POSTER PRESENTATIONS

Effect of Subsurface Drainage on Water Table Depth and Soybean Yield

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Subsurface drainage in poorly drained soils with seasonally shallow water tables can help avoid excess water and improve crop performance and yield. In Manitoba, most studies examining the effect of subsurface drainage on crop yield were limited to fewer crops including corn, potato, and canola. A two-year field study (2021-2022) was conducted to evaluate the drainage influence on soybean yield under shallow water tables. Two different drainage treatments were carried out in replicated field plots on heavy clay soils in Arborg, Manitoba: tile drainage and no drainage as control treatment. Tile drain spacing of 4.5 m (15 ft) and 13.7 m (45 ft) were used during the 2021 and 2022 growing seasons, respectively. Tiles were installed at a depth of 0.9 to 1.1 m. Piezometers were installed with water level sensors (Solinist Levelogger) to measure the water table depth. The soybean yield was obtained from three different strips: over tile, midway between tile, and from control plots where no tile drains were used. In 2022, a significantly higher yield ($p < 0.05$) was observed over the tile compared to the midway between the tile and control plots. The yield impact of the wider spacing (13.7 m) in clay soils was similar for midway between tiles and the control plots. The average water table depth over the tile and midway between tile was 1 m in 2022 and depth was 2 m in 2021 in drained plots from the ground surface. However, in 2021, the soybean yield over the tile and midway between the tiles was significantly higher ($p < 0.05$) compared to the control plots.

Seasonal response of CO_2 and N_2O emissions to nitrogen management strategies in annual cropping systems in New Brunswick

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Nitrogen (N) plays a pivotal role in agriculture, serving as an indispensable element in both the sustenance of global food security and the intricate dynamics of climate change. Nevertheless, poor management of N fertilizers in agricultural systems has led to adverse effects of nitrous oxide (N_2O) and carbon dioxide (CO_2) emissions to the environment. Consequently, researchers have devised many solutions aimed at mitigating N_2O and CO_2 emissions originating from agricultural soils. However, the effectiveness of these solutions varies due to regional variations in climate, geography, and management practices. Therefore, to support the Canadian government's 40% target for reducing greenhouse gas *(GHG) emissions by 2030, this 4-yr on-farm study aims to facilitate the adoption of beneficial* management practices by farmers that reduces GHG emissions, improve carbon storage and other co-benefits in New Brunswick. The study focuses on implementing and evaluating N fertilizer timing (split application) and the use of urease and nitrification inhibitors as strategies for mitigating CO_2 and N_2O losses from cropping systems. The study was conducted in 2023 on three farm sites where corn, oats and potatoes were grown. Treatments included the recommended fertilizer N rate applied at planting (N100) with no inhibitors (urease and nitrification inhibitors), the recommended rate applied with inhibitors at planting (T100), split application of fertilizer N (50% applied at planting and 50% as a topdressing) with inhibitors (TSPLIT), and split application of N fertilizer with both inhibitors and rate reduced by 15% (TSPLIT85). Samples for measurement of N_2O and CO_2 were throughout the growing season using circular static chambers. Ancillary soil and environmental measurements were also taken throughout the growing season. Regression analysis will be conducted to identify the primary factors influencing CO_2 and N_2O emissions. Preliminary results on treatment effects on CO_2 and N_2O emissions will be presented.

Optimizing Struvite Application for Increasing P Efficiency of Organically Managed Green Manure-Spring Wheat Sequences in Manitoba Soils

