# Research and the State

## GRADUATE STUDENT POSTER SESSION

Program Booklet

Wednesday, November 2, 2016
K-State Student Union

***Sponsored by:***
Graduate Student Council
Graduate School
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## POSTER PRESENTATIONS AND JUDGING

**1:00 pm to 3:00 pm**
**Union Courtyard (ground floor)**

Research posters will be presented by approximately 50 K-State graduate students representing five academic colleges and 21 graduate programs. 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**

The top 10 graduate student poster presenters selected to represent K-State by presenting their posters at the 14th annual Capitol Graduate Research Summit (CGRS) on February 28, 2017 will be announced at the awards ceremony. These 10 students will be presented with a monetary award to recognize their achievement.

### About the GRS

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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# Poster Abstracts

***GROUP 1***

**1**

## A NEW RAPID NON-DESTRUCTIVE FLUORESCENCE BASED ANALYSER FOR MONITORING THE CHANGES IN DEPROTEINIZED WHEY POWDER DURING STORAGE

**Karthik Sajith Babu** and Jayendra Amamcharla
*Department of Animal Sciences and Industry/Food Sciences Institute, College of Agriculture*

**BACKGROUND AND PURPOSE:** Deproteinized Whey (DPW) is a co-product obtained during ultrafiltration of whey. Subsequently, it undergoes unit operations like evaporation, crystallization, and spray drying resulting in a non-hygroscopic, free-flowing powder containing more than 80% lactose. DPW is widely used in bakery and confectionary applications, drink mixes, snack foods, and in certain ice-cream formulations. DPW powders may undergo chemical and physical changes such as caking, Maillard browning, and oxidation during storage. The objective of the present study was to use Amaltheys analyser for monitoring Maillard changes during storage of DPW powder. **METHOD:** For this purpose, 30 DPW samples were collected from a commercial manufacturer from different lots of production and storage periods. The FAST index (fluorescence of advanced Maillard products and soluble tryptophan) and the whey protein nitrogen index (WPNI) for DPW powders were measured by fluorescence-based Amaltheys analyser (Spectralys Innovation, Romainville, France). Additionally, differential scanning calorimetry, colorimetric L*, a*, and b* values, and water activity (aW) were also studied. **RESULTS:** It was observed that lightness (L*) was negatively correlated ($R=-0.71$; $P<0.01$) with $a_W$ of DPW powders. On the other hand, redness (a*) value was positively correlated ($R=0.82$; $P<0.01$) with $a_W$ of DPW powders. From the Amaltheys analyser, the highest FAST index was observed as 362.24 for the powder with $a_W$ of 0.394. On the other hand, the lowest FAST index observed was 87.16 at $a_W$ of 0.381. **CONCLUSION:** The FAST index and WPNI obtained using Amaltheys analyser method is a simple, rapid, and low-cost method for the detection of Maillard changes in stored DPW powders.

Relevance of Research to State-Related Topic(s)

Use of non-destructive techniques for monitoring storage changes in dairy powders is gaining attention. Deproteinized Whey (DPW) is an economical source of dairy solids with functionality similar to sweet dairy whey. It's a high quality whey ingredient suitable for use in many applications. DPW is widely used in bakery and confectionary applications, drink mixes, snack foods, and in certain ice-cream formulations. The Maillard reaction is one of the most frequent reactions that take place in technological process of DPW, where heat treatments are involved and it can also occur during storage as well. In DPW, Maillard reaction causes sensory and color changes. On prolonged storage, color changes become noticeable, thus making the product unacceptable. My research will be crucial in optimizing processing and storage conditions in the manufacturing of DPW.

**2**

## EFFECT OF MILK PROTEIN CONCENTRATE (MPC 80) QUALITY ON SUSCEPTIBILITY TO FOULING DURING THERMAL PROCESSING

**Gagan Gandhi** and Jayendra K. Amamcharla
*Department of Animal Sciences and Industry, College of Agriculture*

**BACKGROUND AND PURPOSE:** Milk protein concentrate (MPC) is a novel dairy powder which is incorporated into wide range of dairy beverages. In order to be used for its intended purpose, it is essential to study the functional properties and fouling characteristics of MPC. Fouling of the stainless steel (SS) surfaces during thermal processing of milk is a major problem in the dairy industry. It is important to understand the composition and structure of the fouling layer to minimize the fouling of the processing equipment. The objective of the present study was to understand the effect of MPC solubility on its susceptibility to initiate fouling on SS surfaces during thermal processing. **METHOD:** MPC powder with 80% protein content was divided into two lots and stored at 25°C and 40°C for two weeks. Immediately after the storage, the powder solubility characteristics were monitored using focus beam reflectance measurement (FBRM) technique and solubility index (SI). Fouling characteristics were studied using a custom-build benchtop heat exchanger (bPHE). The fouled layer was characterized using weight of fouling, scanning electron microscopy (SEM), confocal laser scanning microscopy (CLSM), energy dispersive X-ray spectroscopy (EDX), and sodium dodecyl sulfate polyacrylamide gel electrophoresis. **RESULTS/FINDINGS:** Storing the powders at 40°C significantly ($P<0.05$) increased the amount of fouling on SS coupons. Microscopic investigations revealed the heterogeneity of the fouling layer with the discrete distribution of lipids and proteins with uniform calcium distribution. **CONCLUSION:** Thus, the study will be helpful in designing effective strategies to reduce fouling during processing of high protein dairy beverages.

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

Fouling of the heat exchanger surfaces during thermal processing of milk is a major problem in the dairy industry. In the U.S., the total costs of fouling were estimated to be $7 billion which includes cleaning of the equipment, loss of production, additional energy consumption, and design considerations of the heat exchanger unit. In the dairy industry, cleaning of fouled surfaces at regular intervals was reported to be 80% of the total production costs. In addition to the economic implications, fouling of heat exchanger surfaces also has product quality and safety consequences. MPC is a novel dairy ingredient and is used these days in formulation of dairy beverages, so it was imperative to study its fouling behavior. Evaluating MPC's fouling behavior will help in designing effective cleaning protocols. The dairy industry is in need of an efficient cleaning technology in order to meet legal as well as self-imposed safety standards.

