTAR of the soil. However, this approach has caused widespread system malfunctions resulting in groundwater contamination, human illness and adverse impacts on aquatic ecosystems. As a result, an improved methodology has been developed that utilizes soil morphological characteristics to estimate the LTAR. Soil characteristics include soil texture, structure, consistence, and redoxomorphic features. This presentation will provide an overview of this improved methodology as well as its adoption into standards of practice and the training and education needed to support it.

Distribution and Characteristics of Aeolian Deposition in Road-Side Ditches in the Boyne-Morris and La Salle River Watersheds, Manitoba

Brendan Brooks and David Lobb
Department of Soil Science, University of Manitoba, Winnipeg, MB

Wind erosion is a widely recognized avenue of soil loss in the Canadian Prairies, with awareness of its significance spanning back to the founding of the Prairie Farm Rehabilitation Administration in 1935. Road-side ditches – which act as intermediate conduits for eroded soil – have the potential to entrain soil mobilized off bare fields by wind and, as a result of their abundance, can capture sediment across the breadth of a watershed. This can provide insight into when and where aeolian erosion of soil is active, as well as into how much soil is lost via wind erosion through a given sedimentary event.

Wind eroded soil was sampled from road-side ditches in the Boyne-Morris and La Salle River watersheds between 2015 and 2018 in the late winter and early spring. Late winter sampling was of dirty snow, colloquially known as "snirt", representing relatively continuous, annually observed erosion. Conversely, early spring sampling was in response to irregular, short duration dust storms; observed only in 2015 and 2018. Samples were collected from ditches that demonstrated the greatest degree of infilling and the distribution of infilled ditches was inferred through ditch clearing records kept by RMs. Sediment sheet mass was calculated on a per mile basis, with an average of $2.1*10^4$ and $1.4*10^4$ t yr^{-1} deposited as snirt and $1.9*10^5$ and $1.3*10^5$ t yr^{-1} by dust storms (when present) in the Boyne-Morris and La Salle River watersheds respectively. This compares with modeled yields of $8.0*10^5$ and $3.7*10^5$ t yr^{-1}, calculated using wind SoilERI values, cultivated area, and the assumption that 50% of cultivated land was actively eroding. This suggests a general overestimation by current wind erosion models in the Canadian Prairies.

Using Sediment Properties and Hydrodynamic Behaviour of Lake Winnipeg to Identify Zones for Their Potential for Sediment Resuspension

Masoud Goharrokhi[1], David Lobb[1], Greg McCullough[1], Phil Owens[2], Shawn Clark[1]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*University of Northern British Columbia, Prince George, BC*

The fate of nutrients and contaminants in lake systems is heavily dependent on the behaviour of the mineral component of sediment. The inflowing terrestrial sediment is highly episodic and the resuspension of lake bottom sediment is not spatially uniform. A good knowledge of the hydrodynamic behaviour as well as the properties of sediment is, therefore, a key factor for knowing the best place to collect samples representative of a lake, and assessing the effectiveness of sediment management strategies performed on the uplands of the watershed. In this study, surficial and suspended sediment samples from across Lake Winnipeg were collected during ice-free periods in 2016-2017. Fallout radionuclides (i.e., cesium-137 and excess lead-210) and a number of physical properties (i.e., water content, texture, color, and organic matter) of collected samples were obtained to investigate temporal and spatial variability of properties within the lake. Laboratory results were also interpreted to gain insight into the dominant sedimentary processes in different parts of the lake. Sediment property data and information on hydrodynamic processes were used to distinguish erosional, transportation, and accumulation zones of Lake Winnipeg. The influence of 2 Mile Channel operation on specific changes of surficial sediment properties is also highlighted.

Above Ground Residue-Induced Nitrous Oxide (N_2O) Emissions in a Fertilized Spring Wheat Crop in Manitoba

Mike Runzika* and Mario Tenuta
Department of Soil Science, University of Manitoba, Winnipeg, MB