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Organic anions enhance struvite ($MgNH_4PO_4.6H_2O$) dissolution, a phosphorus (P) fertilizer with slow-release properties. Therefore, green manure crops (GMC) that exude abundant organic anions may increase struvite-P availability. The mechanism remains unclear, as evidence suggests increased struvite-P availability even without crops. This study examined spring wheat response to factorial combinations of P source (struvite and monoammonium phosphate (MAP)) and application timing (previous and current year) as affected by the preceding GMC species (faba bean, buckwheat, and field pea) at two organically-managed sites (Libau and Notre Dame) in southern Manitoba. A control (no P fertilizer) was included for comparison. Fertilizers were applied in a band with the seed. Results showed no wheat response to preceding GMC species or to P application at Notre Dame where background soil P concentration was moderately high. Buckwheat exhibited greater capacity to access struvite-P than field pea and faba bean at Libau but did not increase the grain yield of a subsequent wheat crop. Struvite application to a preceding buckwheat crop increased P uptake by the buckwheat-wheat sequence compared to application to wheat. Averaged across GMC and P sources, P application to the previous GMC increased wheat yield and P uptake of the GMC-wheat sequence relative to P application to the current wheat crop. These results will inform strategies for optimizing yields and overall struvite-P use efficiency based on struvite application timing in organic crops in Manitoba.

Soil water extraction patterns and soybean ET_a under subirrigation through tile drains in heavy clay soil

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Effective soil water management requires information on soil water extraction dynamics and crop water use. The objective of this study was to evaluate the effects of subsurface irrigation through drainage systems on soil water extraction patterns and soybean actual evapotranspiration in a humid climate conditions. Field experiments were conducted in 2023 at Prairies East Sustainable Agriculture Initiative (PESAI), Arborg, Manitoba, Canada. Two subsurface irrigation treatments (on tile and midway between tiles) and rainfed conditions were evaluated with soybean at a rate of 444,789 plants per ha in three replicated plots. The change in soil moisture as measured by Meter probes in each layer (0-30, 30-60, and 60-90 cm) were added to compute the water extraction on a daily time step, and these values were added through the growing season. Furthermore, seasonal ET_a (mm) was computed using a general soil water balance model comprising runoff estimated using USDA-Natural Resources Conservation Service curve number procedure and deep percolation estimated through the daily water-balance method with a computer program. Results indicated a water deficit in the irrigated treatments while in the rainfed treatment, average seasonal moisture was above the field capacity which might be detrimental to crop yield. The greatest amount of extraction occurred in the irrigated treatments while the dryland recorded the lowest extraction. Among the soil layers, the water extraction was highest in the first layer with 43.1% of extraction on midway between and 44.9% of extraction on tile treatments. It was maximum on the rainfed setting in the 90 cm layer with 36.7% of extraction. Soybean seasonal ET_a ranged from 183 to 239 mm on rainfed and midway between tile treatments, respectively. The ET_a of the subsurface irrigated treatments averaged 236.2 mm. This study showed the importance of subirrigation through the drainage systems during the early drought experienced at the study location.

Soil microbial community structure dynamics of underground natural gas pipeline right-of-ways of varying ages

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Underground pipeline construction activities change the soil ecosystem of pipeline right-of-ways (ROW). Microbial communities, integral to soil health, offer insights into overall soil fertility, supporting plant growth, and sustaining agricultural productivity. However, the structure of microbial communities on reclaimed ROWs remains poorly understood. In this study, we examined the changes in soil microbial communities with increasing time elapsed since reclamation (TSR) of underground natural gas pipeline ROWs that are cropped. Soil samples were collected in September 2021 from the 0-20 cm layer on five ROWs with TSR ranging from 4 to 12 yr and from adjacent undisturbed locations (off-ROW). Metagenomic analyses of the 16S ribosomal RNA (rRNA) and Internal Transcribed Spacer (ITS) rRNA genes, were performed by Macrogen US. Analysis involved steps of next-generation sequencing and clustering of reads (MiSeq Illumina sequencing, CD-HIT-OTU package), filtering, trimming and chimeric removal of reads (rDnaTools package), and OTU assignment (QIIME 2 platform). The results showed the following: (1) bacterial and fungal abundance and richness varied with site, (2) the diversity and abundance of bacterial and fungal communities were lower in the 6-yr ROW than the 12-yr and off-ROW for two out of the three sites, (3) the dominant bacteria included members of the phyla Actinobacteria and Acidobacteria while the dominant fungi included members of the phyla Ascomycota and Basidiomycota, and (4) the bacterial phyla were more abundant in the off-ROW than the 6-yr ROW for two of the sites while fungal phyla were the opposite. These findings indicate that underground pipeline construction activities impact bacterial and fungal communities on ROWs and that the structure of these communities would improve with increasing time since reclamation. This research improves our understanding of microbial communities in reclaimed pipeline areas, crucial for informed decisions promoting environmental sustainability and successful land reclamation in areas affected by pipeline construction.

