Research and the State

GRADUATE STUDENT POSTER SESSION

Program Booklet

Wednesday, October 27, 2021
Student Union Courtyard

Sponsored by:
Graduate Student Council
Graduate School
Offices of the President and Provost

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Program Schedule

POSTER PRESENTATIONS AND JUDGING

1:00 pm to 3:00 pm
Student Union Courtyard

Research posters will be presented by approximately 30 K-State graduate students representing five academic colleges. The top 10 presenters will be selected by K-State faculty and post-doc judges to participate in the Capitol Graduate Research Summit (CGRS) being held in Topeka in February.

AWARDS CEREMONY

4:00 pm
Big 12 Room, Union

The top 10 graduate student poster presenters selected to represent K-State by presenting their posters at the 19th annual Capitol Graduate Research Summit (CGRS) in February 2022 will be announced at the awards ceremony. These 10 students will be presented with a monetary 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.

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9. **UTILIZING COMPARATIVE TRANSCRIPTOMICS TO UNDERSTAND THE EFFECTS OF VESICULAR STOMATITIS VIRUS INFECTION ON NEURO-SENSORY FUNCTION IN CULICOIDES MIDGES**
   Edward Bird

10. **AGE-ASSOCIATED MICROBIAL STABILITY AND VOLATILITY SHAPE THE GUT MICROBIOME IN A HEALTHY PIG MODEL**
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11. **ACUTE ANAPLASMOSIS REDUCES BREEDING SOUNDNESS IN EXPERIMENTALLY INFECTED BEEF BULLS**
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    Victoria Pickens

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    Theresa Quintana

14. **MOBILITY OF PHOSPHINE-SUSCEPTIBLE AND -RESISTANT RHYZOPERTHA DOMINICA (COLEOPTERA: BOSTRICHIDAE) AND TRIBOLIUM CASTANEUM (COLEOPTERA: TENEBRIONIDAE) AFTER EXPOSURE TO INSECTICIDE NETTING**
    Sabita Ranabhat

GROUP 3

15. INVESTIGATING THE EFFECTS OF NUCLEAR RADIATION ON ADDITIVELY MANUFACTURED PARTS
Mohanish Andurkar

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Poster Abstracts

GROUP 1

1

KERNZA, A LOCAL GRAIN WITH BIG FUTURE

Anusha Dahal[1], Myron Bruce[1], Kathryn Turner[2], and Jessica Rupp[1]
[1]*Department of Plant Pathology;* [2]*The Land Institute*

BACKGROUND AND PURPOSE: Perennial plants have many advantages including preventing soil erosion, restoring soil health, reducing carbon emissions, and providing the world with greater food security. They reduce the need for costly inputs, lessen our need for chemicals, and minimize the operational expenses of tillage. The perennial crop Kernza®, also known as intermediate wheatgrass (*Thinopyrum intermedium*) is a wild relative of wheat which has been grown throughout the USA to provide fodder for livestock and is currently being domesticated for human consumption. This eco-friendly crop is a perfect component of regenerative agriculture and could ultimately be an excellent rotational crop for Kansas. Kansas is the nation's leading wheat producer with records of wheat production predating statehood. One of the most important diseases affecting wheat throughout all wheat-growing regions is *Fusarium* head blight (FHB). FHB causes reduced yield, shriveled grain, reduction in seed quality, and mycotoxin contamination. As Kernza is a relative of wheat, it could also be a host or reservoir of FHB. This project aims to identify pathogens associated with Kernza. **METHODS:** To identify these pathogens, a field survey was conducted. Fungi were isolated from grain samples and identified by analyzing physical characteristics and genetic characteristics (DNA). **RESULTS/FINDINGS:** FHB was identified in Kernza which confirms that Kernza could act as a reservoir of the pathogen. **CONCLUSION:** This information is very useful to alert farmers and researchers about the possible disease transmission threats and for developing disease resistant improved cultivars of Kernza to utilize the environmental benefits.

Relevance of Research to State-Related Topic(s)

Fusarium head blight has been the number one disease affecting wheat across all wheat growing regions of the United States. Eastern KS has the greatest risk of disease due to rotation with corn, another host and increased rainfall. In the last several years there has been an increase of FHB in the central regions of KS, which is a major concern as KS wheat is predominantly grown in the western 2/3 of the state. FHB produces a toxin that is harmful to both human and livestock and is therefore highly regulated. Current management practices involve good rotation away from disease hosts, using genetic resistance, and use of fungicides. Kernza needs to be carefully examined as it will be present in the field for more than one growing season. If Kernza can harbor the disease it may cause disease in neighboring wheat fields the following season.

2

IRRIGATOR PERCEPTIONS AND THE VALUE OF GROUNDWATER QUALITY IN THE HIGH PLAINS AQUIFER

Grant Gardner[1], Gabe Sampson[1], DeAnn Presley[2]
[1]Department of Agricultural Economics; [2]Department of Agronomy

BACKGROUND AND PURPOSE: Groundwater is critical to irrigated production in the western, semi-arid portion of Kansas. Groundwater that is low in quality presents limited value to farmers as an input to agricultural production. We present findings from a survey of irrigator perceptions and irrigation water testing behavior targeted at Kansas Producers in the High Plains Aquifer (HPA). **METHOD:** We estimate the value of an incremental increase in groundwater quality using contingent evaluation. **RESULTS/FINDINGS:** We find that 30% of respondents have either "moderate" or "major" concern over the agricultural impacts of irrigation water quality. Additionally, 20% of respondents indicate that water quality has had either "moderate" or "major" impacts on their crop yields. Lastly, we find a median willingness to pay (WTP) of US$39 well^{-1} for an incremental increase in irrigation water quality, as measured by reduced salt content. **CONCLUSION:** Although 30% of survey respondents indicate they have groundwater quality issues, only 17% of the sample indicated support of a water remediation program. This may indicate that farmers concerned with groundwater quality are more concerned with future government regulation than water quality itself. In addition, Suter et al. (2019) show that irrigators in th HPA have a higher WTP for water quantity remediation than our results for quality remediation, indicating water quality degredation is currently a less prominent issue for Western Kansas Irrigators.

Relevance of Research to State-Related Topic(s)

These findings have important implications for the future of crop production and irrigation use in Western Kansas. We find that 50% of our sample has "moderate" or "major" concern over well yield or water quantity. In contrast, 30% of respondents have "moderate" or "major" concern over water quality. Past research shows declining well yields cause increased saline content and thus water quality degradation (Levy et al. 2021). As Kansas groundwater is depleted, water quality will become a more prominent issue for Kansas irrigators. This may indicate that the State of Kansas needs find policies which preserve groundwater quality as well as quantity in order to sustain the HPA. In addition, we find that many irrigators do not test groundwater quality and that government funded quality tests may be important for future empirical research on the sustainability of the HPA.

3

ARE BIG BLUESTEM PLANTS LOCALLY MATCHED TO THEIR SOIL MICROBES ACROSS A PRECIPITATION GRADIENT?

Eli Hartung, Soumyadev Sarkar, Jack Sytsma, Kierra Holloman, Nassima Amiar, Kori Howe, Ari Jumpponen, Sonny Lee, Loretta Johnson
Division of Biology

BACKGROUND AND PURPOSE: Big Bluestem (*Andropogon gerardii)* is a dominant forage grass of prairies and is distributed across a steep rainfall gradient in the Great Plains. This gradient has given rise to locally adapted wet and dry ecotypes. Soil microbes likely vary along with plant ecotypes and play a role in nutrient availability for Big Bluestem. We investigated how local soil microbes affect Big Bluestem growth and whether specific plant ecotypes are matched to their local soil microbes. We predicted that each ecotype would grow better when grown with its native microbes. **METHOD:** We collected seed and soils from six native Big Bluestem populations from western KS and Illinois. Plants were grown in greenhouses in garden soil with 6 replicates per treatment. We isolated microbes from roots and soil and reciprocally injected wet and dry microbes into the soil weekly for 12 weeks. Plant form and function were measured weekly. **RESULTS:** Ecotypes differed in biomass, leaf area, height, and leaf width. Wet ecotypes produced more biomass, greater leaf area, and were taller than the dry ecotype. Microbe origin (wet vs dry) was less important in affecting plant form. However, physiological traits, such as chlorophyll absorbance, and to a lesser extent photosynthesis, were enhanced in ecotypes growing with their local microbes, suggesting effects of microbe-mediated nutrient availability. **CONCLUSION:** These results provided insight into how plants interact with their native microbes. These results will help to inform range managers and land conservationists to optimize forage and restoration through use of and matching with beneficial microbes.

