Manitoba Soil Science Society

63rd Annual Manitoba Soil Science Society Conference and Annual General Meeting

February 6-7, 2020

Holiday Inn South
1330 Pembina Highway
Winnipeg, MB

2019-2020 MSSS EXECUTIVE

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CONFERENCE PROGRAM

Thursday, February 6, 2020

7:30 am Registration and Continental Breakfast

8:25 am Conference Commences
Opening Remarks –Timi Ojo, MSSS President

PLENARY SESSION: SUSTAINING SOIL PRODUCTIVITY IN A CHANGING CLIMATE
Chairperson:
CCA CEUs:

8:30am Keynote Presentation: **Soil Conservation: Mitigation and Adaptation to Climate Change**
Caley Gasch
Department of Soil Science, North Dakota State University, Fargo, ND

9:15am Keynote Presentation: **Climate, Agriculture, and Soil: The Prairies in 2050**
Brian Amiro
Department of Soil Science, University of Manitoba, Winnipeg, MB

10:00am Nutrition Break and Poster Session

10:30am **Comparing Recent Weather Trends to Climate Normal in MB**
Timi Ojo
Manitoba Agriculture, Winnipeg, MB

GENERAL SESSION: SOIL-WATER MONITORING & MANAGEMENT
Chairperson:
CCA CEUs: 6.5

10:50am **Rye Water Use and Biomass Production in Response to Varying Salinity and Water Stress**
Alec A. Deschene* and Caley K. Gasch
Department of Soil Science, North Dakota State University, Fargo, ND

11:10am **Thermodynamic Modeling of Phosphorus Species in Amended Flooded Soils**
Chammi Attanayake[1,2], Saman Dharmakeerthi[1,2], Carolyn Gregory[3], Doug Goltz[3], Srimathie Indraratne[2] and Darshani Kumaragamage[2]
[1]Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka,
[2]Department of Environmental Studies and Sciences, The University of Winnipeg, Winnipeg, MB
[3]Department of Chemistry, The University of Winnipeg, Winnipeg, MB, Canada

11:30am **Plot Studies to Characterize the Interaction Effect between Water-induced Channel and Tillage Operation**
Fangzhou Zheng[1,2*], Sheng Li[2] and David Lobb[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, Manitoba, Canada.
[2]Agriculture and Agri-Food Canada, Fredericton Research Centre, Fredericton, New Brunswick, Canada

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12:00pm Lunch

1:00pm **Investigating Soil Sedimentary Processes in Cultivated Canadian Prairie Watersheds using Sediment Budgeting**
Brendan Brooks[1*], David Lobb[1], Alex Koiter[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Geography and Environment, University of Brandon, Brandon, Manitoba, Canada

1:20pm **Patterns of fallout radionuclide concentration distributions of suspended sediment in Hudson Bay**
Masoud Goharrokhi[1], David Lobb[1], and Phil Owens[1,2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Environment and Geography, University of Northern British Columbia, Prince George, BC

1:40pm **Sorption of a legacy and current-use pesticides by a range of constituents present in rivers: sediments, charcoal, ash and microplastics**
Marufa Fatema[1*], Annemieke Farenhorst[1], Claudia Sheedy[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Agriculture and Agri-Food Canada, Lethbridge Research Center, Lethbridge, AB

GENERAL SESSION: SOIL ECOLOGY AND PRODUCTIVITY
Chairperson:

2:00pm **Assessment of the agronomic and environmental impacts of land rolling in soybean production in Manitoba**
Ehsan Zarrinabadi[1*], David Lobb[1], Yvonne Lawly[2] and Alexander Koiter[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Plant Science, University of Manitoba, Winnipeg, MB

2:20pm Nutrition Break and Poster Session

2:50pm **Response of root biomass on pipeline disturbed cropland to difference cropping sequences in western North Dakota**

Nicholas Birkhimer[1], Thomas DeSutter[1], Jerry Bergman[2], Kevin Horsager[1], Kyle Dragseth[2], Meridith Ramsey[2], Cameron Wahlstrom[2]
[1]NDSU Department of Soil Science, Fargo, ND
[2]NDSU Williston Research Extension Center, Williston, ND

3:10pm **The Presence of Soybean Cyst Nematode in Manitoba**
Nazanin Ghavami[1*], Mario Tenuta[1], Dennis Lange[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Manitoba Agriculture, Food and Rural Development, Altona, MB

3:30pm **Effect of Salinity on Soil Microbial Community Structure**
Mackenzie Ries[1*], Caley Gasch[1], Jason Harmon[2]
[1]Department of Soil Science, North Dakota State University, Fargo, ND
[2]Department of Entomology, North Dakota State University, Fargo, ND

3:50pm End of Day 1

Friday, February 7, 2019

8:00 am Registration and Continental Breakfast

GENERAL SESSION: NUTRIENT MANAGEMENT

Chairperson:
CCA CEUs: 2

8:30am **Spring Options for Fertilizer Management following a Wet Fall**
John Heard[1] and Don Flaten[2]
[1]Manitoba Agriculture and Resource Development, Carman, MB
[2]Department of Soil Science, University of Manitoba, Winnipeg, MB

8:50am **Evaluation of Fall Versus Spring-Applied Enhanced Efficiency Nitrogen Fertilizers on Crop Nitrogen Use Efficiency**
Ahmed A. Lasisi[1*], Olalekan O. Akinremi[1], Qiang Zhang[2] and Darshani Kumaragamage[3]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Biosystem Engineering, University of Manitoba, Winnipeg, MB
[3]Department of Environmental Studies and Sciences, University of Winnipeg, MB

9:10am **Selecting Right Sources and Placement of Fertilizer N to Reduce N_2O emissions from Canola Production in Manitoba**
Xiaopeng Gao[1], Kevin Baron[2] and Mario Tenuta[1]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Solum Valley Biosciences, Winnipeg, MB

9:30am **Urea fertilizer source and placement effects on soil greenhouse gas fluxes from a loamy sand**
Aaron Glenn[1], Amal Roy[1,2], and Clayton Jackson[1]
[1]Brandon Research and Development Centre, Agriculture and Agri-Food Canada, Brandon, MB
[2]Resource Management, Crown-Indigenous Relations and Northern Affairs Canada, Iqaluit, NU

9:50am Nutrition Break and Poster Session

10:20am **Soil amendments for closing urban to rural nutrient cycles in organically managed systems**
Jessica Nicksy[1*], Brian Amiro[1] and Martin Entz[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Plant Science, University of Manitoba, Winnipeg, MB

10:40am **Productivity of alfalfa fertilized with struvite in low-P soils**
Joanne Thiessen Martens[1*], Francis Zvomuya[1] and Kim Schneider[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Department of Plant Agriculture, University of Guelph, Guelph, ON

11:00am **Soil science elements of a report on the Red River Basin / Cold Climate Ag Nutrients BMP**
Mitchell Timmerman etc
Manitoba Sustainable Development, Environmental Approvals Branch

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11:20am MSSS Business Meeting

12:00pm Lunch

GENERAL SESSION: SOIL PHYSICAL PROPERTIES AND REMEDIATION
Chairperson:

1:00pm **Constructing a biobed system for rinsate management in Manitoba**
Sarah Johnson[1*], Terrance Anseeuw[2], Evan Derdall[3], Jeanette Gaultier[4], Rob Gulden[5], Tammy Jones[6], Alvin Iverson[2], Claudia Sheedy[7], Tom Wolf[8] and Annemieke Farenhorst[1]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*Department of Plant Science, University of Manitoba, Carman, MB*
[3]*Agriculture and Agri-Food Canada, Saskatoon, SK*
[4]*BASF, Notre-Dame-de-Lourdes, MB*
[5]*Department of Plant Science, University of Manitoba, Winnipeg, MB*
[6]*Manitoba Agriculture, Winnipeg, MB*
[7]*Agriculture and Agri-Food Canada, Lethbridge, AB*
[8]*Agrimetrix Research and Training, Saskatoon, SK*

1:20pm **Dissipation of Sulfamethoxazole and Trimethoprim in a Wetland vs. Terrestrial System**
Theresa Adesanya[1*], Francis Zvomuya[1], Annemieke Farenhorst[1], Tamanna Sultana[2] and Chris Metcalfe[2]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*Water Quality Centre, Trent University, Peterborough, Ontario, Canada*

1:40pm **Research results from a five-year oil spill study: The secret hope of everyone!**
Tom DeSutter
Department of Soil Science, North Dakota State University, Fargo, ND

2:00pm **Natric Soils of North Dakota: Does characterization legacy data support our taxonomy?**
David Hopkins and Tom DeSutter
Department of Soil Science, North Dakota State University, Fargo, ND

2:20pm **Detailed Soil Survey for the RM of De Salaberry and its Application in Land Use Planning**
Megan Wespthal and Michelle Erb
Manitoba Agriculture and Resource Development, Manitoba, Canada

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2:40pm Presentation of Awards and Passing of the Shovel

3:00pm End of Day 2

POSTER PRESENTATIONS

4R Nitrogen Management Strategies for Corn Yield in Southwestern Manitoba

Kody Oleson*, Mario Tenuta, Lanny Gardiner, Brad Sparling, and Don Flaten
Department of Soil Science, University of Manitoba, Winnipeg, MB

Increases in corn (Zea mays L.) yields are dependent on nitrogen (N) fertilizer inputs. There is an increasing need and interest for more efficient use of N fertilizer applications to achieve high yields while reducing environmental losses of N. The 4R N management framework is a research and management approach for selection of the Right Source, Right Rate, Right Time, and Right Placement of N fertilizer appropriate for given soil and production conditions. This current project focuses on combinations of 4R management strategies to investigate how farmers in southwestern Manitoba can reduce fertilizer inputs while achieving high yield and minimizing environmental losses of N by leaching and gaseous emissions. Four replicates of 34 treatments including control with no N fertilizer, were placed in a randomized block design in plot trials on a sandy loam soil in south-central Manitoba and on farmer fields. Fertilizer sources (urea, ESN, SuperU, UAN, and UAN with Agrotain+) were used alone and for some treatments, as combinations. Total N addition rates were 56, 84, 112, and 168 kg/ha with different timing and placement (broadcast incorporated pre-planting, or sideband at planting with a second application by surface dribble band, shallow or deep side-dress at V4 stage) treatments. This poster will show preliminary results of corn grain yield and after harvest soil nitrate contents for this study.