Modelling of the effect of nitrification and urease inhibitors on N_2O emissions, grain N, and crop yield – Challenges of using the DNDC model

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The application of nitrification inhibitors and subsurface banding of fertilizer nitrogen can effectively reduce N_2O emissions from cropped soils. Field experiments with inhibitors and banding are important to understand beneficial practices to reduce N_2O emissions. However, estimating the benefit of practices on regional and even national levels can't be done through experiments. This is where models come in. Simulations through models can account for field properties and weather. They can be fast and cheap to use, and different practices and adoption levels by farmers can be tested. The N_2O prediction model we have used is Denitrification-Decomposition (DNDC). Nitrification inhibitor parameters are in the model but very limited. Currently, only a parameter for the efficacy of inhibitors (from 0 to 1) to inhibit nitrification and the duration in days of the effect can be adjusted. The aim of this study is to compare predicted and measured N_2O emissions from field studies with different inhibitors (eNtrench, LIMUS, SuperU) using published data (Wood et al. 2023). The sampling in the fields was for on-band and off-band areas. The following statistical coefficients were calculated to verify the model results: the coefficient of correlation (Pearson, *r*), root mean square error (RMSE), normalized root mean square error (nRMSE%), and index of agreement (*d*). Soil moisture, soil temperature (5 cm), as well as crop yield, and grain N, showed a great correlation between measured and predicted values. In general, DNDC significantly underestimated measured N_2O emissions for all treatments. The closest prediction was for the SuperU treatment, and the worst for eNtrench. A major limitation of the model is banding cannot be simulated; rather, nitrogen addition is assumed to be homogeneously mixed into the soil. The research is continuing, and the next steps are to update the model so that it can predict emissions from on-band and off-band, as well as the effect of soil properties on the inhibitors' effectiveness.

Enhancing soil health and soybean production through livestock integration

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Producers in the Northern Great Plains are looking to maximize the economic and soil health impacts of cover cropping. Livestock integration has demonstrated positive effects to soil health while providing income through forage utilization. The objective of this study is to evaluate the influence of winter rye (*Secale cereale* L.) management through livestock integration on soil health and soybean (*Glycine* max (L.) Merr.) production. Management treatments include dual (spring and fall) grazing (DG), spring grazing (SG), no grazing (NG), and no winter rye (NR). Two study locations were established near Carrington N.D., and Streeter N.D. in fall of 2022. Forage yield and absolute ground cover were evaluated pre- and post-grazing. Stocking rates were calculated for each location and cattle were grazed in fall (DG) and spring (DG and SG). Post-grazing evaluations of soil bulk density, aggregate stability; nutrient analysis of nitrate (NO_3), phosphorous (P), potassium (K), and total carbon; and biological analyses of mycorrhizal fungi (AMF) hyphae count, and microbial biomass carbon (MBC) were completed. Soybeans were seeded following rye termination and performance was evaluated through yield data. Grazing during fall establishment did not affect spring yield or ground cover of the winter rye. Post-grazing bare ground was greatest within DG and SG, however annual weed establishment was significantly greater in NR compared to all other treatments. Bulk density and wet-stable aggregation did not differ between treatments post-grazing. Soil NO_3 was significantly higher at 15-30cm depth in NR at Carrington, but no other differences in nutrient analyses were observed. Soil AMF hyphal count did not differ, and MBC analysis is pending. Soybean yield was not significantly different. Year one of this two year-study demonstrated the ability to integrate livestock into crop production systems without compromising soil health attributes of a winter cover crop or impacting cash crop performance.

