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Effect of Cover Crop Mixtures and Crop Rotation on Nitrogen Dynamics and Crop Yield in Southeast Nebraska

Keywords: Nitrate leaching, groundwater, winterkill, mixed cover crops, corn-soybean

Moriah Brown

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Watershed Monitoring of Shell Creek for Antibiotics and Antibiotic-Resistant Bacteria

Keywords: Antibiotics, Antibiotic Resistance, Water Quality

Runoff from agricultural fields poses a significant threat to water bodies, carrying sediments, nutrients, and chemicals, including antibiotics and antibiotic-resistant bacteria (ARBs), which degrade water quality. Despite their crucial role in disease prevention and growth promotion in agriculture, antibiotics' presence in watersheds raises environmental and health concerns, particularly regarding the spread of antibiotic resistance. This study focuses on the Shell Creek watershed in east-central Nebraska, an agriculturally dominated area, where antibiotics are extensively used in farming practices. Bi-weekly grab samples are collected from four locations along Shell Creek and are processed for bacteria and antibiotics. Results indicated infrequent antibiotic detections, mostly below quantification limits, while ionophores, notably monensin, were more frequently detected. The presence of antibiotic-resistant bacteria highlights the potential risks associated with agricultural practices and antibiotic use in the watershed, highlighting the need for sustainable management strategies to mitigate water contamination and safeguard public health and ecosystems.

Gustavo Castro-Garcia

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Evaluation of contaminant fate and transport originating from swine carcass decomposition through two Nebraska soils

Keywords: water quality, mortality management, pollutant leaching, composting, biochar

Composting and shallow burial with carbon are common on-farm mortality disposal methods. An important consideration is how leachate contaminants generated during animal decomposition are transported through the soil and what management practices may protect

groundwater quality. However, little preparation of the soil is usually conducted prior to establishing mortality disposal units. Therefore, this study evaluated the transport dynamics of pollutants originating from swine carcass decomposition through two Nebraska soils during a 33-d column study. Soils included a Valentine fine sand (well-drained) and Aksarben silty clay loam (poorly drained). The results show the potential risk of infiltration in both soils, showing that the infiltration in Aksarben silty clay loam was higher than in Valentine fine sand soil. The data obtained from this study will be used in a pollutant transport model to assess groundwater quality contamination risks associated with swine carcass decomposition.

Kalley Collins

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Monitoring semi-immobile and mobile weathering products in agricultural soils to quantify initial carbon capture of an enhanced rock weathering project deployed in Nebraska

Keywords: Enhanced Rock Weathering, Carbon Sequestration, Aglime, Modeling, Negative Emissions Technology

Japhet Dushimeyesu

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Nitrous Oxide Production in Undisturbed Subsoil: a column experiment.

Keywords: Nitrous oxide, Irrigation, Vadose zone, Production, Emission

Nitrous oxide (N_2O) is a potent greenhouse gas whose global warming potential is 298 times that of CO_2. Agriculture is the most important of N_2O emission as it contributes 60% of all anthropogenic N_2O nitrous oxide emissions; however, its production and consumption in subsoil below rootzone is not well understood. In a four months experiment, we studied impact of irrigation and fertilizer application on subsoil N_2O concentrations using 18 soil columns reconstructed from undisturbed sections of water-table deep cores from a natural prairie, provided them with artificial groundwater and planted them with corn. We had six treatments with three replicates each. Every two weeks gas samples were collected at depths of 0 cm, 50 cm, 100 cm, 145 cm and ground water. The samples were analyzed for CO_2, N_2O, and CH_4 concentrations using gas chromatography. The average N_2O concentration in pore gas ranged between 0.308 ppm and 0.426 ppm; our results show an increase in N_2O concentration in pore gas with depth in pivot irrigation treatments and nitrate fertilizer treatments and they show that water application on the surface have influence on N_2O production in horizons deeper than rootzone.