Presence of coliform and antibiotic resistance genes in tap water from direct lined piped water and water storing cisterns in a First Nation community, Manitoba, Canada

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

In the province of Manitoba in Canada, about one in every three homes on First Nation reserves rely on cisterns. Water is often delivered to cisterns by water trucks that fill up at the water treatment plant. The goal of this study is to investigate the load of E. coli, total coliforms and antibiotic resistance genes (ARGs) in a fly-in community. In collaboration with community's Chief and Council, water was collected from various points along the water distribution system during the months of October (2018) and June (2019)? This included samples from the water source, water treatment plant, water delivery trucks, stand pipe, direct lined piped water in homes and cisterns (made of plastic) in homes. Total 44 samples have been collected from this community in two defined months. About 50% of samples from plastic cistern showed E. coli, coliform presence during October whereas 14% showed positive result for June. In contrast, all the piped water samples showed negative results for coliforms. About 85% and 42% of water samples collected in October from plastic cistern and piped home, respectively the presence of a β-lactamase gene. Whereas 43% and 29% of water samples from plastic cistern and piped home, respectively showed positive result for β-lactamase genes during June. In conclusion, the E. coli, coliform loads and presence of ARGs varied from community to community and water contamination is higher in cistern than piped based home.

Spatial Variability of Soil Bulk Density in Grassed Riparian Areas

Adriana Avila*, Hannah Ziegler-Blair, Maria Luna and Alexander Koiter
Department of Geography and Environment, University of Brandon, Brandon, MB

Soil bulk density is a key physical property with respect to vegetation growth, ecological activity, gas exchange, and hydrology. Further, the efficacy of riparian areas to intercept and buffer the flow of water, sediment, and nutrients tends to diminish with increasing compaction resulting in the pollution of surface waterways. Therefore, characterization of bulk density is important in understanding and modelling riparian processes as well as assessing the impacts of disturbances such as cattle grazing. In this study, soil bulk density was measured within four riparian areas at the Manitoba Beef and Forage Initiatives (MBFI) Brookdale farm, located approximately 25 km north of Brandon, MB. Each riparian area extended for 100 m along the edge of a prairie pothole (wetland) and extended 25 m from the water edge towards the pasture area. Furthermore, within each riparian area a small plot (1m2) was also intensively sampled. This sampling design allowed the variability of bulk density measurements to be assessed at three different scales: between riparian areas (~2.5 km^2), within an individual riparian area (1500 m^2), and at the small plot (1m^2) scale. Overall, there was substantial variability in bulk density measurements across all spatial scales. Within a riparian area, samples collected near the edge of the wetland had the lowest soil bulk density values, but the highest variability and the bulk density increased and the variability decreased as you moved towards the pasture area. These results were consistent between each riparian area. Within each riparian area there was also considerable variability in bulk density measurements at the small plot scale. The high spatial variability found in bulk density within riparian areas has implications for modelling riparian processes and detecting changes as a result of disturbances.

Highs and Lows of 2019 - Weather Monitoring in Ag Manitoba

Kevin Johannesson
Soil and Ag Weather Surveillance, Manitoba Agriculture and Resource Development, Glenlea, MB

Weather is one of the main factors that determines the success or failure of agricultural production and accurate weather monitoring is essential for all facets of farm management planning. The 2019 growing season in Manitoba was filled with highs and lows; from extreme dryness in the Interlake to excess rainfall equivalent to an entire year's worth of rain in a week in the eastern region. Manitoba Agriculture Weather Program has a network of 108 weather stations across the agricultural region of Manitoba. These stations have research-grade weather monitoring sensors that meet World Meteorological Organization standards. The stations monitor soil temperature and moisture at 5, 20, 50 and 100 cm depths, precipitation (rain and snow), air temperature, humidity, wind speed and direction, solar radiation and more recently, barometric pressure. The poster focuses on an overview of the Manitoba Ag weather network, the instruments and equipment used as well as some valuable information on the weather extremes experienced in the agricultural region for 2019.

Comparing aerial imagery resolution from different sources to identify in-crop variability in HRS wheat

Réjean Picard, P. Ag.
Farm Production Extension Specialist, Manitoba Agriculture and Resource Development
Somerset, MB

This Hard Red Spring wheat field was seeded May 7 with the cultivar AAC Brandon at a rate of 146 lbs per acre aiming for a plant population of 32 plants/ft2. A
A field scale trial was setup to evaluate the effectiveness of applying a fungicide at different timing to control Fusarium Head Blight. The treatments were replicated and applied using the operator's equipment. Untreated checks were compared to early anthesis (standard) timing and another delayed by 3 days.
Aerial imagery was captured by satellite, plane and fixed wing drone providing different resolutions while using different light spectrums (Red, Red Edge) with the hope of visualizing the treatments applied as the crop progressed to maturity. Having different resolutions provides a visual comparison to evaluate what level of resolution is sufficient to identify in-season variability within in the field. All imagery resolution show similar patterns and zones where green is active vegetative plant biomass, yellow having less and red the least.
Considering the variability of the field and the location of some of the zones seen on the imagery collected during the 2018 growing season, highlights the need to determine the type of limitation and their location in order to apply inputs and/or set up field scale trials.
Fungicide treatments did not show up in any aerial imagery. The treatments applied in N-S strips across the field were weighed at harvest to compare yield. The analysis showed that there were no significant yield differences between the untreated check, treatment at anthesis and delayed by 3 days (See table and graph).
The imagery resolution from the drone, plane and satellite varied from approximately 4 cm, to 50 cm, to 3 m per pixel respectively. All three resolution levels provided satisfactory level of detail of the variability within the field. The lower resolution satellite imagery was available on a more than weekly basis and most useful by providing information on how the crop was doing during the season. The plane and drone images were higher resolution but one time snapshots taken in the early maturing stage.
Satellite imagery captured during the peak growing stage (drone image) of the crop (post anthesis) showed no differences between the different zones that developed as the crop matured. According to the image at the time, it appeared that the crop was doing equally well across the field and management decisions considered in season would have led one to treat the field uniformly across.
Determining productivity zones within a field will be influenced by a variety of factors including soil type, field topography and grower experience as major factors. Aerial imagery can be used to help determine productivity zones but need to be adjusted using other sources of information to better reflect their potential and be useful decision making tools.

Growing Season Soil Moisture Monitoring 2019: A Case Study from Portage la Prairie, MB

Curtis Cavers[1], Zisheng Xing1 and Timi Ojo[2]
[1]Agriculture and Agri-Food Canada, Portage la Prairie, MB
[2]Manitoba Agriculture and Resource Development, Winnipeg, MB

The role of available soil water is crucial for crop production, yet conditions of excess moisture can pose just as severe limitations to productivity as do conditions of limited moisture at critical growth stages. Differences in available soil moisture vary spatially, with depth and temporally, and these differences are dramatically influenced by weather and crop management practices.
Both the federal (Agriculture and Agri-Food Canada) and provincial (Manitoba Agriculture and Resource Development) government agriculture departments operate, collect and interpret data from networks

of weather stations that measure a suite of meteorological and soil conditions. In an attempt to increase familiarity with the data collected and to interpret these data for practical agronomic decisions, we are presenting graphically soil moisture data collected from a single in-field weather station at AAFC-Portage la Prairie during the 2019 growing season. Determination of critical values for available soil moisture in the rooting zone (i.e. field capacity and permanent wilting point) along with values for field access and trafficability (i.e. plastic limit) and saturation were conducted for the 2019 growing season, which was relatively dry for most of the growing season until September, when record levels of precipitation were received.

Interpretation of the data will allow for quantification of: available soil water in the profile, the influence of crop type and growth on water use, and the impact of tillage and compaction on water movement through the soil profile. Application of this information should help to bring soil moisture status to the forefront of management decisions pertaining to crop productivity and field access for timely operations.