Mapping Manitoba's Grasslands Using Remote Sensing Data and Random Forest Method on Google Earth Engine

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Grasslands play a crucial role in soil carbon sequestration, biodiversity conservation, and agricultural support through livestock grazing. This study uses remote sensing and machine learning to assess remaining grasslands in Manitoba's Prairie Ecozone, estimating native, tame, and mixed grassland classes across 69,647 km^2. Due to the large area of our case study, Google Earth Engine (GEE) was selected as a planetary-scale platform for big data analysis. This study utilized monthly Sentinel-1 (S1) and Sentinel-2 (S2) images, both satellites launched by the European Space Agency (ESA), along with auxiliary data such as slope and aspect extracted from a Digital Elevation Model (DEM). For each monthly S2 scene, surface reflectance (covering spectral bands Blue, Green, Red, Red Edge 1, Red Edge 2, NIR, Red Edge 4, SWIR 1, and SWIR 2) and five key indices (NDVI, PSRI, NDMI, RVI, and RDVI) were extracted. Additionally, the ratio of VV (vertical transmit/vertical receive) and VH (vertical transmit/horizontal receive) bands of S1 ground range detection (GRD) for each month were included as features. A total of 66 features were included into the random forest (RF) method on GEE. Initially, an RF classification was employed to differentiate the grassland class from the non-grassland class, utilizing 3,004 ground truth survey points for the general grassland class and samples extracted from the Canada AAFC Annual Crop Inventory and ESA WorldCover 10m products. Subsequently, a second RF classification was applied specifically to the grassland class to identify three distinct grassland classes (native, tame, and mixed). The overall classification accuracy was 75.16%, with producer's accuracy for tame, native, and mixed at 81.73%, 80.89%, and 61.01%, respectively, while user's accuracy was 76.30%, 77.91%, and 69.83%, respectively. This research approach effectively maps large areas with advanced analytics, offering valuable data for stakeholders like government, growers, and NGOs.

Influence of Temperature on a Thin-Layer Active cap for the Remediation of Potentially Toxic Elements in Contaminated Sediment.

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Metal and metalloid contamination of aquatic ecosystems is an extensive environmental issue, which has the potential to be exacerbated by an increased demand for rare metals used in the electrification of the global economy. Once introduced, metal(oid)s persist and accumulate in sediment, where they may be resuspended into the overlaying water. In excess, metals such as lead, copper, and zinc may become toxic to aquatic ecosystems. Over the last few decades, research has increasingly focused on remediation strategies for persistent pollutants. Our research wanted to assess the viability of an active capping system containing amine-modified biochar and zeolite to immobilize multiple contaminants, including arsenic (64.6 mg/kg), cadmium (14.75 mg/kg), copper (330 mg/kg), lead 134 (mg/kg), and zinc (2840 mg/kg). In addition, we wanted to explore an existing knowledge gap in the research by investigating the potential influence that sizeable seasonal temperature fluctuations, like those seen across the boreal forest, may have on the immobilization of the contaminants of interest. Our research has been organized into three primary experiments. First, we chemically altered pristine biochar to amine-modified biochar through a two-step nitrification process and subsequent reduction. We then conducted a microcosm study to test contaminated sediment collected near a decommissioned metal smelter. Biochar, amine-modified biochar, and zeolite were tested in warm (20° C) and Cold (4°C) conditions to assess if the temperature significantly influences the adsorptive properties of the amendments. Water quality parameter data and surface samples were collected to assess changes in chemistry and metal(oid) concentrations. Sequential extractions of metal(oid) fractions in active capping material will be conducted to assess the ability of the amendments to immobilize the potentially toxic elements of concern. Finally, an adsorption experiment will be conducted on each amendment type to assess their viability in mono-metal and multi-metal solutions to assess their adsorptive capacities.