Agroecosystems are dominant sources of anthropogenic nitrous oxide (N2O) emissions and they contribute significantly to N2O atmospheric loading. Fertilizer-induced N2O emissions has been studied extensively, but information on emissions from low C: N ratio crop residues such as, those of soybean is still unclear. This study was done to firstly, determine if above ground (AG) soybean residue-induced nitrous oxide (N2O) emissions are lower than previously predicted for Manitoba. Lastly, examine the contribution to N uptake of wheat from residues of a previous soybean crop. Here, a two-year rotation cycle field study was done; in the first-year soybean and spring wheat were isotopically-labeled with 15N to investigate the contribution of their AG residues to N2O emissions. Above ground residues were then moved within subplots after each crop harvest in a certain scheme which allowed the determination of the contribution of both below (BG) and AG residues to N2O emissions. In the spring of each second year, the entire trial was planted to spring wheat so that the contribution of labeled soybean and wheat residues to N2O emissions and N uptake may be determined. Similar residue-derived cumulative N2O emissions were found regardless of crop residue type in the first (0.10 and 0.11 kg N ha-1) and second (0.77 and 0.29 kg N ha-1) rotation cycles, for both soybean and wheat residues, respectively. In the first year, 0.17 and 0.20 % EFs (emission factor) were obtained, for soybean and wheat residues, respectively. Furthermore, similar (1.08 and 0.70) %EFs were also found despite of crop residue type in the second year, for soybean and wheat residues, respectively. Total N derived from AG residues by spring wheat were similar (6.29 and 4.07 kg N ha-1) in the first cycle and statistically different (13.69 and 5.82 kg N ha-1) in the second cycle, for soybean and wheat residues, respectively. The emission factors found in the first year were significantly less than the proposed IPCC emission factor of 1%, for both soybean and wheat residues. Conversely, in the second year, the %EFs were not different from the IPCC emission factor of 1%, for both residues. However, most of the emissions in the second year were during the freeze thaw period compared to the entire year. Therefore, basing with the second year of this study N2O EFs of soybean residues in Manitoba might not be different from the predicted 1% by the IPCC, however, most of the emissions in this year occurred during the freeze thaw period compared to the entire growing season. Nevertheless, if freeze thaw emissions are low as in the first year of this study, N2O EFs from soybean residues might be lower than the IPCC figure of 1%.

2019 MSSS BUSINESS MEETING AGENDA

February 8, 2019
11:10am
Holiday Inn Winnipeg South

1. Call to Order – Welcome & Introductions
2. Review meeting agenda
3. Approve meeting minutes from February 2, 2018

Old Business

4. President's Report
    a. 2018 AGM
    b. 2018 Summer Tour
    c. Soil Fertility Workshops
    d. New Website Launch
    e. 2019 Calendar
    f. 2019 Sponsors
5. Financial Statements
    a. Treasurer's Report
    b. Internal Auditor's Report
    c. Review and Approve Financial Statements

New Business

6. Election of Directors
    a. President-Elect
    b. Secretary
7. Appointment of Financial Review Committee
8. Approval of Actions of Directors
9. 2019 Summer Tour
10. 2020 Business Meeting

2018 MSSS BUSINESS MEETING MINUTES

February 2, 2018
10:45am
Holiday Inn Winnipeg South

In attendance:

MSSS Executive
Kevin Baron, President
Laryssa Stevenson, Vice President/President-Elect
John Heard, Past President
Christine Rawluk, Treasurer
Lindsey Andronak, Acting Secretary

MSSS Members

Marla Riekman	Jarrett Powers	Ruidong Mi	Thesesa Adesanya
Curtis Cavers	Sachelle Johnston	Sirajum Munira	Marufa Fatema
Chamara Acharige	Fahad Khan	Aaron Glenn	Kevin Johannesson
Geza Racz	Taras Lychuk	Kristy Anderson	John Fitzmaurice
Michelle Erb	Mayowe Adebeku	Rejean Picard	Manasah Mkhabela
Megan Bourns	Vitaly Golubev	Rotimi Ojo	Megan Westphal
Elaine Gauer	Ronggui Wu	Don Flaten	Mitch Timmerman
Jordan Karpinchick	Diane Smith	Ikechukwu Agomoh	Steve Crittenden
Olayinica Adamolekun	David Whetter	Clayton Jackson	Geethani Amarawansha
Brian Wiebe	Ikenna Mbakwe	Mauli Gamhewage	
Sheila Cook	Steve Sager	Alan Moulin	

1. Call to Order – Welcome and Introduction
Call to order at 10:45 am by Kevin Baron

2. Review Meeting Agenda
Kevin Baron added agenda items under President's report: b) Newdale provincial soil; f) technical training. Motion to accept the agenda by Elaine Gauer, seconded by Michelle Erb. **Carried.**

Old Business

3. Review 2017 Business Meeting Minutes
Rejean Picard moved to accept the 2017 AGM minutes as presented. Seconded by Diane Smith. **Carried.**

4. President's Report

a. 2017 AGM

We celebrated the MSSS 60th annual AGM at the evening banquet on February 2, 2017. The event was a great celebration. Curtis Cavers and Sheri Grift were recognized for their efforts in organizing the banquet activities and celebrations. Bob Eilers and Geza Racz were also recognized for their assistance at the banquet.