Evaluation of Ferric Chloride Amendment to Reduce Phosphorus Losses from Flooded Soils to Waterways

Emily Van[1*], Darshani Kumaragamage[2], Doug Goltz[1]
[1]Department of Chemistry, The University of Winnipeg
[2]Department of Environmental Studies and Sciences, The University of Winnipeg

Phosphorus (P) is often added to soils as a way to enhance fertility in crops. During prolonged flooding, P may be released to floodwater and transported to lakes downstream, contributing to eutrophication and unwarranted algae blooms. Previous studies demonstrated that gypsum and magnesium sulfate ($MgSO_4$) were effective in reducing P loss from soils. Ferric chloride ($FeCl_3$) is a potential soil amendment but its effectiveness in reducing flooding-induced P losses from soils is not well documented. Intact soil columns were collected from four flood-prone fields in Manitoba's Red River Valley region. Soil columns (triplicates) were amended with $FeCl_3$ at three rates (0, 2.5, & 5 Mg/ha) to evaluate the effectiveness of $FeCl_3$ in minimizing P losses to floodwater. Over an 8-week period of flooding at +4 °C to simulate snowmelt flooding conditions, floodwater was analyzed for dissolved reactive P (DRP). Floodwater DRP concentrations significantly increased in all unamended soil columns with time of flooding. Floodwater DRP concentrations were significantly less in flooded soil columns amended with FeCl3. The two rates of $FeCl_3$ showed similar reduction in floodwater DRP concentration except for one soil that had very high floodwater DRP concentration, in which, higher rate of $FeCl_3$ was more effective than the lower rate. Our preliminary results suggest that $FeCl_3$ is successful in minimizing P release to floodwater. Further studies examining $FeCl_3$ on flood-prone fields must be conducted as to assess its effectiveness under natural snowmelt conditions.

Pesticide Mineralization in Biochar Amended Biomix of Agricultural Biobeds

Fahad Khan* and Annemieke Farenhorst
Department of Soil Science, Faculty of Agricultural & Food Sciences, University of Manitoba, Winnipeg, MB

Pesticide mineralization refers to the process whereby microorganisms facilitate the complete breakdown of pesticides into carbon dioxide and other inorganic chemical compounds. Biochars are

carbon-rich porous materials derived when feedstocks are exposed under limited oxygen to pyrolysis temperatures ranging from 250 to 1500°C. Depending on the feedstock type and pyrolysis temperature, biochars can have vastly different physiochemical properties. Biobeds can be an effeictive method to minimize environmental contamination from pesticide use when filling, washing and rinsing spraying equipment. The objective of this study was to determine the impact of biochar types and their application rates on pesticide mineralization in biobed mixtures. Biomixtures were obtained from each cell of a dual biobed located at Canada-Saskatchewan Irrigation Crop Diversification Centre (CSIDC), Outlook, SK, and from each cell of a dual biobed located at Summerland, BC, Canada. The study design used the herbicide 2,4-D [2,4-(dichlorophenoxy) acetic acid] and two different biochars [Willow Slow (WS) and Willow Fast (WF)] that were individually mixed at 2, 4 and 8% rate (w/w) into the biomixtures. Biochar WS is derived at a pyrolysis temperature of 700°C and hence is richer in aromatic C than biochar WF that is derived at a pyrolysis temperature of 400°C. Microcosm incubation experiments were conducted at 20oC and 60% of the field capacity to optimize conditions that promote microbial activities and 2,4-D mineralization. Results indicated a relative rapid onset of 2,4-D mineralization after application followed by a slower mineralization phase after approximately one week after application. At about 5 weeks, 2,4-D mineralization in the biomixtures ranged from 52 to 57% in the first biobed cell and from 44 to 52% in the second biocell of CSIDC. 2,4-D mineralization was somewhat slower in the biomixture samples from Summerland, ranging from 31 to 46% in the first biobed cell to 35 to 41% in the second biobed cell. Regardless of the biobed cell, 2,4-D mineralization was typically smaller in the treatments with WS than WF additions, suggesting lesser bioavailability of 2,4-D because of greater sorption of 2,4-D by the WS. In addition, 2,4-D mineralization was typically slowest with additions of biochar at 4% and 8%, further suggesting that biochar additions to biomixtures may decrease 2,4-D mineralization due to the sorption of 2,4-D to these biochars. We conclude that the addition of biochar to biomixtures may render a biobed to become less effective in degrading pesticide residues hence reducing the biobed effectiveness in minimizing environmental contamination.

Is the Biobed an Effective Approach to Manage Pesticide Rinsate in the Canadian Prairies?

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

On-farm biobeds are designed to minimize point-source pollution by allowing for the capture and degradation of pesticide residues associated with sprayer filling and rinsing. Invented by a Swedish farmer in the 1990s, biobeds have been widely adopted in European and Latin American countries. The main objective of this study was to evaluate the performance of biobeds in the Canadian Prairies. Two types of biobeds (single versus dual cell biobeds) were included in the study with data collected from 2014 to 2017. Samples from biobed influent and effluent were screened for 143 active ingredients of pesticides and metabolites and a total of 70 compounds were detected across study sites and years. The effectiveness of single cell and double cell biobeds were similar and, regardless of the type of biobed materials used, biobeds were mostly efficient (upto 100%) in treating a wide range of pesticides. This included compounds that are currently among the most frequently detected pesticides in Prairie rivers; compounds that are relatively persistent; and compounds that have a relatively high potential to accumulate in organisms or have relatively larger toxicological risks to indicator species such as fish, invertebrates, earthworms. However, for some pesticides, the biobeds were less effective and further

studies are required to investigate such discrepancies. Cleaning up sprayers may introduce pesticides into surface waters, thereby contributing to water pollution. Pesticide Toxicity Index (PTI) is a potential toxicity indicator of pesticides mixture to fresh water aquatic organisms. PTI was determined in this study for fish, invertebrates, and vascular, non-vascular plants using pesticides concentration present in the biobed system influent and effluent. The median PTIs for influent samples exceeded frequently (upto 69%) the threshold toxicity risk factor 1, chosen for the endpoints LC50 and EC50 and occasionally (upto 23%) in effluent samples.

Microbial Recovery in Soils Treated by Ex-Situ Thermal Desorption and Mixing after Crude Oil Spill in Western North Dakota

Zachary J. Bartsch *, Thomas M. DeSutter, Caley K. Gasch
Department of Soil Science, North Dakota State University, Fargo, ND

Arbuscular mycorrhizal fungi (AMF) can help vascular plants acquire extra micronutrients by invading root cells with arbuscules and vesicles, and although most plants take advantage of this symbiotic relationship, AMF may provide additional benefits for revegetation of remediated soils that contain limited nutrient or water availability. In 2013, an oil spill in semi-arid western North Dakota on agricultural land prompted a large-scale remediation project using ex-situ thermal desorption (TD). Plots were constructed in 2015 with native, uncontaminated topsoil (A), TD treated subsoil (TDU), untreated subsoil (SP), and composted manure (m) to create the following treatments: A, A+m, TDU, TDU+A, TDU+m, TDU+A+m, SP, SP+A, SP+m, SP+A+m where soil ratios were 1:1 by volume and manure was applied at 40 Mg/ha to the 0-15 cm depth. In 2019 grain sorghum was planted, and at the 2nd leaf stage soil and root samples were taken for quantification of phospholipid-derived fatty acid (PLFA) for microbial abundance in the soil, and for infection of roots by AMF. These root infection and PLFA data will be analyzed using single factor analysis of variance tests with a least significant difference test planned for any significance findings. Results from this study will increase our knowledge of how TD treated soils, and soils having little to no organic matter, may be populated with microbiological species as a result of cropping sequence and natural conditions.

Polymer-coated urea and urease and nitrification inhibitors affect N uptake and yield of cotton under drip irrigation in a dry climate

Yanyan Li[1,2,*], Xiaopeng Gao[1,2] and Mario Tenuta[1]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*State Key Laboratory of Desert and Oasis Ecology, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi, China*

Enhanced-efficiency nitrogen (N) fertilizers (EENFs) has the potential to increase crop yield while reducing environmental N loss. Drip-fertigation is widely used for crop production in arid regions to improve water and nutrient use efficiency. However, the effectiveness of EENFs on N use of crops grown with drip irrigation remains unclear. A field experiment was conducted in 2015 and 2016 to evaluate the impact of EENFs on yield, N use and quality of cotton (*Gossypium hirsutum*) grown under drip-fertigation system in arid NW China. Treatments included an unfertilized control and application of 240 kg N ha-1 by polymer-coated urea (ESN), urea alone, or urea plus urease (NBPT) and nitrification (DCD) inhibitors. ESN was all banded in the plant row at planting, whereas urea was applied with 20% N banded at planting

and 80% N by six fertigation events over the growing season. Results showed there was generally no significant treatment effect on boll and lint yield, N concentration or allocations, N recovery efficiency and fiber quality index of cotton. The ineffectiveness of EENFs could be due to the unique conditions under the drip-fertigation in the arid ecosystem. Limited water supply could have reduced the likelihood of nitrate leaching and thus caused the relatively high soil native NO3- availability, which hindered the effect of polymer-coated urea and double inhibitors. These results highlight the importance of soil N test to establish the reasonable N rates for crop production in the region and the challenge of the employment of EENFs products for drip-fertigation system in arid NW China.