Quantifying plant heights with aerial based Light detection and ranging (LiDAR) sensor

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Measuring plant heights is a key part of wheat breeding program as breeders aim to develop semi-dwarf varieties as they are less prone to lodging. In most breeding programs, plant height is measured with a marked meter stick and usually this process is very labor intensive. Advances in technology related to sensors have shifted focus on automating plant height measurements. Light detection and ranging (LiDAR) is a laser-based sensor that can be used to measure plant heights. It is an active sensor having its own light source, thus making it independent from light conditions, air temperature and wind. Although, ground-based LiDAR has been used to measure plant heights, the applications of aerial based LiDAR remain unexplored. Lidar sensor 'DJI Zenmuse L1' was mounted on a medium sized drone 'DJI M300 RTK' and the drone was flown over preliminary yield trials located at University of Manitoba campus. The initial pre-processing of the data was done in Cloud-compare software where "segmenting tool" was used to segment each plot. Quantile method previously used in plant height estimation in Wheat by LiDAR mounted terrestrially was used to calculate plant heights. In this method lower quantile in the point cloud is assigned as the base of the plant/soil and the upper quantile is assigned to top of plant heads (ideally excluding awns). The difference between lower and upper quantile values will give the plot's plant height. Regression analysis was used to compare the heights calculated with LiDAR and heights calculated manually with a meter stick. The upper and the lower quantiles were selected based on the coefficient of determination (R^2) and the Root Mean Square Error (RMSE).

Optimizing Potato Nutrient Management in the Canadian Prairies Using High-Throughput Technologies

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Potatoes hold a vital position in the agricultural domain of the Canadian Prairies, constituting approximately 45% of the total potato production in Canada. The imperative lies in refining fertilizer application methods for heightened precision, effectively mitigating the risk of nutrient losses and environmental consequences, including gas emissions and leaching. Achieving precision in using fertilizers becomes crucial to promoting sustainable potato farming practices in this region. To achieve this goal, this study will leverage high-throughput technologies to optimize the assessment and management of potato nutrients (specifically nitrogen and sulfur) with high precision. The objectives of this study are to evaluate the influence of timing and application rate of two control-release fertilizers (ESN and SuperU) on various characteristics of potato, to identify variations in spectral patterns associated with N and S deficiencies, and to predict potato crop yield and nutrient status with robust machine learning algorithms (i.e. ANN, RF, and SVR). During the 2023 growing season, we gathered data by utilizing of multispectral and LiDAR drones, a high-resolution satellite, and spectrometers, as well as conventional soil and plant nutrient analysis. Combined with advanced machine learning techniques, these tools were employed in a research potato field in Carberry, Manitoba, which is responsible for about 70% of the province's processing potato production. The field underwent various fertilizer treatments, including applying different fertilizers administered at different times and rates. Overall, this diverse and rich data set will enable us to gain deep insights into the dynamics of crop growth and health, ultimately leading to more effective and sustainable farming practices.

Multi-year Cover Cropping with Living Mulches – Year 1 Establishment with Wheat

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The use of perennial cover crops in temperate regions outside of the usual margins of the growing season provides well-documented benefits to the soil. The nitrogen-fixing ability of legume crops is of particular interest. In a growing season that typically consists of 90-110 frost-free days, establishing a living mulch system at the time of seeding the grain crop may be necessary to allow sufficient time for cover crop growth. To achieve the producer's goals, the intercrop must provide sufficient grain yield. A well-established living mulch using perennial legumes allows the understory crop to maintain its performance throughout a subsequent growing season with the continued presence of living roots in the ground between cash crops.

Preliminary results are for a spring wheat-living mulch system established in May 2023 at four Manitoba sites. Four legume species and one grass species were seeded in the same row and at the same depth as wheat. Data collection included wheat and living mulch establishment; wheat and cover crop mid-summer biomass; wheat yield and protein; and cover crop fall biomass. Results show that compared to wheat-only controls, wheat emergence, wheat biomass, wheat yield and wheat protein were not significantly affected by the presence of the living mulch. Results also demonstrate that more deeply tap rooted mulches produced more biomass than fibrous rooted mulches.