Relevance of Research to State-Related Topic(s)

Big Bluestem is the dominant grass species of the Great Plains and accounts for roughly 70% of the biomass of prairie systems. Millions of acres of agricultural land have been restored to prairie throughout the Great Plains and cattle ranching is a multi-billion-dollar industry in Kansas. Because of the large role it plays in prairie restoration and importance as forage for cattle, understanding how Big Bluestem ecotypes interact with their local soil microbes is crucial for productivity and sustainability of this ecosystem. Understanding the relationship between Big Bluestem and its soil microbes directly impacts the effectiveness of restoration efforts as well as the forage productivity for cattle.

4

DEVELOPING A PROBABILISTIC DECISION TOOL TO ACCOUNT FOR WEATHER VARIATION TO OPTIMIZE FARMER INPUT USE IN AGRICULTURE

Josefina Lacasa[1], Carlos D. Messina[2], and Ignacio A. Ciampitti[1]
[1]Department of Agronomy; [2]Corteva Agriscience, Johnston, IA

BACKGROUND: The paradigm of developing relevant decision tools for agriculture relies heavily on static information and lacks integration of dynamic variables accounting for risk and uncertainties. Achieving optimum uses of inputs (e.g. water and nitrogen) ought to include the influence of weather uncertainty through probabilistic forecasts. In this case study, we analyze the effects of plant density (i.e. plants acre^{-1}) on rainfed corn (*Zea mays* L.) yields, highly influenced by weather seasonality (i.e. water supply). The main goal was to (i) identify the key weather variables explaining the yield-density relationship, and (ii) forecast economic optimum plant density (EOPD). **METHODS:** Corn hybrid by density trials were conducted in 89 locations from 7 US states (including Kansas) during 2010-2019. Climate, weather, and soil data were retrieved and fitted to a Bayesian hierarchical shrinkage model describing yield as a function of PD, crop and environmental variables. This model was used to forecast EOPD using seasonal weather forecasts. **RESULTS:** The most important covariates were soil water holding capacity, corn relative maturity, and precipitation and air temperature anomalies. The EOPD was sensitive to initial planting conditions (i.e. soil moisture), but even more to season-specific weather. **CONCLUSION:** This study introduces a novel framework that provides probabilistic forecasts with dynamic (i.e. seasonally-varying) components for input optima recommendations. This case study merges a biophysical model with a set of crop, environmental and agronomic management data. Lastly, the research framework has the potential to be transferred to other relevant inputs, offering degrees of uncertainty on the associated risks for the farming decision process.

Relevance of Research to State-Related Topic(s)

Kansas relies heavily on its rainfed farmlands and may show contrasting productivity levels depending on seasonal weather. Thus, Kansas farmers working on water-limited areas would be the most benefited parties of solid forecast tools assisting agronomic decisions. Probabilistic forecasts are ideal tools to communicate outcome uncertainties and allowing each party to decide the level of risk to take in each season. Moreover, this framework could be a great opportunity to bridge the gap between novel scientific discoveries and government agents, extensionists, farmers and other decision makers.

5

KANSAS SOIL HEALTH PARTNERSHIP

Carlos Bonini Pires, Dorivar Ruiz Diaz, Ignacio Ciampitti, and Charles W. Rice
Department of Agronomy

BACKGROUND AND PURPOSE: Soil health is proven to have wide-ranging benefits and is of increasing interest to farmers and agricultural stakeholders. Although no-till adoption has been growing, there is still relatively low adoption of cover crops. As soil health practices become more common, data on on-farm soil health metrics changes are needed to target middle and late adopters. The objective of this study is to measure and communicate the environmental benefits of cover crops. **METHOD:** The Kansas Soil Health Partnership is a five-year project and currently involves four farms across the State of Kansas: (1) Solomon, (2) Bucyrus, (3) Beloit, and (4) Glen Elder. For this abstract, we will focus on results from site 1. Site 1 is located at the Knopf Farms and is in year three of five. The experimental design was four randomized and replicated strips (RCBD) of the farmer standard practice (no cover crop) and the improved practice (cover crop). Soil samples were taken on a GPS coordinated grid at 0-5 and 0-15 cm soil depth at the first (2019 - benchmark) and third (2021) year of the study. The soil health indicators measured were: β-glucosidase activity (βG), microbial biomass (MB), and arbuscular mycorrhizal fungi (AMF). **RESULTS:** We observed that cover crops increased all soil health indicators at 0-15 cm when comparing 2019 and 2021. The increments in βG, MB, and AMF were even higher at 0-5 cm. **CONCLUSION:** Cover crops have demonstrated a great potential for improving soil health across Kansas.

Relevance of Research to State-Related Topic(s)

In 2017, Kansas led the nation with 48% of acres under no-till system. However, only 3.2% of the available acres were in winter cover crops. Significant attention has been given to cover crops as a potential solution to improve soil health by reducing soil erosion and compaction and increasing soil organic matter and microbial biomass. However, in the traditional corn-soybean rotation, cover crops have a narrow window to grow since they are planted after soybean harvest, in the fall, and terminated before corn planting in the following year (or vice-versa). This research aims to generate recommendations that farmers can use to improve the productivity and sustainability of their farms through soil health. It is crucial to understand better how soil health is interacting with crop productivity and how soil health management strategies can address the issues that compromise the sustainability of croplands for future generations in Kansas.

6

FIRST TIME DETECTION OF BROME MOSAIC VIRUS ASSOCIATED WITH OTHER WHEAT VIRUSES IN KANSAS WHEAT USING NANOPORE SEQUENCING

Nar B. Ranabhat[1], John P. Fellers[2], Myron A. Bruce[1], and Jessica l. S. Rupp[1]
[1]Department of Plant Pathology; [2]Hard Winter Wheat Genetics Research Unit, USDA-ARS

BACKGROUND AND PURPOSE: diagnosis of virus-like symptoms in plants has been mostly dominated by specific methods with known antibodies, primers, and probes. These methods are specific to known viruses and virus combinations. Infection of plant samples with multiple viruses is common and detection of potential new combinations of viruses can help to manage these viruses effectively through genetic resistance. Modern molecular detection techniques such as next generation sequencing are powerful tools to detect novel viruses in the plant. **METHOD:** virus infected samples were collected in a statewide survey conducted from 2019-2021. PCR-cDNA sequencing libraries were made from symptomatic wheat sample total RNA and sequenced using the Oxford Nanopore MinION flow cells. Sequencing reads were aligned to known cereal virus reference genomes. **RESULTS/FINDINGS:** we recorded a high frequency of Brome mosaic virus (BMV) in Kansas wheat that was associated with the three viruses of wheat streak mosaic complex and Barley yellow dwarf virus. The whole and partial genome of BMV was obtained from the 55.56 % and 80.0 % of samples mapped with reference genome in 2019 and 2020 respectively. In 2021 samples from lane county, Kansas, a hotspot of wheat virus infection, showed 55.0 % of the samples contained whole or partial genome of BMV. **CONCLUSION:** our findings show that BMV is associated with wheat streak mosaic complex and warrants further research to determine its spread and economic impact on Kansas wheat production.

Relevance of research to state-related topic(s)

My research relates to plant health and food safety because I am working on the area of management of Kansas wheat viruses. Kansas wheat growers lose millions of dollars in wheat production every year by the infection of wheat viruses. My research focuses on identification and characterization of field isolates are essential to determine the population structure of the virus in the field to explore the presence of potential new variants or isolates of the virus. The information of characterization of the wheat virus population will enable us to manage the wheat viruses through genetic resistance efficiently by knowing the complexity of host-virus interaction.

7

INCREASED TOLERANCE OF WINTER WHEAT TO MESOTRIONE AND TEMBOTRIONE

Susee Sudhakar[1], Sridevi Nakka[2], Asif Mohammad[2], and Mithila Jugulam[1].
[1]Department of Agronomy; [2]Hearland Plant Innovations, Inc. Manhattan, KS

INTRODUCTION: Wheat is one of the most important crops in KS. Weed management is crucial for increased yields in wheat. Herbicides, e.g., mesotrione and tembotrione are widely used to control broad-spectrum of weeds by inhibiting carotenoid biosynthesis; but not registered for use in wheat. Preliminary work in our laboratory suggested that wheat can survive > field recommended rates of mesotrione (1X=105 g ai ha^{-1}) or tembotrione (1X=92 g ai ha^{-1}). Therefore, we hypothesize that wheat may exhibit natural tolerance to these herbicides. The objective of this study was to evaluate and characterize the level of tolerance to mesotrione and tembotrione in wheat. **METHODS:** About 24 winter wheat varieties were grown under greenhouse conditions (18°C/15°C, 18/6 h photoperiod & 300 µmol m^{-2} s^{-1} light intensity) and at 3-5 leaf-stage, plants were treated separately with 6X rate of mesotrione or tembotrione. Further, to characterize the level of tolerance, the response of wheat varieties to different rates [0 to 10X] of these herbicides was also tested. Three weeks after treatment, the plants were visually scored for herbicide injury (bleaching symptom). **RESULT& CONCLUSION:** The results of this study identified two highly tolerant i.e., KS19H10, and Hamilton and a more sensitive i.e., Silverado varieties of wheat. The analyses of dose-response data are in progress. Overall, this research will help determine the level of tolerance to mesotrione or tembotrione in wheat. The outcome of this research will help develop wheat cultivars tolerant to these herbicides, which can facilitate wide spectrum weed control without injury to crop.