**3**

# *MACROPHOMINA PHASEOLINA* PROMOTES CHARCOAL ROT SUSCEPTIBILITY IN SORGHUM THROUGH INDUCED HOST NITRIC OXIDE (NO) BIOSYNTHESIS

**Ananda Y. Bandara**[1], Dilooshi K. Weerasooriya[2], Sanzhen Liu[1], and Christopher R. Little[1]
[1]*Department of Plant Pathology, College of Agriculture;* [2]*Department of Agronomy, College of Agriculture*

**BACKGROUND AND PURPOSE:** *Macrophomina phaseolina* (MP) is a fungal pathogen causing charcoal rot disease in sorghum. The objectives of this study were to exploit data derived from a recently conducted RNASeq experiment to investigate the impact of MP inoculation on sorghum genes involved in NO biosynthetic pathway and to biochemically validate the transcription data. **METHOD:** SC599 (resistant) and Tx7000 (susceptible) sorghum genotypes were grown in the greenhouse and inoculated with MP and phosphate-buffered saline (mock-inoculated control). RNA was extracted from three biological replicates at 2, 7, and 30 d post-inoculation (d.p.i.) from stalk tissues adjacent to the inoculation point and subjected to RNA-Seq. Analysis for differentially expressed genes (DEG) was performed with DESeq2. Metabolic pathway analysis was performed to explore the involvement of DEG in NO biosynthetic pathway. Confocal microscopy was used for biochemical investigations where in-situ NO production in MP- and mock-inoculated stalk cross sections of two resistant (SC599, SC35) and two susceptible (Tx7000, BTx3042) sorghum genotypes was analyzed using a fluorescent dye; 4-amino-5-methylamino-2′,7′-difluorofluorescein diacetate at 7 d.p.i,. **RESULTS/FINDINGS:** Among the DEG, three genes (*Sb08g011530*, *Sb05g000680*, and *Sb04g027860*) involved in NO biosynthesis were significantly upregulated in Tx7000 at 7 d.p.i., while those of SC599 were not differentially expressed. Strong green fluorescence was observed in cross sections of both MP-inoculated susceptible sorghum genotypes confirming the presence of NO while no signal was detected in the resistant genotypes. **CONCLUSION:** NO-mediated cell death contributes to enhanced disease manifestation in susceptible genotypes. The genes involved in NO biosynthesis could be useful as markers for screening sorghum germplasm for charcoal rot resistance.

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

Charcoal rot disease causes tremendous yield losses in grain sorghum around the world. Although the top sorghum producer in the nation, Kansas undergoes a 4% average grain yield loss due to stalk rot diseases, resulting $15 million annual economic loss. Inability to achieve a complete control of the disease through host resistance has been partly attributed to lack of understanding on the molecular basis of resistance and the deficiency of molecular markers for highthroughput resistance screening. Here, we report potential tools for accurate and rapid screening of sorghum germplasm for charcoal rot resistance, enabling sorghum breeders to produce high yielding sorghum hybrids with resistance to charcoal rot disease.

**4**

## CHARACTERIZATION OF PARENTS OF SORGHUM MAPPING POPULATIONS EXPOSED TO WATER-DEFICIT STRESS DURING THE VEGETATIVE STAGE

**Enninful Regina**, John V. S. Sunoj, Impa Somayanda, Vara P. V. Prasad, and Krishna S.V. Jagadish

*Department of Agronomy, College of Agriculture*

**BACKGROUND AND PURPOSE:** Agricultural productivity is threatened by scarcity of water, particularly in the arid and semi-arid regions of the world where sorghum is an important component of the cropping systems. Global climate models have projected increased intensity and magnitude in water-deficit conditions. Consequently, characterizing and identifying plant traits that augment resistance to water-deficit conditions are indispensable. The research is of the intent that when genomic regions could be mapped as a result of the characterization, tolerance to water-deficit stress will be improved. **METHOD:** Greenhouse experiments were conducted using 1 m lysimetric pots. Using eleven sorghum genotypes, water-deficit stress (55% to 60% Field capacity) was imposed for a 15-days period, starting from 35-days after emergence. Gravimetric pot weighing was followed daily during the stress period so as to impose uniform level of stress across genotypes and also to determine cumulative water transpired. Data collected at the end of the period included agronomic and physiological traits plus changes in leaf lipid content. **RESULTS/FINDINGS:** Almost all traits measured varied significantly between stressed and well-watered plants. With respect to traits such as photosynthetic assimilation, stem height, leaf and tiller numbers, effects of the stress differed among the sorghum genotypes. Results from leaf lipid analysis showed significant effects of water-deficit stress on the regulation of leaf membrane lipid composition. **CONCLUSION:** In view of sorghum's adaptation to challenging environmental conditions, critical traits identified will be used to map genomic regions responsible for increased water-deficit stress resilience in sorghum. The findings will help standardize phenotyping efforts in enhancing sorghum productivity.

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

Kansas State owns 3.4 million acreage of sorghum producing lands, being the topmost sorghum-producing state. In 2015, the value of sorghum production for Kansas State was $ 859,443,000. Maintaining this feat and ensuring profitability in the face of water-deficit conditions would require better drought-adapted sorghum. Although sorghum is a dependable alternative to crops such as corn when water becomes limiting, the question remains as to whether it can be relied on when water-deficit conditions intensifies. In this light, the current research seeks to dissect and identify key physiological traits that would induce greater drought resilience in sorghum. This should serve to boost sorghum productivity necessary to meet the growing demands, particularly exports to China. More so, the research is useful in ensuring water conservation and addressing farming needs of Kansas, both in the dryer regions and even the humid areas where there can be periods of drought within growing seasons.

**5**

## CAN CURRENT PROMINENT KANSAS WINTER WHEAT LINES TOLERATE POST-FLOWERING HEAT STRESS?

**Blake Bergkamp**, John Sunoj. V.S, Impa Somayanda, Allan Fritz, and Krishna Jagadish S.V.
*Department of Agronomy, College of Agriculture*

**BACKGROUND AND PURPOSE:** Post-flowering heat stress is one of the major environmental constraints for wheat (*Triticum aestivum* L.) production in Kansas. Wheat is the most widely grown crop in Kansas and usually encounters temperatures up to 30°C during grain-filling during May and June, while 15-18°C is recorded to be optimum for normal grain development. Scenarios such as these have resulted in lower productivity in Kansas compared to other parts of the US. Hence, the major objectives were to (i) quantify the ability of prominent Kansas winter wheat varieties and (ii) explore new sources of tolerance to post-flowering heat stress under field conditions. **METHOD:** To impose heat stress, custom built "heat tents" were placed over the plants ten days after flowering and remained until maturity. Temporal physiological measurements recorded throughout the grain filling period included: chlorophyll concentration, chlorophyll fluorescence, and gas exchange. Yield and yield components were recorded at maturity. **RESULTS:** Chlorophyll content and photochemical efficiency of PSII showed rapid reduction under heat stress over time compared to control plants indicating early senescence. Popular cultivar "WB 4458" recorded highest percent reduction in grain weight per spike under heat stress over control whereas, Larry, Zenda, and two other breeding lines recorded the lowest percent reduction. Heat stress reduced grain number per spike and 1000 grain weight in nearly all the genotypes compared to control. **CONCLUSION:** Genetic diversity documented for heat stress response under field conditions will provide opportunities for incorporating higher heat tolerance into future commercial cultivars.

### Relevance of Research to State-related Topic(s)

Winter wheat grown in Kansas is often exposed to high temperatures up to 30$^{o}$C during grain filling which is well beyond the optimum temperature 15-18$^{o}$C for wheat growth. This scenario is predicted to worsen with increased frequency and magnitude of heat stress exposure due to changing climate, which could lead to large economic losses for Kansas growers. Hence, increasing our local cultivars tolerance to sustain heat stress during the critical grain filling stage is crucial and timely.

