Research and the State
GRADUATE STUDENT POSTER SESSION

Program Booklet

Tuesday, October 24, 2023
Student Union Courtyard

KANSAS STATE
UNIVERSITY

Graduate School

KANSAS STATE
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Graduate Student Council

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Program Schedule

POSTER PRESENTATIONS AND JUDGING

Session 1 – 10:00 am to 12:00 pm
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K-State Student Union Courtyard

Research posters will be presented by over 75 K-State graduate students representing seven academic colleges. Ten presenters will be selected by judges to participate in the Capitol Graduate Research Summit (CGRS) being held in Topeka in March.

AWARDS CEREMONY

4:00 pm
227, Union

The 10 graduate student poster presenters selected to represent K-State by presenting their posters at the 21st annual Capitol Graduate Research Summit (CGRS) in March 2024 will be announced at the awards ceremony. These 10 students will be presented with a scholarship award to recognize their achievement.

About the CGRS
The CGRS is an annual showcase of research conducted by graduate students from Emporia State University, Fort Hays State University, Kansas State University, Pittsburg State University, the University of Kansas, the University of Kansas Medical Center, and Wichita State University. Participants have the opportunity to present their research posters and discuss the important implications their research has for issues in the state of Kansas with state legislators, the governor, and the Board of Regents. Academic and industry representatives serve as judges to select the top presenters from each institution to receive scholarship awards.

Award Recipients

The following ten presenters were selected for a $250 award and to represent K-State at the annual Capitol Graduate Research Summit (CGRS) at the State Capitol Building in Spring 2024. Additionally, three of the presenters were selected for awards from K-State's Chapter of Sigma Xi.

Read a [full news release](#) about the award recipients.

- Amirsalar Bagheri, doctoral student in chemical engineering.

- Brooke Balderson, doctoral student in couple and family therapy

- Holly Ellis, master's student in architecture.

- Reza Nematirad, doctoral student in electrical and computer engineering.

- Fidelis Onwuagba, master's student in geology.

- Jaymi Peterson, doctoral student in food, nutrition, dietetics and health. Peterson was the first-place Sigma Xi winner and was awarded a $150 scholarship.

- Andrea Salazar, doctoral student in entomology. Salazar was the second-place Sigma Xi winner and was awarded a $100 scholarship.

- Manivannan Selladurai, doctoral student in grain science.

- Savannah Stewart, doctoral student in food science.

- Ramona Weber, doctoral student in kinesiology. Weber was the third-place Sigma Xi winner and was awarded a $50 scholarship.

Poster Titles and Presenters

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10:00 am to 12:00 pm

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Poster Abstracts

Agricultural Sciences 1

1

TEMPERING VS SOAKING: DIFFERENCES IN THE BREAKAGE BEHAVIOR OF SINGLE WHEAT KERNELS

Anu Suprabha Raj, Hulya Dogan, and Kaliramesh Siliveru
Department of Grain Science and Industry

BACKGROUND AND PURPOSE: Tempering, a crucial step in conditioning wheat kernels prior to milling, involves adding a calculated amount of water to the kernels and allowing them to rest for a specified duration. This process toughens the bran and mellows the endosperm, enhancing flour extraction. During tempering, the limited availability of water influences moisture migration within the kernels, subsequently affecting their breakage behavior. In this study, we conducted an evaluation of the breakage patterns exhibited by wheat kernels subjected to tempering and compared them to kernels subjected to soaking. Unlike tempering, where the kernels receive calculated moisture, soaking immerses the kernels entirely in water, resulting in modifications to properties such as peak compressive force and elasticity. **METHOD:** To assess the breakage behavior of wheat kernels, we employed a texture analyzer over a 12-hour period. Soaked kernels were tested hourly, while tempered kernels, with moisture contents of 14%, 16%, and 18%, were tested every three hours. **RESULTS/FINDINGS:** The compressive strength of soaked samples exhibited significant variations over time, whereas tempering moisture levels significantly impacted the properties of tempered samples. **CONCLUSION:** The findings from this study provide valuable insights for optimizing the tempering process and enhancing its efficiency.

Relevance of Research to State-Related Topic(s)

Wheat milling is a major contributor to the Kansas economy. The state consistently ranks among the top wheat producing states in the United States, and wheat milling is a significant sector within the state's agriculture industry. The milling industry generates revenue through the processing of wheat into various products, including flour, bran, and wheat germ, which are used in various food products. For the efficient production of these products, conditioning of the wheat is inevitable. The research focuses on optimizing the tempering process, which is a critical step in wheat milling. Improved tempering practices can lead to enhanced flour extraction rates, potentially increasing the overall productivity and profitability of Kansas milling facilities.

MOLECULAR CYTOGENETIC MAPPING OF THE HOMOEOLOGOUS RECOMBINATION PROMOTOR GENE(S) IN WHEAT WILD RELATIVES

Yoonha Ju and Dal-Hoe Koo
Department of Plant Pathology

BACKGROUND AND PURPOSE: Genetic diversity provides a source of genetic variation for a trait of interest that can be exploited in crop improvement programs. Wheat has narrow genetic diversity due to *Ph1* gene, which makes it difficult to bring beneficial genes from wild relatives into cultivated wheat. The use of *Ph1* deletion mutant, *ph1b*, enables homoeologous recombination which helps to transfer alien gene into cultivated wheat. Unfortunately, using *ph1b* mutant in expedited breeding programs is impractical. Previous study revealed that $5M^g$ chromosome of *Aegilops geniculata* induces homoeologous recombination at greater frequency even in the presence of *Ph1*. This led us to hypothesize the existence of *homoeologous recombination promoter* gene on the $5M^g$ chromosome (HRPG-$5M^g$). **METHODS:** To map the HRPG-$5M^g$ region we used six cytogenetic stocks, each containing varying proportions of $5M^g$ segments integrated into 5B chromosome of wheat. Crosses were made between each of the cytogenetic stocks with *ph1b* mutant and SprNuplains, respectively. Analysis of F_2 plants in each cross was done by genomic *in situ* hybridization for determing the homoeologous recombination frequency. **RESULTS:** GISH analysis revealed that in the absence of *Ph1*, the long arm of $5M^g$ significantly increased the homoeologous recombination frequency ranging from 1.38 to 2.84%. In particular, the distal 20% region of long arm of $5M^g$ chromosome showed higher homoeologous recombination frequency of 2.84%. **CONCLUSION:** We identified the putative *homoeologous recombination promoter* gene (HRPG) was present in the distal 20% region of $5M^g$ chromosome. The novel cytogenetic stock with smaller *Ae. geniculata* segment carrying *HRPG*-$5M^g$ will enhance the genetic diversity in wheat.

Relevance of Research to State-Related Topic(s)

Kansas is the largest wheat producing state, contributing nearly one-fifth of all wheat grown in the U.S. and earning the titles "Wheat State" and "Breadbasket of the World." Notably, the 10-year average wheat production in Kansas stands at an impressive 309,255,000 bushels (USDA, 2022). As a staple crop in Kansas, wheat plays a critical role in ensuring food security and sustaining agriculture. However, wheat production is constrained by biotic and abiotic stresses. To sustain wheat production under these stresses developing stress tolerant varieties is essential. To do so, the genetic diversity of wheat is crucial for successful crop improvement program. Transferring agronomically important genes from wild relatives to cultivated wheat by chromosome engineering is a powerful tool for increasing the genetic diversity in wheat. Chromosome engineering using *HRPG*-$5M^g$ will accelerate the transfer of agronomically important genes from wild relatives to cultivated wheat.

NIXTAMALIZATION OF SORGHUM FOR TORTILLA APPLICATIONS

Mayra Perez-Fajardo[1], Hulya Dogan[1], Shawn Wu[2] and Scott Bean[2]

[1]Department of Grain Science and Industry; [2]United States Department of Agriculture-Agricultural Research Service (USDA-ARS), Grain Quality and Structure Research Unit

BACKGROUND AND PURPOSE: Sorghum is the fifth most produced grain worldwide, and the United States is the top sorghum producer followed by Nigeria and Mexico. Sorghum's drought resistance, ability to be grown in arid and semi-arid regions, and high yield make it an attractive crop to produce. Furthermore, there has been growing popularity in the antioxidant capacity found in sorghum due to its preventative abilities for obesity, type 2 diabetes, cardiovascular disease, cancer, and hypertension. However, tannin-containing sorghum varieties contain anti-nutritional compounds that have limited the use of sorghum for human consumption. Nixtamalization refers to the alkaline steeping of corn and is an ancient Mayan/Aztec method used today to produce masa and corn tortillas. Nixtamalization has been shown to improve the nutritional profile and digestibility of sorghum. Therefore, the purpose of this proposal is to justify the potential of sorghum to be used for tortilla production. **METHOD:** Literature encompassing the effects of nixtamalization on the grain structure, nutritional profile, flour functionality, and potential for tortilla production were studied. **RESULTS/FINDINGS:** It was found that nixtamalization chemically modified the grain which in turn improved the flour functionality. Nixtamalized flour functionality showed an increase in water absorption, oil absorption, and emulsion capacity. Nutritionally, the protein digestibility of red and white sorghum varieties was increased after nixtamalization, and it was shown that the antioxidant potential of sorghum was most prominent after nixtamalization. Good quality tortillas were produced from low-tannin white sorghum varieties. **CONCLUSION:** The use of sorghum for tortilla applications as an alternative to corn has great potential.

Relevance of Research to State-Related Topic(s)

Kansas is the topmost producing state of sorghum; however, the poor digestibility has restricted the use of sorghum to animal feed. Developing methods to improve the nutritional profile of sorghum such as nixtamalization would allow for sorghum to be used for human consumption. The tortilla industry is a growing market within the United States that is projected to reach $28 billion dollars in market size by 2027. Introducing sorghum as a promising grain for tortilla production would add value to sorghum. Thus, allowing Kansas farmers to sell their sorghum crops for higher prices and thereby increasing their revenue.

FUNCTIONAL EVALUATION OF NEW KERNZA CULTIVARS

Brianna Iorga[1], Elisa Karkle[1], and Lee DeHaan[2]
[1]Department of Grain Science and Industry; [2]The Land Institute

BACKGROUND AND PURPOSE: The search for alternative grains has recently shed light on perennial crops. These may offset ecological problems associated with annual crops, such as soil quality and fertilizer needs. Kernza, developed in Kansas, is the first commercially available perennial crop, with positive impacts on carbon sequestration and prevention of soil erosion. Mixing quality has been identified as a hurdle towards utilization. The objective of this project was to test the effectiveness of breeding efforts focused on mixing quality among 4 different Kernza cultivars: C1, C2, C3, and C4. **METHOD:** Kernza grain was harvested from plants cultivated in 4 different plots, in a randomized complete block design. Dough mixing characteristics and baking quality of the whole grain flour were evaluated. The breads were analyzed for specific volume and internal structure. **RESULTS/FINDINGS:** Cultivars differed in terms of peak mix time, dough consistency at peak, energy required to mix to peak, and tolerance to overmixing. For the baked loaves, proof height, specific volume, brightness, number of cells, and cell diameter were significantly different. C4 performed better than all other cultivars in mixing quality parameters. It also resulted in the largest loaf, compared to C1, C2, and C3. **CONCLUSION:** C4 was bred specifically for mixing quality, and based on the results, the breeding efforts were successful. The dough had higher quality, compared to parent lines, and resulted in loaves of higher volume. This information can help breeders to continue improvements and increase the demand for Kernza due to increased functionality.

Relevance of Research to State-Related Topic(s)

Kernza is a perennial grain being developed in Salina, KS. Perennial crops reduce labor input, soil erosion, carbon emissions, and use of herbicides, as well as help make the future of food more sustainable through regenerative agriculture. Kernza is also drought, frost, and disease resistant, thus supporting sustainable food production in a changing climate. The use of Kernza in food is limited mostly because of poor dough characteristics compared to wheat. Targeted breeding and end-use quality studies are important to increase functionality and find new avenues for utilization. Increased growing and processing of Kernza in Kansas supports the environment, regional economic development, and food security in the region.

NITROUS OXIDE EMISSIONS IN CORN WITH ASSOCIATIVE NITROGEN-FIXING BACTERIA

Irosha Wanithunga, Wagner Squizani, and Charles W. Rice
Department of Agronomy

BACKGROUND AND PURPOSE: Nitrous Oxide (N_2O) emission is one of the inadvertent Nitrogen (N) loss pathways in agriculture, which is a potent greenhouse gas with a ~300 times greater warming potential than atmospheric carbon dioxide (CO_2). Mitigation and quantification of N_2O emissions from cropping systems are critical to limit future climate warming effects and measure the carbon footprint of cropping systems for future carbon markets. Practicing innovative crop production strategies to reduce N_2O emissions and increase N efficiency and profitability in agriculture is important. The increased cost of N fertilizers has stimulated interest in biologically fixed N. A commercially available newly developed bioinoculant associates with corn roots and fixes N which could reduce N_2O losses. **METHOD:** The research was conducted at the Agronomy North Farm in Manhattan KS. The experiment was a Randomized Complete Block design with 4 N fertilizer rates (0, 56, 112, and 168 kg N/ha) with and without Proven. The experiment had 6 replicates. The static chamber technique was used to quantify the N_2O flux with measurements taken twice a week. **RESULTS:** Higher N_2O emissions were detected during the precipitation events early in the growing season in the year 2022. Emissions of N_2O increase with increasing N fertilizer application rates and N_2O emissions were reduced with bio-inoculant. **CONCLUSION:** The results of the 2022 season suggested lower N_2O emissions with bio-inoculants and were insignificant.

Relevance of Research to State-Related Topics (s)

Sustainable agriculture practices are essential for Kansas, as they play a pivotal role in maintaining and enhancing soil fertility while creating a resilient ecosystem capable of adapting to changing climate conditions. Transitioning to these methods and reducing reliance on synthetic nitrogen fertilizers would promise a transformative era aligned with legislative goals. This shift would nurture healthier soils, improving structure, nutrient retention, and resilience to extreme weather. It would solidify Kansas as a sustainable food production leader, addressing the global call for eco-friendly agriculture by curbing greenhouse gas emissions like nitrous oxide (N_2O) and conserving natural resources, notably through reduced nitrogen losses and water pollution. Economically, it would offer farmers cost savings, and secure agriculture's long-term viability. Furthermore, it would align Kansas with a sustainability-driven market and open avenues to carbon credit markets.

ASSESSING NITROGEN USE EFFICIENCY WITH INNOVATIVE ROOT-ASSOCIATED BACTERIA

Wagner Squizani de Arruda, Irosha Wanithunga, and Charles W. Rice
Department of Agronomy

BACKGROUND AND PURPOSE: Nitrogen (N) is a crucial fertilizer needed in the USA and worldwide for plant growth. It is highly valued in the agricultural sector, as it enables farmers to achieve greater yields and helps to feed the population. A bio-inoculant called Pivot Bio Proven® colonizes corn roots by fixing nitrogen bacteria, forming plant-microbe relationships that could improve nitrogen use efficiency, increasing sustainability and productivity. The objective of this study is to evaluate the impact of diazotrophic bacterial inoculant on corn cropping system for N use efficiency, yield and net return. **METHOD:** This study was initiated in 2021 and was performed over the course of three years located at the Agronomy North Farm, Manhattan, KS. The experiment has 4 Nitrogen rates (0, 56, 112 and 168 kg N/ha) with and without Proven® with six replicates. Plant biomass was sampled during the corn development stages (V8, VT, and Harvest), and grain yield was recorded at harvest. RESULTS: It was found that Proven® yielded better results at 0 and 112 Kg N/ha in both 2022 and 2023. Furthermore, the net return on investment was higher with Proven® when 112 kg N/ha was applied in 2022 and in 2023, and N uptake by plants with Proven® was recorded higher in the V8 and VT stages at all N rates when compared without Proven® in 2023. **CONCLUSION:** In 2022 and 2023, Proven consistently demonstrated trends of improved nitrogen use efficiency, particularly at 112 kg N ha^{-1}. Regarding net return, Proven appeared to be more favorable at 112 kg N ha^{-1}.

Relevance of Research to State-Related Topic(s)

Nitrogen (N) is an essential element that plays a crucial role in agriculture. However, Nitrogen use efficiency is often only 50% which translates to N loss to the environment. One way to increase efficiency is to manage N fertilizer inputs and develop alternative sources of N through biological N fixation. Thus, my research is to determine nitrogen use efficiency in corn with an N-fixing root-associated bacteria. The outcome will be to reduce the environmental impact of N on the environment while maintaining food production and profitability for the farmer.

EXPLORING FIELD-LEVEL SPATIAL AND TEMPORAL SOIL MOISTURE DYNAMICS WITH THE OPTRAM MODEL

Neda Mohammadzadeh[1], Andres Patrignani[2], and Marcellus M. Caldas[1]
¹Department of Geography and Geospatial Sciences; ²Department of Agronomy

BACKGROUND AND PURPOSE: Microwave remote sensing such as NASA's Soil Moisture Active-Passive (SMAP) satellite has great potential for global- and continental-scale soil moisture mapping. However, its coarse spatial resolution (36 km) often hinders field-scale applications in agriculture. The Optical TRApezoid Model (OPTRAM) is an emerging method that fills this gap by harnessing high-spatial resolution satellite images to estimate surface soil moisture. This study evaluated the spatial and temporal accuracy of OPTRAM-derived soil moisture against a dataset of in situ soil moisture measurements. **METHOD:** The spatial analysis consisted of using harmonized Sentinel-2 MSI reflectance data obtained from Google Earth Engine (GEE) to generate 20-m spatial resolution soil moisture maps at the KONA site of the National Ecological Observatory Network (NEON) near Manhattan, Kansas. OPTRAM-based soil moisture maps were compared with spatially intensive (n > 200) soil moisture surveys using a hand-held sensor obtained in July 2019. The temporal analysis consisted of comparing OPTRAM-derived soil moisture timeseries in 2019 and 2020 with daily volumetric water content at 5 cm depth collected using five calibrated capacitance sensors available at the NEON site. **RESULTS/FINDINGS:** Our findings indicate that OPTRAM effectively captures temporal variations in soil moisture at the field-scale with a root mean square error (RMSE) of 0.089 m3m-3, but does not accurately capture intra-field spatial variability with a root mean square error (RMSE) of 0.111 m3m-3. **CONCLUSION:** In conclusion, OPTRAM effectively captures temporal variations in soil moisture at the field-scale but requires modifications to better represent intra-field spatial variability for broader application.

Relevance of Research to State-Related Topic(s)

Western and central Kansas, known for their enduring agricultural heritage, are currently facing a significant decline in Aquifer water levels, as confirmed by the annual report from the Kansas Geological Survey. This situation, combined with the potential implications of climate change, underscores the urgent need for an enhanced understanding of the underlying processes governing the hydrological cycle. As surface soil moisture is one of the factors playing an important role in hydrology by influencing rainfall-runoff processes, the acquisition of precise spatio-temporal soil moisture data is of high importance. Numerous techniques for measuring SSM through ground instrumentation exist; however, implementing these methods across extensive regions, such as an entire state, has proven challenging due to the intricate, costly, and labor-intensive nature of deploying in-situ sensor networks at field-level. Consequently, the findings of this study hold the potential to provide the state with a technique to capture high-resolution soil moisture data at the field level in Kansas, offering the prospect of enhancing sustainable utilization and management of water supply management.

REDUCING TICK POPULATIONS THROUGH PRESCRIBED BURNING

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BACKGROUND AND PURPOSE: Ticks are one of the most important obligatory blood-feeding ectoparasites of livestock and humans. High tick burdens on cattle can result in decreased production and the transmission of a wide variety of pathogens. Tick control is difficult to achieve because a large proportion of the tick's life is spent off the animal host. Intentional burning of vegetation (prescribed burning) has been suggested as a potential method to reduce tick abundance; however, the efficacy of prescribed burning as a mechanism for tick control needs to be further evaluated. This study aimed to explore the effect of seasonal prescribed burning on the tick population in the Kansas Flint Hills. **METHOD:** Study areas have been burned annually in either the spring, summer, or fall for four consecutive years. Cattle are grazed on burn-treated pastures at an equal stocking density from early May to August. Ticks were collected from three pastures of each prescribed burn treatment while an unburned pasture served as the no-treatment control. Ticks were collected every other week from March to August and identified morphologically utilizing a microscope and published keys. **RESULTS:** Significantly fewer ticks were collected from fire-treated areas compared to unburned areas ($P<0.0001$). Additionally, the season of the burn can potentially further impact tick populations with significantly lower tick populations observed in spring burned vs. fall burned areas ($P= 0.0403$). **CONCLUSION:** This study suggests that repeated annual burning of grazing areas could be an effective method to effectively reduce tick abundance in cattle pastures.

Relevance of Research to State-Related Topic(s)

The beef cattle sector is the most significant agricultural industry in Kansas, essential for both the economic and food security of the state. One of the greatest risks to the industry is the losses caused by ticks and tick-borne pathogens. Tick control has largely relied on the use of in-animal acaricides; however, chemical control has significant deleterious effects and tick resistance is building. Alternative and effective non-chemical methods for tick control are urgently needed. Prescribed burning of grazing areas has been suggested as an alternative method to reduce tick abundance and potentially tick-borne pathogen prevalence. Strategically timing burn times to align with the vulnerable off-host periods during the tick life cycle is important to maximize the effects of prescribed burning for tick control.