b. Newdale Provincial Soil

On June 7, 2017, members of MSSS including Elaine Gauer, John Heard, Bruce Delgarno and Curtis Cavers traveled to Newdale to participate in the unveiling of the Newdale provincial soil kiosk. Dignitaries in attendance included Ralph Eichler, Minister of Agriculture.

c. 2017 Summer Tour

Thanks were given to all who participated in the 2017 summer tour in August, which was organized by John Heard and toured through Portage and the surrounding area. Highlights of the tour were Connery vegetable farms carrot production, cover crop demonstrations, soil pits, phosphorus extraction processes and strip tillage at Toews farm. Host farmers will be presented with monoliths from their farms as thank you gifts.

d. 2018 Calendar

The 2018 calendar was put together by Laryssa Stevenson with a theme of Maintaining Soil Fertility in Manitoba. Due to popular demand, they were distributed at Ag Days.

e. Sponsors

We ask for annual sponsorship of the society, which supports all the activities of MSSS. We would like to officially thank the 2018 AGM sponsors:

- Ah Horizon: Agrium, Fertilizer Canada, Manitoba Institute of Agrologists, Manitoba Canola Growers, Koch Agronomic Services, Agrotain
- Bt Horizon: Tone Ag Consulting, AgriEarth Consulting Ltd., Manitoba Pulse & Soybean Growers
- Ck Horizon: AgVise Laboratories, Western Ag Innovations, Manitoba Oat Growers Association, Manitoba Forage & Grassland Association, ManFlax

It was also noted that MSSS has had more success approaching potential sponsors only once a year, instead of for individual events.

f. Technical Training

Another successful Soil Fertility course was put on by MSSS and MSSS is having a similar course in Portage for 2018. Curtis Cavers and Marla Riekman are looking to develop a Soil and Water Management course as well.

g. 2018 AGM

Thank you to the executive, grad students, speakers, growers and Holiday Inn staff for making this event a success. The Plenary Session was great.

5. Financial Statements

a. Treasurer's Report

See attached. Financial transactions related to the 2016 AGM and 2016 summer tour are included in the 2017 financial report due to delays in receiving payment for lump registrations for University of Manitoba and Manitoba Agriculture participants, plus one summer tour expense that was delayed in being processed. The 2017 AGM incurred a loss while the 2017 summer tour and soil fertility course each generated a net profit. General sponsorship for 2017 totalled $3,865.16. Partial income for 2018 sponsorships was received in 2017 ($2,753.12 of a total $7,500). There was a net positive change in funds in 2017. There were no questions about the report.

b. Internal Auditor's Report

Christine Rawluk reviewed the decision of the MSSS Financial Review Committee, comprised of Haben Asgedom, Lindsey Andronak and Manasah Mkhabela. The review committee reviewed the financial records for 2017 and they found the financial report to be an accurate statement of the financial transactions for the MSSS for 2017.

c. Review and Approve Financial Statements

Marla Riekman moved that the financial review of the Corporation for the fiscal period ending December 31, 2017 are hereby approved and adopted. Seconded by Brian Wiebe. **Carried.**

Rotimi Ojo moved that the financial statements of the Corporation for the fiscal period ending December 31, 2017 are hereby approved and adopted. Seconded by Marla Riekman. **Carried.**

New Business

6. Election of Directors

The outgoing past president, John Heard was recognized for his efforts on behalf of the society. The one position vacant for 2018 is President-Elect.

a. President-Elect

John Heard nominated Rotimi Ojo for President-Elect. Seconded by Kevin Baron. Rotimi accepted the nomination. No further nominations were received. Rotimi Ojo acclaimed as President-Elect.

Laryssa Stevenson moved that the individuals listed below be elected as director for a term to expire at the conclusion of the annual meeting of member held in the calendar year shown opposite their name:

Name	*Position*	*Calendar Year*
Rotimi Ojo	President-Elect	2021

Seconded by Christine Rawluk. **Carried.**

The hard work of all the graduate student volunteers providing AV and AGM assistance was recognized.

7. Appointment of Financial Review Committee

Christine Rawluk moved that the following volunteers: Lindsey Andronak, Manasah Mkhabela and Haben Asgedom; be appointed as a Committee of Members to review the financial statements of the Corporation prepared by the Board of Directors for presentation to the members at the annual meeting held in 2019 and to report their comments on such financial statements to such annual meeting. Seconded by Aaron Glenn. **Carried.**

8. Approval of Actions of Directors

Brian Wiebe moved that all acts, contracts, by-laws, proceedings, appointments, elections and payments enacted, made, done and taken by the directors and officers of the Corporation since the date of the last annual meeting of members (as the same are set out or referred to in the minutes of the meetings of the directors of the Corporation or the resolutions of the directors of the Corporation or in the financial statements submitted to this meeting) be and the same are hereby approved, sanctioned and confirmed. Seconded by Lindsey Andronak. **Carried.**

9. 2018 Summer Tour

The 2018 Summer Tour will likely be held the third Thursday of August. There is interest in touring the Interlake. Volunteers would be greatly appreciated.