Britt Fossum

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Impacts on Soil Nitrate Retention and Arsenic Following Application of Biochar and Biosolid

Keywords: Arsenic, Biochar, Leaching

Application of biosolids, a form of organic fertilizer sourced from wastewater treatment, makes up more than 90% of biosolid use and disposal in Nebraska. Biosolid application can impact arsenic content in soil, which can impact water resources in urban-rural transition zones where biosolids are commonly applied. Combining biosolids with a biochar may lower the risks of biosolid use in agriculture. A field experiment combining biosolids at a rate of 60 Mg ha-1 and biochar at a rate of 20 Mg ha-1was established on 16 acres of farmland in April 2023. Soil samples were analyzed for nitrate, ammonium, and arsenic content. Biochar application increased nitrate retention in topsoil, with biochar+MAP retaining an additional 3 mg kg-1 soil and biochar+biosolid retaining an additional 3.75 mg kg-1 12 months after application. Potentially leachable (30-60 centimeter) arsenic content was higher 15 months after biosolid application, indicating biochar may not fully mitigate impacts of biosolid application.

Dipesh Giri

University of Nebraska - Lincoln

Evaluation of Urease, Nitrification, and Dual Inhibitors for Reducing Nitrogen Losses in Coarse Texture Soils of Nebraska

Keywords: Nitrogen, UAN, Urease inhibitor, Nitrification inhibitor, Incubation study

Urease inhibitors (UI), nitrification inhibitors (NI), and their combination (UI+NI) can reduce nitrogen (N) loss and improve nitrogen use efficiency. This incubation study assessed the impact of various N inhibitors on nitrate (NO3-N) leaching, ammonia (NH3) volatilization, and nitrous oxide (N2O) emissions under controlled laboratory conditions. Treatments included urea-ammonium nitrate (UAN) with different inhibitors such as Agrotain (UI), Instinct (NI), Nitrolock (UI+NI), and new VLS formulations. The results showed that NI reduced nitrate leaching by 20%, while UI and UI+NI reduced NH3 volatilization by 82–89%. The UI+NI combination also decreased N2O emissions by 23%, although VLS-UI+NI increased N2O emissions by 59%. Overall, established inhibitors generally outperformed new products. These findings highlight the potential of specific nitrogen-inhibiting products to mitigate N losses from loamy sand soils, particularly in conditions prone to high N losses.

Victoria Guaratti

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Effects of Irrigated and Fertigated Corn (Zea mays) on Carbon Dioxide and Nitrous Oxide Emissions in West-Central Nebraska

Keywords: Greenhouse gas emissions, irrigation management, nitrogen fertilization, corn productivity

Greenhouse gas (GHG) emissions reflect the microbiological activity of the soil and can impact plant development. Irrigation and nitrogen management are known to impact corn productivity, but they may also influence GHG emission. The objective of this study was to analyze carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions under different irrigation and fertigation regimes. Measurements were taken with LI-COR machines LI-870, LI-7820 and 8200-01S Smart Chamber at intervals of 24 hours before and 24, 48, 72 and 96 hours after selected irrigation and fertigation operations. The study was conducted during the 2024 corn (Zea mays) growing season in North Platte, Nebraska. Although the data analysis is still being conducted, some preliminary data suggests that monitoring the flow of greenhouse gases can help improve management of irrigation and nitrogen, as plots with higher amounts of irrigation and nitrogen fertilization were associated with increased emissions.

Rimsha Hasan

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Geospatial Analytics of Remote Sensing for Desertification in arid and semi-arid regions of India

Keywords: AHP, Desertification, Geospatial Analytics, Remote Sensing

Desertification is a global environmental concern attributed to climate change that threatens the biodiversity, land productivity and creating economic instability in a country. Jharkhand, the 15th largest state in India, has 68.98% area under desertification. This study aims to evaluate the state's susceptibility to desertification using satellite remote sensing and GIS tools. The factors included for the analysis Topsoil Grain Size Index, NDVI, Aridity Index, Land Surface Temperature, Land Use-Land Cover, and population density, were used to analyze and map desertification-sensitive regions. For identifying desertification-prone zones, Analytical Hierarchy Process (AHP) and Weighted Overlay Analysis. The findings reveal that 16% of Jharkhand's total area lies in a very high-risk desertification zone, 34% in a highly vulnerable zone, 37% in a moderately vulnerable zone, and 13% in a low-risk zone. We identified high-risk areas, providing valuable insights for creating strategies to mitigate desertification, supporting sustainable land management, ecosystem restoration, and biodiversity conservation.