DELINEATING DYNAMIC VARIABLE RATE IRRIGATION PRESCRIPTIONS

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BACKGROUND: Agriculture in the Colorado River Basin and Salinas River Valley produce nearly \$12 billion per year in income and employ more than 500,000 people. Irrigated agriculture in these regions consumes almost 32 million acre-feet of water per year (39% of the US total). Due to changes in climate and degradation of soil and water resources, the region has experienced prolonged and major droughts. In-season variable rate (VR) irrigation management (in space and time) across the field offers a promising solution to this problem. While nozzle-level VR control technology within irrigation systems has advanced, there remains a gap in research concerning how to effectively define these VR irrigation prescriptions. **METHOD:** A logical approach involves leveraging diverse data sources to understand the intricate interactions within the crop-soil-water-atmosphere system. To identify the necessary data for delineating these prescriptions, an extensive dataset is being compiled across Kansas and Colorado, encompassing soil samples, plant tissue samples, UAS multispectral imagery, soil moisture data, satellite imagery, weather parameters and more. This comprehensive dataset is used to monitor corn cultivation at a research site in Fruita, Colorado under uniform sprinkler irrigation. **ANTICIPATED RESULTS:** After monitoring the data collected throughout the season, we will utilize postdictive analysis to create dynamic VR irrigation prescriptions for future growing seasons. The effectiveness of this research will be based on the VR prescription's ability to both conserve water and maintain a high yield. **CONCLUSION:** While VR irrigation poses a promising solution to maximizing water effectiveness, continued research into this technology is vital for the prosperity of agriculture.

Relevance of Research to State-Related Topic(s)

In Kansas, an average of over 2 billion gallons of ground water have been depleted per day from agriculture irrigation so far in 2023. In 2022, the Kansas Geological Survey found that across the state, ground water levels dropped by an average of 2 feet as extreme drought caused farmers to irrigate crops more than usual. Irrigation strategies have historically been made without accounting for the variability in the field, leading to flat-rate applications that often over-irrigate parts of the field that do not need as much water. The future of agriculture in Kansas depends on advancing our ability to account for and leverage the natural variability in our farm fields so that we can mitigate wasted water. Variable rate irrigation offers a promising solution, but more research into delineating the dynamic variable rate irrigation prescriptions needed to utilize this technology effectively is required.

ROLE OF BIOLOGICAL NITROGEN FIXATION IN SOYBEAN PRODUCTION

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BACKGROUND AND PURPOSE: Biological nitrogen (N) fixation (BNF) is the primary source of N for soybean [*Glycine max* (L.) Merr.] and plays a crucial role in intensified systems. BNF dynamics are complex and are influenced by environmental factors and management practices, such as fertilization. While N fertilization for soybeans is unlikely to increase yields and isn't economically or environmentally feasible, sulfur (S) has emerged as an important co-limiting factor for soybean production. Currently, there is a gap in knowledge regarding BNF contribution across the United States (US). This research aims to gather soybean BNF data from diverse environments without S limitation. **METHOD:** Following a standardized protocol, we studied 37 locations during the 2021 and 2022 soybean growing seasons. Soybean plots were fertilized with Gypsum at planting time (34 kg ha^{-1} of S). Soybean BNF was estimated at the full-seed phenological stage by the ^{15}N natural abundance method. Seed yield was measured at maturity and adjusted to 13% moisture. **RESULTS/FINDINGS:** The BNF contribution averaged 43% across locations, reaching up to 90% of contribution. Seed yield ranged between 1.8 Mg ha^{-1} and 5.9 Mg ha^{-1}. Greater yields correlated with higher BNF contribution ($R^2 = 0.31$). **CONCLUSION:** Assessing BNF across multiple environmental conditions is crucial to identify the drivers of this process. With insufficient contribution of BNF, the crop potential is limited. Furthermore, BNF is essential for the long-term sustainability of the US corn-soybean system.

<u>Relevance of Research to State-Related Topic(s)</u>

Soybeans play a significant role in US agriculture. Kansas alone produces approximately 5.4 million Mg annually, ranking 9th nationally. Soybeans require a significant amount of nitrogen (N), and this need is primarily met through biological N fixation, a symbiotic relationship between the plant and specific soil bacteria. This process enables the plant to capture atmospheric N and integrate it into its tissues and seeds. Without N fixation, the crop is not sustainable and cannot achieve its full potential, which can also be limited by environmental and management factors. Assessing and understanding N fixation is crucial for the sustainability of the entire US corn-soybean system. If N fixation is insufficient, the soybean crop negatively impacts the broader concept of sustainability, presenting long-term challenges for future farming generations. This research aims to bridge the knowledge gap by summarizing data from multiple locations, underscoring the importance of biological N fixation in soybean production.

STARCH-BASED FOOD 3D PRINTING: IMPACT OF STARCH SOURCE, MOISTURE LEVEL AND SUGAR INCLUSION ON PHYSICO-CHEMICAL PROPERTIES AND PERFORMANCE

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BACKGROUND AND PURPOSE: Extrusion-based Food 3D printing is an emerging technology within food science and works by depositing 'food ink' through a nozzle to create shapes layer-by-layer. This study focused on characterizing physico-chemical properties of starch-based inks and their 3D printing performance. **METHOD:** Food ink mixes were formulated with a raw degermed corn and wheat base to study the impact of starch source, moisture content and sugar as a plasticizer. Water absorption index (WAI), phase transition anaylsis (PTA), differential scanning calorimetry (DSC) and rapid visco analysis (RVA) were used to determine physico-chemical properties of the raw materials. DSC and RVA were again used to study the printed samples, which were also evaluated for printing accuracy. **RESULTS/FINDINGS:** Sugar decreased the viscosity of the raw materials (2591 and 703 mPa·s, respectively, for wheat base and 12% wheat sugar inclusion, and 4655 and 1410 mPa·s, respectively, for corn base and 12% corn sugar inclusion), which in turn lowered water absorption for the samples due to sugar effecting the water activity of the food ink material. A decrease in viscosity initially led to a better 3D printing performance in terms of printability, but also led to poorer printing accuracy past 8% sugar inclusion. Additionally, higher moisture levels increased flow of materials out of the nozzle head of the 3D printer, but worsened printing accuracy. **CONCLUSION:** Further studies will be informed by these results to improve starch-based food 3D printing performance and accuracy.

Relevance of Research to State-Related Topic(s)

This research acts as a gateway for a new innovative food processing method that could provide economic development and job creation within the State of Kansas. Many food-processing companies use the principles behind this technology with food extrusion, and this would expand those businesses into new developments. Additionally, approximately 5% of Kansans suffer from dysphagia, or have some form of difficulty with swallowing. This research can help improve delivering nutrition compared to current processing methods for people who suffer from dysphagia. Because food 3D printing can produce more intricate shapes and unique textures, the approach outlined in this study will help design high performance food inks, which can contribute as a proof of concept for specialty foods designed for people with dysphagia.

EFFECTS OF PH AND WET COOKING ON SORGHUM STARCH DIGESTIBILITY, PHENOLIC PROFILE, AND CELL BIOACTIVITY

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BACKGROUND: Kansas is the top producer of sorghum grain. Some varieties contain high levels of health promoting phenolics that have shown anticancer properties in laboratory studies. However, the presence of phenolics is known to decrease digestible starch. **PURPOSE:** To examine the effect pH and wet cooking times on sorghum by evaluating starch digestibility, phenolic profile, and cell bioactivity. **METHODS:** Brown, whole grain sorghum flour was combined with buffers at various pH levels (3, 4, 5, 7, & 8), heated in a 100°C water bath for 0, 10, 30, 60, and 120 minutes and then freeze dried for 36 hours before analysis. Starch digestibility of sorghum was determined using the K-DSTRS kit from Megazyme. Changes in phenolic profile was measured using the total phenolic content (TPC) and condensed tannin content (CTC) assays combined with reverse phase high performance liquid chromatography (RP-HPLC). Cell bioactivity was determined using the cell inhibition assay in human colon cancer cells. **RESULTS:** Digestible starch increased after wet cooking. Cooking samples for 10 minutes did not reduce TPC of samples. CTC of samples decreased after cooking while pH had no affect. All 3-deoxyanthocyanidins decreased after 10 minutes of cooking. However, select flavanoids of interest either did not change or increased after cooking. Bioactivity was diminished by cooking for longer than 10 minutes. The bioactivity of sorghum polyphenols was more effective by cooking at lower pH levels. **CONCLUSION:** Cooking samples for 10 minutes improved starch digestibility without decreasing potential health benefits. This shows potential for polyphenol-containing sorghum to be used for health food applications.

Relevance of Research to State-Related Topic(s)

Kansas is the top sorghum producing state in the nation and produces around 50% of the country's total yield. Sorghum is an agronimically advantageous crop due to its drought, pest and disease resistance and ability to grow in a variety of soil conditions. Although sorghum is considered a food staple in many African and Asian countries, most of the grain produced is used for livestock, ethanol production or exported. Despite this, sorghum has gained recent attention for containing health promoting compounds called, polyphenols. The reported health benefitss from sorghum phenolics are extensive and include: antioxidant activity, anticancer, antidiabetic, diabetic control, anti-inflamatory, cardiovascular disease prevention, and obesity control. Validating sorghum processing methods is an important step in developing sorghum products for human health foods. Doing so may increase end-use of sorghum as a specialty crop will increase the profit margin for Kansas farmers.

CHANGES IN SOIL PHOSPHORUS POOLS AND LABILITY PROMOTED BY P FERTILIZATION AND COVER CROPPING

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BACKGROUND AND PURPOSE: Our production systems are threatened by agricultural phosphorus losses to the environment, which have severe consequences for surface water quality. Cover cropping to improve soil health and reduce soil erosion in cropping systems could also increase P loss unintentionally. Our previous results showed that cover crops increased dissolved reactive P (DRP). This could be related to changes in P speciation in soils. Our study aims to understand why cover cropping in our copping system has increased P loss. We hypothesize that cover cropping will increase plant available forms of P regardless of the P fertilizer management leading to increased availability of P. **RESULTS/FINDINGS:** Some of our results show that cover crops significantly decreased STP in 2019 but had no effect on STP in 2020 or 2021. Phosphorus fertilizer management significantly affected STP in all three years ($p<0.001$). The BM and SF fertilizer management had greater STP in comparison to the CN at the beginning of the study (2019) and both remained greater than CN throughout the study. **METHOD:** The field study was conducted near Manhattan, Kansas. The study included 18 plots. Soil samples were collected from three different points within each plot from three different depths (0-5, 5-10, and 10-15 cm). **CONCLUSION:** Understanding P forms and speciation will assist us to come up with substantial P fertilizer management practices in cropping systems including cover crops which can minimize P loss from agricultural lands.

Relevance of Research to State-Related Topic(s)

Farmers apply P fertilizers because this essential nutrient leads to plant growth and productivity, and better root, seed, and grain development. The cycle of the nutrients and in this case, phosphorus in the soil determines its availability and loss. Overloading the water resources with nutrients leached from agricultural lands to the water resources stimulates the rapid growth of algae and aquatic plants, resulting in dense mats or blooms on the surface. There is a natural and necessary level of nutrients in an aquatic ecosystem, but excessive levels can harm the ecosystem and the environment. Kansas, as an agricultural state that includes several lakes and water reservoirs, is experiencing severe blue-green algae outbreaks. Our research aims to understand the cycle of P in a cropping system including cover crops which unintendedly increase P loss to eventually assist farmers and researchers in applying substantial P fertilizer management practices to minimize P loss.

INVESTIGATING THE ROLE OF SORGHUM POLYPHENOLICS IN MEDIATING RESISTANCE TO STORED PRODUCT INSECT INFESTATION

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BACKGROUND: Feeding by stored product insects threatens the quality of stored grain and finished food products can cause significant economic losses. Traditional pest control methods, such as fumigation, often fail due to insecticide resistance. Polyphenols are plant compounds that can prevent insect feeding and may protect stored grains from insect damage. Our study examines the impact of sorghum polyphenols on population growth and development of four species: red flour beetle, warehouse beetle, lesser grain borer, and Indianmeal Moth (IMM). **METHOD:** We reared adult insects on four sorghum varieties containing a range of polyphenol concentrations using 20 grams of sorghum flour in half-pint jars. For IMM we used immature stage as adults do not consume food. A standard diet used for lab rearing was used for comparison. Jars were maintained at 32°C and 65% humidity, with each insect-sorghum combination replicated six times. After one-week, adult insects were removed and offspring were reared for approximately 65 days to monitor population numbers, mortality, development time, and weight. **RESULTS:** Initial findings reveal a negative relationship between polyphenolic concentrations and adult insect emergence in *T. variabile* and *P. interpunctella*. Ongoing research aims to identify specific polyphenol compounds responsible for these observed effects. **CONCLUSION:** Sorghum polyphenols potentially exert a negative impact on insect pest populations, offering promise for novel and sustainable pest management strategies.

Relevance of Research to State-Related Topic(s)

Our research plays a crucial role in enhancing food safety by tackling the pressing issue of protecting raw grain and food products commodities from stored product pests. These pests pose a substantial threat to both food security and safety, causing extensive damage and economic losses. Conventional pest control methods often fall short due to the development of insecticide resistance, increasing the risk of contamination and compromising food quality. Our study delves into the potential of sorghum polyphenols as a natural deterrent against these persistent pests. If sorghum polyphenols can hinder insect population growth or development, they could be utilized for eco-friendly and sustainable pest management strategies. This could lead to the development of non-toxic alternatives for pest control in food storage facilities, maintaining the safety and integrity of stored food products. Ultimately, our research aims to bolster food safety by offering innovative solutions to safeguard post-harvest commodities.

EFFECT OF REDCEDAR REVETMENTS ON STREAMBANK STABILIZATION IN MCCONNELL AIRFORCE BASE, WICHITA, KS

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BACKGROUND AND PURPOSE: Water bodies play a vital role in supporting ecosystem health, fostering diverse biodiversity, and facilitating natural processes. This research is centered on the assessment of stream health and the evaluation of redcedar revetments' effectiveness in mitigating streambank erosion along McConnell Creek at McConnell Air Force Base, Wichita, Kansas. The primary aim is to monitor and document the overall condition of the stream, focusing on the impact of revetment installations. This investigation seeks to determine the effectiveness of these revetments in reducing streambank erosion and assess their influence on the ecosystem. **METHOD:** Firstly, the impact of revetments was assessed by recording erosion and deposition rates before and after their installation. With rebar pieces, we measured the exposed length of burial to estimate erosion or deposition rates. Secondly, a bioassessment was conducted using macroinvertebrates before and after the revetment installation. Various indices were calculated to provide insights into water quality, habitat quality, species richness, and biodiversity. **RESULTS/FINDINGS:** By comparing pre- and post-installation data, a reduction in erosion rates and corresponding deposition rates has been observed. Additionally, the bioassessment involving macroinvertebrates revealed significant changes in water quality, habitat suitability, and an increase in species diversity following the installation of the revetments. **CONCLUSION:** The effectiveness of redcedar revetments in reducing erosion and enhancing habitat quality in stream restoration efforts. Moreover, the positive influence on macroinvertebrate populations suggests improved ecological health. These findings can inform future streambank management strategies, contribute to the preservation of ecosystem integrity, and serve as a model for similar restoration projects in different ecosystems.

Relevance of Research to State-Related Topic(s)

This study closely relates to several crucial concerns and themes that are crucial to Kansas as a state. First, it tackles the crucial problem of sustainable water supply, which is a top priority in a region where agriculture is very important. This research makes important contributions to the preservation and management of water resources by examining streambank erosion and the effectiveness of redcedar revetments. Second, by proposing solutions that not only safeguard the environment but also potentially open employment prospects in the field of ecosystem restoration, it links economic development and job creation. Additionally, the study's emphasis on enhancing habitat adaptability and water quality is related to plant and animal health. Since safer agricultural goods are influenced by cleaner waterways, it also indirectly addresses food safety. Overall, this research promotes environmental sustainability and fosters economic and community development while addressing important issues to Kansas legislators.

REATL-TIME MONITORING OF MICROWAVE TUMOR ABLATION PROCEDURES

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BACKGROUND AND PURPOSE: Microwave ablation (MWA), minimally invasive tumor treatment, uses a needle-like applicator to generate controlled heat for eradicating tumors. The goal is to destroy tumors while safeguarding nearby healthy tissue and preventing potential recurrence. Real-time monitoring of ablation procedures to determine when to terminate the ablation procedure is challenging and remains an unmet clinical need. The purpose of this research is to assess the technical feasibility of predicting the extent of tissue ablation between a pair of MWA applicators. **METHOD:** In multi-applicator MWA, we can monitor power propagation between applicator pairs by measuring complex transmission coefficients (CTCs), representing the power fraction transmitted between antennas. We conducted experiments using custom-built applicators in *ex vivo* bovine liver, varying power levels, distances, and applicator types to measure CTCs. To assess the predictability of ablation extents, we developed a linear regression model that relates the gathered CTCs to the actual ablation zones. We determined ablation zones by visually assessing tissue discoloration of the ablated tissue samples. The changes in CTCs and ablation extents during the ablation process were approximated using an exponential function for comparison. **RESULT:** Utilizing the linear regression mapping between the datasets, we accurately estimated ablation extent from CTC data with less than a 3% error. **CONCLUSION:** We have demonstrated the potential of employing CTC measurements as a tool to monitor the dynamic progression of thermal ablation zones in *ex vivo* tissue samples. This approach provides a means for real-time tracking of MWA, potentially guiding time termination of ablations.

Relevance of Research to State-Related Topic(s)

In 2023, the American Cancer Society estimates 5,690 cancer-related deaths and 16,840 new cancer cases in Kansas, underscoring the urgency of advancing cancer treatment methods. Recent advancements, like thermal ablation, offer cost-effective alternatives for patients ineligible for surgery. While microwave ablation is becoming an established approach, a critical challenge remains determining the optimal termination point. Our research introduces a novel monitoring technique, empowering clinicians to make more informed decisions about when to conclude ablations. This innovation can reduce costs by minimizing imaging and procedure durations, enhance precision, curbing tumor recurrence, and minimizing harm to healthy tissues. It promises to cut healthcare expenses while improving public health in Kansas and beyond, providing hope in the cancer battle. This research collaborates closely with Precision Microwave, Inc., a Manhattan-based startup backed by SBIR grants, working on groundbreaking microwave ablation technology.

NUMERICAL SIMULATION OF PHOSPHINE MOVEMENT IN BULK-STORED GRAIN

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BACKGROUND AND PURPOSE: Bunker storage is an inexpensive, and thus popular, method for medium- and long-term storage of wheat. To control insect infestations in bunker storage, phosphine (PH_3) fumigant, released from aluminum phosphide (AlP) tablets, is commonly used, especially in Australia. For fumigation to be effective, a lethal concentration of PH_3 throughout the bunker must be ensured. Because bunkers are exposed to ambient conditions, temperature gradients are created throughout the bunker, resulting in natural convection currents that move PH_3 from areas around the fumigation points to the entire bunker. **METHOD:** This research used simulations using a standard computer modeling technique, computational fluid dynamics (CFD), to investigate the effect of natural convection on fumigation in bunkers. The model was validated against published benchmarks and a field experiment with a full-scale bin with sorption and leakage. The effects of PH_3 release point location, bunker shape, bunker orientation, leakage, sorption, ambient temperature fluctuation, and PH_3 motion in 3D were studied. The simulations were done with the aid of the computer program ANSYS FLUENT 2021 R1. **RESULTS/FINDINGS:** Results agreed well with the experimental data, identified several issues, and provided various recommendations for best management practices for PH_3 fumigations in bunkers. Results showed that diffusion and natural convection alone are insufficient in spreading out PH_3 within bunkers. **CONCLUSION:** The CFD model can be extended to further improve the fumigation process in bunkers. Further research is needed to investigate the effects of tarpaulin billowing on the PH_3 behavior and effectiveness of fumigation.

Relevance of Research to State-Related Topic(s)

This study adresses food safety. With bunker storage being a widely-used method for medium- and long-term storage of wheat, there is a strong need to control insect infestation within the bunkers. An effective fumigation application will ensure the quality of wheat is maintained during storage and minimize contamination and associated economic losses. The complete mechanisms of the movement of fumigants (i.e., phosphine) in grain bunkers are difficult or impossible to observe and measure experimentally, but a validated CFD model can reveal those important aspects. A valid CFD model, which this study seeks to develop, will provide measures to improve management practices for PH_3 fumigations in bunkers and such practices can eventually be standardized for all bunker storage systems.

AUTOMATED PIPELINE FOR MULTI-POLYGON SHAPEFILE GENERATION FOR PHENOTYPE AND PRECISION AGRICULTURE APPLICATIONS

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BACKGROUND: The plant breeding community increasingly adopts remote sensing platforms like Unmanned Aerial Vehicles (UAVs) to collect crop phenotype data. These platforms capture high-resolution multi-spectral (MS) image data during extensive field trials, enabling concurrent evaluation of hundreds of plots with diverse seed varieties and management practices. Plant breeders rely on manual and intricate data extraction, processing, and analysis of high-resolution imagery to draw conclusions and achieve numerical targets. However, a significant challenge lies in precisely identifying plot locations within high-resolution field imagery, delineating plot boundaries, and providing spatial references according to the experimental design. Therefore, the study aimed to create multiple polygon shape files with unique identifiers for overlaying on drone imagery data with centimeter-level accuracy. The goal was to develop a pipeline without assuming field uniformity, plot spacing, size, or quantity, eliminating the need for manual adjustments. **METHOD:** The proposed method utilized precision agriculture techniques, incorporating high-accuracy plot position data from a precision planter and georeferenced UAV imagery. This process automatically generates plot boundaries and converts planter-logged real-time kinematic GPS points to polygons representing each planted row. **RESULTS:** The resulting pipeline automatically produced maps, multi-polygon shape files, and CSV files of plot boundaries for external software and downstream analysis. Notably, the polygon shape file consistently aligned with plot boundaries within the image and even across temporal data sets. **CONCLUSION:** This approach provided an efficient, adaptable, and replicable automated solution, minimizing time, labor, and user involvement while facilitating zonal statistics extraction of each phenotype plot.