Effects of Climate Change, Agricultural Inputs, Cropping Diversity, and Environment on Soil Nitrogen and Phosphorus: a Case Study in Saskatchewan, Canada

Taras E. Lychuk[1], Alan P. Moulin[1], Reynald L. Lemke[2], Roberto C. Izaurralde[3], Eric N. Johnson[4], Owen O. Olfert[2], Stewart A. Brandt[5],

[1]Agriculture and Agri-Food Canada, Brandon Research and Development Centre, Brandon, MB

[2]Agriculture and Agri-Food Canada, Saskatoon Research and Development Centre, Saskatoon, SK

[3]University of Maryland, College Park, Department of Geography, College Park, MD

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Climate change will influence agricultural production and environmental quality in Canada in the coming decades. Previously, the relative impact of climate change, agricultural inputs, crop diversity, and environment on soil nitrate-N (NO_3-N) and labile soil phosphorus (P) has seldom been assessed in the scientific literature. This modeling study assessed soil NO_3-N leaching and labile P simulated with the Environmental Policy Integrated Climate (EPIC) model for historical weather (1971-2000) and future climate scenarios (2041-2070) for the Alternative Cropping Systems (ACS) study research site in Saskatchewan, Canada. Nineteen years of field and crop management information from the 1994-2013 ACS study were input to the EPIC model. Main-plot treatments consisted of three levels of agricultural inputs [organic (ORG), reduced (RED), and high (HI)] and sub-plots comprised of three levels of cropping diversity [low (LOW), diversified annual grains (DAG), and diversified annuals and perennials (DAP)]. Changes in NO3-N and P under climate change were explored with recursive partitioning in multivariate analyses of inputs, diversity, growing season precipitation (GSP), and growing degree days (GDD) and terrain attributes (TA). Under climate change, NO_3-N losses increased by 28% (from 27.1 to 34.7 kg ha^{-1} y^{-1}), while labile soil P decreased by 12% (from 24.7 to 21.6 kg ha^{-1} y^{-1}) compared to historical weather. Summer precipitation explained 12% of total variation in future NO_3-N losses. The combination of input and diversity was correlated with 23 and 20 percent of variation in NO_3-N losses and labile P, respectively. Cropping diversity was most significant, with reduced NO_3-N leaching and labile P under climate change, accounting for 22 and 13% of total variation, respectively. The combination of RED inputs and DAG diversity reduced the impact of climate change on NO_3-N losses and soil P and may provide a sustainable, adaptive solution for farming with regards to upcoming seasonal variations in temperature and precipitation.

U of M Long-term agronomic studies

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Long-term studies increase our understanding about sustainability, yields, economics, and crop rotations that often requires many years to see. The difficulties of maintaining long-term studies are continued funding, ensuring practices and equipment can be consistent or comparable, and ensuring the data produced continues to be meaningful. The University of Manitoba has five long-term agronomic studies that will be discussed. These studies highlight the importance of long-term studies and the types of agronomic research being done at the U of M. The Glenlea Long-term Rotation study began in 1992 and is the oldest study of organic cropping systems in Canada. This study compares two crop rotations under organic and conventional management. The Pesticide Free Production (PFP) study began in 2000 to investigate the effects of PFP on weed populations and crop performance in two fully phased rotations. The goal is to maintain productivity and reduce pesticide applications. A new phase is now looking at row spacing and seeding density to control weeds. The National Centre for Livestock and the Environment aims to further the economic and environmental sustainability of integrated livestock and crop production. This field trial compares the impacts of several types of manure and manure management on annual and mixed annual/perennial cropping systems. Optimizing Systems Productivity, Resilience and Sustainability in Major Canadian Ecozones is a long-term study that began in 2018. The study is one of seven sites in three ecozones that will look at six carefully designed cropping systems and determine the best one for each ecozone. Early adopters are growing cover crops in Prairie Canada, but questions about their viability, impact, and benefits remain. This project will evaluate cover crops in rotations in MB, SK, and AB over a four-year period.

Effective field day demonstrations of tillage erosion and soil-landscape restoration

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The Manitoba Crop Diagnostic School provides training to over 400 agronomists per year and providing valuable Soil and Water Management training and credits for CCAs. In 2018 we employed a novel technique to demonstrate soil erosion caused by tillage implements by showing the extent of soil movement across a slope with tandem disk, cultivator and high speed shallow disk. Additionally we scalped soil from upper slopes to simulate typically eroded knolls and replaced soil via soil-landscape restoration techniques. Corn and soybeans were seeded with and without starter fertilizer to assess the crop growth response. Field research results on crop yield recovery and economics were shared with participants.

ORAL PRESENTATION ABSTRACTS

Soil Conservation: Mitigation and Adaptation to Climate Change

Caley Gasch
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We have long recognized that soil regulates terrestrial carbon and nutrient cycling, hydrology, and land productivity. For this reason, soil is considered to play an important role in mitigating rising levels of atmospheric carbon dioxide and ecosystem processes that may respond to a changing climate. However, the ability of soil to participate in these functions depends on inherent limitations as well as how it is managed. Future agricultural and environmental productivity relies on soil conservation to improve and maintain soil function. Increasingly, land managers are encouraged to adopt practices that conserve soil and enhance its ability to provide important ecosystem services. To explore the potential for soils to mitigate the effects of variable climate conditions, I'll share observations from a spatially-intensive 10-year dataset on soil temperature and water regimes, collected as an annual crop field was transitioned into conservation management. I'll also share the thoughts of producers from the northern Great Plains on their anticipated future management challenges related to environmental change, their plans for adaptation, and how they can play a role in conserving soil resources.

Climate, Agriculture, and Soil: The Prairies in 2050

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We continuously adapt agricultural practices to changing conditions. As we look into the next few decades, we have a high confidence that global temperatures will continue to increase. This will affect global agriculture with a likelihood that areas at low latitudes will mostly be negatively affected. At higher latitudes, such as the Canadian Prairies, agriculture has a primary climate limitation of insufficient heat, relatively short growing season and inadequate moisture; all of which will likely be affected by the changing climate over the next few decades. However, the full impact of this change is less clear because of the interactions among crops, the environment, and pests. We have no appropriate analogue for our future projections because there will also be changes to our technologies and management systems. We should have high confidence that technology and management changes will support adaptation to a changing climate to some level, aiding resilience at least in the near term. We also have high confidence that the global human population will increase with a higher demand for food. But we have uncertainty in many other factors such as political and social drivers, transportation and trade. One important aspect will be adapting agriculture to the demands of consumers. These demands are broad and continually evolving; with examples like decreasing the carbon footprint, changing dietary preferences, and conserving the environment. Perhaps our greatest uncertainty is "wild cards": events with a low predictability that will have a large impact. As Soil Scientists, we need to be mindful that the global soil resource will be central to this future. So, what will be our strategy going forward?

Comparing Recent Weather Trends to Climate Normal in MB

Timi Ojo

Manitoba Agriculture, Winnipeg, MB

Rye Water Use and Biomass Production in Response to Varying Salinity and Water Stress

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Widespread soil salinity occurs across the Great Plains region of the United States, cumulatively impacting over 10 million hectares (25 million acres). Cash crops in these areas, such as soybean and corn, have relatively low salinity tolerances, resulting in yield deficits and ultimately economic loss. Producers should consider crops and cover crops with higher salinity tolerances to achieve ground coverage, water use, and salinity alleviation in saline areas. Cereal rye (*Secale cereale*) is a popular cover crop in the region for its higher salinity tolerance and water usage, ability to overwinter, and low cost. However, cereal rye water use and biomass production across salinity gradients is not well understood. This research project set out to quantify rye development in response to varying salinity and water treatments. In a greenhouse, pots conditioned with varying levels of salinity (EC1:1 = 0.8 dS m^{-1}, 2.0 dS m^{-1}, or 4.0 dS m^{-1}) had different rye seeding rates (0 kg ha^{-1}, 44 kg ha^{-1} and 90 kg ha^{-1}) applied. The pots were then watered for the duration of the project (30 days) under one of two stable water regimes (0.22 g H2O g $soil^{-1}$, 0.12 g H2O g $soil^{-1}$). Each treatment was analyzed for total water use and above/below-ground biomass after one month of growth. We found that cereal rye grew at all salinity levels, but that biomass production did decline with increasing salt concentrations. Doubling the seeding rate (plant density) of rye did not significantly affect the total water use between treatments. Similarly, there was no difference in above/below-ground biomass when seeding rate was increased, indicating that individual rye plants grew larger at lower plant densities. Results of the project did provide evidence that cereal rye can be a competitive cover crop that achieves multiple soil health goals in saline areas.