Exploring the impact of natural salinity on common lambsquarters and kernza

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Regardless of time or geography, whether occurring naturally or exacerbated by anthropogenic activity, soil salinity is a persistent issue that poses a growing concern. For the oil and gas industry there has been a noticeable lack of information concerning the effectiveness of phytoremediation, and the identification of suitable plant species and their tolerances to salinity as well as to accidental releases of oil-field produced waters (aka brine). After a preliminary growth chamber experiment screening five plant species for their salinity tolerance, *Chenopodium album* (common lambsquarters) and *Thinopyrum intermedium* (kernza) were selected as candidates for further study. A field experiment was conducted to determine the relative salinity tolerances of these species from germination to maturity as well as their potential as phytoremediators by monitoring their ability to uptake and store salt. A site with a natural salinity gradient was mapped using an EM38 and divided into eight distinct EC ranges. Common lambsquarters and kernza were planted in June of 2023 in the designated areas, and within each salinity range, sample locations measuring $1m^2$ were established. In October of 2023 lambsquarters was harvested, however, kernza failed to establish as a result of soil crusting post planting followed by a dry growing season. Kernza was replanted in September and will be assessed in 2024. Future analyses of lambsquarters and kernza biomass will include dry weight, animal feed values, seed yield, and ion concentrations (including Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}, and NO_3^-). Soil samples were collected during biomass harvest from each sample location, dried, and will be analyzed for electrical conductivity (EC_e), sodium adsorption ratio, pH, as well as the aforementioned ion concentrations.

'*Phaseolus vulgaris* L.' tolerance to waterlogged conditions: 2023 North Dakota field study

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Ancient geological events throughout the Red River Valley (RRV) of North Dakota and Manitoba have resulted in an accumulation of fine silt and clay particles, as well as an extensive flat landscape. Precipitation infiltration is reduced in areas with higher clay concentrations and runoff is slow due to the unvarying topography. The combination of these conditions can often lead to periods of waterlogged soil. Increased precipitation variability and intensity during the spring and early summer months has led to the occurrence of waterlogged fields across the RRV. Most modern crop species are intolerant to waterlogged conditions, including dry bean (*Phaseolus vulgaris* L.), which North Dakota contributes over 30% of the US dry bean production, with a majority produced within the RRV. The goal of this project was to improve cultivar selection of dry beans for waterlogged soil conditions. This goal was accomplished through a field trail of dry bean cultivars previously screened for waterlog tolerance in greenhouse conditions. Flooding was controlled using a continuous drip system. Hypocotyl length, chlorophyll content, growth stage, and an established visual score were recorded throughout the study. Dry weight of above ground biomass, nodule count, nodule wet and dry weight, and average nodule size of rhizobium were also recorded. Tolerant cultivars found in this field trial will be confirmed in a 2024 field trial and to the understanding of dry bean-rhizobia interactions during waterlogging conditions.

Soybean Cyst Nematode, *Heterodera glycines* Ichinohe 1952, Spatial Distribution and Impact in a Manitoba Coarse Texture Field

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Soybean Cyst Nematode (SCN) is a devastating pathogen, known for causing significant yield losses in soybean and certain dry bean varieties across North America. Although SCN was first identified in Manitoba in 2019 with low cyst populations, a subsequent investigation in July 2021 revealed an SCN symptomatic and cyst-laden roots of soybean in a field located in the Rural Municipality of Thompson. The affected area was at the field entranceway for machinery. Detailed soil sampling in the affected area was conducted in a grid patten (6 m x 10 m) covering a 1,680 m^2 area. Molecular analysis confirmed the cysts to be *Heterodera glycines*, establishing the presence of SCN in the field. The maximum egg density was 7,797 eggs 100 cm^{-3} soil, which is moderate to high for SCN levels, concentrated in the centre of the patch. Densities tapered to zero in visually healthy soybean growth areas. We were then curious if SCN had spread to other areas of the field and thus sampled the entire 93-acre field using a 1-acre grid pattern, yielding 91 soil samples. Four cores were taken at evenly spaced points within each grid, from 0 to 20 cm depth, and then composited for analysis. Soil samples were extracted for eggs, eggs stained, and counted to determine soil densities. Analysis of soil properties, pH, electrical conductivity (EC), total nitrogen (TN), soil organic carbon content (SOC), and the C:N ratio, were also done. Data analysis was conducted using SAS University, transformed to fit normality. Multiple Linear Regression was employed for modeling density relation to soil properties. No statistically significant correlations between soil properties and SCN egg counts were observed at the 5% significance level. The maximum observed egg count was 933 eggs 100 cm^{-3} soil, and the spatial distribution of SCN eggs reflected a nematode spread pattern based on translocation within the field. The highest egg density was at the affected field entrance, with spread in a north-south orientation attributed to direction of soil disturbance during seeding and tillage operations. Of note, the entrance area with SCN disease symptomology and highest egg densities did not reach complete reproductive maturity and consequently did not yield.