**6**

## GENOMIC STUDIES OF WEST AFRICAN SORGHUM GERMPLASM

**Fanna Maina** and Geoffrey P. Morris.
*Department of Agronomy, College of Agriculture*

**BACKGROUND AND PURPOSE:** Sorghum *(Sorghum bicolor* L. Moench) is the most drought tolerant of the major cultivated cereal. This crop has a tremendous potential to contribute to food security in the face of increasing temperatures and drought due to climate change. Substantial genetic diversity exists in sub-Saharan African sorghum germplasm, which can be used to introduce new alleles into global breeding programs. However, the utilization of these resources is limited because of inadequate knowledge of genetic diversity of the germplasm. Therefore, the objectives of this study are to characterize the genetic diversity and the population structure of sorghum germplasm collection from West Africa and understand sorghum adaptation to different agroclimatic environments. **METHOD:** We conducted Genotyping by Sequencing (GBS) of 1,500 lines and identified about 150,000 single nucleotide polymorphisms (SNPs). **RESULTS/FINDINGS:** The SNP distribution across the chromosomes shows a high number of SNPs per bin in subtelomeric regions versus a low number of SNPs in pericentromeric regions. The genetic relatedness within the collection showed five main clusters grouped by botanical races (Durra, Caudatum, Guinea, and their intermediate races). A large cluster of intermediate races between Durra and Caudatum, which are frequent in semi-arid parts of West Africa, was observed. **CONCLUSION:** These results will foster the use of germplasm collections through superior lines that will be used for the introgression of new alleles into the Kansas breeding pools. In addition, they will serve as genetic resources for mapping the genetic basis of important agronomic traits for marker-assisted selection.

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

Kansas is the largest producer of grain sorghum in the US with an estimated production of 1,575,000 tons in 2015. The expansion of sorghum growing areas where drought, heat, and diseases are frequent reduces sorghum productivity. Consequently, yield losses during these periods are recorded in addition to stressors such as sugarcane aphid. Therefore, it is important to breed for improved adaptation to these different climatic regions. Our study focuses on the evaluation of genetic diversity of sorghum collection from West Africa that can be used to introduced new alleles confering adaptation to heat, drought, diseases and other important agronomic traits into Kansas sorghum breeding programs.

*GROUP 2*

**7**

## ABUNDANCE AND ACCUMULATION OF BACTERIA ACQUIRED BY MALE AND FEMALE HOUSE FLIES EXPOSED TO CATTLE MANURE

**Jessica L. Thomson**[1], Kathleen M. Yeater[2], Ludek Zurek[1], and Dana Nayduch[1, 3]
*[1]Department of Entomology, College of Agriculture; [2]USDA-ARS-PA-NRRC, Office of the Director, Fort Collins, CO; [3]USDA-ARS, Arthropod-Borne Animal Diseases Research Unit, Manhattan, KS*

**BACKGROUND AND PURPOSE:** House flies develop within and feed upon microbe-rich substrates such as manure, acquiring and potentially disseminating disease-causing bacteria. Because adult female flies frequent manure due to egg laying or nutrition requirements, we hypothesized females contact manure more than males even in the presence of additional food sources (e.g. sugar), resulting in measurable differences in bacterial load between sexes. **METHODS:** House fly acquisition of bacteria from manure inoculated with *E. coli* or *Salmonella* sp. was examined for both sexes over 24 h in assays where (1) inoculated manure was the only food source and (2) both inoculated manure and sugar water were provided. We conducted assays with mated male and female flies separately to determine sex-specific effects on bacterial acquisition. **RESULTS:** Over 24 h, bacterial abundance increased in manure inoculated with *S.* Typhimurium, but not with *E. coli*. In flies, bacterial abundance increased within sex only in *S.* Typhimurium assays. Overall, female flies harbored more bacteria than males; however, differences in abundance were only significant at early time points. In the *E. coli* manure-sugar assays, male and female CFU abundance differed at 4 h and 12 h, while CFU abundance differed at both 4 and 12 h in all *S.* Typhimurium assays. Fly digestive tract observations from manure-sugar assays supported these initial differences especially at 4 h where females contained manure and fly food, while males contained only sugar water. **CONCLUSION/SIGNIFICANCE:** Identifying sex-specific effects on house fly acquisition and carriage of bacteria from manure facilitates risk assessment of pathogen transmission on farms.

Relevance of Research to State-Related Topic(s)

Microbe-rich cattle manure serves as major developmental sites for house flies. Moreover, house flies can act as potential vectors by disseminating harmful bacteria from these developmental sites to nearby residential areas posing an important human and animal health risk. Kansas ranks third in the U.S. in cattle population making manure management an important strategy for pest control on farms.The presence of house flies in Kansas farms during pre-harvest and post-harvest season remains a great concern for food safety in animal and crop agriculture. This research shows that female house flies initially carry more bacteria than male house flies from exposure to cattle manure. Our findings emphasize the importance of considering fly sex in assessing risk for bacterial carriage. Future research focusing on exposure to manure in wild flies will be required to determine appropriate techniques to monitor pathogen dispersal as well as reduce food contamination during the harvesting process.

**8**

# ROLES OF SECRETED SALIVARY GLAND PROTEINS OF HESSIAN FLY LARVAE *MAYETIOLA DESTRUCTOR* (SAY) IN INSECT PHYSIOLOGY AND PLANT INTERACTIONS

**Zainab Al-jbory** [1], Mustapha El-Bouhssini[2], R. Jeff Whitworth[1] and Ming-Shun Chen[1,3]
*[1]Department of Entomology, College of Agriculture; [2]INRA, Rabat, Morocco, [3]USDA - ARS, Manhattan, KS*

**BACKGROUND AND PURPOSE:** Hessian fly is one of the most destructive insect pests that causes serious damage to wheat-growing areas in USA and worldwide. The weapon for Hessian fly larvae in attacking wheat plants is the saliva primarily produced in the salivary glands. The previous studies have revealed that Hessian fly salivary glands are specialized to produce thousands of secreted proteins. During larvae feeding, some of these secreted proteins (also called effector proteins) are injected in the wheat tissues to affect cell chemistry and to finally inhibit plant growth. On the other hand, the pair of salivary glands in a Hessian fly larva is differentiated into two regions: a basal region, which connects to mandibles directly, and a filament region, which extends into the abdomen of the insect. In this research, we separated the base and filament regions and studied the characters and structure of the secreted proteins in these two parts. **METHODS:** We dissected salivary glands of Hessian fly larvae, and separated the base region from the filament. A library of genes for each region was constructed and sent to a sequencing facility. Sequences then were analyzed by using various BLAST programs. **RESULTS/CONCLUSION:** Our results revealed that the majority of the secreted proteins in the basal region are effector proteins that are most likely injected in plant tissues to inhibit wheat growth. Whereas the majority of the secreted proteins in the filament are larger proteins and are likely to have enzymatic activity that play roles in the insect growth and development.

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

In Kansas and many other states controlling Hessian fly is a crucial factor in wheat production and industry. The most effective way to control damage from Hessian fly is deploying resistant plants to the field. Indeed, numerous resistance genes have been identified and are being used successfully to control Hessian fly damage. Unfortunately, there are more than 2000 SSGP genes in the Hessian fly genome and it is difficult to single out which gene(s) is critical for Hessian fly virulence. Our study aimed to identify and characterize the secreted proteins that are expressed in the base region from those that are expressed in the filament. By doing this, we will reduce the number of candidate genes potentially involved in insect virulence. Our results may help plant breeders in the efforts of developing more durable resistant wheat.