Thermodynamic Modeling of Phosphorus Species in Amended Flooded Soils

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Phosphorus enrichment causes eutrophication in surface water bodies. Flooding of agricultural lands in the prairies due to snowmelt could increase P in surface runoff water as a result of reductive dissolution of Mn and Fe bound P in soils. The effectiveness of gypsum and biochar on reducing solubility of P in flooded soils was studied using soils packed in incubation vessels. Two soils with variable P sorption capacities were used: Fyala clay (FYL-Cl) had higher P sorption capacity than Neuenberg sandy loam (NBG-SL). Speciation of soil P was assessed at 0, 5 and 10 weeks after flooding at 22°C using the thermodynamic modeling program, Visual MINTEQ. Thermodynamic modeling revealed that the initial concentrations of P in the soil solutions were maintained by hydroxyapatite ($Ca_5(PO_4)3OH$) in NBG-SL and calcium phosphate ($Ca_3(PO_4)_2$) in FYL-Cl. Soluble P concentration increased with time upon flooding. Addition of gypsum favored the formation of ($Ca_3(PO_4)_2$) in flooded NBG-SL soil, which resulted in lower concentrations of P in both pore-and flood-water in the gypsum-amended soil compared to biochar-

amended and unamended soil. Gypsum and biochar were not effective on reducing soluble P in flooded FYL-Cl compared to unamended soil. Formation of vivianite ($Fe_3(PO_4)2.8H2O$) was favored in amended and unamended FYL-Cl soil at 10th week of flooding. Our results suggest that gypsum reduced the P solubility in the flooded soil that had a lower P sorption capacity by forming ($Ca_3(PO_4)_2$) precipitates.

Plot Studies to Characterize the Interaction Effect between Water-induced Channel & Tillage Operation

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Water-induced channels are often observed on the bare cultivated surface after water erosion events. These channels are not only the source for sediment but also the pathways for sediment transport. The most common way to erase these channels is the tillage operation. Actually, the tillage operation is another erosive process, which can be affected by local topography. Therefore, the existence of channels may affect the soil movement of tillage and vice versa. However, no studies were conducted to characterize such interaction effects. So, the objectives of the studies are to understand 1) the effect of the water-induced channel on tillage translocation, 2) the effect of the interaction on the water erosion in subsequent events. These two objectives were examined with two different plot studies, respectively. The first objective was examined using the point tracer method under three types of tillage conditions: upslope; downslope; contour tillage and three surface conditions: flat soil surface; 10 cm by 10 cm channel; 20 cm by 20 cm channel. The results show that, with a channel, tillage translocation was greater in the lateral direction, whereas the forward tillage translocation was less. Also, the effect of channel size appeared with downslope tillage. The forward tillage translocation decreased with an increasing channel size, whereas the lateral tillage translocation increased with a larger channel. The second objective was examined using the rainfall simulation under four plot treatments: no channel, no tillage (control); with channel, no tillage; no channel, with tillage; with channel and tillage. The results indicated that the channel significantly increased (~ 70%) the sediment yield for the subsequent water erosion event. In contrast, the tillage operation decreased the sediment yield. The tillage operation actually reduced the impact of the channel on the following water erosion. Overall, these results characterized the interaction effect between two erosive processes.

Investigating Soil Sedimentary Processes in Cultivated Canadian Prairie Watersheds using Sediment Budgeting

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Sediment budgets were drafted for two sub-catchments of Manitoba's Boyne-Morris and La Salle River watersheds to investigate the sedimentary processes pertaining to soil in Canada's cultivated prairie landscapes. Budgets included regional estimates of in-field soil erosion risk, measurements of soil deposition in ditches, and measurements of sediment transportation through streams. Two budgetary features reflected unique the sedimentary characteristics of the landscape which should be considered when making soil erosion management decisions.

1. Masses of sediment eroded in fields, deposited in ditches, and transported through streams were found to sequentially decrease by orders of magnitude in both sub-catchments. This suggests substantial storage of sediment in the sub-catchments. The mass of sediment excavated from ditches by municipalities to maintain ditch grade exceeded the mass of sediment deposited, decreasing the likelihood of is remobilization by subsequent flows and transport into streams.
2. Estimated wind erosion risk was greater than tillage erosion risk, whereas measured tillage deposition was greater than wind deposition. Water erosion risk and deposition were negligible. This disagreement between wind and tillage may indicate shortcomings of soil erosion risk models when applied to landscapes with minimal slope.

The state of soil erosion in the Canadian prairies is often considered at a broad scale. At such a scale, extensive in-field soil redistribution has the potential to mask the severity of erosion in spatially limited erosive "hot-spots". This can erroneously portray soil erosion as a non-issue in the prairies. Minimal downstream transfer of eroded soil further supports this flawed perspective. Future evaluation of soil erosion risk should focus on the in-field effects of soil erosion, derived from high-resolution spatial data. Process-based soil erosion risk models drawing from such data will need to be tailored to the minimally sloping Canadian Prairies to make appropriate management decisions regarding wind, water, and tillage erosion.

Patterns of fallout radionuclide concentration distributions of suspended sediment in Hudson Bay

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The first collection of a substantial quantity of suspended sediment in Hudson Bay was performed in fall 2016 using two high-flow-rate suspended sediment samplers (i.e., continuous-flow centrifugation and filtration). In total, 21 sets of suspended sediment samples were collected along approximately a 2,000 km cruise of Hudson Bay. Particle-size distribution and fallout radionuclide concentrations (cesium-137 (^{137}Cs), radium-226 (^{226}Ra), and unsupported lead-210 ($^{210}Pb_{ex}$)) for all samples were determined. Cesium-137 concentration distribution was used to provide information on terrestrial suspended sediment sources (i.e., surface and sub-surface sources), and $^{210}Pb_{ex}$ content of suspended sediment was assessed to confirm the source of transported sediment from the watershed to the bay. The spatial variability of the concentration of this natural radionuclide (i.e., $^{210}Pb_{ex)}$ along with suspended sediment availability was considered to investigate the intensity of scavenging of such element in different parts of the bay. These patterns have important implications for the interpretation of the downward transfer of substances within the water column to the bed sediments in Hudson Bay.

Sorption of a legacy and current-use pesticides by a range of constituents present in rivers: sediments, charcoal, ash and microplastics

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A pesticide in surface water can reside in the aqueous phase or in the solid phase such as sorbed by suspended or bottom sediments. In addition to sediments, pesticides can sorb to other constituents present in rivers such as ash, charcoal and microplastics. The sorption of persistent organic pollutants by

microplastics has been reported, for example for the legacy insecticide DDT (Dichlorodiphenyltrichloroethane), but current-use pesticides have received lesser attention. This study compared the affinity of DDT and of three current-use pesticides (2,4-D, atrazine, glyphosate) for suspended and bottom sediments collected from the Red River, and for ash, charcoal and four types of microplastics (fiber, tire, PVC and polyethylene beads). A range of batch equilibrium experiments were carried with the liquid phase being CaCl2 or KCl solutions, deionized water or river water, and the solid phase (sorbent) being constituents alone (e.g., sediment, ash or fiber) or in combination with sediment (e.g., ash + sediment, fiber + sediment). Results indicated that sorption was more strongly influenced by the nature of the pesticides and sorbents than by the nature of the liquid phase. Glyphosate sorption was significantly greater for suspended and bottom sediments than for other sorbents. In contrast, DDT, 2,4-D and atrazine demonstrated between 90 and 100% sorption by charcoal and ash. Fiber, tire, PVC and beads sorbed between40 and 94% DDT, and PVC sorbed between 29 and 39% glyphosate. In all other cases, the sorption of current-use pesticides by microplastics was less than 10%. We conclude that, contrary to the previous published work on persistent organic pollutants, microplastics are not a strong sorbent for current-use pesticides in river systems.

Assessment of the agronomic and environmental impacts of land rolling in soybean production in Manitoba

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In the Northern Great Plains, Land rolling after planting of soybeans has become a popular practice during the past decade. Although this technique was first employed to push rocks back into the soil to prevent damage to harvest equipment and aid in harvesting lodged crops, producers learned that pushing corn root-balls flat at the time of planting into the soil can improve harvest efficiency. Land rolling is simply pulling a large cylindrical roller over the field. Many Manitoba soybean fields are routinely rolled and usually fields are rolled shortly after planting. Therefore, an experiment was conducted as an on-farm trial in eight different locations in in the Red River Valley of southern Manitoba during 2018 and 2019. The experimental trials were established with two treatments (rolled and non-rolled) and was set up as a randomized complete block design. Soybean growth characteristics such as plant height, plant population, number of seed pods, and lowest pod height indicated no significant among rolling treatment. The land rolling significantly increased the gravimetric soil moisture content at 0-10 cm soil depth. The result of this study did not show that land rolling increased wind erosion risk by reducing soil surface roughness. With respect to the experimental evidence on amount of sediment collected by wind erosion samplers, the results show that there is a significant difference among samplers with collection opening at 5cm and 20cm, which indicates that most of the particles transported at 5 cm height.