Relevance of Research to State-Related Topic(s)

Kansas is the largest wheat producer in the US. Sustainable wheat production can be hindered by factors such as lack of availability of arable land, adverse environmental conditions, and pest infestation, including weeds. If uncontrolled, weed infestation (e.g., cheatgrass, jointed goatgrass, kochia and buckwheat) in the wheat crop can result an estimated crop loss of $50 million annually in Kansas. Availability of herbicide-tolerant wheat technology is valuable for weed control throughout the crop-growing season. This research focuses on identification and characterization of herbicide, e.g., mesotrione or tembotrione tolerance in wheat, which can help improve crop yield for Kansas growers by facilitating effective weed control.

8

DOMINANT PRAIRIE GRASS CROSS-TRANSPLANTED ACROSS THE MIDWEST RAINFALL GRADIENT: RESPONSE TO DROUGHT

Jack Sytsma[1], Kori Howe[1], Matthew Galliart [2], Eli Hartung [1], Loretta Johnson [1]
[1]Division of Biology; [2] Department of Biological Sciences, Fort Hays State University

BACKGROUND AND PURPOSE: Big bluestem (*Andropogon gerardii*) is a dominant, native, tall grass that is for critical cattle forage, conservation, and restoration. This grass has a wide geographic distribution across the Great Plains rainfall gradient (500-1200 mm rain/yr). Distinct wet and dry ecotypes, each adapted to its local regional climate, have been recognized. The objectives were to observe growth of big bluestem ecotypes that were cross-transplanted into wet and dry climates. We predicted that each ecotype would perform best in their home site, but perform poorly when foreign sites. **METHODS**: Reciprocal gardens (cross-transplants) were established in 2010 and growth was monitored over time until 2021 in four garden sites (Colby, Hays and Manhattan, KS to Carbondale IL). To specifically examine the effects of drought, rainfall was reduced by 50% using rainout shelters in three sites. Cover was measured to estimate growth. **RESULTS**: By 2021, the wet ecotype had 54% less cover than the dry ecotype in Colby but had 43% more cover in Illinois. In contrast, the dry ecotype cover is lower in Illinois but higher western Kansas. These results confirm that wet and dry ecotypes perform best in their home environments. Interestingly, the mesic ecotype had intermediate cover (~40%) in all four sites. Experimental rainfall reduction resulted in increased cover in the dry ecotype in Illinois. **CONCLUSION:** These results indicate the prominent role of ecotypes across the natural and experimental rainfall conditions. Thus, restoration should consider the use of climate-adapted ecotypes in anticipation of future droughts.

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 tall grass prairie, it controls the ecological structure, function and sustainability of this vital ecosystem. Yet, this ecosystem is predicted to be threatened by severe drought. Thus, it is crucial to understand big bluestem response to drought for cattle production, conservation, and restoration. Results will provide recommendations on climate-adapted populations in the face of future drought.

GROUP 2

9

UTILIZING COMPARATIVE TRANSCRIPTOMICS TO UNDERSTAND THE EFFECTS OF VESICULAR STOMATITIS VIRUS INFECTION ON NEURO-SENSORY FUNCTION IN CULICOIDES MIDGES

Edward Bird[1], Brandon Hall[1], Kristopher Silver[1], and Dana Nayduch[2]
[1]Department of Entomology; [2]USDA-ARS Center for Grain and Animal Health Research

BACKGROUND AND PURPOSE: *Culicoides* midges are important vectors of many livestock pathogens, including orbiviruses and rhabdoviruses. These viruses heavily infect the insect's eyes and other sensory organs as the infection disseminates. Previous midge infection studies with the orbivirus epizootic hemorrhagic disease virus (EHDV) have shown that many genes associated with vision, memory and other behaviors were downregulated, while a few genes associated with olfaction were upregulated. Because vision is important for midges to navigate their environment and is key for vector surveillance via light trapping, virus alteration of these traits has significant implications on host seeking and disease risk assessment. We hypothesized that the reported effects of orbivirus infection on gene expression in midges would also be observed in rhabdovirus-infected midges. **METHOD:** In this study, we used RNAseq to determine differential expression (DE) of genes in female *Culicoides sonorensis* infected with the rhabdoviral livestock pathogen, vesicular stomatitis virus (VSV). Midges were fed either blood meals spiked with media containing VSV or virus-free media (controls) and were collected 8 days post-ingestion. RNA was extracted and sequenced from pools of midges in 5 replicates. **RESULTS:** Overall, 65 genes were significantly (FDR > 0.05) differentially expressed between virus infected and uninfected midges. Many of these genes were associated with the innate immune system, as well several genes in association with olfaction, vision and other neuro-sensory functions. This information will give us valuable insight into altered sensory perception and neurological function of midges, which can inform behavioral phenotypic studies and ultimately better management methods.

Relevance of Research to State-Related Topic(s)

Culicoides biting midges are an important agricultural pest in Kansas, as they carry and transmit viral pathogens of animal health importance to a wide range of livestock hosts. Many of these diseases result in weight loss and fatality, which greatly impact Kansas livestock industries. Biting midges also serve as a reservoir for viral pathogens, even during the winter. Disease risk assessment is often conducted through the surveillance of midge populations via light trapping, however recent studies suggest viral infection causes midges to avoid such traps, hindering studies' accuracy in disease detection. While severe viral infection of the eyes has been observed, our results show significant changes in the expression of genes associated with vision, olfaction, and memory, which could all contribute to midge behavior and viral transmission. Understanding how viruses alter sensory perception and neurological function of midges can inform behavioral phenotypic studies, and ultimately better management strategies.

10

AGE-ASSOCIATED MICROBIAL STABILITY AND VOLATILITY SHAPE THE GUT MICROBIOME IN A HEALTHY PIG MODEL

Brandi Feehan[1], Megan Niederwerder[2], Bob Goodband[3], and Sonny T.M. Lee[1]
[1]Division of Biology; [2]Department of Diagnostic Medicine/Pathobiology; [3]Animal Sciences and Industry

BACKGROUND AND PURPOSE: The gastrointestinal microbiome plays a critical role in swine health with implications on the sustainability and competitiveness of Kansas swine production. Microbes harbored in the gastrointestinal system are crucial for metabolizing dietary nutrients into utilizable sources for the host while also limiting pathogen invasion leading to disease. This study demonstrated how the swine gut microbiome, specifically bacteria and fungi, develop over a pig's life. **METHODS:** Fecal samples from ten pigs were collected during three age-dependent stages: preweaning (1-3 weeks of age), nursery (3-11 weeks), and finishing (11-22 weeks). We performed bacterial 16S rRNA amplicon sequencing to determine diversity and identify taxonomy of distinct bacteria between growth stages, and qPCR for a swine fungus of interest (*Kazachstania slooffiae*). **RESULTS/FINDINGS:** Our results indicated that the preweaning microbiome was relatively more different among the pig hosts as compared to the nursery and finishing aged swine. *Kazachstania slooffiae* abundance was highest immediately following weaning but decreased to a plateau during the middle of the nursery stage. **CONCLUSION:** Both the plateau of *Kazachstania slooffiae* abundance and bacterial convergence occurred in the middle of the nursery stage which indicated an interplay between bacterial and fungal establishment within the gut. Our study provided the foundation for future research to evaluate how bacteria and fungi interact with the swine host for diet metabolism, and maintenance of a healthy gut environment. This knowledge can be utilized to improve swine growth and pork production, such as through altered diets and therapeutics, for Kansas agriculture.

Relevance of Research to State-Related Topic(s)

Kansas' swine industry is a large and robust farming sector which produced $467 million in annual sales in 2017. The industry also supports KS crop farmers as these herds consumed over $162 million in grain sorghum, corn and soybean meal. The swine industry is continuously looking for improvements to herd health, productivity, and animal welfare. The swine microbiome is a promising research topic which could lead to novel diagnostics for pathogens and health indicators, altered diets for optimized nutrient utilization, and effective alternatives to antibiotics. This study illustrates how the bacteria and fungi change throughout a pig's lifetime. Future research will involve building upon and applying this longitudinal, microbiome knowledge to improve swine health and welfare.