**9**

## PROTECTING KANSAS WHEAT: ASSESSMENT OF A NOVEL HESSIAN FLY MONITORING STRATEGY

**Ryan Schmid**[1,2], Darren Snyder[1,3], Lee Cohnstaedt[1,3], and Brian McCornack[1,2]
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**BACKGROUND AND PURPOSE:** The Hessian fly, *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae), has been a significant pest of wheat in Kansas since the early 1900s, resulting in significant economic losses to this multi-billion dollar commodity to Kansas. The current Hessian fly monitoring trap, utilizing Hessian fly female sex-pheromone, does not consistently reveal field infestations, which greatly hinders control strategies for this pest. Recent research has demonstrated Hessian fly attraction to green light emitting diodes (LEDs) (~525 nm) set to high intensities ($16W/m^2$) does not interfere with their attraction to the sex-pheromone. However, before LEDs are incorporated into traps, a better understanding of Hessian fly response to LEDs under field conditions is required. Therefore, the purpose of this research was to examine Hessian fly response under controlled laboratory conditions toward LEDs and interacting factors (light dilution and wheat odor) found under field conditions. **METHOD:** Choice bioassays assessing the effects of light dilution on fly response were conducted in a four-leaf, clover-shaped arena, in presence and absence of white, simulating day and night. The effect of wheat odor on female Hessian fly response to LEDs was conducted in Y-tube shaped arenas in choice bioassays. **RESULTS/FINDINGS:** Female Hessian flies chose the green LEDs 98% more than wheat odor; however, white light illuminating the arena did reduce fly attraction to LEDs causing no significant response. **CONCLUSION:** These results help us to better understand how Hessian flies will respond to LEDs under field conditions, and ultimately demonstrate the potential for incorporation of LEDs into Hessian fly traps to improve monitoring.

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

Kansas is one of the top wheat producing states in the U.S., annually producing an average of 382 million bushels over the past decade, worth over $2 billion annually. As such, this commodity affects the livelihood of a significant portion of the state's rural population. The Hessian fly first threatened Kansas wheat production during the first half of the 20th century, resulting in reports of 5-50% injury in winter wheat across many counties. However, development of management practices reduced many Hessian fly outbreaks during the latter half of the 20th century. Unfortunately, outbreaks have become more frequent in recent years due to outdated management techniques. My research demonstrates the potential for LEDs to improve Hessian fly monitoring, and consequently will provide Kansas wheat producers much needed information to make judicious management decisions, thus protecting this valuable commodity and the livelihood of much of rural Kansas.

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## USING PICTURES TO ESTIMATE SOYBEAN APHID DENSITIES IN SOYBEANS

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**BACKGROUND AND PURPOSE**: The soybean aphid, *Aphis glycines* Matsumura, (Hemiptera: Aphididae) is a major pest of soybeans, *Glycine max* (L.), in the Midwestern United States. This pest can cause yield loss in excess of 50% when colonizing young soybean plants. Current scouting methods can either be labor intensive or require human estimation of the aphid infestations. The objective of this study was to validate an existing computer program designed to estimate soybean aphid numbers on leaflets under field conditions. **METHOD:** Two soybean fields in Iowa and two in Minnesota were sampled for soybean aphids. In each field three leaflets were randomly pulled from the same plant at three different heights (e.g., canopy, middle, and bottom). Thirty plants were sampled in each field unless aphid densities were too low, where only 10 plants were sampled per field. For each leaflet sampled, we tested camera sensor distance (X, X, and X cm), background color behind each leaflet (green, black, and white), and camera type (Samsung Galaxy S5, Apple iPhone 6, and Samsung Galaxy Note 5) . **RESULTS:** Initially, green backgrounds associated with mid-level heights had the most aphids detected by the computer program. The iPhone 6 camera was the only sensor that did not result in correct counts by the program. **CONCLUSION:** Preliminary results suggest that a green background behind a soybean leaflet works best for estimating aphid counts, followed by black and white backgrounds, respectively.

### Relevance of Research to State-related Topic(s)

Soybean aphids are an important pest of soybeans in the Midwest, including soybean in North Central Kansas. This pest can cause anywhere from 10-50% in yield losses infestations are left untreated. Sampling these small pests can be time consuming and difficult and variability in estimates can be quite large due to human error. My computer program is expected to be at least twice as fast as human counts and more accurate, which will leading to more informed decisions. In the long run, this lead to fewer pesticides applied and less time making decisions in fields, both of which help farmers conserve valuable resources. In addition, outcomes from my research are potentially transferable to other commodities like sorghum; this program could be used to count sugarcane aphid, which is a new pest in Kansas. The results of this study show that a simple background color and sensor distance from the leaflet can give accurate pest population estimates much faster than established sampling methods.

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## WHEAT GERMPLASM DEVELOPMENT AND GENETIC MAPPING FOR HESSIAN FLY RESISTANCE

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**BACKGROUND AND PURPOSE:** Wheat (*Triticum aestivum*) is the most widely grown cereal, and a primary source of protein and calories consumed by humans. However, it's production is frequently challenged by diseases and pests. Hessian fly (HF; *Mayetiola destructor*), also known as gall midge, is an important insect pest of wheat that results in 5-10% annual yield loss in the US alone. HF has thirteen reported biotypes designated as A-L and GP. GP is the prevalent biotype in Kansas and is one of the most virulent biotypes. Seven of the 35 identified genes provide resistance to GP biotype, and all are mapped on short arm of chromosome 1A. Due to strong selection pressure posed by these genes, HF evolve faster to overcome resistance, therefore, it is imperative to keep up with the discovery of new genes that can be quickly deployed in a breeding program. **METHODS:** We developed and screened 589 $BC_3F_{2:3}$ lines from 'Overley' x *Aegilops tauschii* backcross population to identify HF resistance gene. We have genotyped this population using genotyping-by-sequencing (GBS). Reference and non-reference based SNP calling resulted in ~47K and 220 SNPs, respectively. For reference based SNPs, all the markers with more than 50% missing data were filtered out, which resulted in only ~23K SNPs, whereas for non-reference based SNPs, all markers were retained. These were used for further statistical analyses. **RESULTS AND CONCLUSION:** Phenotypic screening and distribution has indicated that it is a single dominant gene that fits classical 1:2:1 ratio. This gene provides immunity to plants carrying this gene. Association analysis showed that this gene is present on the distal part of chromosome 3D and is possibly a new gene. This germplasm will be available for the plant breeding community under Wheat Genetics Resource Center guidelines.

Relevance of Research to State-related Topic(s)

In wake of climate change and faster evolving biotic stresses, there is an imminent need to develop better, resilient and high yielding cultivars under these stresses. Hessian fly is highly damaging insect, and developing wheat varieties with built in host resistance is an effective and sustainable way to control HF. This will result in less use of pesticides, and will result in increased and stable farmers' income. Ultimately this translates to strengthened food security and better environment.