Response of root biomass on pipeline disturbed cropland to difference cropping sequences in western North Dakota

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The expansion of infrastructure needed to extract and transport oil and natural gas from the Bakken and Three Forks regions may potentially impact agricultural lands, such as soil compaction in the right-of-way caused by pipeline installation and negatively affecting crop yields. A six-year reclamation study was initiated in 2015 when a 91 cm diameter water pipeline was installed at the Williston (North Dakota) Research Extension Center to assess the affects of cropping sequences, tillage, and manure application on reclaiming farmland affected by pipeline installation. This study aims to determine how the cropping sequences of four years of durum, a four-year durum-cover crop rotation, and a perennial grass mix impacted the biomass of roots on the plots on the roadway and pipeline disturbances in the right-of-way compared to the control plots. In fall 2019 soil samples were taken at depths of 0-15, 15-30, and 30-61 cm, roots removed from soil by hand washing, and dry mass quantified. Further results will be summarized in more detail during the presentation.

The Presence of Soybean Cyst Nematode in Manitoba

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Soybean Cyst Nematode (SCN), *Heterodera glycines Ichinohe*, is one of the most devastating disease/pest organisms of soybean worldwide. The nematode is expected to soon be present in Manitoba as the pest has progressed northward in Minnesota and North Dakota to reach the Manitoba border. Therefore, the objective of this study was to survey soybean fields in Manitoba for the presence of SCN. Several surveys of soybean fields in Manitoba for SCN have been conducted by our laboratory from 2012 to 2015 that did not find the nematode. A third soil survey was conducted in Fall 2017 of 30 commercial fields in Manitoba, mainly along the Manitoba/U. S. border with history of soybean and edible bean cultivation. Three soil samples were collected per field yielding a total of 90 composite samples. A modified Fenwick elutriator, based on the USDA soil cyst extractor was used to recover nematode cysts. Overall, 17 samples from 12 fields yielded a total of 42 nematode cysts. Of the cysts, 30 were brown and lemon-shaped, as expected of SCN and were from 7 fields. Based on the morphological characters of cysts, PCR with species-specific primer sets (SCAR and CoxIII) for *H. glycines*, and DNA sequencing of several genes (ITS and 18s), four fields were positive for the nematode. The cyst levels were extremely low being 2, 1, 14, and 4 cysts 2.2 kg-1 soil in each of the fields. The four positive fields were reextracted and resampled with two of the fields again having cysts of *H. glycines*. In August 2019, the field with the highest number of cysts was visited to check for the presence of the nematode on roots as soybean is planted this year. Some soybean plants had a few cyst nematodes on their roots consistent in appearance to that of SCN females. In conclusion, resampling of positive fields and presence of the cysts on soybean roots confirm the presence of the nematode in Manitoba. The fields in which the nematode was found occur in the RM of Norfolk Treherne, Grey, Rhineland, and Montcalm.

Effect of Salinity on Soil Microbial Community Structure

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Soil salinity is a widespread problem in the Northern Great Plains that affects crop productivity and presumably influences belowground organisms. We expect that soils with moderate concentrations of

salts alter the structure and function of soil food webs and related soil properties. Our main objective is to determine if soils with moderate salt concentrations (EC1:1 = 2.0-4.0 dS m^{-1}) have different microbial communities compared to soils with lower salt accumulations (EC1:1 < 1.0 dS m^{-1}). To answer our research question, we sampled field soils across four farms in eastern North Dakota that host salinity gradients. We examined microbial community structure through phospholipid fatty acid analysis and nematode abundance using sucrose flotation. Additionally, we measured a specific set of soil properties that aim to quantify potential food sources and habitat characteristics that may influence microbial communities. Data collected from the 2018 and 2019 growing seasons indicate that microbial abundance, especially bacterial groups, was higher in saline soils than in non-saline soils. Data from the 2019 growing season reflected that nematode abundance was lower in saline soils than in non-saline soils. These observations coincide with increased labile carbon, nitrogen, phosphorus, and water content in the moderately saline soils. Based on these results, we believe the soil food webs and microbial habitat conditions differ drastically across salinity levels. Researching these potential changes in microbial communities will be valuable in better understanding the impacts of salinity on soil communities and soil function.

Spring Options for Fertilizer Management following a Wet Fall

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An extremely wet fall of 2019 thwarted many harvest and tillage operations and prevented much fall fertilizer application. Traditionally fall nitrogen fertilizer is applied in Manitoba to 45, 34 and 32% or wheat, canola and corn acreages, respectively. Fortunately there are numerous strategies for spring applications, employing timing, placement and source options such as:

- Preplant – broadcast, broadcast and incorporated, banded
- At seeding – seed-placed, sidebanded, midrow banded
- Post seeding – banded, top dressed broadcast, dribbled, and side dressed
- Split applications of some preplant or seeding time fertilizer followed with in-season applications

The use of new fertilizer efficiency products with properties of controlled release or urease inhibition, assist with the success of these placement options.

Evaluation of Fall Versus Spring-Applied Enhanced Efficiency Nitrogen Fertilizers on Crop Nitrogen Use Efficiency

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Urease inhibitor [N (n-butyl) thiophosphoric triamide (NBPT)] and nitrification inhibitor (NI) have been reported to conserve urea-based nitrogen (N) fertilizers by reducing N losses. However, their effects on crop yield and N uptake are inconsistent. In addition, fall-applied N fertilizer is usually less efficient than spring application. We conducted field studies in two years on two contrasting soils (sandy loam and clay loam at Carman and Portage, respectively) to evaluate the efficiency of NBPT with and without NI in

increasing grain yield and N uptake from fall and spring-applied urea-based fertilizers. Treatments (applied at the rate of 75 or 100 kg N ha^{-1}) consisted of surface-applied urea and urea ammonium nitrate (UAN) treated with and without NBPT or NBPT+NI. Grain yield of canola and wheat and N uptake were not consistently greater from urea and UAN treated with inhibitors. The significant effect of inhibitor on grain yield and N uptake was only observed in urea treated with NBPT at Carman sandy loam but not at Portage clay loam. Average agronomic efficiency (AEN; kg grain kg^{-1} N) was significantly greater from spring than fall-applied treatments across years. Although average AEN was significantly greater from spring-applied untreated urea or UAN than fall-applied urea or UAN treated with inhibitor at Portage clay loam, there was no significant difference between fall-applied urea or UAN treated with inhibitor and spring-applied untreated urea or UAN at Carman sandy loam. The conserved N by the inhibitors did not show up in the soil as nitrate-N. We conclude that while NBPT and NI may safeguard the environment through reduced N losses, their use to increase grain yield and N uptake relative to untreated urea and UAN may be site specific. Also, the potential of NBPT with or without NI to bridge NUE gap between fall and spring-applied urea-based fertilizers may be site specific. The inherent high fertility level of Canadian prairie soils to supply N coupled with the relatively low N requirement of canola and wheat compared to corn may explain the inconsistent benefits of the conserved N by inhibitors on crop yield.

Selecting Right Sources and Placement of Fertilizer N to Reduce N_2O emissions from Canola Production in Manitoba

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Information about the impact of placement of urea and enhanced efficiency nitrogen fertilizer (EENF) sources on N_2O emissions from agricultural soils are limited. This study compared N_2O emissions from urea and SuperU using broadcast-incorporation, shallow (2.0-2.5 cm) and deep (4.0-10.0 cm) banding placement. Replicated field trials were conducted for six site-years planted to canola using recommended N rates based on soil residual N and target yield. Nitrogen source showed more consistent impact on N_2O emissions compared to placement methods. Reduction of emissions with SuperU was observed at 4 site-years and coincided with the slow N release to the soils. Compared to broadcast-incorporation, shallow and/or deep banding placement reduced N_2O emissions at site-years with less rainfall whereas increased emissions at site-years with more rainfall at timing of application, highlighting the importance of soil moisture in determining the efficacy of placement. Applied N-scaled N_2O emission factors were lower with SuperU than conventional urea and varied between 0.09-3.13% across six site-years, suggesting the need for considering site- and season-specific conditions at estimating N_2O emissions from fertilizer application. Yield-scaled N_2O emission intensity was lower for SuperU than urea. These results demonstrate that N source determines more than placement for reducing N_2O emissions.

Urea fertilizer source and placement effects on soil greenhouse gas fluxes from a loamy sand

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Several studies have investigated the impact of nitrogen (N) fertilizer application on soil greenhouse gas (GHG) fluxes, however, questions remain regarding the influence of source and placement under various environmental conditions. In summer 2014 and spring 2015, a study was conducted with a randomized block design with three replicates to determine the effect of two sources of urea N (urea and SUPERU®) and two urea placement methods (broadcast-incorporated vs. banded) on soil carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) fluxes from a loamy sand soil near Brandon. Soil GHG fluxes were most strongly influenced by soil moisture content which exhibited positive relationships with CO_2 and N_2O fluxes (i.e., higher fluxes to atmosphere following rainfall) and negative relationships with CH4 fluxes (i.e., more uptake during dry periods). There were no significant N fertilizer treatment effects ($P > 0.1$) on CO_2 and CH_4 fluxes. Mean soil CO_2 fluxes were 13.5 kg C ha^{-1} d^{-1} and 3.7 kg C ha^{-1} d^{-1} during the summer and spring periods, respectively. Mean soil CH_4 fluxes were -2.6 g C ha^{-1} d^{-1} and -3 g C ha^{-1} d^{-1} during the summer and spring periods, respectively. Soil N_2O fluxes were significantly higher ($P = 0.06$) from the broadcast incorporated urea treatment compared to control (0 N fertilizer applied) plots during summer 2014 but not spring 2015. Fluxes from the banded urea (4.3 g N ha^{-1} d^{-1}) and broadcast-incorporated SUPERU® (4.1 g N ha^{-1} d^{-1}) treatments were not significantly different from broadcast-incorporated urea (10 g N ha^{-1} d^{-1}) or the control (2.8 g N ha^{-1} d^{-1}) treatments, though they were numerically lower and higher, respectively. The results from this short measurement campaign suggested limited impact of the placement methods chosen for conventional urea or SUPERU® on soil GHG fluxes under the field conditions experienced.