11

ACUTE ANAPLASMOSIS REDUCES BREEDING SOUNDNESS IN EXPERIMENTALLY INFECTED BEEF BULLS

Anne Lovett[1], Emily Reppert[1], John Jaeger[2], Qing Kang[3], Macy Flowers[4], Naemi Bickmeier[4], Tippawan Anantatat[4], and Kathryn Reif[4]

[1]Department of Clinical Sciences; [2]Department of Animal Sciences and Industry;[3] Department of Statistics; [4]Department of Diagnostic Medicine and Pathobiology

BACKGROUND: The causative agent of bovine anaplasmosis, *Anaplasma marginale*, costs the U.S. cattle industry an estimated $300 million annually. Anemia and fever during clinical anaplasmosis may reduce bull breeding soundness. The study objective was to evaluate breeding soundness outcomes and clinical changes in beef bulls during clinical anaplasmosis and after recovery. **METHOD:** Six healthy, *Anaplasma*-negative, mature, Angus bulls of satisfactory breeding status were included. Blood from an infected donor cow was used to challenge three bulls, the other three remaining unchallenged controls. Fever, anemia (via packed cell volume, PCV), pallor, and icterus were monitored weekly in all bulls. Infection progression was evaluated via quantitative PCR and percent parasitized erythrocytes (PPE). Seroconversion was monitored by cELISA. Oxytetracycline was given to bulls with PCVs <15% or temperatures >105°F. Weekly breeding soundness examinations were performed on all bulls for 16 weeks. Breeding soundness parameters included sperm morphology and motility, external and internal genitalia, and physical exam. **RESULTS:** All *A. marginale*-challenged bulls were PCR-positive, seropositive, and clinical by 3-, 17-, and 24-days post-challenge, respectively. Clinical signs included weight loss, pallor, icterus and fever (≥104.3°F). Anemia in all challenged bulls reached PCV nadirs ≤18% and peak PPEs ≥50%. Breeding soundness reductions were observed days after clinical onset and continued weeks beyond resolution of clinical anaplasmosis. Bulls in the control group remained negative for *A. marginale* by PCR and cELISA, and maintained consistent breeding soundness outcomes. **CONCLUSION:** Findings from this study suggest acute anaplasmosis is a driver of reduced breeding soundness in beef bulls.

Relevance of Research to State-Related Topic(s)

Bovine anaplasmosis is a significant economic- and production-liming cattle disease, costing the U.S. cattle industry ~$300 million in losses annually. In Kansas, beef cattle industry is the single largest agriculture sector, with a direct output of $6.3 billion and supporting 34,130 jobs. Approximately 50% of Kansas beef cattle herds are actively infected with the agent of bovine anaplasmosis, *Anaplasma marginale*, placing herd management and financial strains on cow-calf producers in this state. In cow-calf operations, 94% of cows are bred by bulls, thus bull value is directly related to their ability to reproduce. Impairment of bull reproductive abilities through death or disease has significant economic consequences for producers. This study demonstrates that clinical anaplasmosis can eliminate bull breeding soundness for 1-3 months, suggesting this endemic disease is an underappreciated source of economic loss for Kansas cow-calf operations and supporting need for increased research and biosecurity.

12

CARRIAGE OF BACTERIA AND MULT-DRUG RESISTANT BACTERIA BY HOUSE FLIES AT KANSAS DAIRY AND BEEF OPERATIONS

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BACKGROUND AND PURPOSE: House flies harbor and transmit pathogenic and antimicrobial resistant (AMR) bacteria acquired from frequent interactions with microbe-rich substrates for reproductive and developmental purposes. In confined cattle operations, which generate large quantities of microbe-rich substrates like manure, adult house flies might be integral in the prevalence of bacterial pathogens and AMR within these environments. **METHOD:** Adult house flies were collected from dairy and beef facilities within three Kansas counties for five alternating weeks in summer 2019. Bacteria were enumerated from flies on non-selective (TSA, overall bacteria) and selective media (VRBA, coliforms). Distinct coliform morphotypes were screened for tetracycline resistance on tetracycline-infused agar. Resistant coliforms were then confirmed by disc diffusion and tested for multidrug resistance (MDR) to tetracycline, florfenicol, enrofloxacin, ceftiofur, and ampicillin. **RESULTS:** Overall, 73% of house flies carried AMR coliforms and 24% carried MDR coliforms. In addition to tetracycline, most MDR coliforms were resistant to ampicillin and/or florfenicol. Fly sex and climate conditions such as average soil and ambient temperatures, and average humidity were associated with bacterial and coliform quantities. Female house flies carried significantly more coliforms and overall bacteria than male flies and were the only flies that carried enrofloxacin- or ceftiofur-–resistant coliforms. One coliform isolated from a beef operation female fly was resistant to all five antibiotics. **CONCLUSION:** Our results identify house flies as reservoirs and potential disseminators of AMR and MDR bacteria at confined cattle operations. Fly management should be considered in integrated management methods for mitigating AMR persistence and spread.

Relevance of Research to State-Related Topic(s)

Kansas is among the top beef producers in the United States and rapidly expanding its dairy sector. In both industries, there is a worldwide consumer demand for high quality and safe products. Unfortunately, the rise in antimicrobial resistant (AMR) bacteria is threatening these industries. Confined cattle operations are conducive to AMR and house fly populations due to their high density of microbe-rich substrates like manure and feed. While many studies have investigated the prevalence of AMR bacteria within the substrates of confined cattle operations, few have attempted to identify how flies might be facilitating the spread of AMR bacteria within these environments. By identifying flies as an additional factor in the spread of AMR, we can improve AMR mitigation strategies for producers through fly management. Such strategies can help protect animal health, in turn contributing to the sustainability and quality assurance of Kansas confined cattle industries.

13

INNOVAPREP MANO SURFACE SAMPLERS ENABLE RECOVERY OF INFECTIOUS CORONAVIRUS FROM LARGER SURFACE AREAS

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BACKGROUND AND PURPOSE: Infectious virus instead of viral RNA quantification enables more accurate assessment of the risk of transmission of SARS-CoV-2. The similar morphology and inactivation profile of human coronavirus OC43 (OC43) recommends its use as a surrogate for SARS-CoV-2, for which research is restricted to biosafety level 3. Using OC43, we examined InnovaPrep Mano Surface Samplers' (Manokit) ability to recover virus from large surfaces compared to cellulose sponges, widely used for environmental sampling. **METHOD:** In triplicate per treatment, 1.0×10^5 $TCID_{50}$ of virus was distributed as if from a cough or sneeze on optimal sampling surface areas, 1267.36 cm^2 and 100 cm^2, respectively for Manokit and cellulose sponge within a biological safety cabinet. The designated areas were sampled with eluant presoaked Manokits (20 ml) and cellulose sponges (15 ml). Samples were aliquoted and stored at -80ºC until batch titration by immunofluorescence $TCID_{50}$ assay. Eluants tested included pH 7 beef extract buffer (BEB7) with and without 0.05% tween-20 (T) and, for Manokits only, PBS/T, the vendor default. **RESULTS/FINDINGS:** The best Manokit virus recovery was with BEB7 (2.21×10^4 $TCID_{50}$); the worst with PBS/T (3.7×10^3 $TCID_{50}$). After normalization for sampling area and eluant, the best recovery was with the BEB7 Manokit (17.3%) compared to cellulose sponge (14.7%). **CONCLUSION:** Use of virus stabilizing eluant BEB7 and elimination of the detergent improved Manokit virus recovery. We are testing Manokits on larger surface areas and with SARS-CoV-2.

Relevance of Research to State-Related Topic(s)

This project is part of a USDA-funded investigation into SARS-CoV-2 transmission in the meat processing industry, which employs nearly twenty thousand Kansans and generates $11.2 billion in direct output annually. COVID-19 outbreaks in facilities caused disruptions that threatened national food supply, while endangering workers and surrounding communities. Keeping mission critical industries operating safely requires a science-based understanding of virus transmission within these facilities, risk identification, and determination of mitigation approaches. Our work to identify optimal recovery methods for infectious virus in these complex environments is critical to these efforts. Additionaly, this research effort provides high quality training for future Kansan scientists aligned with employment needs at organizations such as the National Bio and Agro Defence Facility (NBAF). These investments keep Kansas on the forefront of emerging infectious disease and agricultural research, stregthening our place in protecting U.S citizens and our food supply.