Do Tillage, Cover Crops, and N Stabilizers Affect Growing Season N_2O Emissions and Corn Yield in Southern Manitoba?

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Corn is a major agricultural commodity in Canada with recent yield and planted area increases in Manitoba. Nitrogen inputs are high relative to other crops and are expected to increase with genetic improvement of yield potential. Thus, it's important to find ways to reduce N_2O emissions without compromising farm productivity and profits. We tested the combination of cover crop (fall rye - *Secale cereale* L.), tillage method (No-till vs. Conventional tillage), and nitrogen stabilizer (nitrification inhibitor Centuro and combined urease + nitrification inhibitor Tribune) in 2023 on growing season N_2O emission and corn yield in Southern Manitoba at the Ian N. Morrison Research Farm in Carman. For each treatment (except control), 105 kg ha^{-1} N was applied: 26.25 kg ha^{-1} N (urea) was side-banded at corn sowing, and an additional 78.75 kg ha^{-1} N (UAN) was split applied as a side-dress injection at about 4-5 leaves stage. The stabilizers were applied with the split application of UAN. No-till reduced soil N_2O emissions (in average by 40%) as well as increased corn yield by 16% compared to conventional tillage. The cover crop increased N_2O emissions in average by 16% as well as reduced yield by 15%. The highest cumulative N_2O emissions were observed with combined cover crop and conventional tillage. Despite the hot and dry summer, inhibition of nitrification was effective in reducing N_2O emissions without compromising yield. The reduction in cumulative emissions was 23-36% for No-till and 45-51% for conventional tillage. There was no additional effect of including the urease inhibitor as Tribune on N_2O emissions or yield. However, this is just the first year of five-year study, results are thus preliminary.

Effect of Fall Rye Cover Crop on CO_2 and N_2O Fluxes in the Red River Valley, Manitoba, Canada

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Cover crops can increase carbon (C) sequestration in soils. However, there is limited understanding of how cover crops affect carbon dioxide (CO_2) and nitrous oxide (N_2O) fluxes from agricultural soils in the Canadian Prairies. Research was conducted at the Trace Gas Manitoba (TGAS-MAN) long-term research site to determine the effect of a fall rye (*Secale cereale* L.) cover crop on spring-thaw and post-fertilizer N_2O emissions, CO_2 fluxes, and grain yield. Fluxes were measured over four years (2019-2022) from four 4-ha fields using the flux gradient method. In the fall of 2018 two fields were seeded no-till with fall rye and two were cultivated and left into winter. The cover crop was terminated the following spring with an herbicide application and the cash crops oats (*Avena sativa*), canola (*Brassica napus*), and spring wheat (*Triticum aestivum* L.) were grown in 2019, 2020, 2021, and 2022. 2020 and 2021 CO_2 fluxes were removed due to unreliable data caused by flux measurement equipment. In 2019, C assimilation by the cover crop resulted in the system being a C sink of 424 kg C ha^{-1} after accounting for harvest removals, and the conventional system was a C source of 248 kg C ha^{-1}. In 2022, wet growing conditions resulted in both cropping systems being a C source, with the conventional and cover crop system losing 1,366 kg C ha^{-1} and 1,558 kg C ha^{-1}, respectively. The cover crop fields saw lower spring-thaw N_2O emissions during years of good cover crop establishment. N_2O emissions following fertilizer application and cumulative N_2O fluxes were lower in cover crop fields in all study years. Combining cumulative CO_2 fluxes and N_2O emissions in CO_2-equivalents (CO_2-eq) in 2019 and 2022, the cover crop system was a net greenhouse gas source of 5,665 CO_2-eq ha^{-1} and the conventional system was a source of 7,653 CO_2-eq ha^{1}. The cover crop did not significantly affect crop yields.