Relevance of Research to State-Related Topic(s)

The research is a vital part of a larger soybean breeding project that has the potential to enhance food security in Kansas and beyond borders. The goal is to develop an automated tool for swift analysis of soybean breeding plots. This methodology enables rapid extraction of individual plot responses and analysis of seed varieties in the field. It aims for efficiency, adaptability, and reproducibility while minimizing time and labor. Quickly and accurately analyzing breeding data, especially for drought and disease-resistant varieties, can accelerate the development of soybean varieties that farmers can adopt promptly. Given unpredictable weather and the impact of diseases on crop yields, these resistant varieties could boost soybean producers' productivity and profits. Furthermore, remote sensing data is becoming essential for researchers and producers seeking to collect and utilize data. The tool can quickly analyze large datasets collected multiple times during the crop cycle, enabling valuable insights.

OPTIMIZING PLANTER DOWNFORCE MARGIN AND GROUND SPEED FOR CORN SEED PLACEMENT

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BACKGROUND: Much research has been conducted to study the effects of downforce on the planting quality of a crop. Determining and implementing appropriate gauge wheel margins is still conducted by manual estimation. The lack of knowledge of gauge wheel margins with changing speeds limits new control strategies for greater system accuracy. **PURPOSE:** Therefore, this study aimed to quantify seeding depth, emergence uniformity, and plant spacing during ground speed changes to understand gauge wheel margin implementation strategies. **METHOD:** The crop was planted using a John Deere 24-row planter with "ExactEmerge" Row units and individual row hydraulic downforce control. The experiment was designed in a split-split plot design. Within each block, four treatments of gauge wheel load were selected: 100 lb., 175 lb., 250 lb., and 325 lb. combined with three ground speeds: 5 mph, 7.5 mph, and 10 mph. Within each experimental unit, 17.5 feet of experimental strips were demarcated. After the sowing of the experiment, and within the strips on experimental units (EU) of each block, seed depth was measured using digital calipers from the top of surface stubble, emergence speed every 12 hours, and distance between emerged plants. **RESULTS:** A strong positive correlation ($\alpha=0.05$) was observed between seed depth and forward speed for each chosen downforce margin. Furthermore, the findings suggest that strips with superior seed depth uniformity and closer proximity to the target depth exhibit a higher emergence percentage. **CONCLUSION:** We conclude that a specific combination of downforce margin and ground speed for every soil condition is needed for optimal corn seed placement.

Relevance of Research to State-Related Topic(s)

The agricultural economy in Kansas heavily relies on the corn industry. The corn sector produces bushels and contributes significantly to the economy. Moreover, it supplies feeding intakes for the cattle sector and is a feedstock for biofuel industries. For many years, improving the uniformity of corn seed placement in terms of both location (vertical and horizontal axis) and emergence has been a critical focus area in the research and development of precision planters. Planting is a pivotal step in corn production that enables the optimal placement of seeds for uniform emergence, ultimately leading to maximum yield. This can only be achieved by ensuring the seeds are placed in a favorable environment for germination and growth. To attain optimal outcomes for the state of Kansas Corn industry, it is imperative to pay close attention to two critical factors during planting: uniform seeding depth and seed spacing achieved with the planter.

MICROPLOTTER-PRINTED GRAPHENE-BASED ELECTROCHEMICAL SENSOR FOR DETECTING PHOSPHATES

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BACKGROUND AND PURPOSE: Agriculture continues to be the foundation of global food security and economic prosperity. As the world's population grows and urbanization persists, improving crop yields on farmland while mitigating environmental impacts is paramount for many stakeholders. Phosphorus (P), in the form of phosphate ions, is a key macronutrient essential for robust plant growth. While the deficiency of P in soils hampers healthy plant development, excessive P due to the usage of P-based fertilizers causes eutrophication. This necessitates monitoring phosphate levels in soil and water through accurate and reliable detection technologies, such as sensors. The development of such sensors requires careful evaluation of the sensing material, its manufacturing, and the sensing mechanism. **METHOD:** Herein, we report the manufacturing of a high-quality graphene nano-ink and its use for the first time in fabricating printed phosphate sensors. The graphene nano-ink was synthesized in-house using a large-scale polymer-assisted liquid phase exfoliation method. After an extensive characterization of the ink to validate its quality, it was printed as sensor electrodes using a Microplotter. The printed sensor electrode was utilized in an electrochemical system to detect phosphates. **RESULTS/FINDINGS:** The proposed method showed a sensitivity of $0.3223 \pm 0.025 \, \mu A \, \mu M^{-1} \, cm^{-2}$ with a limit of detection of 2.2 μM and a linear sensing range of 1 to 600 μM. The electrode also indicated excellent selectivity towards phosphate ions in the presence of common interfering ions. **CONCLUSION:** The sensor has the potential for cost-effective, prolonged monitoring of real-time phosphate levels in soil and water.

Relevance of Research to State-Related Topic(s)

Agriculture, the heart of Kansas, presents 42% of the state's total economy, establishing itself as the major economic driver. According to the 2022 economic contribution report by the Kansas Department of Agriculture, agriculture and agriculture-related sectors yielded $53.4 billion in output and 136,227 jobs. In light of these numbers, it becomes evident that legislators and lawmakers must seek solutions to sustain and enhance the productivity of this pivotal sector. One such solution is to foster technological innovations for soil nutrient monitoring, as outlined in the abstract above, through the development of high-precision sensors. Adoption of cutting-edge technologies like the printed graphene electrochemical phosphate sensor will pave the way toward ensuring the state's agricultural resilience, sustainability, and global competitiveness. Additionally, these innovative technologies possess the potential to increase agricultural productivity and address the environmental challenges associated with the sector, proving their multifaceted nature and extended benefits.

IMPROVED REAXFF PARAMETERS FOR SIMULATING NUCLEATION AND CRYSTAL GROWTH IN ICOSAHEDRAL BORON MATERIALS

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BACKGROUND AND PURPOSE: Icosahedral boron materials, which include regular icosahedra of 12 boron atoms(B_{12}), have gained increasing attention due to their potential applications in areas such as super-hard materials, semiconductors, and energy storage. However, the synthesis of high-quality crystals of these materials has been a major barrier to the development of these applications. Our research aimed to evaluate and enhance the accuracy of Reactive Forcefield (ReaxFF) parameters in simulating small boron clusters, specifically B_{80}, and B_{103}, by comparing their minimized energy values with Density functional theory (DFT) results, which is the closest computational approach to the experimental in terms of accuracy. The overarching goal was to improve the fidelity of these simulations, paving the way for accurate predictive models. **METHOD:** We employed the GPU-accelerated ReaxFF implementation in Large Atomic Mass Molecular Simulation (LAMMPS). Additionally, we simulated the growth of B_{12} from a seed crystal at various temperatures below boron's melting point, maintaining a pressure of 1 atm. **RESULTS/FINDINGS:** Our findings indicated that while the original ReaxFF parameters showed minimal icosahedrality during seed crystal growth, the refit versions evidenced the rapid formation of icosahedron-like motifs over nanosecond scales. **CONCLUSION:** The refitted parameters showcased enhanced agreement with DFT for relative energies of B_{80} and B_{103} clusters and exhibited a more pronounced icosahedron-like local structure. However, crystal growth from seeds remains elusive, suggesting a necessity for enhanced sampling. Additionally, certain low-energy clusters indicate potential improvements in refit ReaxFF. Our ongoing endeavors focus on the development of ReaxFF parameters potentials to effectively simulate crystal growth in icosahedral boron materials.

Relevance of Research to State-Related Topic(s)

Boron compounds, with their unique B_{12} icosahedron structure, are pivotal for alternative energy development due to their super hardness, radiation resistance, and electronic properties. These materials are key to betavoltaics, especially in space, where battery replacement is costly. Unlike traditional pacemakers that need battery replacements every 5 years, nuclear batteries, powered by the consistent decay of radioisotopes, can last decades, eliminating frequent surgeries. Our computational study on boron synthesis is vital for Kansas's sustainable energy and health objectives, spurring economic growth and positioning Kansas as a sustainable energy research leader.

GROWING MORE WITH LESS: SMART IRRIGATION FOR A SUSTAINABLE FUTURE IN WESTERN KANSAS

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BACKGROUND AND PURPOSE: Given the dwindling groundwater resources of Western Kansas and to ensure their long-term sustainability for agricultural production, we must implement more efficient irrigation management practices that can address the two most prominent challenges in the area: the prevalent impacts of extreme climate conditions on crop yield, and the excessive withdrawal of water resources. **METHOD:** Our research employed the DSSAT-CERES Maize model to assess the efficacy of evapotranspiration-based (ET-based) irrigation scheduling in improving Maize crop resilience to extreme growing-season climate conditions. We conducted a 30-year simulation on twelve different irrigation treatments defined by four ET requirement thresholds (15mm, 20mm, 25mm, and 30mm), each replaced at three levels (50%, 75%, and 100%). A baseline for comparison, referred to as the farmers' choice, was provided, where irrigation was initiated automatically when the plant-extractable water in the soil profile dropped below 50%. **RESULTS/FINDINGS:** In comparison to the farmers' choice, we found that applying a 75% deficit of the cumulative ET of 30mm or 25mm maintains yield loss below 12%, saves up to 20% on water use, and can improve water productivity by up to 6%, under normal weather conditions and when the maximum temperature and the duration of dry periods are increased by up to 4°C and 1 day, respectively. **CONCLUSION:** ET-based deficit irrigation adapts well to extreme heat and water stress, bearing important implications for irrigation management decisions in the future.

Relevance of Research to State-Related Topic(s)

Kansas, especially the western region, faces challenges of limited water resources for agricultural production. Currently, measures such as limiting water rights are being implemented to curb excess use of the Ogallala aquifer, a vital water source in the region. However, reports of extreme climate events such as drought and heat waves further complicate the situation, as these events can potentially increase the water demand, which, when unmet due to limited water rights, can drastically reduce the overall agricultural production capacity of the entire state. Our research provides a ray of hope in this challenging situation. By incorporating the findings and recommendations from this research, agricultural producers can be better prepared against the potential impacts of harsh weather conditions without significantly decreasing their productivity or needing to acquire additional water rights.

OPTIMAL SIZING OF PHOTOVOLTAIC-BATTERY SYSTEM FOR PEAK DEMAND REDUCTION USING STATISTICAL MODELS: A CASE STUDY IN GREENSBURG, KANSAS, US

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BACKGROUND AND PURPOSE: This research designs a photovoltaic (PV) system for Greensburg, Kansas. The challenge is determining optimal PV size, requiring technical and financial evaluations. Often, customers are charged for energy and peak demand. Thus, PV installations should decrease energy costs and peak demand. We observed peak loads in Greensburg typically arise in winter mornings and partially in spring and fall when there is little to no PV generation. While PV can reduce energy costs anytime during its operation, peak demand reduction is more complex. To tackle this problem, excess energy can be stored in batteries to address peak demands during low PV generation. Traditional methods, relying on historical data, don't consider uncertainties. **METHOD AND FINDINGS:** We introduce a unique method to determine optimal PV-battery sizes, focusing on peak demand reduction, especially tailored for small electricity distributors or rural areas. The strategy seeks to identify a peak threshold where further expansion of battery capacity no longer delivers significant peak reduction or financial benefits. The outcomes of this research have been rigorously verified using real-world data from the case study, leading to a system design of 1200 kW PV and 3600 kWh battery. The findings demonstrate that the designed model can flatten the peak loads up to 2078 kW with 95% probability. The designed PV-battery system yields a benefit of $820,373 over two decades and recoups its installation cost within six years. This represents a pioneering advancement, offering a practical alternative to conventional methods and facilitating informed decision-making in real-world scenarios.

Relevance of Research to State-Related Topic(s)

My research revolves around the design and optimization of solar photovoltaic (PV) systems coupled with battery storage solutions, specifically targeting rural settings like Greensburg, Kansas. This work is directly relevant to the state's legislature. By promoting renewable energy sources such as PV-battery, it champions Kansas's focus on sustainable energy, paving the way for a more environmentally-greener state. The advancement of these systems can boost economic development and job opportunities, especially in renewable energy installation, maintenance, and research sectors. Additionally, in rural communities like Greensburg, where consistent energy access is pivotal, optimized PV-battery systems can elevate community development and living standards. Notably, in line with the "Kansas rural economic development act," which aims to invigorate economic growth in rural regions, my research offers an energy solution that aligns with the state's vision. It not only ensures sustainable power but also contributes to economic growth, community enhancement, and environmental stewardship in Kansas.

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AGRICULTURAL STAKEHOLDERS DISCUSSING IMPLICATIONS OF CROPPING SYSTEM DECISION FACTORS FOR U.S. AGRICULTURAL DIVERSIFICATION

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BACKGROUND AND PURPOSE: In recent years, there has been a growing interest in the sustainability of farming systems, raising specific inquiries with respect to the need to match agricultural productivity with sustainable farming practices. Agricultural diversification has been promoted among management strategies that demonstrated beneficial impacts on agricultural productivity and ecosystem health, thus providing a pathway toward sustainable agricultural systems. This study investigates factors influencing decision-making in cropping system management within this context. **METHOD:** We interviewed 48 agricultural stakeholders in 4 counties that represent diverging trends in cropping system diversity. **FINDINGS:** The preliminary results show that both human and environmental factors and their interactions guide cropping system decision-making related to diversification and sustainable agriculture. Markets, networking, labor, policies, technology, climate, and soil type are the fundamental elements that drive decisions on land use and crop selection. **CONCLUSION:** This research shows how agricultural producers navigate complexity to decide which species to plant on their farm grounds. The study also highlights the tensions and possibilities created by diversifying farming systems.

Relevance of Research to State-Related Topic(s)

My research on factors shaping the management of cropping systems diversification has significant relevance to several topics and issues in the state of Kansas. Kansas' agriculture is in the top ten states that contribute significantly to the United States' commodity production. Therefore, improving our knowledge of management decisions that can improve the sustainability of agriculture is critical to designing farming systems that focus on ecosystem health and community well-being. The findings of this study will help agricultural stakeholders to better address the key farming issues in Kansas.

TRANSFORMING K-12 EDUCATION BY BLENDING THE UBUNTU PHILOSOPHY WITH SOCIAL JUSTICE PRINCIPLES

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BACKGROUND AND PURPOSE: Recently in both formal and informal communities in the USA where the researcher is a graduate student, there has been some growth in the application of diversity, inclusion, cultural responsiveness, and social justice concepts. Considering the highly diverse nature of the population in the U.S., there is no surprise for the calls for a socially just education and a transformative diverse pedagogy in schools, which seeks to promote an Ubuntu learning community and, bridge distances and differences of people. The researcher is of the view that while sections of the population such as Native Americans, People of African Ancestral Origin (Blacks), and Hispanics come from a background of oppression, marginalization, limited opportunities, and exclusion, a study that highlights the sense of community and a social just education will make a great impact that brings transformation. **METHOD:** The research used a qualitative research method, employing content analysis of available literature as well as reports from both government and non-government organizations. The Inductive thematic analysis approach was utilized to analyze data that emerged from the document analysis. First, recurring words, phrases, and text were coded. Pertinent patterns identified were put into categories, and then themes were developed from the categories. **RESULTS/FINDINGS:** Some interventions that promote togetherness, coexistence, respect, and cooperation were identified with the intersection of the *Ubuntu* pedagogy and Collective Fingers principles and have been essential to enact students and the community with values capable of cultivating equity, recognition, and fair participation of diverse people from various social, economic, cultural, linguistics, and sexual background in present society. **CONCLUSION:** The researcher concludes that if these proposed interventions are considered, with deliberate systemic and structural efforts, the calls to promote coexistence among students and people in our communities will be an easy accomplishment toward the journey of social cohesion.

Relevance of Research to State-Related Topic(s)

The study identified interventions that promote unity, coexistence, respect, and cooperation through the intersection of the Ubuntu pedagogy and Collective Fingers principles. These interventions have proven crucial in instilling values that can foster equity, recognition, and active participation among individuals from diverse social, economic, cultural, linguistic, and sexual backgrounds in the State of Kansas. The researcher asserts that by considering these proposed interventions and implementing them with deliberate systemic and structural efforts, it will be attainable to promote coexistence among students and community members. This, in turn, will facilitate the achievement of social cohesion in educational contexts within the state of Kansas.

DILAPIDATED TO VIBRANT: ADAPTIVE REUSE AS A CATALYST FOR REGENERATING URBAN AREAS THROUGH PUBLIC PRIVATE PARTNERSHIPS

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BACKGROUND AND PURPOSE: Urban areas, once thriving, have faced deterioration, leading to environmental degradation, social inequalities, and cultural loss. Adaptive reuse, which involves repurposing existing buildings for new uses, has emerged as a sustainable solution to these challenges. This research focuses on understanding the process in the success of adaptive reuse projects, aiming to revitalize urban areas while preserving their cultural heritage. **METHOD:** A case study approach will be employed, analyzing planning and project documents from three adaptive reuse projects: The West Bottoms and The Crossroads District in Kansas City, Missouri, and The Old Market in Omaha, Nebraska. The study will examine land use, demographic data, zoning codes, and the mechanisms of PPPs in these areas. Informational interviews with key personnel involved in the projects, city planners, and developers will further enrich the research. **RESULTS/FINDINGS:** Preliminary findings suggest that adaptive reuse projects, backed by PPPs, have the potential to regenerate urban areas, making them more vibrant and sustainable. These projects not only contribute to environmental sustainability but also play a pivotal role in preserving cultural heritage and fostering community interaction. **CONCLUSION:** Adaptive reuse, supported by PPPs, offers a holistic approach to urban regeneration. It not only addresses the challenges of urban decay but also ensures the preservation of cultural identity. The insights from this research can guide policymakers, city planners, and developers in implementing successful adaptive reuse projects.

Relevance of Research to State-Related Topic(s):

This research directly relates to economic development, job creation, community development, and quality of life in urban communities within Kansas. By understanding the process and role of PPPs in adaptive reuse projects, Kansas can leverage this approach to revitalize its urban areas, attract businesses, create jobs, and enhance the quality of life for its residents. The findings can guide state legislators in formulating policies that promote sustainable urban development, preserving the state's cultural heritage while ensuring economic growth.

I NEED HELP! THE ASSOCIATION BETWEEN MOTHER'S SUPPORTS, OVERALL LIFE SATISFACTION, AND CHILD'S FELT CLOSENESS

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PURPOSE: The purpose of this study is to understand how financial support, family support, and employment affect the overall life satisfaction of mothers, and the felt closeness of their children. **METHOD:** Using data from the Fragile Families and Child Wellbeing Study (FFCWS) wave 5 (n = 2541), this study provides insight to factors that directly affect mothers over all life satisfaction and how life satisfaction affects child's felt closeness. **RESULTS:** There was a correlation between higher levels of social and familial support and mothers' overall life satisfaction, specifically emergency childcare. Child's felt closeness was directly affected by the number of hours mother worked. **LIMITATIONS:** Mothers were not categorized by any demographic information, the only specification used was to be identified as a mother.

Relevance of Research to State-Related Topic(s)

Healthy happy mothers raise happy healthy children. It is important identify and isolate the challenges mothers face when measuring over life satisfaction, services and resources can be offered to increase over-all life satisfaction. Mother's access to outside social support can increase their ability to parent healthy and effectively. Community mental health services and employment balance could help to strengthen the connections between mother and child.

DEMOGRAPHIC PREDICTORS AND MENTAL HEALTH OUTCOMES OF THERAPY ATTENDANCE

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BACKGROUND AND PURPOSE: Therapy is a service which may not be equitably accessible to marginalized groups (Aratani, 2011). To better understand which populations may need more equitable care, this study will investigate gender, race, ethnicity, sexual orientation, income, and level of education as predictive factors of therapy attendance. Measured mental health outcomes are depression, anxiety, and resilience. **METHOD:** The study was guided by biopsychosocial theory, as we examine social, biological, and psychological factors and their association with participation in therapy. A series of logistic regressions were run from online survey data to examine psychological, social, and biological factors and their association with attending therapy in one's lifetime. **RESULTS/FINDINGS:** Being a female (OR = 2.64, p < .001), being LGBTQ+ (OR = 2.47, p < .001), and being white (OR = 2.12, p = .021) were all significantly related to therapy attendance. Higher levels of anxiety (OR = 1.06, p = .002) and higher levels of depression (OR = 1.04, p = .033) were both associated with an increase in the likelihood of ever going to therapy. Higher levels of resilience was associated with a decrease in ever going to therapy (OR = 0.74, p < .001). Employment, age, education level, income, IPV perpetration and IPV victimization were not significantly related to ever attending therapy. **CONCLUSION:** These results provide information on which populations may benefit from an increase in mental health care through policy and resource allocation. The results also emphasize a need for further investigation into potential barriers of attendance, such as stigma and treatment tailoring.