*GROUP 3*

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## IMPACTS OF SUBSURFACE FLOWS ON CONCENTRATED FLOW EROSION IN CENTRAL KANSAS

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**BACKGROUND AND PURPOSE:** Soil erosion is a serious threat to agriculture worldwide. Unsustainable agriculture practices may produce significant amounts of sediment resulting in land degradation and reservoir sedimentation. Soil erosion in the form of rills, gullies and channels is the major source of the sediment. It was extensively studied for decades, but the influence of the subsurface water processes was rarely accounted for. Our goal was to develop a soil erosion model that accounts for subsurface fluxes and to compare the erosivity of representative soils of Central Kansas. **METHOD:** We introduced a new physically based concentrated flow erosion model with the assumption of the critical shear stress being a function of seepage forces. We developed a 2-D numerical model of subsurface flows near the channel to compute seepage gradients and erosion rates for various soils with parameters assessed with ROSETTA model based on the textural data from the SSURGO database. **RESULTS/FINDINGS:** Simulations of seepage/drainage conditions showed an acceptable performance of the model when compared to the experiment. Simulation of the erosion processes for various soils showed that arable soils are more erodible and are more sensitive to seepage conditions. Another finding was that the erosion modeled with variable critical shear stresses was higher for small rainfall events than the ones produced by the model with constant critical shear stress. **CONCLUSION:** Our results showed that the proposed approach may be useful in the modeling of erosion processes. Simulations of the erosion of soils of Central Kansas stressed the problem of soil erosion of arable land.

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

The State of Kansas faces difficult issues of sustainable water supply. While Western Kansas struggles from drought, and Eastern Kansas from rainfall excess, Central Kansas suffers from excessive soil erosion and reservoirs sedimentation. As an example, the Cheney Lake Reservoir, water supply for the city of Wichita, experiences great problems with both water quality and quantity caused by soil erosion. There are well known and already applied management practices to address this problem. However, the problem is still there, and new techniques and new solutions are necessary. For this, we need to develop a better understanding of the problem and apply new innovative approaches for the estimation of soil erosion from recommended practices. Our research provides a new fundamental model to account for the wider range of underlying physical processes such as subsurface flows in computations of soil erosion in the form of rills, gullies, and channels.

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## RAPID ADATATION IN A CONTAMINATED ENVIRONMENT: EVOLUTIONARY ADAPTIVE RESPONSE OF OLD FIELD GRASS *Andropogon virginicus* TO HEAVEY METALS IN AN ABANDONED LEAD AND ZINC MINE

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**BACKGROUND AND PURPOSE** Soil and climate factors, historically important drivers of speciation, have been substantially altered by human activities, placing new selective pressures on plant populations. Rapid adaptation to changing local environmental conditions has been shown to occur in plants exposed to copper and coal mines, as well as other extreme environments. My research investigates potential adaptive variation in populations of the perennial grass *Andropogon virginicus* in response to Lead and Zinc contaminated soils in the Tar Creek Superfund Site in Southeast Kansas and Northeast Oklahoma. Using plants from inside and outside this abandoned mine, I can quantify and compare phenotype, genotype, and gene expression between populations to investigate the basis of metal tolerance. **METHODS**: Seeds were collected from populations of *A. virginicus* and germinated in the greenhouse. Plants from 12 locations (6 in mine areas, 6 in uncontaminated old field sites) were planted in soils collected from the same 12 locations in a greenhouse soil reciprocal transplant. Each combination of plant population and soil (12X12) was replicated twice (for a total of 288 plants). Physiological data (SPAD, chlorophyll fluorescence, height) was periodically collected to compare the effects of soil treatment and source population. Additionally, DNA was extracted and sequenced from plants from these 12 populations and 8 additional populations to compare between and within population variation. **RESULTS AND CONCLUSION:** The results of the soil reciprocal transplant experiment and the genetic data from mine and old field populations will allow us to test hypotheses about the nature of metal tolerance in a widespread old field grass.

Relevance of Research to State-Related Topic(s)

The Tar Creek Superfund Site is part of the Tri-State Mining District, which includes abandoned Lead and Zinc mines in southeastern Kansas, southwestern Missouri, and northeastern Oklahoma. Although it has been a Superfund Site since 1983, efforts to remove waste and decontaminate the soil and water are still underway, and over 1,444 acres of tailing piles remain. Exposure to the contaminated soil, water, and wind-blown dust in this area poses a significant risk to human health. Heavy metals present in and around the Superfund site have also been shown to reduced local biodiversity. Metal tolerant populations of *A. virginicus* could be used in restoration efforts in order to help recolonize vegetation and stabilize contaminated soils, reducing erosion and runoff of heavy metals. I will communicate the results to my experiments to the EPA and USFWS to help guide seed sourcing decisions, especially if locally adapted ecotypes are identified.

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# EFFECTS OF INTENSIVE LATE-SEASON SHEEP GRAZING FOLLOWING EARLY-SEASON STEER GRAZING ON POPULATION DYNAMICS OF SERICEA LESPEDEZA IN THE KANSAS FLINT HILLS

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**BACKGROUND AND PURPOSE:** Sericea lespedeza (SL) is an invasive weed in the Tallgrass Prairie ecosystem. Infestations of SL reduce native grass production by up to 92% through a combination of aggressive growth, prolific seed production, and plant community dominance. Herbicides slow the spread of SL but application is difficult and expensive; moreover, herbicides may harm ecologically-important, non-target plant species. Increased grazing pressure on SL by beef cattle may slow its spread and facilitate some measure of biological control. Unfortunately, mature plants contain high levels of toxic compounds called condensed tannins, which are a strong deterrent to grazing by beef cattle. Sheep, in contrast, appear less susceptible to certain plant toxins than beef cattle and may be useful to selectively pressure noxious weeds like SL through grazing. **METHOD:** In this study, sheep were used to intensively graze SL-infested pastures from 8/1 to 10/1 over the course of 2 years. Sheep grazing followed early-season beef steer grazing from 4/15 to 7/15. **RESULTS:** Late-season, intensive sheep grazing on native Tallgrass Prairie decreased the vigor and reproductive capabilities of SL. Sheep appeared to preferentially select SL and other undesirable broadleaf plants (e.g., Baldwin's Ironweed), whereas steers avoided these plants. Annual seed production by SL and whole plant weight at dormancy were less in pastures treated with late-season sheep grazing. **CONCLUSION:** Late-season, intensive grazing by sheep may be an effective means for controlling SL infestations in the Tallgrass Prairie ecosystem.

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

In Kansas, Sericea lespedeza (SL) infests approximately 980 square miles of pasture, primarily in the Flint Hills region. The predominant grazing management practice in this region of Kansas involves annual spring burning followed by intensive grazing with yearling beef cattle from April to August. During seasonal grazing, 40 to 60% of annual grass production is removed and pastures remain idle for the remainder of the year. Under this prevailing management practice, invasion by SL into the tallgrass prairie biome has steadily increased. SL flowers and produces seed in late summer from August to October. The absence of grazing pressure during this interval strongly promotes seed production, seed distribution, and continued invasion of the Flint Hills by this noxious weed.