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THE MOBILITY OF PHOSPHINE-SUSCEPTIBLE AND -RESISTANT RHYZOPERTHA DOMINICA (COLEOPTERA: BOSTRICHIDAE) AND TRIBOLIUM CASTANEUM (COLEOPTERA: TENEBRIONIDAE) AFTER EXPOSURE TO INSECTICIDE NETTING

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BACKGROUND: Long-lasting insecticide-incorporated netting (LLIN) with the active ingredient deltamethrin has been effectively used to intercept immigrating stored-product beetles at food facilities. Phosphine resistance is serious and widespread across food facilities in the US, including Kansas. We hypothesized that LLIN might be effective for managing phosphine resistant insect populations by providing multiple barriers to infestation at facilities. In this study, we evaluated the efficacy of LLIN and compared it to control netting without insecticide in reducing movement of phosphine-susceptible and -resistant *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae), and *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae). **METHOD**: Mixed-sex adults were exposed for 30 s, 2-, or 60 min, and their movement was assessed for 1 h immediately after the exposure, or after waiting for a post-exposure holding duration of 24 or 168 h using video-tracking and Ethovision software. **RESULTS:** The total distance traveled, and velocity of adults were recorded. We found that exposure to deltamethrin-based LLIN significantly reduced the beetles' travel distance and velocity by multiple-fold compared to the control netting regardless of beetle's susceptibility to phosphine. **CONCLUSION:** Our results demonstrate that LLIN can be a new tool to diversify IPM programs at food facilities for combatting phosphine-resistant populations, including in Kansas.

Relevance of Research to State-Related Topic(s)

In Kansas, agriculture accounts for over 40% of the total economy, and the post-harvest industry is a key part of this. As agriculture commodities move along the supply chain from farms to end consumers, insects can readily attack at each link. Insect damage causes economic losses by reducing the quality and quantity of food. Therefore, it is critical to develop effective pest management strategies to mitigate losses. Phosphine is the most common fumigant for stored products, and 60–80% of insect populations in Kansas are resistant to this fumigant. So, it is important to develop diversified pest management programs for the post-harvest supply chain. Our studies have found that LLIN is equally effective against phosphine-resistant populations of key stored product insects, reducing movement by up to 95%. It may therefore be used as a new, highly effective tool to combat phosphine resistance and protect food facilities across Kansas.

GROUP 3

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INVESTIGATING THE EFFECTS OF NUCLEAR RADIATION ON ADDITIVELY MANUFACTURED PARTS

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BACKGROUND: The growing interest in developing safe modular nuclear reactors has resulted in a need for advanced materials/parts that can tolerate intense radiation while in service. Manufacturing of such advanced materials via traditional machining processes present several challenges. Recently, Additive Manufacturing (AM), or 3D printing, has shown capablity of fabricating complex-shaped nuclear components. AM offers a unique opportunity to print parts on demand with a reduced need to rely on external suppliers. **PURPOSE:** The aim of this research is to compare the mechanical properties of metal samples fabricated using conventional machining and AM methods before and after nuclear radiation. This research will help engineers design next-generation, radiation-resistant nuclear reactor components using AM processes. **METHOD:** Inconel 625 (a nickel-based superalloy) was fabricated using the laser powder bed fusion (L-PBF) AM process. The samples were placed inside a nuclear reactor for 2 weeks. The mechanical properties of these samples were examined by measuring hardness before and after nuclear radiation. The hardness values of the AM samples were compared to traditional machined samples**.** **RESULTS/FINDINGS:** Results indicate that AM specimens are less prone to radiation hardening defects relative to their wrought counterparts. As-printed AM specimens showed an increase in hardness by 1.2% hardening. The wrought samples displayed an increase in hardness by 5.25%. **CONCLUSION:** Results provide insight into how one can minimize radiation hardening in nuclear materials for their safe and reliable use. Results should increase confidence levels for adopting AM for building nuclear reactor components which perform the same or better than conventionally manufactured components.

Relevance of Research to State-Related Topic(s)

Nuclear energy contributes to 10% of electricity generation in Kansas. Many nuclear reactors in the US including the Wolf Creek Generating Station reactor in Kansas face issues of manufacturing reactor core components that is complex in structure and has high structural integrity under harsh radiation environments. Production of complex nuclear reactor structures via conventional machining is tedious. This research will enable the engineers to comprehend that AM can serve as an alternate manufacturing process to build reactor components that has similar or superior mechanical properties compared to conventional machined components. Using AM process to build components, the life cycle and safety level of the reactors may be increased. Also, fabricating components using AM processes will enable reactors to run at higher power (high radiation enviroments) resulting in more reliable generation of electricity. It can also provide advantage of replacing the in-service components with AM components without any concerns and inspections.

16

ARTIFICIAL NEURAL NETWORK TO PREDICT TRACTION PERFORMANCE OF AUTONOMOUS GROUND VEHICLE ON A SLOPED SOIL BIN AND UNCERTAINTY ANALYSIS

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BACKGOUND: A fleet of autonomous ground vehicles (AGV) is envisioned to expand farming to arable land suitable for production except for being too steep for conventional equipment. Therefore, the drawbar pull (DP) performance of a prototype AGV was evaluated in a soil bin at varying slopes, speeds, and DP. The performance was expressed in terms of tractive efficiency (TE) and travel reduction ratio (TRR). Optimizing the control variables is intricate and ill-defined, which requires an accurate model to predict the performance of the proposed multi-AGV system. **GOAL:** The study aims to design an artificial neural network (ANN) to estimate the traction behavior of the AGV on a sloped testbed as a function of speed, DP, and slope. **METHODS:** A multi-layer feed-forward ANN architecture trained with a back-propagation algorithm was adopted. A series of ANN models with increasing complexity were developed for each variable (ANN-TE and ANN-TRR). K-fold cross-validation was employed to estimate the generalization error. The model success was evaluated via Mean Squared Error and the R^2 against a test set. The final predictive model was trained on the entire data set and a Monte-Carlo Simulation based uncertainty analysis was performed. **RESULTS AND CONCLUSION:** The R^2 of ANN-TE and ANN-TRR were 0.933 and 0.882, respectively. The model robustness and reliability is assessed by constructing a 95% prediction interval. This study shows ANN as a promising, robust, and reliable method to predict traction performance in agricultural tillage-traction studies and developed models can empower the multi-AGV system on steep-uneven slope terrain.

Relevance of Research to State-Related Topic(s)

Kansas is a leading wheat, grain sorghum and beef producer in the USA. Great plains lies across the Kansas, which are characterized by gentle rolling hills, broad expanse of prairie with little elevation change, and grassland; used for croplands, hay pastures and grazing. These rolling hills/prairies with a slope steeper than 6^0 has never been cultivated in USA, due to fact, it is unsafe to cultivate with large conventional farm equipment and left for pasture. However, this technological barrier to slope farming could be potentially addressed by developing a fleet of AGV. The multi-AGV system is fast-growing trend on smart farms and small AGV's can accomplish the same work as a large machine; addition to reduced soil compaction and improved safety. This study is fundamental to understand the limitations and capabilities of Multi-AGV system which targets to expand the agricultural land to boost the state food production.

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SUSTAINABLE RECOVERY OF VOLATILE FATTY ACIDS FROM SWINE WASTEWATER

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BACKGROUND AND PURPOSE: Volatile fatty acids (VFAs) are short-chain organic acids naturally generated from complex organic compounds through intermediate fermentation reactions during anaerobic digestion. Currently, 90% of these organic acids are produced as byproducts of petrochemical reactions. Production of VFAs is high in demand since they are the building blocks of many valuable commercial and cosmetic chemical products. This study aims to develop a modified fermentation biotechnology platform from swine wastewater coupled with membrane filtration and further aided by microbial electrochemistry. **METHOD:** Controlled and efficient swine wastewater fermentation experiments were conducted with two different inocula (wastewater sludge and cattle rumen fluid) with or without a microbial bioanode. Temperature, pH, Solids Retention Time (SRT)/Hydraulic Retention Time (HRT), and the anode potential were the main requirements for enhancing the anaerobic fermentation reactions. A series of experiments have been performed at different SRT conditions (20 to 8 days). Performance was characterized by electric current production, VFA quantification through High-Performance Liquid Chromatography (HPLC), and gas composition through Gas Chromatography (GC). **RESULTS/FINDINGS:** The two inocula exhibited a decisive shift in the fermentation product profile from glucose. The microbial biofilm anode showed a different fermentation product profile with an accumulation of higher molecular weight VFAs compared to the non-electrode reactor. The anode area was observed to be a rate-limiting step that drives the kinetics and extent of swine wastewater fermentation. **CONCLUSION:** The recovery of VFAs from wastewater based on microbial reactions is becoming a promising research and development portfolio in the future due to its favorable life cycle and techno-economic footprint.