10. **2019 MSSS Meeting**
    Tentative dates for the event will be February 7 and 8, 2019 (first Thursday and Friday of February), provided the Holiday Inn has availability.

11. **Other Business – MSSS Website**
    MSSS is still looking to update and streamline the website as well as archive materials

12. **Motion to Adjourn** 11:25 am by Don Flaten.

MANITOBA SOIL SCIENCE SOCIETY
Financial Report to the Annual General Meeting - 2019 Feb 8

		31-Dec-16	31-Dec-17	31-Dec-18
Cambrian Credit Union Accounts				
	Chequing	$ 31,465.65	36800.47	$ 26,758.85
	Savings	$ 1,648.82	1661.22	$ 11,753.34
	Share	$ 5.00	$ 5.00	$ 5.00
Cash		$ 9.56	$ 9.56	$ 9.56
	TOTAL	**$ 33,129.03**	**$ 38,476.25**	**$ 38,526.75**
	change		**$ 5,347.22**	**$ 50.50**

2018 Activity - Chequing Account

	Credit	Debit
2017 ST		$71.30
2018 Sponsorship	$5,115.95	
2018 Calendar		$1,358.26
2018 Website		$1,601.25
2018 Banking		$287.78
2018 Incorporation		$630.81
2018 Transfer to Savings		$10,000.00
2018 NDL	$380.00	
2018 AGM	$11,818.35	$16,239.87
2018 SFC	$8,125.00	$6,409.51
2018 ST	$3,420.00	$3,270.14
2019 Sponsorship	$1,200.00	
2019 Calendar		$1,017.00
2019 AGM	$185.00	
2019 SFC	$600.00	
TOTAL	**$ 30,844.30**	**$ 40,885.92**
net	**$ (10,041.62)**	

2018 Activity - Savings Account

	Credit	Debit
Transfer from Savings	$ 10,000.00	
Interest	$ 92.12	
TOTAL	**$ 10,092.12**	**$ -**
net	**$ 10,092.12**	

Summary of Account Activities

	Credit	Debit	Net
Chequing	**$ 30,844.30**	**$ 40,885.92**	**$ (10,041.62)**
Savings	**$ 10,092.12**	**$ -**	**$ 10,092.12**
TOTAL	**$ 40,936.42**	**$ 40,885.92**	**$ 50.50**

CONFERENCE EVALUATION

To assist with planning of upcoming MSSS events, we would appreciate your feedback and comments. Please rank each of the following on a scale of 1 (poor) to 5 (excellent).

Conference and Annual General Meeting	**Poor ----------Excellent**				
Location	1	2	3	4	5
Facilities (meeting room, food, parking etc.)	1	2	3	4	5
Timing (early February)	1	2	3	4	5
Notification (adequate notice; notice by email)	1	2	3	4	5
Program booklet	1	2	3	4	5
Registration fee	1	2	3	4	5
Poster Session	1	2	3	4	5
Business meeting (timing, format)	1	2	3	4	5
The following sessions:					
Plenary: Management impacts on soil functions and productivity	1	2	3	4	5
Water Monitoring and Management	1	2	3	4	5
Nutrient Management	1	2	3	4	5
Soil Physical Properties and Remediation	1	2	3	4	5
Soil Productivity	1	2	3	4	5

Should a special session, followed by panel discussion, be included next year? Y N
If yes - proposed topics for special session of the 2020 conference: _____
What is your preference for poster sessions? ___ during breaks ____dedicated session

Summer Tour

The MSSS typically holds a summer tour/workshop in late August. For 2019, please indicate:
Topics/regions of interest: _____
Preferred dates (if not late August): _____
1-day vs. 2-day tour: _____
Winnipeg, Brandon or Portage la Prairie starting point: _____

General Questions

Please indicate if you would like to participate in an MSSS Organizing Committee for one of the following events: __2019 Summer Field Tour __2020 Conference & AGM

Name: _____ Email address: _____
Affiliation: __Student __Faculty __ Government __Industry __Other:_____

Please submit at registration desk at the end of conference, or email to msss@umanitoba.ca
Please write any additional comments on the back of the page.