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## REDUCED RAINFALL PREDICTS DIMINISHED BIG BLUESTEM GROWTH ACROSS THE PRAIRIES OF KANSAS

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**BACKGROUND AND PURPOSE:** The prairie grass *Andropogon gerardii* (big bluestem) represents as much as 80% of plant biomass of tall grass prairie. A rainfall gradient from very dry in the west (Colby, KS) to wet in the east (Manhattan, KS) coincides with a similar pattern in diminished to robust plant biomass in populations across KS. Understanding how rainfall and plant phenotypes are related will help us predict how big bluestem may respond to predicted drier climate. **METHOD:** Our study utilizes growth data from 37 geographically distributed populations across the central U.S. to explore species-growth-climate relationships. For each population, we grew plants from seed under greenhouse conditions and measured the phenotypes. We used phenotype data along with climate projections to create phenotypic distribution models which show current and future phenotypes across Kansas and the Midwest. Our approach is an improvement over current practice that models a species response to climate change but fail to incorporate phenotypic variation within a species. **RESULTS/CONCLUSION:** Data shows populations varied in phenotypes ($p<0.001$) and a gradient across populations can be partially explained by longitude, mean annual precipitation, and vegetation type. These results support evidence for ecotypic variation in drought tolerance across the Kansas climate gradient. Phenotypic distribution models, for the year 2070, show phenotypes from dry areas are predicted to occur through the Midwest, eclipsing phenotypes from wet areas. Our future climate models predict that big bluestem in Kansas will have less biomass due to predicted decreased rainfall and this may impact the forage industry.

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

The tall grass prairies ecosystems of Kansas, are a state treasure that provide recreation, habitat and revenue for citizens and visitors to Kansas. How big bluestem, which is the ecologically dominant plant of the tall grass prairie, responds to predicted climate change is a critical area of research. Land managers that calculate grazing potential of land based on the amount of biomass produced, will be affected most severely if our predictions of less biomass hold true under future climate scenarios. In this case, the number of cattle that could be produced currently, will be greatly diminished in the future, and this will result in less income on the family ranch. In summary, our research identifies and quantifies future predicted changes of big bluestem biomass in the tall grass prairies, and its impact on rangeland and conservation of tall grass prairies.

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## SOIL MICROBIAL PROPERTIES WITH DEPTH IN CLAYPAN SOILS OF SOUTHEAST KANSAS

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**BACKGROUND:** Claypan soils are a dense, impermeable subsoil of clay that impedes root growth and water movement. Plants rely on soil microbes to break down soil nutrients, making them available for the plant. Therefore, soil microbial properties can potentially indicate how well the soil microenvironment supports root growth and hence the productive capacity of the soil. The soil microbiology has not been studied in detail in claypan soils. **METHOD:** Soil microbial communities were examined through PLFA analysis. Two enzyme groups, hydrolases and oxidases, are tested in this study. Hydrolytic enzymes (hydrolases) decompose labile organic compounds, and oxidative enzymes (oxidases) destabilize phenolic compounds from soil organic matter. Soil texture and chemical properties including pH, moisture content, and nutrients were also examined. **RESULTS:** The hydrolase activities increased at 35-45 cm deep, which is close to the surface of the claypan layer. As depth increased, soil microbes expended more energy acquiring phosphorus relative to carbon, and more energy acquiring nitrogen relative to carbon. Enzyme activities were highest in the grassland soils, and lowest in the conventional tillage soils near the surface. **CONCLUSION:** Soil microbial properties in the top 15 cm were mainly affected by agricultural practices, while soil below 35 cm were determined by inherent soil characteristics. The microbial properties at 15-35 cm depended on a mix effect of inherent properties and surface management. Clay content, soil moisture and carbon were key drivers of microbial properties. High clay content was usually coincident with high moisture content and hydrolase activity. Tillage reduced microbial activity.

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

Soil is the base of plant and animal health. There are around 4 million hectares of claypan soils in the Midwestern United States, including Kansas, Missouri, Illinois, and Oklahoma. Claypan soils create serious limitations to crop production by restricting root development and water movement. Previous research on claypan soils showed that the response to crop management practices including crop rotation, irrigation, and tillage may be different on claypan soils than for typical soils. The objective of this study is to assess how claypan subsoils and tillage mediate changes in soil microbial properties with depth in southeast Kansas. By examining soil microbial profiles and differences between tillage practices, our finding will help illustrate the interrelation of management practices and soil properties in claypan soils, and assist farmers and agriculturalist in managing soils to improve soil health and productive capacity.

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## GREENHOUSE GAS EMISSIONS FROM BEEF-CATTLE GRAZING SYSTEMS ON TEMPERATE GRASSLANDS

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**BACKGROUND AND PURPOSE:** At a global scale, cattle production is responsible for 65% of livestock sector GHG emissions. During 2014 cattle management was the largest emitters of methane ($CH_4$) representing a 23.2% of the total $CH_4$ from anthropogenic activities. This study analyzes the dynamics of GHG on grazing system under three different burning regimes on temperate grasslands. **METHODS:** Since 2014, gas samples have been gathered and analyzed for carbon dioxide ($CO_2$), $CH_4$ and nitrous oxide ($N_2O$) from three grazing areas under different burning regimes at the Konza Prairie Biological Station in Kansas. Burning regimes included annually burned, and patch burned every three years on offset years. **RESULTS/FINDINGS:** Burning regimes showed no effect on $N_2O$ emissions ($p<0.05$). Annual burning lowered $CO_2$ emissions relative to patch burned. There was a significant interaction between emissions and season. Maximum $CO_2$ and $CH_4$ fluxes occurred during summer and fall; which coincided with high biomass production. Weather and soil conditions during fall and winter increase $N_2O$ emissions. A decrease in $CO_2$ and $CH_4$ fluxes, and $N_2O$ and $CH_4$ soil uptake occurred during winter. **CONCLUSION:** Data gathered since 2014 implies $CH_4$ and $N_2O$ are consumed on grazed grassland soils; with an increase in consumption with patch burning. Temperate grasslands serve as a sink of $CH_4$, and a possible sink of $N_2O$ thus reducing the environmental footprint of livestock grazing systems. This study provides evidence of $CO_2$, $CH_4$ and $N_2O$ emissions as a consequence of burning regimes, and quantifies the role of temperate grasslands as a sink of $CH_4$ and $N_2O$ for recommended best management strategies for a resilience of beef cattle grazing system.

### Relevance of Research to State Related Topics

Beef produced in the Great Plains provides a significant portion of the United States red meat. However, beef production and farm incomes are at risk because during the last years farmers had observed lower capacity for protein production due extreme weather events. This PhD project is part of the Great Plains Grazing project aimed to generate scientific data on the environmental footprint of beef cattle grazing systems and its resilience to climate change. The specific objective of this study was to determine grassland management strategies to reduce the environmental footprint of beef cattle grazing systems. A better understanding of the cattle grazing systems will lead to improvements in greater efficiency of beef cattle production while maintaining of environmental resources and food security.