Sydney Kohl

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Guiding Optimal Engineered Reef Setup With Compound Coastal Flood Modeling

Keywords: Hydrodynamic modeling, compound coastal flooding

Low-lying coastal communities face heightened risks from compound flood events, where multiple flood factors interact nonlinearly, causing significant damage to infrastructure and ecosystems. This study aims to use a loosely coupled inland-oceanic hydrodynamic model to simulate flood scenarios and assess how engineered reef structures can reduce coastal inundation. By constructing a "most probable" flood scenario based on the joint probability of individual hazard components, we intend to identify optimal reef configurations for mitigating flood inundation events. So far, we have established our model's domain and inland-oceanic boundary conditions with MIKE 21 hydrodynamic modeling software. As work progresses, we intend to provide an efficient, low-computational cost modeling framework to guide real-world implementation and enhance coastal resiliency efforts. This work was funded by the National Science Foundation (grant no. 2318123; PI:Warda Ashraf).

Nishant Kumar

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Trend of extreme rain-on-snow floods

Keywords: Trend, Frequency, Efficiency, rain-on-snow, floods

Rain-on-snow (ROS) events occur when rain on a pre-existing snowpack, poses a significant risk of flooding. Intensified rainfall and rapid snowmelt have historically a fair amount of contribution to floods during large ROS events. In this study, we proposed a new approach to defining ROS events leading to actual floods by putting thresholds on rainfall, snow water equivalent, air temperature, dew point temperature, and discharge of 90th percentile simultaneously, which overcomes some of the limitations in the existing definitions. This research also assesses the temporal frequency and spatial trends of actual ROS floods, and the efficiency of ROS events with potential flooding leading to actual floods.

Shabani Muller

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Tracking Agrochemical Contaminants in Aquatic and Terrestrial Environments Using Tadpoles and Songbirds as Sentinels

Keywords: Agrochemical, Aquatic and terrestrial environments, neonicotinoids, tadpoles, songbirds

Agrochemical contamination can adversely impact human, animal, and ecosystem health. The AltEn Ethanol plant in Mead, NE processed waste seed products treated with neonicotinoid insecticides and fungicides through 2020, with liquid and solid byproducts entering streams and applied to fields. We sampled tadpoles and songbirds to detect pesticides in surrounding aquatic and terrestrial environments. In 2021, we collected American Bullfrog (*Lithobates catesbeianus*) tadpoles from surface-water sites and Red-Winged Blackbird (*Agelaius phoeniceus*) and Brown-headed Cowbird *(Molothrus ater)* eggs from farmland/wetland sites. Tadpole tissues and songbird eggs were analyzed for pesticides and degradation products using gas and liquid chromatography-tandem mass spectrometry. Neonicotinoid and fungicide residues were detected, with the highest concentrations bordering the AltEn facility (songbird eggs) and at sites downstream (tadpoles). Our results show that tadpoles and songbird eggs are effective wildlife sentinels in this environment. We expanded sampling in 2022 – 2024 to investigate spatial and temporal trends in contamination.