Soil amendments for closing urban to rural nutrient cycles in organically managed systems

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Nutrient export from agricultural land can lead to nutrient deficiency and system collapse over time. This problem is especially prevalent for phosphorus in organically managed systems where options for nutrient import are limited. Simultaneously, nutrients exported from farms contribute to environmental problems like eutrophication if released to the environment. Diverting more food and human "waste" products back to farms, rather than allowing them to enter landfills or waterways, is necessary for long term food system sustainability.

This research project investigates the phosphorus supplying potential of three "anthronutrients", which are defined in this study as nutrients which pass through urban areas before cycling back onto farms:

1. Struvite, a hydrated magnesium ammonium phosphate mineral which can be extracted from municipal wastewater
2. Black soldier fly larvae frass, the waste product of larvae that have been used to process urban food waste
3. Anaerobic digestate produced from municipal green waste and food processing waste

The anthronutrients are compared with an unfertilized control and common organic and conventional nutrient sources: composted livestock manure and synthetic mono-ammonium phosphate fertilizer. The nutrient sources were applied to wheat and alfalfa crops in the field, and ryegrass in a greenhouse pot study. Preliminary results indicate that the anthronutrient sources vary in their potential to support crop

growth. Frass and synthetic fertilizer generally showed the greatest yields, while the struvite and digestate showed variable results depending on experiment and sampling time.

Productivity of alfalfa fertilized with struvite in low-P soils

Joanne Thiessen Martens[1*], Francis Zvomuya[1] and Kim Schneider[2]
[1]*Department of Soil Science, University of Manitoba, Winnipeg, MB*
[2]*Department of Plant Agriculture, University of Guelph, Guelph, ON*

Use of struvite (magnesium ammonium phosphate hexahydrate, $NH_4MgPO_4 \cdot 6H2O$) recovered from municipal wastewater as a phosphorus (P) fertilizer can contribute toward closing regional and global P cycles by diverting P from waste streams to agricultural land. Struvite generally produces crop response similar or slightly reduced relative to soluble fertilizers, depending on soil pH and other properties, and may be suitable for use in organic cropping systems. Our objective was to test the effect of differing rates of struvite fertilizer, relative to monoammonium phosphate (MAP), on productivity response of alfalfa (Medicago sativa L.), an important crop in Canadian organic cropping systems, in two soils with low soil test P, under controlled conditions. Application rates ranged from 62 to 248 mg P $(kg\ soil)^{-1}$, as well as a nil-P control. Productivity response of alfalfa (shoot dry matter yield (DMY)) was similar for struvite and MAP across all application rates and both soil types. A soil by P rate interaction and linear regression indicated a significant response of alfalfa DMY to increasing P application rate in a sandy loam soil with an Olsen P of 10 mg kg^{-1}, pH 7.0, and 3.2% soil organic matter (SOM), but no response in a clay soil with an Olsen P of 6 mg kg^{-1}, pH 8.1, and 5.6% SOM. We conclude that struvite's fertilizer value for alfalfa is similar to that of MAP in the soils tested, but that crop response to P fertilizer in general depends heavily on soil properties.

Constructing a biobed system for rinsate management in Manitoba

Sarah Johnson[1*], Terrance Anseeuw[2], Evan Derdall[3], Jeanette Gaultier[4], Rob Gulden[5], Tammy Jones[6], Alvin Iverson[2], Claudia Sheedy[7], Tom Wolf[8] and Annemieke Farenhorst[1]
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[2]*Department of Plant Science, University of Manitoba, Carman, MB*
[3]*Agriculture and Agri-Food Canada, Saskatoon, SK*
[4]*BASF, Notre-Dame-de-Lourdes, MB*
[5]*Department of Plant Science, University of Manitoba, Winnipeg, MB*
[6]*Manitoba Agriculture, Winnipeg, MB*
[7]*Agriculture and Agri-Food Canada, Lethbridge, AB*
[8]*Agrimetrix Research and Training, Saskatoon, SK*

Pesticides are a significant component of crop production systems in Manitoba. Point source pesticide pollution associated with their use poses a risk for surface and ground water contamination. A new biobed is under construction at the Ian N. Morrison Research Farm in Carman Manitoba. Rinsate from the cleaning of agricultural spraying equipment on this farm will be collected and applied onto the biobed which contains a biomixture of soil, peat and straw that promotes the retention and degradation/mineralization of pesticides contained within the rinsate. The construction of this biobed was designed after observing other biobed systems currently operating in the Canadian Prairies. The construction process at the Ian N. Morrison Research Farm is nearing its completion with the intention to have the biobed fully operational in 2020 to collect data and provide information on this pesticide

rinsate management option relevant to broader adoption in Manitoba. In addition, data about the design and effectiveness of this biobed will be part of the ongoing effort by Agriculture and Agri-Food Canada's Biobed Working Group to provide further insight on the potential for implementing on-farm biobed systems in the Canadian Prairies for their potential to reduce pesticide contamination risk for surface and ground water.

Dissipation of Sulfamethoxazole and Trimethoprim in a Wetland vs. Terrestrial System

Theresa Adesanya[1*], Francis Zvomuya[1], Annemieke Farenhorst[1], Tamanna Sultana[2] and Chris Metcalfe[2]
[1]Department of Soil Science, University of Manitoba, Winnipeg, MB
[2]Water Quality Centre, Trent University, Peterborough, Ontario, Canada

Remediation approaches such as constructed wetlands and terrestrial phytoremediation can be used to facilitate the removal of contaminants from biosolids before land application, disposal or recycling. There is currently a poor understanding of the rate of dissipation of microcontaminants in constructed wetlands or terrestrial phytoremediation systems in the early stages, when plants are not fully established. The objective of this study was to characterize the dissipation kinetics of the antibiotics, sulfamethoxazole and trimethoprim in a simulated wetland and a terrestrial system prior to plant establishment. The laboratory incubation experiment was conducted at 22°C using biosolids spiked at an initial nominal concentration of 10 mg kg-1 for each of the two target compounds. Biosolids were then collected at seven sampling times over a period of 42 days. Extracts were prepared by pressurized liquid extraction and the extracts were cleaned up using solid phase extraction (SPE) cartridges. The concentrations of sulfamethoxazole and trimethoprim in the extracts were quantified using liquid chromatography and tandem mass spectrometry. The time to 50% dissipation for sulfamethoxazole was significantly faster for the terrestrial system (i.e. 2.8 d) than wetland system (i.e. 4.4 d), while for trimethoprim, 50% dissipation was significantly faster in the wetland treatment (i.e. 10 d) in comparison to the terrestrial system (i.e. 116 d). Therefore, constructed wetlands may be effective treatment systems for removing antibiotics from media such as biosolids, even during the early stages of phytoremediation.

Research results from a five-year oil spill study: The secret hope of everyone!

Tom DeSutter
Department of Soil Science, North Dakota State University, Fargo, ND

In 2013 a pipeline leak of Bakken crude oil impacted agricultural soil and underlying subsoil down to 60 ft, impacting over 1 million tons of material that needed remediation to less than 500 mg/kg total petroleum hydrocarbon. Material was remediated using thermal desorption (TD), which heated material under low oxygen conditions at 350 C for 15 min. North Dakota State University's involvement was to ensure, post remediation, that the agricultural soils were again productive and that environmental quality was not compromised. This talk will provide the final summary of project results and include the relationships that made this project a success.

Natric Soils of North Dakota: Does characterization legacy data support our taxonomy?