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## TIME SERIES ANALYSIS OF PHENOMETRICS AND LONG-TERM VEGETATION TRENDS FOR THE FLINT HILLS ECOREGION USING MODERATE RESOLUTION SATELLITE IMAGERY

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**BACKGROUND AND PURPOSE:** A time-series analysis of Moderate Resolution Imaging Spectrometer (MODIS) 16-day maximum value composite normalized difference vegetation index (NDVI) data (MOD13Q1 Collection 5) was performed to explore differences in vegetation phenology, assess long-term trends in vegetation quality, and to quantify the frequency and magnitude of significant disturbances within grasslands of the Flint Hills ecoregion of Kansas and Oklahoma. **METHOD:** The Breaks for Additive Season and Trend (BFAST) decomposition method was applied to a time series of images from 2001-2015 to derive estimates of gradual interannual and abrupt intraannual change. The program TIMESAT was used to extract key measures of vegetation phenological development (e.g., start of growing season, maximum NDVI) across the same fifteen year period. Phenometrics extracted included (1) season length, (2) start of growing season, (3) end of growing season, (4) middle of growing season, (5) maximum NDVI value, (6) small integral, (7) left derivative, and (8) right derivative. **RESULTS/FINDINGS:** Analyses were performed to determine the significance of spatiotemporal differences in grassland phenology across the Flint Hills and interannual changes in vegetation quality with the additional goal of quantifying the influence of climate and key regional anthropogenic factors (e.g., fire) on shaping long-term vegetation trends. **CONCLUSION:** This research will allow researchers, policy-makers, and landowners to better understand vegetation dynamics within the Flint Hills ecoregion and evaluate trends in grassland development that have both ecological and economic impacts.

Relevance of Research to State-Related Topic(s)

The Flint Hills of Kansas is an important ecological region and economic driver within the state. Given the role of prescribed burning on maintaining the tallgrass prairie system, understanding differences in vegetation development through diagnostic phenometrics offers the potential to reveal significant heterogeneity within the region and inform burning management plans. Further, detecting and analyzing long-term trends in vegetation growth will highlight challenges in maintaining the tallgrass prairie under conditions of increase anthropogenic and climate change impacts.

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# EXPERIMENTAL NATURAL SELECTION OF BIG BLUESTEM ECOTYPES ACROSS THE GREAT PLAINS: A NOVEL TEST FOR THE STRENGTH OF LOCAL ADAPTATION

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**BACKGROUND AND PURPOSE:** *Andropogon gerardii* (big bluestem) represents ~70% of prairie biomass and has a wide geographic distribution across a precipitation gradient (500-1200 mm/yr, western Kansas to Illinois). Thus, we expect bluestem to be adapted to home climate conditions. Ecotypes (central Kansas (CKS), eastern Kansas (EKS), and Illinois (SIL)) were reciprocally planted in Colby, Hays, and Manhattan, KS, and Carbondale, IL. Plantings consist of single ecotype plots (seeded with other prairie plants to simulate a natural prairie) and plots with all three ecotypes mixed together. Mixed plots allow for competition between ecotypes and one of the first rigorous tests of local adaptation, under natural ecological conditions. **METHODS:** For the mixed ecotype plots, we first genotyped plants of known ecotype to be used subsequently to determine composition of unknown plants in mixed plots. We used known genotypes to train a random forest model that assigned unknown individuals in mixed plots to one of three ecotypes. **RESULTS AND CONCLUSION:** Single ecotype plots show evidence of local adaptation of the dry CKS ecotype to western Kansas and the wet SIL ecotype to Illinois. For mixed plots, if there was no selection, all three ecotypes should be represented equally at all sites. However, the random forest model confirms CKS ecotype dominates Colby and Hays sites and SIL ecotype dominates Manhattan and Illinois sites. Combined, results from single ecotype and mixed plots similarly show evidence of local adaptation of distinct dry and wet ecotypes. These results will provide recommendations on climate-adapted source populations for restoration planting in future warmer and drier climates.

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

Big bluestem is the ecologically dominant warm season grass that is dominant across the Great Plains. Our garden sites across the Great Plains' precipitation gradient allows for tests of varying climates, ranging from dry in western Kansas to wet in Illinois. It is crucial to understand bluestem how responses to climate, particularly with the recent drought in 2012 being the worst the state has seen in ~50 years. Climate models predict increased future drying in the Midwest. Ultimately, this research will inform land managers as to which ecotypes are best suited for conservation and restoration for future dryer climates. This information is crucial for agriculture sustainability with big bluestem being the major forage grass for cattle, a ~6 billion dollar industry for Kansas alone. Additionally, this is important for programs such as USDA Conservation Reserve Program with ~ 5 million acres of restored marginal agriculture land across the Great Plains.

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*****NO SHOW*****

## IMPACTS OF TILLAGE AND FERTILIZER ON SOIL ORGANIC C AND N

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**BACKGROUND AND PURPOSE**: Sustainable intensification including no-till systems and increased C inputs can improve soil quality and provide a sink for greenhouse gases. The objective was to assess soil organic carbon (SOC) and nitrogen (SON) as affected by tillage and nitrogen source after 25 years. **METHOD**: The study conducted was at the North Agronomy Research Farm, Manhattan, KS. Tillage systems were no-till and chisel/disk and the N sources were No N, organic (compost) and synthetic N fertilizer. The experiment was a split plot design. The soil profile soil was sampled to a depth of 90 cm and partitioned into 0-5, 5-15, 15-30, 30-45 45-60 and 60-90 cm. Analyses included bulk density (BD), SOC and SON stocks. **RESULTS AND CONCLUSION**: Tillage and depth and source and depth had a significant effect on both SOC and SON. Manure increased SOC and SON stocks of 194 Mg C $ha^{-1}$ and 17 Mg N $ha^{-1}$ respectively. Much of the gain in SOC and SON was lost with tillage. Gains in SOC and SON in no-till were still apparent but less than with the organic N source. Results show that the combined adoption of no-till and compost is a potential strategy to enhance crop productivity and to sequester SOC and SON in agricultural systems.

Relevance of Research to State-Related Topic(s)

Soil is a critical resource to Kansas. Previous soil management has degraded our soils resulting up to 50% loss in soil organic matter. Improved management such as reduced tillage and increased inputs can restore soil organic matter thus improving soil quality and productivity. A long-term study (25 years) provides a unique opportunity to determine the impact of tillage systems and inputs on soil quality. No-tillage with organic inputs greatly increased soil carbon and nitrogen even to depth of 90 cm (3 ft). This study illustrates the importance of promoting no-till (minimum soil disturbance) and the use of organic inputs as a soil management strategy in Kansas to sustain soil resources and food productivity. Enhanced soil quality will increase productivity, profit, and decrease production costs.