Greici Parisoto

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Temporal analysis and trend impacts of extreme events on Brazilian soybean production

Keywords: climate, yield gap, agricultural production

To meet the growing demand for food and address climate challenges, crop production must increase by 60% by 2050. The aim of this study was to assess the trends and temporal impacts of extreme events on crop yields in key Brazilian soybean-growing regions. A 60-year time series (1961-2020) from the BR-DWGD dataset was used, incorporating daily data on air temperature, precipitation, and evapotranspiration across major soybean-producing areas. The results indicate a gradual increase in agricultural productivity over time, with some reductions corresponding to extreme events. Similarly, increases in the productivity gap coincided with periods of reduced soybean production in each region. Trend analyses indicated a significant rise in temperature and a slight drop in precipitation across most regions, pointing to potential challenges for future agricultural practices. These findings suggest that adaptation strategies will be necessary to sustain soybean yields under increasingly extreme climatic conditions.

Kaitlyn Richards

University of Nebraska - Lincoln

Linking Reactive Nitrogen Species within the Vadose Zone with Surface Irrigation

Keywords: Agriculture, Nitrogen, Vadose Zone, Nebraska, Irrigation

Rintu Sen

University of Nebraska - Lincoln

Using the DSSAT CERES-Maize Model to Evaluate Farmers' Irrigation Decisions

Proper irrigation management is essential for optimizing crop productivity and sustaining natural resources. This study calibrated and validated the DSSAT CERES-Maize model using seven years (2017-2023) of data from a farm management competition in the Testing Ag Performance Solutions (TAPS) program. The goal was to evaluate farmers' irrigation decisions and their effects on water use and yield. Soil, weather, and management data from 27 replicated plots were used to calibrate the model. Simulated yields had an average RMSE of 0.75 Mg/ha and a d-stat of 0.97. The calibrated model was then used to obtain the optimized irrigation scheduling. The comparison of optimized and actual irrigation schedules revealed that 70% of farmer teams over-irrigated (average of 57 mm), while 30% under-irrigated (average of 48 mm). In conclusion, this study underscores the importance of optimizing irrigation for improved water management and crop performance, highlighting DSSAT as a valuable tool for sustainable farming.

Anmol Singh

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Assessing the AquaCrop Model's Accuracy for Soybean Under Variable Irrigation

Keywords: AquaCrop, soybean, Irrigation scheduling, Nebraska

Increasing pressure on freshwater resources and the need for food security make optimizing irrigation management a critical concern. Crop models have become vital and reliable tools for making irrigation decisions under varying weather and field conditions. In this study, AquaCrop model was calibrated to predict soybean yield and soil moisture content. The research was conducted at the Eastern Nebraska Research and Extension Center (ENREEC), Nebraska, from 2017 to 2023, with different irrigation levels. The model was calibrated using 13 treatments from 2017, 2019, 2020, and 2021, with the remaining years reserved for validation. This study is significant because the AquaCrop model has not been extensively calibrated and tested in Nebraska and its neighboring states, where soybean is a major crop. The calibrated and

validated model can be used by extension educators and technical staff of state and federal agencies to test and recommend a wide range of soybean irrigation scenarios.

Kaitlin Steinauer

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Repeated Gravity Surveys to Track Seasonal Groundwater Level Variations in Nebraska

Keywords: Groundwater, Groundwater Monitoring, Gravity, Geophysics

This project tests the capability of a relative gravimeter to track seasonal groundwater level changes in Nebraska's aquifers to provide an additional method for groundwater monitoring. Two study areas were selected next to monitoring wells which exhibited large seasonal water level changes due to irrigation. The first area is in Plymouth, NE over the unconfined aquifer with up to 15 ft of annual groundwater change. The second study area consists of four observation wells in the confined aquifer with up to 50 ft in annual groundwater variations. Gravity surveys started in April 2024 and will continue through December 2024. Surveys in Oakland show gravity changes through time, but well data will not be downloaded until December. In Plymouth, gravity trends show strong correlations to the groundwater level recorded in the well. Overall, a relative gravimeter appears to be a useful noninvasive tool to track seasonal water variations in Nebraska's aquifers.

Bincy Sunny

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Assessing the impacts of recreation and protected status designation on aquatic microbiomes

Keywords: Freshwater ecosystem, Aquatic microbiome, Anthropogenic impact, Microbial diversity, Functional profiling