Relevance of Research to State-Related Topic(s)

Therapy is an essential tool for the national population to help with a wide variety of mental health issues (Prince, 2007). As therapy continues to grow in demand (Lipson, 2019), so does the need to monitor participation across demographics and impact on mental health factors. A better understanding of which populations require more mental health resources may help point legislation in an equitable direction in this field. The Kansas State Legislature have taken major steps towards supporting the mental health of its citizens, and taking steps towards learning what to do next is essential to future change.

HOW THE ROLE OF SELF OF THE THERAPIST WORK IN SUPERVISION IMPACTS THERAPEUTIC GROWTH AND DEVELOPMENT
Brooke Balderson
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BACKGROUND AND PURPOSE: Supervision is one of the most important aspects of clinical development in Marriage and Family Therapy training. A key focus of development in clinical supervision is the clinician's Self of the Therapist, which is becoming aware of one's biases, positionality, and conceptual preferences (lenses, models, theories) and how these impact the therapeutic process and client outcomes. The purpose of this study is to provide insights into how Self of the Therapist work develops in clinical supervision to promote therapist growth. **METHOD:** A pilot study was conducted using in-depth interviews to explore Self of the Therapist work during supervision. The interviews consisted of structured, open-ended questions that allowed for follow up probing questions and lasted 90 minutes. The interviews were recorded allowing for transcripts to be coded, looking for themes and patterns. **RESULTS/FINDINGS:** Therapist credits Self of the Therapist awareness to their growth and development as a clinician. Themes of therapist's presence in the therapy room, therapist feelings in the room, post-session feelings and reactions, trigger awareness, work ethic, client/therapist awareness, safety with supervisor, and bidirectional impacts (outside world impacting the room and the room impacting the outside world) were present. **CONCLUSION:** Additional research that highlights patterns of SOT themes across multiple developing clinicians could be merged into a grounded theory allowing for additional supervisory models to be developed to standardize SOT work during training.

Relevance of Research to State-Related Topic(s)

Mental health remains an interest to the Kansas State Legislature as indicated by their special committees on the topic. Self of the Therapist work serves an integral role in the training of Kansas clinicians by strengthening therapist awareness. This becomes paramount when working with clients of differing demographics. Oftentimes, there is a difference in political views, religious stance, and economic status between larger communities and their rural counterparts. Self of the Therapist work highlights WHY a clinician makes therapeutic choices based on their own biases. By not having an awareness of this process, therapists could inadvertently cause more harm than benefit when working with populations that differ in values, priorities, and beliefs.

ALZHEIMER'S DISEASE MODEL DISPLAYS SEX DIFFERENCES IN EXERCISE TRAINING ADAPTATIONS

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BACKGROUND AND PURPOSE: Exercise represents a promising strategy for protection against Alzheimer's disease in older adults. However, our understanding of exercise-induced neuroprotection remains incomplete. In order to further our understanding of the connection between skeletal muscle and the brain using biochemical analysis, the present will first determine the effects of chronic aerobic exercise on behavioral and body composition in the TgF344-AD rat model of AD. **METHODS**: Male and female TgF344-AD rats with confirmed AD transgene presence and wild-type (WT) littermates, underwent an six-month progressive treadmill training protocol or remained sedentary from 12-18 months of age. Training was five days per week, maximizing at 24 meters per minute for 60 minutes. At 18 months we assessed spatial learning, motor coordination, and mass of skeletal muscles (SkM), whole brain, and hippocampi. **RESULTS**: In females, AD impaired spatial learning ($p<0.05$) and exercisers had improved motor coordination ($p<0.05$). In males, exercise increased brain mass (% body mass, $p<0.01$) and hippocampus mass (% brain mass, $p<0.05$) independent of AD genotype. In females, exercise-induced changes in hippocampus were different in AD and WT littermates ($p<0.05$). SkM mass (% body mass) was increased by exercise independent of AD genotype in males and females ($p<0.01$). Male AD animals increased slow-twitch fiber mass ($p<0.05$) while female WT animals increased slow- ($p<0.05$) and fast-twitch fiber mass ($p<0.05$) greater than respective sedentary counterparts. **CONCLUSION**: Body mass and cognitive adaptations to aerobic exercise manifest differently in male and female TgF344-AD rats.

<u>Relevance of Research to State-Related Topic(s)</u>

Alzheimer's disease (AD), the leading cause of dementia, is a major health condition impacting the health of Kansans. It it estimated that 55 thousand Kansas over the age of 65 lived with AD in 2020 and this figure is projected to rise to 62 thousand by 2025, representing a 12.7% increase in prevalence. In addition to impacting residents' quality of life, increases in AD prevalence impose a burden to the state's health care systems and KanCare program. However, for older adults, exercise is one of the most promising strategies for reducing the risk of AD onset. A recent study of >78,000 older adults suggests that 10,000 steps per day may reduce AD risk by 50%. Our understanding of exercise-induced neuroprotection remains incomplete. This line of research builds toward understanding how exercise protects the brain which may improve preventative or theraputic strategies and mitigate the increasing prevalence of AD.

EFFECT OF TREADMILL TRAINING IN A RODENT MODEL OF AUTISM SPECTRUM DISORDER

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BACKGROUND: Autism prevalence has increased 175% since 2000 with 1% of the world's population identified with autism spectrum disorder (ASD). Today, ASD affects 1 in 36 children and is characterized by delayed language, motor and cognitive skills. **PURPOSE:** Provide a better understanding into the pathology and the potential impact of exercise. **METHODS**: Sixteen Long-Evans pregnant rat dams were injected with a single dose of either saline (n=5) or VPA (Sodium Valproate (sigma), 250mg/ml, mixed in saline, 600 mg/kg, n=11). Prenatal exposure to VPA increases the risk of ASD development in offspring. Rats began a 4-week exercise protocol on the treadmill (Harvard Apparatus, Holliston, MA) on post-natal day 40. Rats ran 5 days a week for 40 minutes at 5-13 cm/s at 0° inclination. Motor coordination was measured with a rotarod pre and post intervention. The rod maintained a constant 5rpm speed and the trial ended after 180 seconds. Latency time was recorded for each trial. Following behavioral testing, brain and skeletal muscle tissues were collected. Skeletal muscle was homogenized, and western blots were conducted to quantify protein expression. **RESULTS**: While not statistically significant due to high variability, trends toward reduced motor coordination in the VPA groups was improved with exercise. Treadmill trained animals trended towards higher citrate synthase expression compared to sedentary animals (not statistically significant), indicating an exercise effect. **CONCLUSION**: The protective effect of exercise against ASD pathology is important to understand both in its use as a therapy but also as a tool to highlight the protective pathways.

Relevance of Research to State-Related Topic(s)

In Kansas, the care available to individuals with ASD is limited. Only 65 children receive services while 400 remain on the medicaid program waiting list. The lack of services is especially apparent in rural areas where healthcare facilities and services are already limited. The foster care system takes an extra hit, as many children in fostercare struggle with ASD. Over the last fiscal year, 57 children were removed from the Kansas foster care system due to the great cost and commitment of caring for ASD. Autism can be improved with early interventions, and with the current state of knowledge on care, and the lack of available services, early intervention does not happen often. Understanding the impact that an exercsie intervention may have on ASD can be greatly impactful to help individuals sturggling with the disorder, their families, and in turn their communities.

EFFECTS OF INTERMITTENT FASTING ON BRAIN AND SKELETAL MUSCLE TISSUES IN MALE FISHER-344 RATS

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BACKGROUND AND OBJECTIVES: Intermittent fasting (IF), time-restricted eating, has been shown to improve cognition in animal models through the regulation of protein synthesis (mTOR pathway) and oxidative stress damage (antioxidant expression). We hypothesized that IF would improve antioxidant expression and reduce protein synthesis. **METHODS**: Twenty-four, 10-week-old male Fisher-344 rats were randomly assigned into two groups (ad-libitum, or IF) and housed 4 per cage, on a 12:12 light: dark cycle. Ad-libitum group had 24/7 access to food and water while the IF group had 24/7 access to water and full access to food on an every-other-day basis for ten weeks. At 20 weeks of age, animals were euthanized and brain and skeletal muscle tissues were sectioned, and snap-frozen. Following homogenization, Jess Protein Simple automated western blotting was used to quantify mTOR (Santa Cruz, sc-517464), and SOD2 (Abcam, ab68155). Compass software-generated *area under the curve* values were used to determine protein expression and analyzed with a two-tailed T-test per Prism Graph Pad software. **RESULTS:** In cortex tissue and skeletal muscles, mTOR expression was significantly reduced in the IF group compared to the AL group ($p<.001$, $p<0.05$), however, mTOR expression was not significantly different in the hippocampus. Antioxidant enzyme, SOD2, was significantly higher in IF cortex tissues ($p<.05$) compared to AL controls. **CONCLUSION**: In the present study, IF significantly impaired protein synthesis) in the brain cortex and skeletal muscles. However, the fact that no decline was present in the hippocampus and the reduction of the antioxidants in the hippocampus were intriguing and will be the focus of follow-up investigations.

Relevance of Research to State-Related Topic(s)

Examining the mechanisms that are responsible for early intervention of Intermittent fasting (IF) in healthy non-transgenic animals would be the succeeding process in the study of dietary interventions to optimize the protection in several neurodegenerative diseases. Neurodegenerative diseases such as Alzheimer's disease is a growing and devastating disease in our senior communities. The most recent data found that 55,000 people aged 65 or older live with AD in the state of Kansas. By investigating the impact of IF on cognition, my PhD research aims to provide valuable insight into the potential non-pharmacological and cost-free approach to managing age-related cognitive dysfunctions in the state of Kansas and beyond.

A TROJAN HORSE APPROACH TO DELIVERY OF SMALL-MOLECULE ANTI-CANCER DRUGS

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BACKGROUND AND PURPOSE: Cancer accounts for one out of every six deaths, making it the second most common cause of death worldwide. One of the reasons why finding cures for cancer is incredibly challenging is due to the broad toxicity of anti-cancer agents. As a result, many chemotherapies kill healthy cells with high-growth fractions making the treatment hard on the patient. In our proposed research, we plan to design a vehicle that can deliver anti-cancer agents in close proximity of tumor cells thereby limiting unwanted detrimental effects on normal cells. **METHOD:** Here, we will adopt a 'Trojan horse' approach to deliver anti-cancer agents to diseased cells using capsule-like molecules capable of acting as hosts for small drug molecules. For this, we need to have a suitable cup, pre-programmed self-assembly of these cups into capsules and, finally, a method for opening this capsule once it arrives at its destination. **RESULTS/FINDINGS:** We were able to synthesize a variety of cup-shaped molecules, 'cavitands', and planned to decorate the upper 'rims' with suitable functional groups in order to promote self-assembly into capsular entities. For this we have explored the structural landscape of a family of 2-aminopyridine derivatives, and we discovered that they are favoring dimeric self-assembly through directional hydrogen bonds which are pH sensitive which means that we have an opportunity to take advantage of the more acidic microenvironment around many tumor cells. **CONCLUSION:** Our work so far, allowed us to succesfully synthesized the molecular sized cup required for this approach and the glue required for the self-assembly.

Relevance of Research to State-Related Topic(s)

Cancer is a widespread health issue that affects people all around the world. Like many other States, Kansas has a significant population of individuals who have been diagnosed with various types of cancer. For this reason, cancer research, broadly defined, will directly benefit current and future Kansans. For example, Kansas State University has its own research center to support basic cancer research and many professionals, collaborators, and students are working to fight cancer. At the same time, the state supports different activities to raise awareness about cancer prevention, early detection and healthcare.

ASSESSMENT OF LEVODOPA IN HUMAN SERUM BY UPLC-MS: A POTENTIAL METHOD FOR THE EVALUATION OF PARKINSON'S TREATMENTS

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BACKGROUND AND PURPOSE: Levodopa (LD) is a drug mainly used to treat Parkinson's disease (PD). LD is a precursor of dopamine and norepinephrine that acts as a chemical messenger in brain areas related to mind-body and emotional functions. The use of LD as a treatment for PD increases the dopamine levels in humans, preventing and reducing the intensity of PD symptoms. Accurate assessment of LD in human serum is required to monitor drug metabolism and to facilitate the advancement of future treatments. **METHOD:** A simple and fast protein precipitation was used to extract the analyte from human serum. The analysis was achieved with a Waters UPLC-MS instrument. **RESULTS/FINDINGS:** The analysis of human serum was performed with a strong correlation over a range of 63.1 to 20000 ppb; the detection limit and limit of analysis was 19.1 and 63.1 ppb, respectively. **CONCLUSION:** The developed method could be extended to other complex biologic samples with minor modifications and could improve PD treatment assessment.

Relevance of Research to State-Related Topic(s)

This research is significant to the Kansas State legislature due to its relevance in healthcare and treatment of noncommunicable diseases. Parkinson's is a neurodegenerative disease which has a high prevelance in the United States, more specifically the elder population in Kansas. The advancement of PD treatment evaluations is important to the development of novel medical strategies which have the potential to improve senior Kansans' quality of life.

EFFECT OF DIETARY NITRATE SUPPLEMENTATION ON TUMOR OXYGENATION

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BACKGROUND AND PURPOSE: 1 in 8 women will be diagnosed with breast cancer (BC) during their lifetime. Hypoxia (low oxygen pressure, PO_2) is a characteristic feature of BC and is associated with a more aggressive phenotype, increased risk of metastasis, and resistance to anti-cancer treatment. Thus, increasing tumor PO_2 is integral to advance treatment outcomes for BC patients. Dietary nitrate supplementation via beetroot juice (BRJ) has been demonstrated to increase PO_2 and improve metabolic function in skeletal muscle, however little is known on its effects within a tumor. We tested the hypothesis that 5 days of BRJ supplementation would decrease tumor growth and increase tumor PO_2 in a BC model. **METHODS:** MAT B-III cells were injected into the mammary gland of aged female Fischer-344 rats (n=6). Rats were randomized into BRJ supplementation (BRJ, n=3) or water (CON, n=3) groups. Following tumor palpation and 5 days of BRJ/water consumption, phosphorescence quenching determined the PO_2 within the tumor during normoxia (21% O_2) and hyperoxia (100% O_2). **RESULTS:** The BRJ rats had decreased tumor size versus CON rats (BRJ, 13±1mm; CON, 23±4mm; P<0.05). During normoxia and hyperoxia, BRJ rats displayed increased tumor PO_2 compared to the CON group (P<0.05). Blood gas analyses revealed a decreased lactate production in BRJ versus CON rats (BRJ; 0.5±0.1 mmol/L, CON; 1.18±0.12 mmol/L, P<0.05). **CONCLUSION:** This study suggests that BRJ supplementation can decrease tumor growth and increase tumor PO_2 in BC. These findings hold significant promise for enhancing treatment results and quality of life in individuals battling BC.

Relevance of Research to State-Related Topic(s)

The American Cancer Society's data for 2023 paints a concerning picture for Kansas, with approximately 17,000 new cancer cases and around 6,000 cancer-related deaths projected. Notably, Kansas ranks at a discouraging #37 in terms of up-to-date mammography screening for women aged 45 and older, potentially contributing to delayed cancer diagnoses. This delay often translates to more advanced stages of breast cancer, characterized by hypoxic and treatment-resistant tumors, ultimately resulting in higher mortality rates. In light of these disconcerting statistics, our research endeavors to uncover dietary mechanisms that can mitigate cancer metastasis and enhance treatment outcomes for cancer patients. By addressing these critical factors, we aim to provide hope and improved prospects for individuals battling cancer in Kansas and beyond.

ANALYZING THE SPATIAL PATTERNS OF HISTORICAL CASES OF CHRONIC WASTING DISEASE IN KANSAS

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BACKGROUND: This preliminary retrospective investigation aimed to identify the presence of Chronic Wasting Disease (CWD) in Kansas. CWD is a fatal transmissible spongiform encephalopathy that affects deer, elk, moose, and related cervids. Kansas began surveillance of CWD in 1996, with the first case identified in 2001 in captive Bull Elk. This study utilized surveillance data collected between 2006 and 2023, representing a subset of CWD surveillance data in Kansas. **METHODS:** Immunohistochemistry (IHC) was employed to analyze samples for the presence of protease resistance (PrP-res) prion proteins. IHC results were then classified as positive, negative, suspect, or unsuitable. IHC results were sorted to be either farmed or wild cervid samples, with 1,152 wild cervid samples and 5,493 farmed cervids tested from 2006 to 2023. **RESULTS:** The findings from this study identified a higher incidence of CWD in wild cervids compared to their farmed counterparts. In the samples gathered between 2006 and 2023, the highest annual average of CWD cases was recorded in 2022, with 14 positive cases, representing 1.3% of the sampled cervids that year. The estimated overall prevalence was 2.6 CWD cases per 100 cervids from 2006 to 2023. Geographic information system (GIS) mapping was utilized to visually analyze data at zip-code level. The outcomes of this examination revealed that zip-code 67701, encompassing portions of Thomas County and Rawlins County in Kansas, exhibited the highest cumulative count of positive cases from 2006 to 2023. **CONCLUSIONS:** These findings emphasize the necessity of continued CWD surveillance in Kansas cervids as positive cases continue to occur.

Relevance of Research to State-Related Topic(s)

Managing Chronic Wasting Disease (CWD) in Kansas is imperative. With no known cure, prevention is key for the well-being of local deer herds. The potential for transmission between captive cervid farms and wild cervid populations is a major concern, underscoring the need for early detection through monitoring programs. CWD's impact extends beyond cervids, affecting the ecosystems that infected cervid populations exist within. Additionally, the emergence of different CWD stains increases the importance of continual research on potential zoonotic transmission to humans. Economically, communities dependent on hunting face burdens from reduced wildlife populations. Adopting a comprehensive One Health approach is essential. Understanding the multidimensional effects of CWD is crucial for effective control and prevention, safeguarding both wildlife and communities in Kansas.

JUST KEEP BREATHING: NEW APPROACHES TO IMPROVING RESPIRATORY MUSCLE FUNCTION IN DISEASE

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BACKGROUND AND PURPOSE: Numerous diseases, as well as aging, result in respiratory muscle dysfunction - making breathing harder, at rest, and especially during physical activity. Our research question is: can exercise training or a novel antioxidant supplement (SFN) provide therapeutic countermeasures to prevent dysfunction? Proper respiratory muscle function is a widespread concern, given the pulmonary damage induced by smoking/vaping, obesity, heart failure, COVID-19, and mechanical ventilation. My research focuses on a specific lung disease called pulmonary hypertension (PH), which can develop idiopathically or along with any of the above pathologies. Therefore, by determining 1) the underlying cause of respiratory muscle dysfunction, and 2) whether these therapeutic alternatives are effective in PH, this can help patients, as well as guide future research to extend these treatments to other pathological conditions. **METHODS:** We utilize rodent models of PH to allow more powerful technologies to determine specific mechanisms of respiratory muscle dysfunction including: maximal exercise tests, fluorescent microspheres for blood flow distribution, and isolated blood vessel functional analyses. **RESULTS/FINDINGS:** 1) PH alters blood flow to the diaphragm, the primary breathing muscle. 2) Diaphragm blood vessels are dysfunctional. They do not dilate to the same extent as a healthy vessel. 3) Exercise capacity is reduced in PH. 4) SFN improves vascular function in the PH diaphragm. **CONCLUSION:** These investigations have provided novel and valuable insights into cardiovascular-related mechanisms of respiratory muscle failure in PH. The research currently underway will determine the efficacy of these specific treatments in improving diaphragm blood flow, vascular function, and exercise capacity in PH.

Relevance of Research to State-Related Topic(s)

My research focuses on understanding the mechanisms which underlie difficulty breathing in lung disease, and alternative methods to alleviate such difficulty by targeting the cardiovascular system in the primary breathing muscle. Importantly, these methods are low cost, feasible, and safe. With respect to health, Kansas is in the lower half of the U.S. Understanding the causative mechanisms and developing treatments for respiratory muscle dysfunction can improve the health of Kansas citizens suffering from a variety of prevalent, debilitating conditions including COVID-19, heart failure, aging, and obesity, while reducing health care costs. The findings of this research will guide future investigations, improve quality of life and physical activity capacity for patients, and reduce the health care system burden.

IDENTIFICATION OF FUSARIUM HEAD BLIGHT RESISTANCE (FHB) IN USA WHEAT BREEDING PROGRAMS

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BACKGROUND AND PURPOSE: *Fusarium* Head Blight (FHB) is a major pathogenic fungal disease affecting wheat in Kansas caused by *Fusarium graminearum* (*Gibberella zeae*), with a major economic impact on wheat production and human health due to the production of mycotoxins. Breeding for FHB resistance in adapted wheat varieties is not trivial due to the complexity of the wheat genome and several minor effect alleles identified in QTL studies. **METHOD:** To successfully develop resistance wheat to FHB disease, diagnostic markers for quantitative traits loci (QTLs) across the wheat genome need to be identified to help pyramid promising resistance genes into adapted wheat varieties in breeding programs. We are associating phenotypic and genotypic data from a panel of 300 wheat cultivars from across the US covering all market classes. The objective is to identify novel QTLs for wheat resistance to *Fusarium* and build a genomic selection (GS) model. **RESULTS:** Preliminary results show significant variability in phenotypic scab severity, the normalized area under the disease progressive curve (AUDPC), and fusarium-damaged kernels (FDK) across breeding lines, including some more resistant than the moderately resistant control. Additionally, ~15x sequencing data from these lines produced nearly 600,000 variants across the wheat genome for association analyses and model building. **CONCLUSION:** We mapped QTLs conferring resistance and susceptibility alleles for FHB using this panel of wheat lines using mixed linear model genome-wide association studies (GWAS). Markers closely linked to these resistance or susceptibility QTLs will be developed into diagnostic markers for marker-assisted selection of FHB-resistant wheat lines in breeding programs in Kansas/USA.