Relevance of Research to State-Related Topic(s)

The main volatile fatty acids (VFAs) resulting from microbial fermentation reactions are acetic, propionic, and butyric acids. These VFAs serve as precursors to produce paint, rubber, plastics, cosmetics, and animal feed supplements. Fermentation reactions from animal wastewater streams coupled with a membrane filtration unit also generate another valuable product for farming operations, water for indirect potable reuse. It also presents the valuable opportunity to recover the nutrients from wastewater, mainly ammonia-N and phosphate-P, in a highly compact and beneficial fashion as Recovered Nutrient Products (RNPs) and preventing any further deterioration of the precious surface and groundwater in the state. The total wastewater resource recovery platform also acts as a catalyst to aid with the re-invigoration of existing agricultural, manufacturing, and biotechnology business with links to food and animal agriculture-based industries in the state.

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AUTOMATIC RISKY TACKLE DETECTION FROM AMERICAN FOOTBALL PRACTICE VIDEOS USING DEEP LEARNING

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BACKGROUND AND PURPOSE: In this work, we consider the problem of automatic risky tackle detection from youth American football practice videos. Researchers have found that early exposure to American football may have a long-term neuropsychiatric and cognitive effect due to repeated head impact. Greater accuracy in the identification and correction of risky tackle techniques is a key step for establishing a safe playing environment. **METHOD:** We have created a new data set that contains 178 annotated videos collected from seven different practice fields in Kansas. We propose a 3-stage deep Convolutional Neural Network (CNN)-based pipeline to improve risky tackle detection accuracy. Our deep learning model temporally segments the informative frames containing the tackle. Then it leverages an object detection model to extract spatial regions of interest from those frames. Finally, 3D CNN is applied to classify risky and safe tackles from the spatiotemporally segmented frame sequence. **RESULTS:** We conduct the experiment on our newly created data set. Empirical analysis demonstrates that our proposed pipeline outperforms state-of-the-art video classification and anomaly detection approaches applied directly to untrimmed tackle videos. We achieve 12%-13% higher balanced accuracy than the existing approaches. This denotes the effectiveness of our approach in detecting the risky tackle. **CONCLUSION:** Our artificial intelligence-based automatic risky tackle detection tool can greatly improve the ability of a coach to correct a player's behavior and reduce the likelihood to sustain head impacts. More importantly, this will enable faster feedback to a player by eliminating the need for manual video analysis.

Relevance of Research to State-Related Topic(s)

American football is the most popular game in the US including Kansas. Almost every school, high school, and university in Kansas has a football team. Unfortunately, the Centers for Disease Control (CDC) has estimated that between 1.6 and 3.8 million sports-related concussions are reported annually and American football shows the highest proportion of head injury or concussions among all sports. Research shows that two-thirds of all football-related head injuries occur during practice and one-third during the games. During practice, coaches use blocking dummies and film the tackles to identify dangerous postures manually from those videos and provide corrective feedback. Our detection tool will save a substantial amount of effort and time for human assessors required for manual processing. Our research will facilitate the youth player of the state to learn proper tackle techniques from an early age which is an important developmental milestone for players to reduce unnecessary head injuries.

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MAKING GRAPHENE INKS FOR PRINTED ELECTRONICS

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BACKGROUND AND PURPOSE: Since 2004, graphene, a two-dimensional (2D) atomically thin nano-material, has demonstrated groundbreaking advancements in nanoscience and nanotechnology owing to its outstanding mechanical, electrical, thermal, optical, and chemical properties. Chemically modified graphene materials (i.e., graphene derivatives) are equally important for interfacing them with chemical/biological applications. As a result, a recent focus on graphene research has been increasingly shifting towards its scalable manufacturing and unique applications for societal needs. **METHOD:** At Kansas State University, in our research group, we are developing a low-cost graphene and graphene derivative based conductive inks (patented technologies) and use them in additive manufacturing for printed electronics that are electrically conductive, mechanically flexible, and are highly compatible to various environments. With our ongoing research on energy storage devices and sensors, we envision to create a paradigm shift in graphene-based electronics and additive manufacturing. Herein, we report the process to synthesize a conductive graphene aerosol-gel ink that is later inkjet-printed on a mechanically flexible polyimide substrate for micro-supercapacitors (MSCs) and sensors. **RESULTS/FINDINGS:** MSCs with interdigitated architecture when used with 1-ethyl-3-methylimidazolium tetrafluoroborate (EMIM-BF_4) ionic liquid (IL) electrolyte shows promising supercapacitor stability, making them a promising candidate for integration with micro/nano-scale electronics. On the other side, the printed electrode/sensor platform shows good electrochemical behavior with a standard redox probe when used in a cyclic voltammetry technique proving its potential for electrochemical sensors. **CONCLUSION:** The MSCs and sensors developed in our group essentially can be used in plethora of energy storage systems and chemical/biological molecule detection respectively.

Relevance of Research to State-Related Topic

Flexible, environmental-friendly, miniaturized and cost-efficient electronic devices are revolutionizing the industrial sector with applications ranging from mobile phones, fitness trackers, micro sensors and other micro devices. Integration of micro supercapacitors with high energy density and superior life cycle into many devices and systems within Kansas can exploit its fast charge/discharge capability while continuing to aid global and local energy conservation, being cost and environmentally friendly. Whereas, the sensor developed in our research group can potentially be used in Kansas agricultural lands for soil quality assessment and nutrient detection helping farmers achieve precision agriculture.

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BOUND MODES IN THE CONTINUUM IN BEAM WITH RESONATORS

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BACKGROUND AND PURPOSE: The ability to both confine and release wave on demand will open a new avenue for elastic wave-based signal processing. To create localized vibration mode, confined in a spatial region, current designs require bandgap and suffer from leakage of energy to surrounding. The goal of this research is to achieve localized modes having zero leakage of energy without requiring bandgaps. Such localized modes are known as bound modes in the continuum (BICs). BICs have recently been demonstrated in electromagnetic media. **METHOD:** Here, by theoretical calculation and numerical simulation, we predict the existence of elastic BICs in one dimensional architected structures: infinite beam with attached spheres. To achieve BICs, we added side beams maintaining reflection symmetry and the geometries of the side beam are determined using the constraint of zero force and moment outside a compact region in the architected structure. **FINDINGS:** We show how a perfect tuning of side beam geometries can exhibit a confinement of the wave in the considered structure. **CONCLUSION:** Our search for simple structure, like beam will lead to a new class of devices for wave control.

Relevance of Research to State-Related Topic

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, agriculture and critical infrastructure, all of relevance to the state of Kansas and its economy.

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APPLICATION OF FLUORESCENCE SPECTROSCOPIC CHARACTERIZATION OF AN ALGAL BLOOM EVENT IN THE MILFORD GATHERING POND

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BACKGROUND AND PURPOSE: An increase in the frequency and geographic distribution of algal and cyanobacterial blooms has been observed over the last two decades, threatening marine and freshwater ecosystems. In situ fluorometers have been proposed for their potential to provide early warning of bloom development through the analysis of fluorescence signatures of the water. Despite the potential of the technology, there has been no in-depth analysis studying the fluorescence and 3-D excitation emission matrixes (EEMs) of an algal bloom in a waterbody experiencing an algal bloom with intensive monitoring. **METHOD:** The Milford Gathering Pond in Geary County, KS experiences annual algal blooms that cause public access closures and affects the Kansas Department of Wildlife and Parks fish hatchery. An algal bloom at the pond was intensively monitored from April 2021 to present. Various water quality parameters such as pH, turbidity, orthophosphate, total nitrogen, and total carbon were tracked and the 3D fluorescent EEM spectroscopy was analyzed. **FINDINGS:** Preliminary findings have shown EEM intensity changes in the M and C1 fluorophores which represent the Aquatic Humic-like and Humic-like components respectively, and as a response the timescale of bloom progression. Although subtle, early changes in the EEMs correspond with the onset of the bloom and the EEMs continued to change with the progression and increase in severity of the bloom. **CONCLUSION:** The findings show promise for a proactive and realistic algal monitoring tool which can be used by regulators and scientists alike for greater societal and environmental well-being.