An Updated Soil pH Map for Agro-Manitoba

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Soil pH is an important factor that can affect soil nutrient availability, microbial activity, pesticide efficiency and crop production. So, it is vital to have an accurate soil pH map for soil and crop management. The last Manitoba soil pH map was delineated in 1987, mainly based on climate, parent material and soil texture. As topography, one of soil forming factors, has a great influence on variations of soil pH in the A horizon, soil pH data from individual soil series was used to create the updated soil pH map. This is because soil series is a production of all soil forming factors. Soil pH values are categorized into eight pH classes: Extremely acid (pH 3.5 – 4.4), Very strongly acid (pH 4.5 – 5.0), Strongly acid (pH 5.1 – 5.5), Moderately acid (pH 5.6 – 6.0), Slightly acid (pH 6.1 – 6.5), Neutral (pH 6.6 – 7.3), Slightly alkaline (pH 7.4 – 7.8) and Moderately to Strongly alkaline (pH 7.9 – 9.0). A total of 3,644 new soil pH values in the A horizon and 850 previous values are analyzed. The results indicate that soil pH can be as low as 4.4 in an imperfectly drained Gleyed Dystric Brunisol in the South Easten region and as high as 9.0 in an imperfectly drained Gleyed Rego Black Chernozem in the South-Central region of Manitoba. Overall, most soils in Agro-Manitoba fall within the Neutral to Slightly alkaline class with 35.5 and 31.4 percent, respectively. Reporting and visualization of soil pH data will greatly aid with best agronomic practices and decisions within Agro-Manitoba.

Comparison of soil properties with and without long term swine manure application in North Dakota

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To investigate the effects of repeated swine manure application, areas of similar soil (silt loam-silty clay loam) were selected from six small grain production fields in northern North Dakota. Three fields had no recent history (ten or more years) of manure application and three fields had received annual applications of liquid swine manure. After grain harvest in 2022, a 4x5 grid of 20 soil sample locations with 25-m spacing was established on each field. At each grid point, a hand trowel was used to collect soil from 0-15 cm depth for 26 chemical parameters and for wet aggregate stability analysis. In addition, a Veris P4000 probe was used to measure EC, penetration resistance, and IR reflectance at 2 cm increments to 1 m. Significant within-field variability of the measured parameters was observed. Principle Component Analysis indicated different correlations of the measured parameters between manure and non-manure sites. Organic matter, TOC, POXC, and total wet-stable aggregation were significantly greater for non-manure sites while salts, nitrate-N, P, Zn and most other micronutrients were significantly greater for manure sites.

Update on Detailed Soil Survey Activities in Manitoba

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Detailed soil survey information is a key tool in making appropriate, economical and sustainable land use and land management decisions to aid in improving agricultural production for Manitoba's land and soil resources. These surveys also contain important agronomic information that can aid in soil and nutrient management decisions on farm. This information includes soil texture, salinity, pH, soil organic carbon and more. Manitoba's soil resource information is also more than just maps. Documents such as "The Description of Soil Series in Manitoba" contains even more information on almost all the soil series found in Manitoba. For example, most soil maps will display soil surface texture only. However, in Manitoba our soils tend to be quite variable in some areas and some soils will consist of medium to moderately coarse surface textures such as fine sandy loam over fine textured soil material such as clay within 1 metre from the surface. These texture differences within the soil profile can have a great impact on water movement and nutrient availability through the soil. Consulting both soil resource maps and other soil resource documents is the best way to make agronomically sound and economically viable decisions on your farm.