Relevance of Research to State-Related Topic(s)

Kansas is the United States' leading producer, the world's best source of high-quality hard red winter wheat. My research which is focused on wheat improvement through transformation sciences will help Kansas wheat breeders in their wheat breeding programs for fusarium head blight resistance. With this research, we aim to reduce economic turmoil due to huge losses to fungal diseases for the farmers and reduce higher mycotoxin of human and animal health concerns in harvested wheat.

A PRELIMINARY EPIDEMIOLOGICAL ASSESSMENT OF CLIMATIC CONDITIONS FAVORABLE FOR COMMON BUNT INFECTION IN KANSAS

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Department of Plant Pathology

BACKGROUND AND PURPOSE: Common bunt (caused by both *Tilletia tritici* and *Tilletia laevis*) is an economically important disease of wheat, resulting in both yield and quality losses. Historically, common bunt has been managed effectively by modern fungicide seed treatments in Kansas. However, seed saving practices and the lack of seed treatment adoption by wheat producers has prompted a recent rise in prevalence in the region, necessitating reevaluation of current management recommendations. Historical literature indicates a narrow range of soil temperature and moisture requirements conducive for common bunt infection. The optimum range of temperature for infection in controlled experimental conditions were reported to occur between 5-15°C, with optimum moisture levels between 11-24 percent moisture by dry weight. **METHOD:** Using this previously described range, an assessment was conducted for the state of Kansas using historic soil moisture and temperature data collected from the Kansas State Mesonet for the last 5 years. Data was analyzed and visualized in the R programming environment. **RESULTS:** Findings establish that optimal conditions for bunt infection were most prevalent mid-October to November which overlap with the recommended wheat planting window. Additionally, the Western Kansas region appears to have less but favorable conditions when compared to Central and Eastern Kansas regions. **CONCLUSION:** These results will parameterize a recommended planting date risk model for Kansas producers to better manage common bunt. Future research will expand on the specific climatic conditions required for common bunt infection and provide a greater foundation for managing this disease.

Relevance of Research to State-Related Topic(s)

Kansas is among one of the largest producers of hard red winter wheat globally. Wheat diseases result in economic losses that impact both producer and consumer livelihoods as well as global food security. This project aims to provide accurate, relevant management recommendations for the region's stakeholders to minimize disease losses. Research findings assist in improving educational outreach efforts conducted by K-State Research and Extension.

THE IMPACT OF ATMOSPHERIC COLD PLASMA TREATMENT ON MITIGATING SALMONELLA AND *E. COLI* CONTAMINATION IN PIZZA DOUGH

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BACKGROUND AND PURPOSE: Wheat, a crucial part of human diets, faces a significant food safety threat due to potential microbial contamination throughout its production and processing. This vulnerability exposes wheat to various sources of intrusion, including harmful pathogens like *E. coli* and *Salmonella*, posing risks to wheat-based foods. Recent incidents, like the 2022 French outbreak and the 2023 pizza recall, highlight these dangers, with investigations tracing the pathogens back to wheat flour. This underscores the ongoing threat of these harmful microorganisms in wheat products. **METHOD:** Organic wheat flour was inoculated with *Salmonella* (cocktail) and was dried for ~6 h at 37°C to its pre-inoculated weight. Following this, the wheat flour was exposed to plasma generated in the air for 5 min to 15 min, with a 5 min increment step at two variable distances (5.7 and 4.7 cm) from the cold plasma source. The reduction of the pathogenic load was evaluated by plating them on xylose lysine deoxycholate agar (XLD) and MacConkey agar for *Salmonella* and *E.coli* respectively after serial dilution. **RESULTS/FINDINGS:** The study's findings revealed that pizza dough prepared from wheat flour exposed to atmospheric cold plasma reduced the *Salmonella* and *E.coli* contamination at least by 3 log CFU/g. Maximum reduction was obtained by the treatment performed at a distance of 4.7 cm from the plasma source for 15 min **CONCLUSION:** The results from this study have the potential to be utilized for developing more effective methods for improving the food safety of pizza dough against *Salmonella* and *E. coli* contamination.

Relevance of Research to State-Related Topic(s)

Wheat grains have been regarded as "microbiologically safe" foods due to their reduced water activity (aw). This attribute has led to the general confidence that wheat flour and other flour-based products are low-risk foods from a microbiological safety standpoint. Research has shown that bacteria, including *E.coli* and *Salmonella*, can persist for a considerable amount of time in reemerge once they are placed in more favorable environmental conditions for growth. Over the past decade, several recalls and illness outbreaks reported in the United States have been linked to contaminated wheat flour or flour-based products like pizza according to the CDC. My research focuses on developing interventions that could ensure microbiological safety without adversely affecting product quality. The results from this study will provide novel solutions to Kansas millers and industries, helping them reduce the risk of *Salmonella* and *E.coli* contamination in pizza dough.

EFFICACY OF COMMERCIALLY AVALIABLE SANITIZERS ON EXPERIMENTALLY INOCULATED HIGH-DENSITY POLYETHYLENE (HDPE) WITH *SALMONELLA* AND *ESCHERICHIA COLI* (*E. COLI*) BIOFILMS

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Food Science Institute

BACKGROUND AND PURPOSE: *Salmonella* and *E. coli* are pathogens of concern for the rendering and pet food industry. Both microorganisms can form biofilms on surfaces found within rendering plants, pet food manufacturing facilities, and transportation vehicles. Because biofilms are difficult to mitigate, it is imporant to find sanitizers that can effectively reduce levels of bacteria present at facilities within the pet food supply chain. Some research has been done to demonstrate sanitizer efficacy on stainless steel: little data is available for more porous surfaces like high-density polyethylene (HDPE). **METHOD:** Mature multi-strain biofilms of either *Salmonella* or *E. coli* were grown on HDPE coupons using a CDC Biofilm Reactor. Coupons were then exposed to different antimicrobial agents; silver dihydrogen citrate (SDC), chlorine, peracetic acid (PAA), steam, and chlorine dioxide (ClO_2). Exposure time was 1- or 2-minutes except ClO_2, which was applied for 24-hours. Surviving cells were enumerated post-exposure. Each treatment was tested 6 times. **RESULTS/FINDINGS:** For both biofilms, all treatments significantly impacted populations when compared to controls. In *Salmonella* biofilms, there was a difference between application times (1- or 2-min) for chlorine (4.14 vs. 3.18 log CFU/coupon) and SDC (5.96 vs. 4.82 log CFU/coupon) ($P<0.05$). In *E. coli* biofilms, there was a difference between application times for steam (3.60 vs 2.53 log CFU/coupon). ClO_2 treatment resulted in no detectable viable cells (<2.40 log CFU/coupon) for either biofilm. **CONCLUSION:** Understanding the efficacy of antimicrobials against biofilms can help improve pet food safety by increasing the treatment strategies avaliable to facilities.

Relevance of Research to State-Related Topic(s)

Pet food manufacturing and animal health companies are a significant industry sector within Kansas, including some of the largest pet food manufacturing companies in the world. An estimated 60% of the total pet food sold within the United States is produced within the KC Animal Health Corridor; in 2021, Kansas was ranked second for global cat or dog food exports, contributing to approximatly 10% of the United State's total. With increasing prevalence of pets within homes, as well as a rise in the popularity of minimally processed pet food diets that require more owner handling, the ability to effectively mitigate pathogens of concern within pet food facilities is important for both animal and human health. Obvious implications of exposure to bacterial pathogens within pet food include major risks to pet and owner health; additionally, recalls due to potential bacterial contamination can result in substantial economic loss for companies involved.

FATE OF 15N FERTILIZER IN RAINFED WHEAT-BASED CROPPING SYSTEMS

Jessica Bezerra de Oliveira and Charles W. Rice
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BACKGROUND AND PURPOSE: Improving crops use nitrogen (N) is essential for enhancing crop yield and quality and protecting the environment. In this research, we looked at how wheat plants in rainfed fields can absorb N more efficiently. **METHOD:** We set up a field experiment with five different methods of growing wheat and applying nitrogen: one standard approach where nitrogen is applied once in early spring, and a progressive method, which involves two nitrogen applications - one in early spring and another in late spring. We used a special nitrogen fertilizer labeled with a stable isotope, ^{15}N-urea, to track how the wheat plants used nitrogen. For the plots with dual nitrogen applications, we created two subplots within each - one received the labeled fertilizer during the first application and regular, non-labeled nitrogen during the second application. The other subplot received non-labeled nitrogen during the first application and the labeled ^{15}N-fertilizer during the second application. We collected plant samples at different growth stages: jointing, anthesis, and soft dough. We sent the samples for lab analysis to understand how the plants were using the nitrogen. **RESULTS/FINDINGS:** The progressive method resulted in the highest N uptake by the plants, especially during the anthesis and soft dough stages. In addition, this method had an impressive N recovery rate in the grain. On the other hand, the standard method at the anthesis and soft dough had lower N recovery. **CONCLUSION**: Our findings suggest that using a dual nitrogen application in wheat farming is a more effective way to improve N use efficiency.

Relevance of Research to State-Related Topic(s)

Kansas stands as one of the leading wheat-producing states in the United States. However, there is a pressing issue at hand: the excessive use of nitrogen. This over-reliance on nitrogen not only places a significant strain on finances but also leads to a multitude of environmental problems. The intense nitrogen application is far-reaching. It contributes to the emission of greenhouse gases, which in turn fuel global warming, a pressing concern for our planet's future. Additionally, the nitrogen from the soil can eventually leach into rivers, which can pollute rivers, posing a serious health risk to humans, particularly infants as young as three months old. Considering these challenges, it becomes clear that we need to seek out more efficient methods of nitrogen application. Striking a balance between optimizing crop production and safeguarding our environment is not merely a preference; it is an imperative.

MODELING FUTURE SCENARIOS OF SUSTAINABLE AGRICULTURAL INNOVATIONS ADOPTION: AN ANALYSIS OF BIODEGRADABLE MULCH SUITABILITY

Michael Madin and Kate Nelson

Department of Geography and Geospatial Sciences

BACKGROUND AND PURPOSE: The agriculture sector is facing the challenge of feeding a growing population in the midst of global environmental change— twin potentially major stressors to the food production systems. For instance, the U.S. in recent decades has experienced climate events such as droughts and precipitation variabilities, which are projected to intensify to levels where all counties could permanently exceed the baseline variability of occurrence by 2050. These impacts on agricultural production systems and environmental degradation demand a transition towards more sustainable innovative practices. **METHOD:** Adoption and utilization of sustainable agricultural practices have been proposed as one part of the viable solutions; however, research on future scenarios of adoptions remain limited. As such, this proposed study seeks to model future scenarios of the prospects of farmers adopting biodegradable mulches (BDM)— environmentally sustainable mulching material aimed to protect crops from climate variabilities. Specifically, a Multi-Criteria Evaluation model in GIS will be used to assess the suitability of BDM applicability under different future scenarios presented in the Shared Socioeconomic Pathways (SSPs) model. **RESULTS/FINDINGS:** The prelimenary results suggest that BDM is suitable for field level application across most parts of Kansas. **CONCLUSION:** An understanding of whether and how the future scenarios of BDM suitability will shift would be useful to policymakers in efforts to promoting its adoption as a sustainable agriculture practice. BDM adoption among farmers would also help replace plastic mulch materials— which take a longer period to degrade and are associated with ecologically and agronomically detrimental outcomes.

Relevance of Research to State-Related Topic(s)

This study would provide information on suitability of BDM, which would promote adoption and utilization among the farmers. Adoption of BDM would contribute significantly to the state of Kansas's efforts toward achieving food safety and sustainable agriculture/ water supply. An increased in crop yield due to BDM application would ensure that there is enough production to feed people and supply feeds and industrial needs. The use of BDM in horticulture agriculture sector will particularly contribute significantly to reducing micronutrient deficiency as it would increase yield of vegetables and fruits, which are major source of micronutrients. Improvement in water use efficiency and replacement of plastic mulch with BDM would contribute to ensuring that agriculture production is based on the use of renewable resources and efficient use of water. Farmers' adoption of BDM will reduce plastic waste in soil/ landfill sites and ensure food safety by minimizing microplastic pollution in food.

DISCOVERY OF THE PRIMARY ENDOSYMBIONTS IN THE SALIVARY SECRETION OF THE LONE STAR TICK (*Amblyomma americanum*)

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BACKGROUND AND PURPOSE: The lone star tick (*Amblyomma americanum*) is an important vector of *Francisella tularensis*, *Ehrlichia chaffeensis*, *E. ewingii*, and heartland virus in addition to being the causal factor of alpha-gal syndrome. Tick endosymbiotic bacteria have often been found to be in commensalism with the tick by nutritional complementation such as vitamin B. In contrast, tick endosymbionts lowering the vectorial capacity of the tick have been also reported in some cases. We hypothesized that the primary endosymbiont of the lone star tick, *Coxiella*-like endosymbiont (CLE) is secreted into the host at the time of tick feeding. In this study, we demonstrated that the salivary secretion contains the primary endosymbiont CLE and another bacterial species *Rickettsia amblyommatis*. **METHOD:** Partially-fed *A. americanum* adults were processed for collections of salivary secretion (SS) and dissections of salivary glands (SG) by dopamine and pilocarpin treatments. The SG and SS samples were analyzed by species-specific quantitative PCR (qPCR) and confocal microscopy for the detection and quantification of CLE and *R. amblyommatis*. **RESULTS/FINDINGS:** The CLE is predominant in SG 100% (30/30) and SS 43.3% (13/30). Lower frequency and abundance was observed for *R. amblyommatis* with a prevalence of 56.7% (17/30) in SG and 13.3% (4/30) in SS. Microscopic observation also supported the presence of bacteria in the SS. **CONCLUSION:** Our result clearly shows the CLE in the SS that may modulate the host immune system in the tick feeding. We will explore the roles of bacteria secreted during tick feeding and its impact on pathogen transmission.

Relevance of Research to State-Related Topic(s)

The lone star tick is the most prevalent species of tick in the state of Kansas and is considered a significant pest in the animal industry and also a threat to human health in the state mainly due to the red-meat allergy also known as alpha-gal syndrome. In 2021, exports of beef and beef products from Kansas totaled $1.3 billion, ranking first among the states. Current approaches to mitigate tick-borne diseases including the alpha-gal syndrome by developing vaccines and tick control have been limited. New knowledge based on tick control methods are in urgent need. Understanding the roles of tick endosymbionts in tick feeding may lead to new tools in the development of vaccines and new measures for controlling ticks and tick-borne pathogens and the diseases they can cause.

DEVELOPING A GROWING DEGREE DAY MODEL FOR THE GIANT EUCOSMA MOTH, A MAJOR PEST OF A NEW OILSEED CROP IN KANSAS

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BACKGROUND AND PURPOSE: Silflower, *Silphium integrifolium*, is a perennial crop native to the prairies of North America. It is currently being domesticated and commercialized for use as an oilseed crop by The Land Institute. However, a major pest interfering with the domestication of *S. integrifolium* is the giant Eucosma moth, *Eucosma giganteana* (Riley) (Lepidoptera: Tortricidae). This specialist pest on *S. integrifolium* is highly destructive to the seed production, decreasing seedset by more than half. Currently, there is no established pest control solution beyond mowing the fields to remove the crop and pest alike, which is not effective or economically sustainable. To guide management, a growing degree day (GDD) model was made to estimate the phenology of *E. giganteana* during the summer. **METHOD:** A lower activity threshold (LDT) was estimated by placing field-collected caterpillars in common garden environmental chambers from 5-20°C after an acclimation period from 7-30°C. After calculating the LDT, the GDD was estimated by approximating the temperature diurnal course with the maximum and minimum temperature. Additional data from 2019 was used to develop GDD predictions for *E. giganteana*. Finally, the GDD predictions in 2019 were tested in two subsequent years of field capture monitoring data of *E. giganteana* that was tied to local meteorological data. **RESULTS:** We found that the GDD predicted the phenology of the species in Kansas well, including emergence and peak infestation for the future years. **CONCLUSION:** With this GDD model we hope to be able to treat the fields for *E. giganteana* early before they can become a problem.

Relevance of Research to State-Related Topic(s)

Currently, sunflowers are used for most of the oilseed production in the USA. The oil is used in cooking, preservatives, as well as in products like sun butter. *Silphium integrifolium* can be used in all the same products, but it is much more sustainable. Instead of an annual, *S. integrifolium* is a perennial, thus there is less disturbance in the landscape because it does not need to be tilled and replanted every year. Moreover, it is highly drought resistant and will continue to flower while nearby plants wilt under hard years. The center for its development is right here in Kansas, and it has attracted researchers around the world to work on domesticating it as an up-and-coming innovative crop. However, until its pest problem is addressed, it cannot be commercialized. Ultimately, *S. integrifolium* can sustainably aid in providing food security for the Great Plains and the USA.

A MULTISTATE SEED TREATMENT EVALUATION FOR SOYBEAN SUDDEN DEATH SYNDROME IN 2022

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BACKGROUND AND PURPOSE: Sudden death syndrome (SDS), most commonly caused by the fungal pathogen *Fusarium virguliforme*, poses a threat to soybean production. This disease causes severe yield loss and has been reported in 16 states, including Kansas, which is a major soybean producer. SDS identification may be challenging under field conditions due to the similarity of symptoms with other abiotic and biotic factors. Additionally, the ability of the pathogen to colonize alternative hosts and survive in soil for long periods of time, makes managing the disease challenging. Pre-planting decisions are the most effective management strategies for controlling SDS. The objective of this project is to evaluate the impact of biological and non-biological seed treatment on SDS using resistant and susceptible cultivars. **METHOD:** The experiment was conducted in nine environments across the United States and Canada, including two locations in Kansas. Resistant and susceptible soybean cultivars were treated with eight seed treatments. The plots were inoculated with *F. virguliforme* and irrigated, creating optimal conditions for high disease pressure. We gathered data on soybean cyst nematode egg counts, live plant counts at V2 growth stage, root rot severity at R3, foliar SDS symptoms at R5, and yield at R8. **RESULTS:** When comparing the cultivars, the resistant cultivar outperformed the susceptible cultivar by yielding an additional ten bushels per acre. In the case of seed treatments, a combination of both a biological and non-biological seed treatment exhibited greater consistency in SDS control and reduced variability. **CONCLUSION:** These findings will aid in making informed and optimal SDS management decisions.

<u>Relevance of Research to State-Related Topic(s)</u>

SDS is an economically damaging disease in soybean production, causing substantial yield losses and financial burdens for Kansas growers. Between 2018 and 2022, the state incurred staggering losses of 1,179,297 bushels per acre, equivalent to $13,279,703, attributable to SDS. In response to this pressing issue, our research aims to develop effective management strategies that address the challenges faced by Kansas growers. Our work equips growers with the knowledge to make informed decisions about SDS management. This research directly confronts a critical issue in the state's agriculture, helping to safeguard soybean yields and the livelihoods of farmers. Furthermore, our research contributes to the broader agricultural community, offering insights that can improve soybean production not only in Kansas but also in regions facing similar SDS challenges. Ultimately, our work stands at the forefront of efforts to enhance crop protection, advance agricultural sustainability, and secure the future of soybean farming in Kansas.

UNDERSTANDING THE DYNAMICS AND PATHOGENIC ROLE OF THE SUPERNUMERARY MINI CHROMOSOME OF *MAGNAPORTHE ORYZAE*

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Department of Plant Pathology

BACKGROUND AND PURPOSE: *Magnaporthe oryzae* (syn. *Pyricularia oryzae*) is a problematic pathogen which cause blast disease in more than 50 grass species, including rice, wheat. The genome of *Magnaporthe oryzae* (Mo) has seven indispensable core chromosomes and frequently contains supernumerary chromosomes. Compared with core chromosomes, supernumerary chromosomes in Mo are typically smaller, and therefore are referred to as mini chromosomes. The dispensable nature of mini chromosome could be evolutionary advantage to Mo pathogens, accumulating the mutations and reshuffling effector gene to core chromosome, facilitating rapid host adaptation. **METHOD:** To test the stability of mini chromosome in Mo genome, we designed an experimental evolution study using a rice field isolate, O135, containing one mini-chromosome. Five single spore cultures of the O135 isolate were independently subjected to 20 successive subculture cycles on oatmeal agar plates and 20 successive infection cycles *in planta*. Two-two single spore cultures from the last cycle were analyzed and compared to original respective single spore cultures. **RESULTS/FINDINGS:** We observed a total of 729 mutations across the genome of 20th generation Mo isolates. The number of mutations accumulated was higher in *in vitro* study compared to in *in planta*. In additon, we observed the large deletion from both core and mini chromosome of 20th generation isolates. **CONCLUSION:** From this experiement we observed that mini chromosome has higher mutations per mb than core chromsome. Mini chromosome in Mo genome is repeat and TE rich and gene poor compartment. Such compartment are considered as hotspot for duplication, deletion and recombination resulting in rapid evolution through structural variation.

Relevance of Research to State-Related Topic(s)

Wheat blast disease is caused by *M. oryzae* Triticum pathotype (MoT), which emerged in Brazil in 1985 and spread within South America for decades. In 2016 and 2018, the disease jumped across the continent to South Asia and Africa, respectively causing massive wheat infection and production losses. The rapid blast disease establishment across continents demonstrate the threat of global spread. The disease mainly infects the wheat head. Due to scarcity of resistant gene and low fungicide efficacy, it is considered as most threatening disease. The disease can cause 100% yield loss under the correct environmental condition in susceptible cultivars. Kansas is one of the top wheat producing state in US generating annual value of $244.2 millions (USDA/NASS, 2022). The long distance move of wheat blast disease is through the agricultural trade. Agricultural threats posed by blast diseases and evolving pathogens make it important to understand the evolution of the pathogen.