Relevance of Research to State-Related Topic(s)

Harmful algal blooms are a significant threat to freshwater ecosystems, public health, economies, and fisheries in Kansas due to increased nutrient loads from urban and agricultural runoff. These blooms can also pose a threat to drinking water production as they cause water discoloration, anoxic conditions, and odor and toxicity problems. Reliable prediction of algal blooms is challenging due to the highly complex mixing and flushing patterns and composition of aquatic ecosystems. Early warning of the onset of an algal bloom using in situ spectrophotometry would be highly beneficial, allowing for proactive responses to minimize the effects of the bloom. This would decrease the costs of mitigating the negative effects of the bloom by lessening the size and duration of the bloom. With a shorter and smaller bloom, the recreational and economic value of ecosystems would be safeguarded and ultimately allow aquatic ecosystems to become more resilient

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DEVELOPMENT OF DURABLE ANODE ELECTROCATALYSTS FOR DIRECT METHANOL FUEL CELLS

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BACKGROUND AND PURPOSE: The increasing energy demand has attracted investigation of alternate energy fuels such as methanol. Methanol when produced from feedstocks is a renewable, carbon neutral fuel. Liquid methanol, as an anode fuel in Direct Methanol Fuel Cells (DMFC) possesses high energy density (6.08 kWh/kg). DMFCs can be deployed in transportation, portable electronics, and as stationary power supply systems. We report a study on the development of efficient, durable PtRu anode electrocatalyst on unique core-shell support architecture for high performance DMFCs. This core-shell support comprises of defective amorphous TiO_2 shell (~10 nm thick) conformally coated on oxygen functionalized nitrogen doped carbon nanotubes (ONCNT). **METHOD:** Our electrocatalyst synthesis approach involves the utilization of low-cost microwave heating and post-synthesis thermal annealing in H_2 environment. The as-prepared nanostructured electrocatalyst, denoted as PtRu/TiO_2/ONCNT-400, was characterized using electrochemical voltametric techniques to determine the methanol oxidation activity and long-term stability. **RESULTS/FINDINGS:** Our results revealed that the PtRu/TiO_2/ONCNT-400 demonstrates improved methanol oxidation reaction (MOR) with a mass activity of about 523.5 mA/mg_{Pt}, enhanced CO oxidation reaction kinetics and excellent stability for 500 cycles when compared to the state-of-the-art commercial PtRu/C anode catalyst. **CONCLUSION:** The ultra-thin amorphous TiO_2 shell provides a strong catalyst metal support interaction to offer excellent stability. It also provides surplus hydroxyl species to efficiently oxidize the reaction intermediates such as CO thereby reducing catalyst poisoning and enhancing the mass activity. Various high surface area carbon supports are currently being explored and the thickness of TiO_2 is being optimized to further improve the performance.

Relevance of Research to State-Related Topic(s)

Development of Direct Methanol Fuel Cells (DMFC), an alternate and carbon neutral energy conversion device, is beneficial to the state of Kansas to meet the future energy demand. Biomass derived methanol is renewable, carbon-neutral fuel, if used in DMFCs could help the state of Kansas to increase its renewable energy usage. Kansas being one of the leading producers of biofuels, such as ethanol, from feedstock is highly advantageous, as similar concepts could be used to convert feed stock to bio-methanol for deployment in DMFCs. This will also be a great opportunity for the growth of state economy. Nevertheless, development of DMFCs requires tackling several challenges such as high cost and poor durability of methanol oxidation electrocatalysts. Our approach to address these challenges by utilizing cheaper earth abundant metal oxides such as TiO_2 as co-catalyst and catalyst support to improve the activity has the potential to foresee a greener environment.

GROUP 4

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TO TALK OR NOT TO TALK: AN ANALYSIS OF PARENTS' INTENTIONS TO TALK WITH CHILDREN ABOUT DIFFERENT SEXUAL TOPICS USING THE THEORY OF PLANNED BEHAVIOR

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BACKGROUND AND PURPOSE: Parent-child sexual communication (PCSC) has positive outcomes for children's sexual health, but parents' intentions to educate children about sexuality are largely understudied. Based on the theory of planned behavior, this study aimed to explore what factors are associated with intentions to talk with children about different sexual topics. **METHOD:** A sample of 561 parents of an oldest child ages 6-11 were recruited to complete a survey through Prolific.co. **RESULTS/FINDINGS:** Results of a path analysis showed that having positive attitudes about PCSC, believing others would approve of them talking with kids about sex (subjective norms), and feeling that they had the ability to engage in PCSC (self-efficacy) were significantly associated with parents' intentions to talk to their children about at least three of the five categories of sexual topics ("the basics," "pleasure," "sex in relationships," "gender identity/sexual orientation," and the "religious meaning of sex"). Of these components, self-efficacy was most consistently and strongly associated with increased intentions to discuss all topics, followed by the attitude of believing sex education was the parents' responsibility. **CONCLUSION:** These findings suggest that building self-efficacy and helping parents feel responsible for educating their children about sex would be most important in attempting to increase parental intentions to engage in PCSC on a wide variety of topics. Funding for parent-targeted programming should be allocated to increase parent intentions to engage in PCSC. This programming should focus on helping parents develop self-efficacy and a sense of responsibility for educating children about multiple sexual topics.

Relevance of Research to State-Related Topic(s)

This is an important topic for Kansas legislators who are interested in public health, welfare, and health and human services. Children whose parents discuss sexuality with them are less likely to engage in sexual risk behaviors and feel more efficacious in making healthy sexual decisions (Rogers, 2017; Widman et al., 2016). Therefore, as supported by our findings, helping parents feel self-efficacious and responsible for educating their children about sexuality can contribute to improved sexual health for young Kansans. This is an especially important topic in Kansas where teen birth rates are higher than the national average (Power to Decide, 2021), rates of STIs are increasing (KDHE, 2019), and students are not required to receive comprehensive school-based sex education (less than 25% of Kansas schools cover the CDC's critical sexual health topics; CDC, n.d.). Accordingly, allocating funds to help educate parents about PCSC should be a priority for improving public health.

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HEALTH IN ALL POLICIES IMPLEMENTATION IN RILEY COUNTY, KANSAS

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BACKGROUND AND PURPOSE: Social determinants of health stem from a variety of factors. The environment people live in, access to healthy and affordable food, and safe transportation are just some of the factors that influence community health. Local governments influence health and health equity through city planning, and local policy influences regional policy via vertical diffusion. Health in All Policies (HiAP) is an intersectoral program to improve health through attention to the full range of social determinants. HiAP challenges political and public service leaders to branch out of their usual roles and commit to a plan to reach health goals. HiAP increases awareness of social determinants of health in non-health agencies, and encourages policymakers to include health as a priority when making decisions. **METHOD:** The scope of the work is to train decision-makers in Riley County on HiAP. A two-hour "train the trainer" session was held in April 2021 to train volunteers in the community to lead sessions with decision-makers. Further trainings with local decision-makers will take place in 2021, starting with an initial session, and groups are invited to attend a customized follow-up session. **RESULTS/FINDINGS:** By working with local policymakers, the needs of the community can be identified and met. Long-term, HiAP implementation can educate non-health sectors and help improve the community's overall health. **CONCLUSION**: Health in All Policies aims to improve determinants of health and reduce inequities by designing policies with health uppermost in mind. Intersectoral work can achieve this with the common goal of a healthy community.

Relevance of Research to State-Related Topic(s)

Health is affected by a cascade of events, and HiAP hopes to help close those gaps. Social determinants of health mainly influence population health and equity. Still, for HiAP to be successful, there must be a shift in health policy from illness-oriented health care to social environments of daily living. The Center for Disease Control and Prevention uses this approach to help achieve both National Prevention Strategy and Healthy People goals. HiAP is diverse in that it can involve engagements from all levels of government and has been increasing in popularity. By starting in one community and moving forward, HiAP has the potential to improve the overall health of Kansas. Current structural and political factors often prevent long-range strategies to improve the health of communities. Through the development of stronger planning for setting policy for health, this project will have an important contribution to Kansas long-term.

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VACCINE HESITANCY IN COLLEGE STUDENTS

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BACKGROUND AND PURPOSE: Vaccine hesitancy is a growing global public health concern, especially in the wake of the COVID-19 pandemic. The World Health Organization defines vaccine hesitancy as "a delay in acceptance or refusal of safe vaccines despite availability of vaccination services". Studies show that young adults are less likely to get vaccinated. We investigated vaccine hesitancy in college students on Kansas State University campus. **METHOD:** A Qualtrics survey was created to address COVID-19 vaccination behaviors/opinions. The survey was administered to K-State students via an email link. Descriptive analysis was completed and inferential analysis is underway. **RESULTS/FINDINGS:** Of the 311 responses, graduate students made up 58% (n=179) and undergraduates made up 42% (n=132). In the 18-26 years old age group, 8.8% indicated they will receive the COVID-19 vaccine, 61% have already received it, 8.8% will wait, and 22% will not receive it. In the 27-49 years old age group, 7.8% will receive it, 82% have already received it, 3% will wait, and 7.8% will not receive it. In the 50-64 years old age group, 50% have already received it and 50% will not receive it. No responses were recorded for the 65 and older age group. **CONCLUSION:** From this data, we can conclude that a majority (n= 210; 68%) of respondents have already been vaccinated. We can also conclude that the age group less likely to be vaccinated is the 18-26 age group, based on the higher number of "no" and "wait" responses. This study demonstrated that vaccine hesitancy is of concern in college students in Kansas.