David Hopkins and Tom DeSutter
Department of Soil Science, North Dakota State University, Fargo, ND

North Dakota contains millions of acres of sodium-affected soils that reduce agricultural productivity and constrain management options. Compounding limitations inherent in these soils is the fact that soil mapping and correlation were inconsistent, sodic soil research was not incorporated in the progressive soil surveys, and an active soil characterization program was never fully compiled. Soil survey administrators in Bismarck realized by 2011 that sodic soil interpretations were a critical issue facing the North Dakota Cooperative Soil Survey and that characterization data was being inefficiently used to address problems. Subsequently, soil survey legacy data for 33 North Dakota soil series classified as Natric by USDA Soil Taxonomy were stratified based on Typic, Leptic, and Glossic subgroups. The closest Canadian System great groups are solonetz, solodized solonetz, and solod. Laboratory data and pedon narratives were compiled in a database of 238 pedons described and/or sampled from 1935 to 2014 to answer a simple question. How closely do sampled natric pedons conform to sodium affected soils criteria according to USDA Agricultural Handbook 60 (1954) or current USDA Soil Taxonomic standards? Pedon narratives were examined for all aspects of morphologic evidence indicative of natric or solonetzic pedogenesis and all relevant chemical and physical data were also included in the database. Only 61 percent of the 238 pedons had sufficient chemical data for all three Handbook 60 criteria, and of those, fewer than 11 percent attain classification as a sodic soil (n=16). Pedons meeting Soil Taxonomy criteria were over three fold higher at 36 percent (n=28), but half as many pedons had sufficient data for the test. Ramifications of these data on soil productivity estimates, soil correlation, and indeed upon soil survey standards will be covered in the presentation.

Detailed Soil Survey for the RM of De Salaberry and its Application in Land Use Planning

Megan Wespthal and Michelle Erb
Manitoba Agriculture and Resource Development, Manitoba, Canada

Sustainable soil management begins with a thorough understanding of the soil resources available, the type of activity they can support and the intensity of management required. Soil surveys are the basis for these important insights and decisions at the farm level and can also be used in land use decision making at the municipal level. Recently the Province completed the detailed soil survey for the Rural Municipality (RM) of De Salaberry. This municipality is located in southeastern Manitoba and covers two physiographic land areas, the Red River Plain and the South Eastern Complex. The Red River Plain is level in topography, fine in texture and generally stone free where the South Eastern Complex is level to gently sloping with low ridges, medium to coarse in texture and is moderately to very stony. A large portion of the RM is classified as prime agricultural land that is used for annual cropping and intensive livestock operations with grazing and forage production occurring on lower class lands. Since agriculture depends on productive soils, these prime and viable lower class lands should be protected for agricultural use. This presentation will summarize some of the key soil characteristics of the municipality and describe how soil survey information was used as a planning tool in review of their municipal land use by-law.

Manitoba Soil Science Society Inc.
Business Meeting Agenda
Friday, February 8, 2019 11:20 am
Holiday Inn South, Winnipeg, MB

In attendance:

Laryssa Stevenson, President
Rotimi Ojo, Vice President/President-Elect
Kevin Baron, Past President
Christine Rawluk, Treasurer
Alison Nelson, Secretary
Chamara S. W. Acharige, Student Rep

Members in attendance:

Tony Britton	Sirajum Munira	Brendan Brooks	Mino Yuan Yin
Ahmed Lasisi	Aaron Glenn	Olayinka Adamolekun	Lanny Gardiner
Fahad Khan	Clayton Jackson	Xiaopeng Gao	Matt Gervais
Brian Wiebe	Kristy Anderson	Paul Bullock	Brian Amiro
Steve Sager	Mauli Gamhewage	Manasah Mkhabela	Geza Racz
Theresa Adesanya	Lindsey Andronak	Darsheni Kumeragamage	Nazanin Ghavami
Alan Moulin	Megan Westphal	Alex Koiter	Priscilla Wenyika
Mitch Timmerman	Rejean Picard	Marufa Fatema	Kate Dorrian
Geethani Amarawansha	Srimathie Indraratne	Megan Westphal	Krista Hanis-Gervais
Mike Rynzika	Unknown		

1. Call to Order – Welcome and Introduction

Call to order at 11:12 am by Laryssa Stevenson

2. Review Meeting Agenda

Motion to accept the agenda by Paul Bullock, seconded by Lindsey Andronak. **Carried.**

Old Business

3. Review 2018 Business Meeting Minutes

Megan Westphal moved to accept the 2018 AGM minutes as presented. Seconded by Rotimi Ojo.
Carried.

4. President's Report

a. 2018 AGM

61st Annual MSSS Meeting was held on February 1-2, 2018, with the theme "Remembering the Dirty 30's - Lessons Learned, Forgotten and Rediscovered. We had nearly 90 members attend the conference, with 23 oral presentation and 19 poster submissions.

b. 2018 Summer Tour

Thanks were given to all who participated in the 2018 summer tour on August 16. About 60 participants toured through the Interlake and the surrounding area. The group visited a lime quarry near Stonewall, saw a Fyala clay and tile drainage site at PESAI, peat soils at a farm near Arborg and carbonated Lakeland soils on the way back to Winnipeg. Soil monoliths were presented to host farmers as thank you gifts. The soil was carved out of the soil pits, and monoliths created by John Heard and his crew.

c. Soil Fertility Workshops

John Heard and other soil fertility experts have created continuing education workshops for professionals. MSSS participates in the course registrations and promotion of the courses. This year they have run two workshops and one 2-day course. There is lots of demand for the courses. Interested members who would like to participate in the running of the courses should contact MSSS or John Heard.

d. New Website Launch

The new website was launched in 2018. There is a new look and feel to the website, with the ability to update easily. The website was the product of many hours of work from Christine Rawluk, and her husband Chris, who was commissioned to build the website. The Executive has been trained on the website maintenance. The Executive is quite happy with the new site and hope it serves our members better. If you have any suggestions for improvement, please speak with any of the executive.

e. 2019 Calendar

Rotimi presented. The 2019 calendar was put together by Rotimi Ojo with a theme of Spatial Scaling in Soil Science: From Microscopic to Global. Distributed at Manitoba Agronomists Conference and Ag Days. Copies are at UofM Soil Science.

Mitch Timmerman made a suggestion that MSSS develop plans in future years to distribute the MSSS calendars more efficiently. The plan would cover who needs to distribute calendars at Ag Days, and Manitoba Agriculture Regional Offices, and ensure that copies of the calendar make it to the events.

f. 2019 Sponsors

We ask for annual sponsorship of the society, which supports all the activities of MSSS. We would like to officially thank the 2019 AGM sponsors:

- Ah Horizon: Nutrien, Fertilizer Canada, Agrologists Manitoba, Manitoba Canola Growers, KOCH Agronomic Services
- Bt Horizon:, AgriEarth Consulting Ltd.

- Ck Horizon: Manitoba Pulse & Soybean Growers, AgVise Laboratories, Western Ag Innovations, Manitoba Oat Growers Association, Tone Ag Consulting, Solum Valley Biosciences

5. Financial Statements

a. Treasurer's Report

See attached.

Christine presented summary values from 2018. Sponsorship is crucial to the continued functioning of the society. Compared to last year, the society is holding steady financially. Special thanks was given to the auditing committee who reviewed every transaction. Profits from sponsorship, soil fertility courses and for the summer tour. The MSSS AGM and calendars are a financial loss.

Opened floor for comments. 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 2018 and they found the financial report to be an accurate statement of the financial transactions for the MSSS for 2018.

c. Review and Approve Financial Statements

Brian Amiro moved that the financial review of the Corporation for the fiscal period ending December 31, 2018 are hereby approved and adopted. Seconded by Paul Bullock. **Carried.**

Ahmed Lasisi moved that the financial statements of the Corporation for the fiscal period ending December 31, 2018 are hereby approved and adopted. Seconded by Brian Wiebe. **Carried.**

New Business

6. Election of Directors

Two positions are vacant for 2019: President-Elect and Secretary.

a) Secretary

Laryssa Stevenson nominated Lindsey Andronak for Secretary. Lindsey accepted the nomination.
No further nominations were received.
Lindsey Andronak acclaimed as Secretary

b) President-Elect

Laryssa Stevenson nominated Megan Westphal for President-Elect. Megan accepted the nomination.
No further nominations were received.
Megan Westphal 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
Meghan Westphal	President-Elect	2021
Lindsey Andronak	Secretary	2022

Seconded by Ahmed Lasisi. **Carried.**

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

7. Appointment of Financial Review Committee

Paul Bullock moved that the following volunteers: Aaron Glenn, Matt Gervais, Xiaopeng Gao; 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 2020 and to report their comments on such financial statements to such annual meeting.

Seconded by Laryssa Stevenson. **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 Aaron Glenn. **Carried.**

9. 2019 Summer Tour

The 2019 Summer Tour will likely be held the third Thursday of August. During the 2018 Summer Tour, interest was expressed in touring the Carberry area. Members are asked to provide suggestions for future themes in the evaluation form at the end of the AGM program.

Volunteers to assist with the 2019 Summer Tour would be greatly appreciated.

10. 2020 MSSS Meeting

Tentative dates for the event will be February 6 and 7, 2020 (first Thursday and Friday of February), provided the Holiday Inn has availability. Members are asked to provide suggestions for future themes in the evaluation form at the end of the AGM program.

11. Motion to Adjourn 11:45 am by Theresa Adesanya.

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: Sustaining Soil Productivity in a Changing Climate	1	2	3	4	5
SOIL-WATER MONITORING & MANAGEMENT	1	2	3	4	5
SOIL ECOLOGY AND PRODUCTIVITY	1	2	3	4	5
Soil Physical Properties and Remediation	1	2	3	4	5
Nutrient Management	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 2020, 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: __2020 Summer Field Tour __2021 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.