**PREDICTING THE IMPACT OF TEMPERING TREATMENTS ON THE *E. COLI*
LOAD OF WHEAT DURING TEMPERING**
Jared Rivera, Shivaprasad D.P., and Kaliramesh Siliveru
Department of Grain Science and Industry

BACKGROUND AND PURPOSE: Various treatments applied to wheat grains during wheat tempering have been developed to help reduce pathogen contamination in wheat grains prior to milling. The objective for this study was to model the inactivation of pathogenic *E. coli* O121/ O26 in wheat grains under different tempering treatments using established inactivation models. **METHOD:** Existing data sets on the inactivation of pathogenic *E. coli* in wheat grains under different tempering treatments were included in the analysis. These treatments include tempering with sodium bisulfate, organic acids (lactic acid), bacteriophage, and a hurdle tempering approach (combination of heating and organic acid tempering. Inactivation models including the the log-linear, and Weibull models were then fitted to the inactivation data. Model fit was then assessed based on the standard error, adjusted R^2, and significance ($P < 0.05$). **RESULTS/FINDINGS:** Model fitting results showed that the Weibull model fits better in the data set based on the R^2 (0.8 to 0.9), standard error (0.2 to 0.3 log CFU/g) compared to the log-linear model. The inactivation parameter (δ - time for first decimal reduction) for the Weibull model showed that tempering treatments involving heating were more effective than non-thermal trearments. **CONCLUSION:** The results indicate that thermal tempering treatments can be an effective intervention in reducing the STEC load of wheat grains after tempering. The results from this study can be used as basis for improving the food safety of wheat flours against foodborne pathogens.

<u>Relevance of Research to State-Related Topic(s)</u>

This research was done to improve the food safety of wheat flour-based products, which falls in the "food safety: from farm to fork" topics of interest to legislators. Increased interest has been given to the food safety of wheat flour-based products due to the occurrence of recalls and foodborne illness outbreaks stemming from contaminated flours. This has led to the need for development interventions to address this issue as wheat flour is historically considered as safe foods. This would be of interest to legislators as the state of Kansas is one of the leading producers of wheat. Ensuring that safe wheat flours are produced by including these interventions in the milling process would prevent the occurrence of foodborne illness outbreaks and recalls, which have significant economic and public health impacts.

SALMONELLA CONTAMINATION OF STORED GRAINS: THE ROLE OF INSECTS

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BACKGROUND AND PURPOSE: *Salmonella* spp. can survive for prolonged times in low-moisture environment and products, and the role of insects in transmitting relevant pathogens is longstanding recognized. Nevertheless, underestimated factors can facilitate the transmission of biological contaminants from grain storage operations to food premises, such as insects' infestation. Understanding the role of insects when considering the safety of grains during storage is necessary. This study aims to evaluate the survival and transmission rate of *Salmonell*a spp. between grains and *Sitophilus oryzae* L. (rice weevil) during storage. **METHOD:** Grain samples (wheat and rice) were inoculated with an overnight *Salmonella* solution. Adult insects were then introduced and allowed to feed on grain for 13 days. At the end of the storage period, samples were sieved to collect the frass and remove the insects. The remaining *S. oryzae* were classified as dead or alive and frozen for 24 h. To enumerate the microbial populations in contaminated grains, frass, and insects, serial dilutions were plated, and *Salmonella* colonies counted. Experiments were run in triplicate and transfer efficiency values calculated. **RESULTS/FINDINGS:** Grain type influenced the transfer efficiency of the pathogen. *Salmonella* population detected on grains, frass and insects varied from 4 log CFU/g to 8.2 log CFU/g on wheat and rice respectively. The values obtained for *Salmonella* transfer efficiency for insects and frass were 84% and 95% in wheat, and 51% and 90% in rice, respectively **CONCLUSION:** Insects can feed and pass foodborne pathogens through their frass on uncontaminated stored grains when favorable conditions exist.

Relevance of Research to State-Related Topic(s)

Kansas has longstanding recognition as the nation's leading wheat producer and is known for producing various types of grain products, resulting in growing demand for commercial and on-farm storage. However, stored grain insects pose a great risk for growers. It is estimated that the damage by the insects and molds accounts for 10 cents per bushel. If this estimation applies to Kansas, it will result in an annual loss of $100 million. Besides severe damage to grains and reduced grain weight, insect infestation is responsible for transmitting pathogens during storage. Therefore, it is crucial to understand the role of stored grain insects in order to eliminate food safety risks, extend the storage life of grains, and prevent economic losses.

KERNZA AND SORGHUM AS SUSTAINABLE INGREDIENTS IN EXTRUDED PRECOOKED PASTA AND QUALITY ANALYSIS

Julia Rivera, Hulya Dogan, and Sajid Alavi
Department of Grain Science and Industry

BACKGROUND AND PURPOSE: This research explores the innovative use of kernza, wheat, and sorghum, both individually and in combinations, as key ingredients for extruded precooked pasta. Kernza, a perennial grain with deep roots, offers soil erosion reduction and carbon sequestration. Wheat, a pasta staple, is often linked to resource-intensive farming, while drought-resistant sorghum provides a sustainable alternative, especially in water-scarce regions. Our study assesses the technical feasibility of precooked pasta production with these grains, aiming to reduce the ecological footprint of pasta production. **METHOD:** Six pasta formulations were extruded, comprising wheat flour, kernza flour, sorghum flour, and 50/50 flour combinations using a pilot-scale twin-screw extruder. Raw materials and extruded samples were analyzed to determine ingredient functionality, degree of degradation, extent of gelatinization, and texture characteristics. **RESULTS/FINDINGS:** Precooked pasta with wheat flour, as well as the wheat/kernza formulation had the highest cooking loss percent (5.6%), while sorghum and the other combinations showed very little cooking loss percentages (1.7%). **CONCLUSION:** This research highlights the potential for enhancing sustainability and quality in precooked pasta production. Kernza, wheat, and sorghum formulation can yield pasta formulations meeting quality standards while reducing resource inputs and environmental impact. These findings pave the way for a more sustainable pasta production future, with significant implications for the food industry. Further analysis will delve into life cycle assessment and consumer acceptance insights.

Relevance of Research to State-Related Topic(s)

By exploring drought-resistant sorghum and kernza's deep root system, we address water scarcity issues. Furthermore, our research ties into economic development and job creation, as it has the potential to introduce innovative, sustainable agricultural practices that can benefit Kansas farmers and stimulate economic growth in the state. In the context of workforce development, our findings may inform training and education in sustainable agriculture and food production practices. By promoting sustainable ingredients, we contribute to plant and animal health, food safety, and the broader farm-to-fork initiative. Overall, our research intersects with multiple aspects of Kansas' legislative interests, offering a pathway towards a more sustainable, economically vibrant, and healthier future for the state.

THE EFFECT OF CROPPING SYSTEMS INTENSIFICATIONS AND DIVERSIFICATION ON SOIL HEALTH

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BACKGROUND AND PURPOSE: Crop productivity lags in the U.S. mostly because of soil health deterioration caused by mono-cropped systems and soil tillage. This research emphasizes that more intense and diverse cropping systems have the potential to improve overall soil health. The study focused on understanding the effect of crop intensification and diversification on commonly used soil health indicators. **METHOD:** Six different rainfed cropping systems under a no-tillage system, ranging from winter wheat monoculture to multi-species crop rotations, were assessed in the Rainfed Agriculture Innovation Network plots in Ashland Bottoms-KS. Soil samples were collected at 0-5 cm depth during the fall of 2019 and the spring of 2023. Soil health was determined through two soil extracellular enzyme activities, soil total microbial biomass, total bacteria, and total fungi. Additionally, cumulative above- and belowground biomass was determined during the study period as a carbon input metric. **RESULTS/FINDINGS:** Enzyme activity analysis revealed decreased activity on most of the treatments after 3 years, except for treatments with higher biomass accumulation. Total microbial biomass, total bacteria, and total fungi results were higher in 2023 than 2019, however, without significant treatment effects. Positive relations between enzyme activities and biomass production over the period were observed. **CONCLUSION:** Preliminary results of this study revealed a positive relationship between soil health indicators and biomass production, highlighting the importance of crop residue management on cropping systems. Results also revealed the importance of no-tillage adoption for enhancing overall soil health. Future research suggests soil health measurements in the long term to assess the viability of the systems.

Relevance of Research to State-Related Topic(s)

Kansas is an agricultural state which contributes to the food chain supply countrywide and worldwide. However, most of the agriculture practices still rely on monoculture and soil tillage. Although the state of Kansas already leads the adoption of no-tillage practices nationwide, there are still opportunities to improve agricultural management and practices. The adoption of intense and diverse cropping systems has the potential to add more carbon inputs to the soil, thus enhancing soil organic matter stocks and improve soil microbial communities and activity, responsible for soil nutrient cycling. Moreover, this project aims to improve carbon sequestration, water and nitrogen use efficiency, as well as develop and extend information to long-term management and in-season decisions to Southern Great Plains cropping systems. Creating alternatives that will improve the relationship agriculture x environment and still deliver food/feed/fiber/fuel production and profitability are essential to sustain modern agriculture while preserving the natural resources.

PHOSPHORUS SORPTION DYNAMICS IN SOIL AS INFLUENCED BY COVER CROP SPECIES AND PHOSPHORUS INPUT

Tamjid Us Sakib and Nathan O. Nelson
Department of Agronomy

BACKGROUND: Phosphorus sorption dynamics are affected by different plant species through their root exudates, especially low molecular weight organic acids (LMWOAs). These LMWOAs compete with P for adsorption sites on soil minerals, which may potentially affect P loss in runoff water. There is very little information regarding the release of LMWOAs from cover crops and their potential effects on P adsorption or loss in soils. The objectives of this study are (1) to identify and quantify the LMWOAs (2) to determine the water-soluble P (WEP) and (3) to determine phosphorus sorption in the rhizosphere soils. **METHOD**: A greenhouse study was established with ten different species of both cover and field crops, two P fertilizer treatments (low and high P), and two-time intervals (35 and 70 days). All treatments were structured in a 10x2x2 complete factorial with two control treatments arranged in a randomized complete block design with five replicates (210 experimental units). **RESULTS**: The preliminary results from this study revealed that LMWOAs release was much greater in low P soil as compared to high P soil in 35 days. Particularly corn, rye, triticale, and crimson clover released much greater LMWOAs in P deficient soil. Species effect on P adsorption to soil was minimal except for rapeseed, which decreased P adsorption at 35 days. The treatment effects were less apparent at 70 days. **CONCLUSION**: This will provide information regarding cover crop species selection for designing conservation systems that take advantage of the benefits of cover crops while also minimizing P loss.

Relevance of Research to State-Related Topic(s)

Kansas soil is natively low in phosphorus, therefore agricultural production in the state relies on phosphorus fertilization. These continual phosphorus inputs increase the potential for phosphorus loss to surface water and promote harmful algal blooms. Around one hundred lakes and reservoirs in over half of all counties in Kansas have reported problems with harmful algal blooms since 2010. We need to design conversation systems that increase phosphorus availability to crops while reducing its loss to surface water. Cover crops are common component of conservation systems to reduce erosion. Plants release root exudates that can increase phosphorus availability for crops and also potentially increase phosphorus loss. Our research will help us understand the factors that affect root exudate release by cover crops and its effect on phosphorus availability. This will help us know how to use cover crops to improve crop growth and protect water quality in the state of Kansas.

SILICA DUSTS FOR GRAIN PROTECTION: A SUSTAINABLE ALTERNATIVE TO CHEMICAL INSECTICIDES

Manivannan Selladurai and Bhadriraju Subramanyam
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BACKGROUND: Silica dusts have emerged as promising solutions for managing insect pests that infest stored food grains, particularly in the context of organic production. Nevertheless, the current silica dusts employed for grain protection tend to exhibit their effectiveness at higher application rates, a factor known to potentially alter the physical attributes of the treated grains. In this research, two novel amorphous silica powders were tested for their efficacy to control rice weevils, which are significant pests affecting wheat grains. **METHODS:** The silica powders were applied to wheat at five different concentrations (0, 0.05, 0.10, 0.20 and 0.25 g/kg) and assessed for their efficacy to control rice weevil after 14 days. Additionally, investigations were conducted on progeny count after 42 days to determine how the silica treatments might impact the reproductive capabilities of the treated insects. **RESULTS:** The findings revealed that silica powder 2 displayed remarkable effectiveness even at lower concentrations of 0.20 g/m^2 when compared to silica powder 1, surpassing the industry recommended dosage. This variance in efficacy between the two powders was attributed to the high oil absorption capacity of silica powder 2. **CONCLUSION:** Consequently, these results suggest that both silica powders, especially silica 1 powder can be employed for rice weevil control in wheat storage systems at significantly reduced application rates compared to industry standards.

Relevance of Research to State-Related Topic(s)

This research addressed a significant farm-to-fork issue in Kansas, where insect pests threaten food security by causing storage losses in food grains. Silica dusts offer a promising solution, especially in organic farming, but the challenge is their high application rates, which can adversely affect the physical properties of wheat grains. Our study evaluated two new amorphous silica powders to manage rice weevils, a major pest of Kansas wheat. Our objective was to assess the efficacy of two novel silica dusts to develop a sustainable and cost-effective pest management solution, requiring lower application rates, benefiting Kansas farmers. This aligns with the state's agricultural priorities, promoting organic farming, reducing pesticide use, and safeguarding grain quality—critical concerns in Kansas agriculture.

PRAIRIE GRASS GROWTH AND FUNCTION ACROSS BROAD ENVIRONMENTAL GRADIENTS

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BACKGROUND AND PURPOSE: Big bluestem (*Andropogon gerardii*) is a dominant Great Plains grass critical for cattle forage, conservation, and restoration. This grass grows across sharp environmental gradients, putatively giving rise to climate-adapted populations. Since it spans a sharp range of temperature and rainfall, we predicted that populations in the center of its range (KS, NE, OK) would perform best in terms of growth and performance, while populations at the margin (TX, CO, WI) would perform relatively poorly. Plants in the center of its range should be more robust and cover more area, have higher photosynthetic rates, and more favorable water balance compared to plants at the edge of its range. The objectives were to measure growth and physiological response across the US range and relate to rainfall and temperature. **METHODS:** We measured performance and physiology in 26 populations ranging from TX to ND, CO to NC (300-1400mm rain/year and 5-24°C annual temperature). **RESULTS/FINDINGS:** Height, canopy diameter, and leaf width increased with higher precipitation at the eastern edge of its range. Interestingly, plants had higher photosynthetic rates, higher chlorophyll absorbance, and thicker leaves at drier western and southern ranges. Plants at the arid sites had the most negative water potential, a proxy for drought tolerance. Finally, the highest canopy cover occurred in the center of its range, with low abundance in the range margins. **CONCLUSION:** These results indicate adaptation across rainfall and temperature gradients. Prairie restoration approaches should use climate-adapted ecotypes to mitigate future climate changes.

Relevance of Research to State-Related Topic(s)

Big bluestem plays a critical role in agriculture since it comprises a major component of forage for cattle. The cattle industry in KS is worth $10 billion /yr. As the dominant grass in tallgrass prairie, it controls this vital ecosystem's ecological structure, function, and sustainability. Yet, this ecosystem is predicted to be threatened by severe drought and increased temperature. Thus, it is crucial to understand big bluestem's response to precipitation and temperature for cattle production, conservation, and restoration. Understanding temperature and rainfall controls on big bluestem is essential for future restoration efforts. Thus, these results will provide recommendations on climate-adapted populations as droughts become more intense and severe in Kansas.

MITIGATING HIGH-FREQUENCY OVERVOLTAGE ON MOTOR WINDINGS: AN ADAPTIVE APPROACH

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BACKGROUND AND PURPOSE: This research addresses the challenges associated with Wide Bandgap (WBG) motor drives, which are crucial components in emerging technologies like electric vehicles and robotics. While advancements in semiconductor materials have led to faster switches and more efficient motor drive systems, they have also reduced the motor's lifespan due to severe voltage stress and insulation failures. Overcoming these obstacles is essential for the widespread adoption of WBG motor drives in renewable energy applications, such as wind turbines and electric vehicles. **METHOD:** To enhance the reliability of these motor drive systems, this study focuses on developing smart coils with adaptive control schemes, eliminating the need for bulky and lossy filters. The research investigates the non-uniform overvoltage distribution on stator windings when driven by Silicon Carbide (SiC)-based inverters, with particular emphasis on the first coil, which experiences severe overvoltage stress. The proposed solution involves using an adaptive circuit with a capacitor and a bidirectional gallium nitride (GaN) switch across the first coil to ensure uniform voltage distribution and suppress overvoltage spikes. **RESULTS/FINDINGS:** Comprehensive experimental analysis is conducted using a 2 hp, 460 V motor powered by a SiC-based inverter, connected through specific cables. The results indicate that inserting a small capacitor during the initial cycles effectively reduces overvoltage stress across the first coil by approximately 47%. **CONCLUSION:** In conclusion, this research offers a promising approach to enhance the reliability and efficiency of WBG motor drive systems, which are vital for the advancement of renewable energy technologies and the broader adoption of electric vehicles and robotics.

Relevance of Research to State-Related Topic(s)

This research aims to make renewable energy systems more reliable and efficient through improved motor drive technologies, ultimately contributing to the global shift towards clean and sustainable energy sources. This work aligns with the broader goal of reducing greenhouse gas emissions and mitigating climate change by facilitating the integration of renewable energy into our energy infrastructure. This research promotes alternative and sustainable energy sources by developing and optimizing electric motor systems, particularly those employing Wide Bandgap (WBG) motor drive technology. WBG motor drive systems offer higher efficiency and performance than traditional systems, making them instrumental in enhancing the sustainability of various applications.

ENHANCING DISASTER RESPONSE THROUGH SOCIAL MEDIA IMAGE ANALYSIS: A PATH TO SAFER COMMUNITIES

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BACKGROUND AND PURPOSE: In today's digital age, smartphones and social media have become ubiquitous, serving as rapid communication channels during crises. This is particularly relevant during natural disasters when traditional emergency lines can be overwhelmed. Eyewitnesses and affected individuals share useful images on platforms like Twitter, offering real-time insights into the crisis. Our research addresses the critical task of efficiently analyzing and classifying these user-generated disaster images, aiding relief and response efforts. **METHOD:** Our study explores state-of-the-art machine learning models to classify disaster-related social media images. Specifically, we employ advanced deep learning models, including CLIP, ViT, CSWin, and ConvNeXt, to facilitate quick automated identification of actionable information. By leveraging these models, we enable rapid content analysis, empowering disaster response organizations to make informed decisions. **RESULTS/FINDINGS:** Our research reveals that the CLIP model outperforms the other three models in disaster image classification, enhancing the ability to assess shared images during crises. **CONCLUSION:** Our work bridges the gap between user-generated visual information on social media and the practical needs of disaster response. Automated image classification enabled quicker, more effective responses, potentially saving lives and reducing economic losses in disaster-stricken communities.

Relevance of Research to State-Related Topic(s)

Kansas faces a significant risk of natural disasters, including tornadoes, floods, and wildfires. Major cities like Wichita and Topeka face increasing threats of climate catastrophes, with thousands of properties at risk of flooding by 2050. Since 2000, certain disasters have inflicted tragic loss of life, such as the May 2011 Tornado Outbreak, which claimed 177 lives, while other disasters have caused massive economic damage, such as the Summer 2008 Midwest Flooding, which incurred a total loss of 14 billion US dollars. Our research is closely aligned with the vital concerns for Kansas, including economic development, healthcare cost management, community development, and quality of life improvement, contributing to a more resilient future for the state. In fact, by automating the classification of user-generated disaster images on social media, we facilitate faster and more efficient responses, damage estimations, and resource allocations, potentially mitigating the loss of life and economic burdens of crises.

OBSERVATION OF BOUND MODES IN THE CONTINUUM AND WAVEGUIDING IN THE CONTINUUM IN ARCHITECTED ELASTIC STRUCTURES

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BACKGROUND/PURPOSE: The ability to both confine and release wave on demand can open a new avenue for elastic wave-based signal processing. The existing structure designs to confine wave energy require frequency bandgap and suffer from energy leakage to surroundings. Our research aims to design elastic structures that can support the localized modes in frequency passband. Such localized modes are known as bound modes in the continuum (BICs), which show zero energy leakage outside a compact region. In our recent work, we observe a BIC in a one-dimensional architected beam and predict a center localized mode in passband in $2D$ elastic structure. **METHOD:** To design the beam structure, we consider an array of periodic masses are attached to a beam structure, and four side beams are added maintaining reflection symmetry. The side beams are designed imposing the conditions for zero force and moment outside a compact region. Next, we work to seek localized modes in continuum in two-dimensional elastic structures. For that, we design topologically trivial and non-trivially square lattices, and combine them maintaining C_2 and chiral symmetry. **FINDINGS:** We observe a BIC in the $1D$ beam structure using laser Doppler vibrometer. Then, we find a localized mode in the passband at the hinge of non-trivial and trivial lattice and arranging an array of such hinges periodically, the localized mode is guided through the hinges. **CONCLUSION:** Our search for BICs in structure based on their symmetry provides a general framework that is applicable for wide range of elastic structure.