Relevance of Research to State-Related Topic(s)

Many factors may play into vaccine hesitancy including social determinants of health such as age, education and socioeconomic status as well as religious beliefs, confidence in the vaccine, media influences, and individual time management. The amount and severity of vaccine hesitancy varies across different parts of the globe and there isn't a defined path to combat the issue. While a clear solution is not evident, the World Health Organization suggests communication and education are two important aspects of creating a vaccine campaign, increasing vaccine awareness, and decreasing the spread of misinformation. Determining where and why vaccine hesitancy exists in Kansas is an important step for health care leaders, local governments, and legislators to identify populations across the state that will benefit from vaccination (COVID-19 and others) programs.

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CAN VIRTUAL REALITY BE USED TO TEST OLDER ADULTS ON DAILY ACTIVITIES PERFORMANCE?

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BACKGROUND AND PURPOSE: The number of people affected by cognitive disorders will increase in the next decades as the US population ages. Researchers need to find effective ways to test, train, and screen individuals affected by normal and abnormal aging processes. Virtual Reality (VR) technology could facilitate screenings by making tests real-life based and more accesible.The purpose of this research is to find out if VR can be used for daily activity testing, and will evaluate differences between younger and healthy older adults in VR task performance, as well as compare real-life performance with VR performance. **METHOD:** 20 young and 20 older adults will participate in a VR study to compare performances during a sorting task in real-life and in a VR environment. Time and effectiveness, measured by the number of correctly executed steps, will be compared between groups and between real-life and VR. **RESULTS:** We anticipate that both groups will be able to effectively complete the sorting task, although older adults might take more time to do so. Longer times to execute tasks in VR versus real-life for both groups are also expected, but without a significant effect of VR in effectiveness of the task. **CONCLUSION:** If the VR option is feasible for daily activity testing, further research will evaluate using this technology to better detect cognitive decline of older adults. This would possibly increase the sensitivity of currently used subjective scales to make this type of assessment.

Relevance of Research to State-Related Topic(s)

The U.S. Census Bureau estimates that nearly 25 percent of Kansas's population will be over age 60 by the year 2030. Facilitating the screening process for cognitive decline will be beneficial for both urban and rural Kansas. It is always a challenge to find out if our loved ones who wish to remain living independently are having a healthy and safe life on their own. VR technology makes testing available anywhere the device can be taken, and without the need of internet access. It could facilitate accessiblity of testing, improve the screening processes, and early detect cognitive decline. Direct benefits of older adults potentially include increased safety of independent living and treatment benefits of early diagnose of cognitive decline.

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PLAYFUL INTERACTION BETWEEN FATHER'S AND CHILDREN IN FRAGILE FAMILIES

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BACKGROUND AND PURPOSE: Children benefit directly when they have an engaged father in their lives. Early childhood and early brain development science suggests that when fathers are engaged in their children's lives in the early years, it has positive lifelong effects. Research indicates that both play, and father-child interactions are important considerations for child development. As a nation of diverse people, understanding the playful interactions between fathers and their children across racial groups contributes to developing prevention and intervention programming and strategies to address specific needs in these contexts. **METHODS**: The current study examined the extent to which there were differences in the amount of time fathers from different racial groups engaged in playful interaction, both indoors and outdoors, with their children at age three and age five. **RESULTS :**There were no significant differences between racial groups with regards to playful interaction between fathers and children at age five for both outside playful *interactions* and inside playful interactions. However, there were significant differences in the *amount of time* fathers spent playing inside with their children at age 3 based on race. **CONCLUSION :** There is the need to consider parent education programs available to fathers and other socio-economic and contextual factors such as level of education , hours spent working and the quality of the parent-child relationship as these have the potential to influence how much time parents have to engage their children in play.

Relevance of Research to State-Related Topic(s)

The children of today are the leaders of tomorrow and early life experiences influence future life outcomes such as health, education, income, and workforce contributions. The State of Kansas is becoming increasingly racially diverse, and there are several steps underway to correct racial disparities in key sectors. As legislators work on this, it is important to start with the basics. One such step focuses on parent education and understanding the differences in parent child-playful interactions based on race. This understanding provides an avenue for more targeted interventions ultimately fostering the bridging of the gaps resulting from racial disparities in the State, a long-term process with possibilities for critical success if tackled with intention.

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BALANCE MATTERS FOR EFFECTIVE DIVERSITY AND INCLUSION POLICIES

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BACKGROUND AND PURPOSE: Striving to increase workplace diversity is important in the hospitality industry due to higher reliance on the interactions between employees and customers from various backgrounds than other industries. A diverse workforce can not only get different perspectives and opinions that can boost creativity but also understand customers' backgrounds and needs which can capture a diverse target market. This trend makes Nasdaq file a proposal to include new listing rules associated with board diversity and disclosure. While having board members from diverse backgrounds really plays a crucial role in sharing company culture, it is not enough to achieve a fully diverse industry workforce. Understanding employees' perception toward diversity in the workplace, which has been overlooked, needs to be investigated. We expect balancing board members' and employees' diversity can lead to financial outcomes. Thus, this study is designed to examine the effects of employees' perceptions of diversity policies, board members' diversity level, and interaction between them on financial performance using publicly traded hotels. **METHOD**: Data are drawn from Glassdoor.com for employees' perception toward diversity and financial report (i.e., 10K report) for board members' diversity and financial outcome. **RESULTS**: Our expected findings show that both employees' evaluations and board members' diversity level increase financial performance. Moreover, the interaction is expected to be significant, implying that the balance between board members and employees is important regarding diversity policies. **CONCLUSION**: The increased diverse workforce would benefit companies' bottom line which could contribute to the local economy and employment in the long term.

Relevance of Research to State-Related Topic(s)

The previous studies show being diverse and inclusive has an impact on local community development and local business. People from various backgrounds share their knowledge and skills, contributing to the local economy and employment. Between 1990 and 2019, the estimated economic benefit of diversity and inclusion was $70 trillion in the United States. However, the survey conducted by the Kansas City Chamber of Commerce in 2018 found that half of the Kansas City regional organizations showed low percentage of diverse senior managers (1%-25%). Moreover, 31% of the organizations still did not have a diversity and inclusion policy statement. Due to this inactive position to diversity issues, Kansas State may have enjoyed fewer economic benefits of being diverse and inclusive. This study proposes that favorable diversity policies for both top management and employees would enhance companies' financial performance. The increased profits could provide economic benefits and employment opportunities for local businesses.

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VALUING TRUST: AN APPLICATION TO AGRICULTURAL LENDING

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BACKGROUND AND PURPOSE: Trust is a vital component of any relationship, especially when a business transaction is involved. It has been found that trust allows for flexibility in decision-making and reduces transaction costs. It increases credibility and decreases uncertainty. Trust is also important when it comes to relationships in the lending space. Small business managers who have a high level of trust from their loan officer obtain more credit at potentially lower interest rates. Can this be translated into the ag-lending space and just how much does trust matter in this space? **METHOD:** The goal of this project is to investigate if farmers are willing to pay for higher levels of trustworthiness in a financial relationship. We measure an overall trust index which is comprised of four components: credibility, intimacy, reliability, and self-orientation. An online survey of Kansas farmers was conducted to gather data for the study. **RESULTS/FINDINGS:** We found that farmers are willing to pay 0.5% more for their operating loan interest rate to have a more trustworthy loan officer. Trustworthiness and its constituent components of a farmer's loan officer varies across farmers by gender, age, years of experience, the size of the farm, and total revenue. **CONCLUSION:** Given these results, loan officers should care about how trustworthy they are to their farmer customers. If not, those farmers may be enticed to find a new loan officer. Additionally, it would be beneficial for a lending institution to promote trust as part of their customer service approach and marketing efforts.

Relevance of Research to State-Related Topic(s)

This research ties into a variety of key topics in the state of Kansas: economic development, community development and quality of life in rural communities, and workforce development. Building trust in various business relationships can enhance credit opportunities for farmers in rural areas. Keeping the financial business of farmers local may be important for community vitality and rural development.