Relevance of Research to State-Related Topic(s)

The fundamental research objective of confining elastic energy with BICs can lead to a new class of mechanical resonators with potential applications in diverse areas of science and engineering. Mechanical resonators are relevant for sensing, communications, non-destructive evaluation, and biomedical imaging. It will also open new avenues for elastic wave-based computation, memory, and signal processing, with potential applications in robotics and IOT devices. Such novel wave control devices have applications as sensors for diverse areas, including biomedical and agriculture, all of relevance to the state of Kansas and its economy. Also, the study can lead to novel concepts for preventing vibration damage in large flexible structures, such as wind turbines. Vibrations due to strong winds, including tornadoes, are the major cause of wind turbine damage, which is extremely expensive to repair. The proposed architected materials could replace or complement currently used composite materials.

pLM4ACE: A PROTEIN LANGUAGE MODEL BASED PREDICTOR FOR ANTIHYPERTENSIVE PEPTIDE SCREENING

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BACKGROUND AND PURPOSE: Hypertension affects approximately 1 billion people worldwide and is a critical risk factor for cardiovascular diseases. Angiotensin-I converting enzyme (ACE) regulates the renin-angiotensin system and is the main drug target in clinical treatment. Recently, natural compound-based alternatives, particularly bioactive peptides, have attracted more attention because of the increasing health concern about the side effects of synthesized drugs. At this time, >1000 ACE inhibitory peptides have been identified with wet experiments. However, given the high cost, low efficiency, reliance on advanced equipment, etc., researchers are turning to bioinformatics to guide efficient peptide screening. The breakthrough in artificial intelligence (e.g., ChatGPT) brought protein language models (pLMs) into our sight, which has the potential to further current available prediction models. This study aims to build a protein language model-based predictor for high-antihypertensive peptide screening and explore its superiority over traditional methods. **METHOD:** The latest pLM (ESM-2) was employed for peptide representation and combined with five machine learning methods for anti-ACE peptide prediction. Besides, twelve traditional peptide representation approaches are also explored for comparison. **RESULTS/FINDINGS:** Among the 65 classifiers tested, logistic regression with ESM-2 showed the best performance, with a balanced accuracy (BACC) of 0.883 ± 0.017. ESM-2 showed superior performance in enhancing the prediction model's performance. **CONCLUSION:** The language model showed extraordinary performance in peptide prediction-related tasks, and the model developed here is expected to accelerate novel peptide discovery in the drug or nutraceutical industries. Also, the model can guide the valorization of proteins in agricultural by-products for nutraceutical production.

Relevance of Research to State-Related Topic(s)

This study provides a user-friendly prediction tool at https://sqzujiduce.us-east-1.awsapprunner.com/ for novel peptide screening with strong antihypertensive activity. With the increasing awareness of health and preference in natural compounds, the model can be used for the bioactive enzymatic hydrolysate formulation design to relieve blood pressure. Meanwhile, the source proteins for the functional hydrolysate production can be selected based on the agricultural products in Kansas, such as wheat, corn, sorghum, etc., for value-added purposes. Beside, the model can also be solely used in highly effective peptide-based drug discovery for hypertension. The more natural drug compounds they are, the easier they will be accepted. The increasing peptide-based drugs will thrive the next generation of antihypertensive drugs.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN OPTIMIZING GREEN AMMONIA PRODUCTION

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BACKGROUND AND PURPOSE: Ammonia is vital in producing fertilizers, which play a crucial role in global agriculture, supporting over half of the world's population. Additionally, ammonia is gaining attention in the energy sector due to its potential as a carbon-neutral hydrogen carrier for sustainable energy storage and transportation. However, the traditional method of producing ammonia via the Haber-Bosch reaction in high-temperature reactors has room for improvement in environmental sustainability and cost-efficiency. To address this, we propose leveraging artificial intelligence (AI) methodologies to optimize the ammonia manufacturing process. **METHOD:** To enhance our understanding of ammonia production, we developed a multiscale model that combines ammonia production kinetics with reactor dynamics. However, the complexity of this system posed challenges for real-time optimization. To overcome this, we employed AI techniques to streamline the reactor's model and integrated it with an advanced optimal process control approach. **RESULTS/FINDINGS:** The results showed that the AI-based model accurately predicted ammonia production dynamics. When combined with the advanced control strategy, it led to significant improvements in production efficiency, reduced energy consumption, and decreased waste generation. **CONCLUSION:** This research highlights the synergy between AI technologies and advanced process control and optimization methods. Simplifying complex processes through AI-based models holds promise for achieving efficient production outcomes, with widespread benefits for agriculture and the promotion of cleaner energy solutions. This approach can potentially contribute to sustainable agriculture and cleaner energy production, addressing critical global challenges.

Relevance of Research to State-Related Topic(s)

With its deep-rooted agricultural legacy, Kansas stands to reap substantial benefits from optimizing ammonia production. As a prominent wheat, corn, and soybean producer, the state's agricultural community could benefit from more cost-efficient and environmentally sustainable ammonia-based fertilizers. Heightened production efficiency equals reduced costs, resulting in more affordable fertilizers for farmers and potentially increased crop yields. Additionally, as the energy landscape in Kansas transforms, the state's pursuit of sustainable energy solutions can harness ammonia's potential as a carbon-neutral hydrogen carrier. This aligns with Kansas's commitment to eco-friendly practices and positions the state as a leader in environmentally conscious energy initiatives. Furthermore, advancements in AI technologies can foster the tech industry's growth, creating new employment opportunities and reinforcing Kansas's reputation as a place that seamlessly integrates its agricultural heritage with modern technological advancements.

QUANTIFYING CONSTANT RATE AND SENSOR-BASED VARIABLE RATE NITROGEN FERTILIZER RESPONSE ON CROP VIGOR AND YIELD

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BACKGROUND AND PURPOSE: In agriculture, applying the right amount of fertilizer is crucial for healthy crops and good yields. Constant rate (CR) and sensor-based variable rate application (VRA) are two commonly used methods. To find out which is better, we conducted a study using a sprayer to apply a type of fertilizer called UAN32 in two fields. **MATERIAL AND METHODS:** Sensors and Y-drops were used on the sprayer to apply UAN32 in all strips at constant and varying rates in both fields. Both fields were applied with 100 pounds more nitrogen than the strips; 100 pounds of UAN32 was added to the strips at the V6 stage. The application rate was set at 28.16 gallons per acre. **RESULTS/FINDINGS:** The crop's nitrogen content was analyzed at different growth stages, and aerial imagery was used to measure crop vigor. The results showed that at the V6 stage, all strips had similar nitrogen levels. At the R1 stage, the constant rate and variable rate had similar nitrogen levels, but the control was lower. Variable rate application showed better crop vigor compared to a constant rate. Crop yields were also higher with variable rates in two of the strips. For strip 3, the yield was similar for both methods. Variable rate used less fertilizer than constant rate in both fields. **CONCLUSION:** Using sensors to adjust fertilizer rates as needed improved crop health and yield. It also saved on fertilizer. Farmers can benefit from this approach for better crops and more efficient nutrient use.

Relevance of Research to State-Related Topic(s)

Our research on fertilizer application methods directly impacts several vital topics in Kansas. It addresses sustainable agriculture by optimizing nutrient use, contributing to a stable water supply, and reducing nutrient runoff. Improved crop yields through precision agriculture foster economic development within the agricultural sector. Effective nutrient management promotes plant health, enhancing food safety from farm to consumer. Additionally, it bolsters rural communities, as higher agricultural productivity strengthens the backbone of rural life. By reducing excess fertilizer use, our research aligns with sustainable practices, supporting the development of alternative energy sources. Lastly, it underscores the importance of education and research, indirectly benefiting student achievement in agricultural fields. In sum, our work resonates with key issues in Kansas, offering insights into sustainable and efficient farming practices that can uplift the state's economy, environment, and communities.

23 BEYOND WATER STRESS: MODELING FUTURE MAIZE PRODUCTIVITY IN THE EASTERN KANSAS RIVER BASIN

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BACKGROUND AND PURPOSE: Though the Eastern Kansas River Basin (EKSRB) is located in the humid region of Kansas, it is still affected by climate change, extreme weather, and significant spatial crop yield variability due to soils. The conditions of future maize productivity in the region are uncertain, with climate projections suggesting an increase in aridity. This study used the CERES-Maize model in the Decision Support System for Agrotechnology Transfer (DSSAT) to estimate yield and irrigation water use in Shawnee County of the EKSRB. It also investigated potential irrigation management strategies in a changing environment. **METHOD:** Model calibration and validation of the model revealed a 0.97 agreement index and a normalized RMSE of 3%. Future climate models (GCMs) from phase five of the Coupled Model Intercomparison Project (CMIP5) and the RCP 4.5 radiative forcing scenario for the region were retrieved, and the model was then run at a 4 km by 4 km scale. **RESULTS/FINDINGS:** Despite irrigation management to improve yield and strengthen resilience, maize yield declined by 31% to 36% under four irrigation management strategies relative to current conditions. Our findings suggest that maize productivity in the future may be influenced more by the projected increase in the growing-season air temperature and atmospheric CO_2 than water stress. **CONCLUSION:** The unconventional irrigation management strategy implemented in this study can result in significant water savings, opening prospects to link irrigation water management to soil health and cultivar genetic improvements to sustain maize production in the future.

Relevance of Research to State-Related Topic(s)

Maize is one of Kansas's most vital crops, and irrigation management optimization of maize production is crucial for maintaining yields, improving water use efficiency, and food security to support the increasing population and the state's economy. Maize sensitivity to climate change has been reported in the form of low yield, alteration in phenology, and shortened photosynthesis. Climate variability has worsened climate stress's impact on maize and may worsen under future climate change. On the other hand, irrigation may close the gaps of the implicit disadvantage of drought stress on maize production but requires proper management and adaptation to save diminishing water resources. My research integrates a model-based approach with field observations to investigate possible irrigation management strategies in a changing environment. The result is a holistic scarce water resource management approach that will save water for supply in other water-dependent sectors and improve farmers' crop productivity.

THE IMPACT OF WORKPLACE PHYSICAL ACTIVITY INTERVENTIONS UPON OCCUPATIONAL WELL-BEING AND/OR WORK PRODUCTIVITY: A SYSTEMATIC REVIEW

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BACKGROUND: A leading cause of chronic disease worldwide is a sedentary lifestyle. Some workplace physical activity interventions (PAIs) have been developed to combat sedentary workplace environments. Improvements in employee well-being and productivity increase the value of a PAI for the employer and employee; however, few PAI studies measure these outcomes. This systematic review aims to identify PAIs that measure employee well-being and productivity and evaluate their effects on employees. **METHOD:** A search following PRISMA guidelines included ten electronic databases. Any US-based PAI study published between 2012 and 2023 measuring employee well-being and/or productivity was included. The intervention type (i.e., educational and/or exercise equipment), physical activity (PA), productivity, and well-being outcomes were extracted and examined for effectiveness. Two experts in the field confirmed article criteria, eligibility, and categorization. **RESULTS/FINDINGS:** Eight studies met the inclusion criteria. Intervention type varied (educational n = 2, equipment n = 2, both n = 4). Common measurements of employee well-being included employee energy, health-related absenteeism, fatigue, pain, social functioning, and non-work satisfaction. Productivity measures included task planning efficiency, concentration, and absenteeism. Five studies reported reduced sedentary time, while three articles had various results including increases in PA but not sedentary time, improvements in both PA and sedentary time, and no PA improvements. Employee well-being and productivity improvements were reported in six and seven studies, respectively. **CONCLUSION:** PAIs can enhance employee well-being and productivity, making employers and employees more likely to implement them. Future research should optimize PIAs to improve well-being and productivity, thus leading to increased adherence and implementation in workplaces.

Relevance of Research to State-Related Topics

Sedentary lifestyle is a primary cause of the top three chronic diseases (heart disease, lung disease, and cancers) that cause most premature deaths in Kansas. The number of sedentary employees continues to climb in the US. Kansas struggles with sedentary behavior as the ratio of adults meeting physical activity guidelines is much lower than the US average (20.8% vs. 24.4%). Workplace physical activity interventions reduce sedentary behavior and improve Kansas residents' chronic disease outcomes. Moreover, they can improve employee productivity and well-being. This research reveals that combining educational and equipment-based workplace physical activity interventions may benefit employees, employers, and policymakers. The benefits could result in an estimated $2.14 billion annual savings for Kansas' health care costs. This research relates to state initiatives of economic development, workforce development, health conditions impacting the health of Kansas, including cancer, obesity, diabetes, and other conditions, health care costs, and alternative health care.

REDEFINING TRADITIONAL LONG-TERM CARE SENIOR LIVING RESIDENCES THROUGH ACCESSIBLE RESOURCE IMPLEMENTATION TO PROMOTE HEALTHIER OLDER ADULTS

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BACKGROUND AND PURPOSE: To promote healthier older adults living in long-term care residential settings, they need access not only to the necessities of life, but also to life-enriching amenities. These amenities provide an abundance of mental and physical health benefits, leading residents to live longer and happier lives. Unfortunately, oftentimes these residences are not adequately programmed for residents to use these amenities, hindering their living experience. There is a need for redefinition of traditional long-term care residences by integrating an opportunistic, educational, walkable campus to promote healthier residents. **METHOD:** Data collected can be assessed under the Activity Theory, which notes that an older adult's degree of commitment, rather than the number of activities, is most critical in perception of quality of life. Older adults will also seek Residential Normalcy; this theoretical framework focuses on older adults who feel they occupy incongruent places, like long-term care residences as aforementioned. **RESULTS/FINDINGS:** When the older adult participates in activities and utilizes a residence's resources as described, they benefit tremendously mentally and physically. When providing older adults access to these amenities through a neighborhood-reminiscent accessible community, their quality of life is improved by means of familiarity. **CONCLUSION:** These strategies benefit residents significantly, though there are still limitations. When residences begin to make these changes to incorporate the extent of what is discussed in this research, that redefinition will likely bring about a change to the requirements of administration practices. Older adults need advocates for these changes; all designers, residence staff, and policy makers should be a part of this movement.

Relevance of Research to State-Related Topic(s)

Redefining long-term care older adult residential requirements is critical in the state of Kansas. Not only do more than a quarter of these residences have substandard levels of care as defined by Medicare & Medicaid. These living conditions can be improved by requiring additional amenity care programs for the residents. Injuries, accidents, and mental health related conditions have been proven to be reduced by implementing life-enriching amenities in these communities. Much of these design considerations are ignored by developer-led firms hired for new construction or renovation, but new policy implementation can make impactful design changes on the resident's mental and physical health.

MANHATTAN'S HIDDEN AFFORDABLE HOUSING: HOW URBAN DESIGN AND REGULATIONS AFFECT MOBILE HOME PARK RESIDENTS

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BACKGROUND AND PURPOSE: With record inflation rates outpacing income growth, United States is facing an affordable housing crisis. In no state in the US can a minimum wage worker afford a market rate rental working 40 hours a week. Mobile homes are the fastest growing source of affordable housing generally concentrated in mobile home parks (MHPs). While there is growing literature on MHPs located in the sun belt, there is little peer reviewed research on MHPs in Kansas and the Great Plains. This research aims to understand who lives in MHPs in Riley County, what their experiences are, and how affordability and design of their home impacts their lives. **METHOD:** Using a mixed method approach of surveys and semi-structured interviews, participants were asked questions regarding how and why they live in MHPs. Additionally, mapping exercises and design analyses of the MHPs shed light on the built environment. **RESULTS/FINDINGS:** Protruding themes are ownership, affordability, and social connections within parks. There is a lack of exterior private space. Most parks have easy access to grocery stores and green space but are located in flood plains. **CONCLUSION:** This research sheds light on a form of housing that has not been studied. These are vital members of our community who are designed to be out of sight both in physical and regulatory design. However, they seem to be providing a source of affordable housing. Design of MHPs seems to be for economic purposes only, disregarding the lived experiences of residents. Residents on average moderately enjoy their housing situation.

Relevance of Research to State-Related Topic(s)

All key topics on the legislature's list can be impacted by an individual's housing, and residents in MHPs have unique relationships with these topics. Affordable housing is vital for job creation and workforce development, but if it becomes unaffordable, Kansas will suffer. Rural communities are reliant on MHPs for a large portion of their housing. Historically, MHPs have been developed alongside new business. Understanding them better, and designing them better, will increase the quality of life for Kansans in its specific labor market. Focusing on MHPs in Kansas is vital for the future success of our state's economic development and quality of life. MHPs are often disregarded in community development initiatives, which further alienates residents who are already ignored by cities. Beginning this conversation can lead to many improvements for MHP residents, and Kansas overall, continuing to make it an affordable and safe place to live and prosper.

ADAPTIVE CAPACITY IN KANSAS: AN UNCERTAINTY ANALYSIS

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BACKGROUND AND PURPOSE: Climate change presents unprecedented challenges for agricultural producers globally. Kansas, a state highly dependent on agriculture, is experiencing longer and more frequent. Understanding the drivers of adaptive capacity (AC) across the state is crucial. There is no consensus on the definition, determinants, or methods in characterizing AC. Additionally, the multidimensional and context-sensitive nature of AC makes it a complex and interdisciplinary subject of study. **METHOD:** To characterize the uncertainty across community types and methodologies in constructing adaptive capacity indices, this study compares four different construction methods in four different sample (whole state, metropolitan, non-metro metropolitan, farming counties). In addition, this study identifies the variables that drive adaptive capacity in each community type through stepwise regression. **RESULTS/FINDINGS:** The study found some consistency in variable selection across community types. Both whole and metro samples featured variables like Households on SNAP, and percent population with graduate degrees, as well as similarities between the non-metro and farming counties. Uncertainty in AC assessment was examined, revealing lower maximum uncertainty in metro, non-metro, and farming counties compared to the whole state. Metro counties had the highest variance in uncertainty with a 37% variance in adaptive capacity values, while the non-metro sample showed only a 1% difference. **CONCLUSION:** This study sheds light on the multifaceted nature of AC assessment, demonstrating variations in variable selection and uncertainty across community types and methodologies.

Relevance of Research to State-Related Topic(s)

Kansas holds the second-highest cropland acreage in the United States, making it a vital component of the country's agricultural landscape (Anandhi et al., 2013) and key driver of Kansas' economic success (Kansas Department of Agriculture, 2022). Kansas agriculture is centered around corn, wheat, grain sorghum, beef production, as well as other nonfood products (Kansas Department of Agriculture, 2022). The corn production area in Kansas is situated above the High Plains (Ogallala) Aquifer, which has experienced a significant decline in water levels due to water withdrawals exceeding the volume of aquifer annual natural recharges (Sanderson & Hughes, 2019). This decline in the aquifer's water levels adversely affects agricultural production in the region and poses a threat to the nation's food security (Anandhi & Kannan, 2018). As droughts in Kansas become longer and with higher frequencies, there is the need to understand what drives adaptive capacity across the state.

THE USE OF A WINTER BREAK PRE-COURSE TO PREDICT LARGE ANIMAL GROSS ANATOMY II PERFORMANCE

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BACKGROUND AND PURPOSE: In veterinary school, student experience with large animals varies among learners. To address this, pre-courses are used to introduce course material and prerequisite knowledge. This study seeks to assess the impact of pre-course engagement on veterinary student grades and perceptions. **METHODS:** An optional winter-break pre-course was offered to first-year Doctor of Veterinary Medicine students to prepare them for the large animal anatomy course. The pre-course featured four modules covering large animal anatomical terminology, landmarks, skeletal features, and musculature, with two cohorts: pre-course A (gated access) and pre-course B (non-gated access). In pre-course A, students had to complete the previous module before accessing the next, whereas in pre-course B, all four modules were accessible simultaneously. **RESULTS/FINDINGS:** Quantitative analysis using Pearson's Correlation revealed significant positive correlations between pre-course interaction and large animal anatomy exam performance, specifically for exam 1 ($R = 0.49$, P-Value = 0.008) and exam 4 ($R = 0.50$, $P = 0.02$), and change in grade from the canine anatomy course ($R = 0.41$, $P = 0.05$), particularly for the middle quartile students based on their final grade in the large animal anatomy course. Qualitative analysis found positive student perceptions, emphasizing the pre-course's value for those with limited large animal experience and its adaptable and accessible nature. **CONCLUSIONS:** This study concludes that a winter-break pre-course is a useful supplemental resource to prepare students for large animal anatomy. It offers a solution to the knowledge variability issue, making it an adaptable resource for other veterinary institutions seeking to enhance their anatomy education.

Relevance of Research to State-Related Topic(s)

The Kansas State University College of Veterinary Medicine is dedicated to advancing One Health through excellence in teaching and research. This study, through the development of a supplemental resource, found that a pre-course can enhance the knowledge of future veterinarians. As Kansas' only veterinary school, many in-state students seek to remain in Kansas to serve their communities. Agriculture continues to be a significant economic driver, with veterinarians at the forefront of ensuring the health and welfare of food and fiber animals. By enhancing veterinary anatomy curriculum, this research seeks to improve food and fiber anatomical knowledge, therefore affecting future Kansas veterinarians and their contributions to the agricultural economy.

MULTILEVEL FACTORS ASSOCIATED WITH PHYSICAL ACTIVITY AMONG ADULT WORKING HISPANIC WOMEN

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BACKGROUND AND PURPOSE: Adult working Hispanic women are at an increased risk of adverse health effects due to low levels of physical activity (PA) attributed to numerous barriers across multiple levels of influence. One model that is used to study these levels is the Social Ecological Model (SEM). The purpose of this study is to utilize the SEM to examine factors associated with PA among working Hispanic women. **METHOD:** Participants (*N=223*) were recruited through the Prolific database. Participants were: (1) Hispanic adult females, (2) working part-time or full-time, and (3) residing in the U.S. The participants completed validated surveys assessing factors across levels of the SEM: individual, interpersonal, organizational, and community. The IPAQ-short form was used to assess current PA levels. Hierarchical linear regression was conducted to examine multilevel predictors of PA among this population, with each level of the SEM entered the model in sequential blocks. **RESULTS/FINDINGS:** The variables included in the linear regression analysis accounted for approximately 14% of the variance in PA ($R^2 = .144$, $p= .031$), with the individual and community levels contributing significantly to PA behavior. The final model demonstrates that the strongest predictors associated with PA were crime ($\boldsymbol{\beta}=-.17$, $p=.009$), hours worked ($\boldsymbol{\beta}=.133$, $p=.040$), and self-efficacy ($\boldsymbol{\beta}=.142$, $p=.059$). **CONCLUSION:** Adult working Hispanic women's PA is influenced by several levels of the SEM. Future intervention programming needs to address crime rates, PA during work hours, and increased self-efficacy for PA participation. Incorporating these variables in future PA programs may assist in reducing the risk of illness/disease among the Latinx population.

Relevance of Research to State-Related Topic(s)

The Hispanic/Latinx community is a growing population within the United States. The rise in this population provides opportunities for cultural diversity and economic growth. However, a concern that must be addressed is the high obesity rates due to low levels of physical activity among this population. Adverse health effects related to the prevalence of obesity include diabetes, hypertension, heart disease, and other chronic illnesses. In addition, these health concerns contribute to increased mortality rates and health care costs at the state level. For the state of Kansas to see positive economic and cultural benefits, it is crucial to minimize the health risks of the growing Hispanic population. To combat these negative effects, it is essential to identify the facilitators/barriers contributing to low levels of physical activity and implement effective programming to improve the health among the Hispanic/Latinx population.

FEMALE VETERANS: CONTRIBUTORS TO HEALTH-SEEKING BEHAVIORS

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BACKGROUND AND PURPOSE: The disproportionate increase in suicide rates among female veterans, particularly those not currently using Veterans Healthcare Administration care, has underscored the need to understand how to reach female veterans. The purpose of this study was to gain a better understanding of how military experiences contributed to female Army Veterans' utilization of health services. The study employed the vulnerability, stress, and adaptation model as the theoretical framework to explore how being female in a military environment characterized by masculinity can impact their health and well-being. Uncovering the factors that hinder the use of health services can guide efforts to improve the accessibility of healthcare and prevent suicides. **METHOD:** This study included 11 female Veterans with lengths of service from 3 to 27 years indicating a diverse range of military experience (Mean service = 10 years). In-depth interviews were conducted using videoconferencing software over two separate interview sessions. **FINDINGS:** The data analysis identified two main themes and corresponding subthemes that serve as barriers to accessing health services during active duty. Theme 1: Sexism**;** Sub-themes: Sexual assault and harassment, Gynecological health, Double standards, Gendered assumptions, and Limited opportunities. Theme 2: The Healthcare System**;** Sub-themes: Poor medical care, Challenges with mental health providers, Invisibility at the VHA, and Healthcare options. **CONCLUSION:** There are varied factors that act as barriers for female service members to access military healthcare. There is an urgent need for gender-sensitive policies, practices, advocacy, education, and outreach to ensure accessible military and civilian healthcare services for female service members.

Relevance of Research to State-Related Topic(s)

The increasing number of female service members significantly impacts the state of Kansas, given the continuous flow of personnel in and out of our state. It is imperative that Kansas recognizes and supports the unique healthcare needs of our female military population given the disproportionate increase in suicide rates among National Guards, Reserves, and Veterans who do not access the Veterans Healthcare Administration for health services. Suicide and suicide attempts cost the U.S. $70 billion a year in lifetime medical and work-loss costs alone. Currently, there is a noticeable gap in the research that addresses the needs of this particular group and the impact that military service has had on them. The findings of this study highlight the factors that act as barriers for female service members to access military healthcare and the implications for gender-sensitive policies, practices, advocacy, education, and outreach to ensure accessible military and civilian healthcare services.

A UNIFIED ALGORITHM FOR PENALIZED LIKELIHOODS IN MODEL SELECTION OF SPATIAL-TEMPORAL MODELS FOR LATTICE DATA

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BACKGROUND AND PURPOSE: A current challenge in agriculture is to determine how environmental factors affect crop production. The task involves analyzing data measured at specific locations and fitting a linear model to determine the importance of features like precipitation, temperature, and soil characteristics on a crop's production level. When fitting linear models to such data collected at specific locations, accounting for the spatial correlation is crucial. Neighboring observations might share some characteristics and, thus, may have similarities that could confound the effects of external factors. **METHOD:** We propose a new method to discern important features while accounting for the spatial dependence structure. The method automatically determines relevant predictors and the dependence structure in the data. Kansas corn yields per county for 2002 are used to illustrate the technique and compare it with Conley's Generalized Method of Moments (GMM) currently used in agricultural economics. We showcase the model's capabilities by identifying relevant factors impacting corn yield per county in Kansas. **RESULTS/FINDINGS:** Hydrologic soil group A and soil organic carbon are considered the relevant and significant factors to the corn yields and any non-significant factors based on the GMM were automatically dropped by the proposed method. Spatial dependence was also detected by the proposed method with moderate spatial correlations between 0.4 and 0.6 among the Kansas counties. **CONCLUSION:** These results show an efficient way to select important predictors and explain the correlations among the counties. The proposed method can be extended further by adding temporal effects to consider multiple years at a time.

Relevance of Research to State-Related Topic(s)

Kansas is known as the country's breadbasket; it is one of the large producers of wheat and ranks high for corn and other grains. Identifying what factors, physical, environmental, agricultural, or others, affect Kansas land production is crucial to understand the impacts of climate change, and to drive policy making on regulations related to farming practices and productivity. When determining relevant factors, failure to account for geographical dependence can lead to mis specified statistical models that miss a significant effect or include false positives. The proposed method of this project could help explain both the relationships between production and relevant features, and the spatial correlations among Kansas' regions.

UNEXPECTED REVERSAL OF REACTIVITY IN ORGANIC FUNCTIONALITIES WHEN IMMOBILIZED TOGETHER IN A METAL-ORGANIC FRAMEWORK (MOF) MATERIAL

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BACKGROUND AND PURPOSE: The synthesis of pharmaceuticals and fine chemicals is extremely challenging because the reactions need to be both efficient and selective. Catalysts are compounds that speed up the rate of reactions and often promote the production of the preferred product. Inspired by Nature's most efficient catalysts, enzymes, we have designed novel metal organic framework (MOF) based catalysts that borrow some of their characteristics. MOFs are materials made from metal nodes and organic linkers to form porous materials, like molecular sponges with identical, nano-sized pores. We have observed unexpected and exciting reactivity within the pores of these materials, and we report the investigation of these nanoconfinement effects. **METHOD AND RESULTS:** Amine functionalities generally react faster than alcohols. We have observed the opposite reactivity when the functional groups are present together in the pores of our MOFs. We synthesized two new MOFs, one containing alcohol groups only and the other containing amine groups only. We found that when the organic functionalities are present individually in a MOF, the amine was more reactive than the alcohol. This result indicates that the reversal in reactivity that we observed is due to the confinement of the two functionalities together within the MOF pores. **IMPLICATIONS OF RESULTS:** These nanoconfinement effects have exciting implications in catalysis as they are reminiscent of confinement effects observed in enzymes.

Relevance of Research to State-Related Topic(s)

Healthy horses, as important companion animals in the state of Kansas, are part of the culture of the state. Equines are considered sentinels of many emerging and re-emerging diseases. We studied ticks that transmit the pathogens causing important horse diseases. Applying sequencing technology to understand the microorganisms associated with this ectoparasite allowed us to complete a comprehensive survey of the different microorganisms carried by different populations of ticks. Deciphering the interactions between different groups of microorganisms occurs within different tick populations will help in the development of pathogen monitoring tools for early detection, prevention, and control of potential disease outbreaks.

A FRAMEWORK FOR IDENTIFYING MARGINAL LANDS FOR SOLAR PHOTOVOLTAIC INSTALLATION

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BACKGROUND AND PURPOSE: Rising energy demand in the United States, projected to increase by 15% between 2020 and 2050, has spurred a growing emphasis on adopting energy-efficient technologies and expanding renewable energy infrastructure. However, this heightened investment in renewable energy infrastructure potentially exacerbates the current competition for accessible land resources between agricultural-based food production and energy generation in rural areas. For instance, while technically and economically promising, utility-scale solar PV facilities face a substantial challenge due to their notable land demand of around 2.5 to 3.5 hectares per MWac of installed capacity. Prior research emphasized identifying suitable SPV installation sites, leaving a research gap in exploring the prospects of marginal land for micro-grid SPV facilities. In their report, the National Renewable Energy Laboratory asserts that Kansas and the Great Plains have great potential for rural SPV power generation, with Kansas ranking 3rd within the CONUS. Thus, this research concentrates on developing a framework to identify marginal lands that would be suitable for SPV deployment in Kansas. **METHOD:** We leveraged the GIS and remote sensing techniques to process the soil biophysical properties and land cover data. **RESULTS/FINDINGS:** We defined marginal land based on two broad criteria: (a) biophysical and environmental properties, such as slope, soil erosion, soil moisture content, soil temperature, drought intensity, and environmentally restrictive areas, and (b) specific land uses, including Conservation Reserve Program (CRP) lands, abandoned mine lands, and unproductive rangelands and pasture lands. **CONCLUSION**: Our findings propose an avenue to harness marginal lands for sustainable energy production while safeguarding crucial agricultural resources within Kansas.

Relevance of Research to State-Related Topic(s)

Solar Photovoltaic technologies offer significant benefits for food security, agricultural production, and rural development. Despite its considerable potential for rural SPV power generation, Kansas lags behind adjacent Great Plains states such as Missouri, Iowa, New Mexico, and Texas in terms of solar PV development. This research contributes to the aim of innovation in the Food and Agriculture system by enhancing our understanding of green energy and bolstering the economic viability of agricultural producers and agribusinesses. Specifically, this research directly addresses the intersection of food production and energy generation by proposing an alternative solution for appropriate land management for SPV installations.

COMPLEX NETWORK ANALYSIS OF SUMMER EXTREME TEMPERATURE EVENTS IN THE CONTIGUOUS UNITED STATES

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BACKGROUND: Extreme temperature events, such as heat waves, are one of the consequences of climate change and global warming. To better understand their complex behavior and forecast climate/hydrologic dynamics, studying their spatial and temporal patterns is essential. We, therefore, investigated extreme temperature events over the Contiguous United States (CONUS) for the summer season using complex network theory. For this purpose, the daily maximum temperature data were collected from the Climate Prediction Center (CPC) database. **METHOD:** To determine the level of similarity between two geographic nodes, we employed the event synchronization method and constructed the network of extreme temperature events. The constructed networks were then corrected for boundary effects, and network measures, such as degree centrality, betweenness centrality, clustering coefficient, and mean geographic distance, were determined to analyze complex patterns within the networks. **RESULTS/FINDINGS:** Our results reveal that California and the Pacific Northwest as important locations for large-scale propagation of extreme temperature events during summer. Furthermore, the evolution of extreme temperature events from 1979 to 2022 uncovered an increasing trend in this season. By applying the Louvain method for community detection, we found four synchronization regions in the network of extreme temperature events during the summer. **CONCLUSIONS:** The approach employed is essential for studying the association among extreme events and for their forecasting.

Relevance of Research to State-Related Topic(s)

The contiguous United States (including Kansas State) has experienced an increase in frequency and severity of extreme temperature events occurrences as a result of climate change. Studying the patterns and propagation of these events is essential for managing natural disasters, ensuring food security, preserving the environment, protecting human health and safety, and understanding climate dynamics. This further provides valuable insights to address the challenges pose by climate change and make informed decisions for a sustainable future.

MODELING SPONTANEOUS IMBIBITION AND ITS SCALING APPLICATION TO UNDERGROUND GAS STORAGE

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BACKGROUND: Spontaneous imbibition (SI) is a natural process through which a liquid (e.g., supercritical CO_2) is drawn into a partially saturated porous medium by capillarity. It has vital applications to underground gas storage and CO_2 sequestration. Scaling SI data has long been a challenge. If data collapse onto a universal curve, recovery factor can be determined for any geologic formation if heterogeneities are captured. One scaling method is based on Richards' equation. However, evidence showed that it may not accurately collapse data from different rock types. **METHODS:** In this study, we apply time-fractional Richards' equation and non-Boltzmann transformation for scaling SI. In our approach, imbibition distance is proportional to time to the power $\alpha/2$, with α theoretically ranging from 0 to 2 ($\alpha = 1$ corresponds to Boltzmann scaling). **RESULTS:** We analyzed SI data reported in the literature including 25 sandstones, 4 diatomites, and 6 synthetic porous media. By plotting the normalized recovery factor against the dimensionless time, we found that the non-Boltzmann transformation (variable α) provided a significantly better collapse in the SI data compared to the Boltzmann transformation ($\alpha = 1$). Specifically, α ranged from 0.88 to 1.21. **CONCLUSION:** These variations could be attributed to differences in contact angle, lithology, and pore structure between samples, requiring further investigation. By using the time-fractional Richards' equation, we aim to predict the rate and volume of fluid undergoing spontaneous imbibition in porous media more accurately. This prediction relies on knowledge of parameters like porosity, permeability, initial and maximum saturations, viscosity, and wettability.

Relevance of Research to State-Related Topic(s)

CO_2 sequestration seems to be feasible in some geological formations in Kansas. The Kansas Geological Survey (KGS) together with the U.S. Department of Energy have been actively researching over the past several years to analyze subsurface rocks and reservoirs and assessing their capacity for CO_2 storage as a mitigation strategy to reduce atmospheric CO_2 levels. A fundamental aspect of this research involves studying fluid flow and transport within geological formations, which is crucial for the successful underground storage of CO_2. Our research primarily focuses on spontaneous imbibition, a key mechanism in underground gas storage. The accurate modeling of spontaneous imbibition while capturing heterogeneity enables us to predict the recovery potential of any geological formation. This approach provides valuable insights into the nature of fluid flow within formations in the state of Kansas and establishing a connection to the process of CO_2 sequestration within the studied geological formations.

COMPLEX NETWORK ANALYSIS OF EXTREME RAINFALL PATTERNS IN KANSAS

Victor Oladoja, Tayeb Jamali, and Behzad Ghanbarian
Department of Geology

BACKGROUND: Global warming and climate change have been having severe impacts on extreme events, such as rainfall, floods, and drought even at the state level. Extreme rainfall events have recently caused considerable economic loss and threatened human lives. Therefore, it is important to better understand patterns of extreme events, improve hydrometeorological forecasts, and develop strategies for coping with related hazards. **METHODS**: In this study, we investigated dynamic behaviors and spatial configurations of extreme rainfall events (EREs) in Kansas using complex network theory. We constructed the EREs network from a gauge-based daily precipitation database provided by the Climate Prediction Center (CPC). The dataset used in this study covers the time 1991-2020 and consists of geographic grid points (known as nodes). We applied the event synchronization method to compute the degree of association among the nodes. We then determined the spatiotemporal patterns of EREs through some network measures, such as degree centrality, mean geographical distance, betweenness centrality, and clustering coefficient. **RESULTS**: We found that the number of EREs increased from 1991 to 2020 for both summer and winter seasons. The slope of the linear trend was 0.51 for summer and 1.14 for winter. Results of betweenness centrality analysis demonstrated geographic locations contributed to atmospheric transport phenomena in the state. Based on the degree centrality analysis, we found local propagation of the EREs in Kansas. **CONCLUSION**: Our study revealed the spatiotemporal patterns of EREs in Kansas and improved our understanding of how they propagate on a local scale.

Relevance of Research to State-Related Topic(s)

The State of Kansas has suffered numerous floods in the past. These floods (e.g., the Flood of May 2007) caused severe damage to the state in terms of lives and properties to the tune of millions of dollars. Floods occur majorly because of intense rainfall referred to as EREs above. To mitigate and prepare for such hazards, it is important to improve EREs predictability. We need to improve climate and hydrologic models to achieve this. For example, one limitation of existing climate models is that they perform better at large scale (e.g., country scale) but less at small scale (e.g., sub-country scale) and inaccurately represent complex natural interconnections. Improving climate and hydrologic models to forecast water-related hazards depends on identifying complex patterns of extreme events, especially at small scales. Therefore, we studied complex patterns of EREs at Kansas-scale and our results when incorporated into existing models will improve their predictions.

URANIUM IN GROUNDWATER AND ITS POTENTIALS AS A NATURAL CONTAMINANT IN THE CHEROKEE BASIN, SOUTHEASTERN KANSAS

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BACKGROUND AND PURPOSE: The ingestion of radioactive nuclides such as uranium has been associated with renal and cancer-related issues in humans. Many previous studies have focused on anthropogenic uranium contamination in groundwater. Here, we examine the potential for natural uranium contamination resulting from rock-water interaction. After uranium ores, black shales are the second most important uranium host. Immobile uranium can be mobilized into groundwater under ideal geochemical circumstances, controlled by factors such as redox status, carbonate speciation, and alkalinity. The sedimentary succession in the Cherokee Basin in southeastern Kansas includes several black shales interbedded with limestones. **METHOD:** We collected and analyzed the chemistry of groundwater samples from domestic wells screened in the Ozark aquifer to investigate whether these black shales were sources of groundwater uranium contamination. **RESULTS/FINDINGS:** Uranium concentration is low in the area, showing that this element remains trapped in the rock. However, some wells had high Hg, Fe, Mn, NO_3^-, NH_4, and K^{2+} concentrations. **CONCLUSIONS:** Potential health effects of these contaminants through ingestion in drinking water are: Hg - damage to the eyes, skin, respiratory, digestive, neural, immune, and renal systems; Iron - iron overload in individuals prone to hemochromatosis; Mn - toxicity can adversely affect the nervous system and cause neurological and developmental effects in children.; NO_3^- - methemoglobinemia in infants; NH_4^+ - potential formation of disinfecting by-products, associated with increased risk of certain cancers.; K^+ - can lead to a condition known as Hyperkalemia, which may cause disruptions in muscle and nerve functions, gastrointestinal irritation, and impairment of heart and kidney functions.

Relevance of Research to State-Related Topic(s)

The United Nations has recognized numerous global concerns contributing to the appalling quality of drinking water supplied to the general populace. Most of these concerns result from a gap in our ability to monitor and manage potable water sources. This research addresses the existing information gap by evaluating the connection between geology and uranium concentration. It specifically investigates the potential risk organic-rich rocks pose to groundwater, a drinking water source. This is relevant, given the broad area of Kansas covered by these rocks. If high uranium concentrations were found, it would have provided crucial information to water-well owners to ensure the quality of domestic drinking water, reducing the amount of uranium-related health issues in the area, such as cancer. The identification of other contaminants is also crucial to alert the rural community about the health risks associated with groundwater contamination from sources like fertilizers and other pollutants.

ORIGIN AND TIMING OF CHERT NODULES IN THE PERMIAN FLORENCE LIMESTONE IN KANSAS

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BACKGROUND AND PURPOSE: This study investigates the origin and timing of chert nodules in the Permian Florence Limestone in Kansas to determine the mineralogy, crystallinity, and paragenetic relations of silica within the host rock. Chert nodules in the limestones control the topography due to its resistance to weathering, creating the rolling hills topography, characteristic of the Flint Hills region in Kansas. **METHOD:** Three sites around Manhattan were selected for collecting samples and observing the distribution of nodules. Petrography is used to describe the paragenetic relations of silica types, and complementary analyses to confirm their composition. **RESULTS/FINDINGS:** The nodules are 4- 6 cm across and up to several feet long, distributed along horizontal, bifurcating layers, locally connected vertically, forming networks closely resembling Ophiomorpha burrows. Nodule boundaries are diffused or abrupt, with different internal textures (homogeneous, rimmed, or wood-grained). Nodule composition includes three distinct phases of silica: opaline, microcrystalline quartz (chert) and chalcedony, and rarely minute bipyramidal quartz. Paragenetic relations indicate that opaline silica was the first phase, extensively replacing micrite and bioclasts. It was later replaced by chert, and chalcedony spherulites locally replaced chert. Calcite rhombs replaced both the original micrite and diagenetic silica. Dissolution pores are partially filled with silica rosettes. **CONCLUSION:** The Florence Limestone underwent multiphase silicification, starting with the precipitation of opaline silica along burrow pathways during eodiagenesis, possibly under evaporative conditions. Later phases may have resulted from the percolation of deep-burial solutions and/or recrystallization of metastable opaline silica into more stable phases during mesodiagenesis.

Relevance of Research to State-Related Topic(s)

The Flint Hills gained its name due to the abundant chert (= flint) nodules spread throughout the area. Nodular chert requires specific environmental conditions to precipitate in a basin. Hence, studies on chert formation can provide valuable insight into paleoclimate and paleoecological conditions that prevailed during the Permian-Pennsylvanian period of Kansas. Being hard and sharp, Chert was widely used by prehistoric people in tool- and weapon-making. Many fossils, including early life forms, are preserved in silica, so it is important to understanding the mechanism of formation. The chert studies in Kansas may serve as a reference to understanding silica source and formation elsewhere in the world and even on other planets.