*GROUP 4*

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## NMR STRUCTURAL STUDIES OF STRESS RESPONSIVE PEPTIDE-2 FROM THE INSECT *MANDUCA SEXTA*

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**BACKGROUND:** With the genome sequence of *Manduca sexta* available, we have identified ten open reading frames coding for precursors of paralytic peptide (PP) homologs: uENF1, uENF2, and SRP1−8. While uENF1 and uENF2 are located upstream of the PP gene, we temporarily call the other eight stress responsive peptides (SRPs), since stress is broader than infection, a type of biotic stresses. SRP2 is predicted to be a 25-residue peptide (FGVKDGKCPSGRVRRLGICVPDDDY) stabilized with a disulfide bond. The proteolytic activation of proSRP2 is likely linked to the serine protease network that mediates and coordinates immune responses in this insect. SPR2 may also participate as a regulator in brain development. **RESULTS/METHODS:** We have determined the solution structure of SRP2 by two-dimensional $^{1}$H NMR spectroscopy to begin to understand structural-functional relationships of this peptide. Our preliminary studies indicate that SRP2 has an ordered structure, which is composed of two short β-strands at residues Arg$^{12}$- Arg$^{15}$ and Ileu$^{18}$-Val$^{20}$, one type I' β-turns at residues Arg$^{15}$-Ileu$^{18}$ and a γ'-turn at residues Cys$^{8}$ - Ser$^{10}$. Work is in progress towards 3D structure determination. Based on our NMR data, a well-defined secondary and tertiary structure for this class of peptides will be presented.

Relevance of Research to State-Related Topic(s)

We are investigating a novel family of peptides which are activated during stress conditions such as wounding, infection and ligation. The results of our structure –activity relationship studies on stress-responsive peptides will lay the basic science foundation to develop anti-bacterial therapeutics.

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# CHARACTERIZING THE INFLAMMATORY RESPONSE TO A HIGH-FAT MEAL IN HEALTHY ADULTS: A SYSTEMATIC REVIEW

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**BACKGROUND:** Previous studies have consistently indicated that heart disease, which is the second leading cause of death among Kansas adults, is underpinned by chronic low-grade inflammation. While poor diet is considered a long-term inflammatory stimulus, a single high-fat meal (HFM) has been suggested to acutely escalate inflammation, although there is ambiguity regarding the specific characteristics of this inflammatory response. **PURPOSE:** We conducted a systematic review of published studies to objectively describe the post-meal timing and magnitude of changes in five commonly measured inflammatory markers: interleukin (IL)-6, C-reactive protein, tumor necrosis factor (TNF)-α, IL-1β, and IL-8. **METHODS:** Ten relevant databases were searched, yielding 494 results, of which 47 articles met the pre-established inclusion criteria: 1) healthy men and women aged 18-60 years; 2) consuming a single HFM (≥30% fat, ≥500 kcal); and 3) assessing relevant inflammatory markers post-meal for ≥3 hours. **RESULTS:** The only marker found to consistently change (increase) in the post-meal period was IL-6 – starting at a baseline of ~1.4 pg/mL and peaking at ~2.9 pg/mL approximately 6 hours post-HFM (an average relative change of ~150%). C-reactive protein, TNF-α, IL-1β, and IL-8 did not significantly change in 79% (23/29), 68% (19/28), 67% (2/3), and 75% (3/4) of included studies, respectively. **CONCLUSIONS:** We conclude that future research should focus on the role of IL-6 in the post-meal period, as it is an inflammatory marker that consistently increases post-HFM. Our findings provide valuable and novel insights regarding the link between diet and inflammation, with clinical relevance for many Kansans burdened by heart disease.

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

Among Kansans, heart disease is the leading cause of death in adults over the age of 85, and the second leading cause of death among adults between the ages of 45-85. Thus, heart disease is a serious risk and reality for many Kansans. Research has revealed that a common antecedent to heart disease is the presence of inflammation, which can be modified by diet. Our lab, as well as others worldwide, has shown that a single high-fat meal can increase inflammation acutely, although this response is not consistent. Consequently, our aim was to systematically synthesize all relevant publications assessing the inflammatory response to high-fat meal intake. Our synthesis showed that one particular inflammatory marker, IL-6, very consistently rises following consumption of a high-fat meal. This finding represents a potential link between daily food intake and the diseases of the heart that afflict many Kansans.

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## DEVELOPING MULTIPLEXED DETECTION OF BLOOD EXOSOMAL MARKERS FOR DIAGNOSIS OF OVARIAN CANCER

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**BACKGROUND AND PURPOSE:** Presently, substantial efforts have been made for improving diagnostic sensitivity and specificity of ovarian cancer, yet not fruitful. To this end, in order to develop a less invasive and more accurate diagnostic device, we introduced a microfluidic-based ExoSearch chip for diagnosis of ovarian cancer by simultaneously detecting three blood exosomal markers. Circulating exosomes in blood contain an enriched group of tumor antigens and represent the tumor origin. **METHOD:** We utilize microfluidic based immunomagnetic manipulation to integrate exosome isolation and multi-marker detection in one device (ExoSearch Chip), in order to rapidly evaluate ovarian cancer status via blood. Standard Bradford assay of total protein levels in ultracentrifugation-purified exosomes from matched human subjects was performed for parallel comparison. **RESULTS:** Both ExoSearch and Bradford assay showed significantly increased the level of exosome proteins from ovarian cancer patients (n=15), compared to healthy controls (n=5) (Bradford assay $p=0.001$; ExoSearch chip $p<0.001$). To determine the diagnostic accuracy of ExoSearch chip assay, we analyzed the true positives (sensitivity) and false positives (one-specificity) by receiver operating characteristic (ROC) curves. The areas under the curves (a.u.c.) obtained for CA-125, EpCAM, and CD24 were 1.0, 1.0 and 0.91, respectively. **CONCLUSION:** The above results suggested that ExoSearch chip enables sensitive multiplexed exosomal marker detection for blood-based diagnosis of ovarian cancer with significant predictive power.

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

The goal of our research is to bring economic, rapid, and accurate cancer detection device to the clinic. According to the statistic by the University of Kansas Medical Center Document "Number of Cancer Cases by Primary Site and Stage in Kansas Residents, 2004-2013", cancer after the local stage is almost 50%. In ovary site, the late stage case is about 79%. The ovarian cancer is hardly to be cured in late stage after metastasis, and patients suffer from chemotherapy or radiotherapy and high costs. Our research focus on the early stage detection of ovarian cancer, or even upstaged tumor cells, hoping to improve the cancer survival rate in Kansas. We are dedicated to push novel, low-cost point of care diagnostic device to the clinic, so that we can help Kansas residents to detect cancer using less invasive tests in lower cost, and shorter waiting time.

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## NEWLY FORMULATED, SORGHUM BASED FORTITIED-BLENDED FOODS FOR FOOD AID: THE MFFAPP TANZANIA EFFICACY STUDY

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**BACKGROUND AND PURPOSE:** Fortified-blended foods (FBFs) are commonly distributed micronutrient-fortified food aid products; the most commonly consumed FBF is corn-soy blend (CSB+). FBFs have been criticized due to lack of efficacy in treating iron deficiency, and it has been suggested that sorghum based FBFs could be a beneficial alternative because of sorghum's global acceptability. The micronutrient fortified food aid pilot project (MFFAPP) Tanzania efficacy study is designed to determine whether newly formulated sorghum based FBFs' consumption could result in similar rates of iron deficiency as CSB+ in children aged 6-60 months. **METHOD:** Between February and July 2016, 2050 children enrolled in MFFAPP Tanzania for a 20-week study. Children were stratified by age groups, and allocated to one of seven treatment clusters. FBFs provided included two white and one red blend of sorghum-cowpea, white sorghum-soy, extruded corn-soy, and CSB+; a negative control group received no FBF during the study duration. Iron deficiency was classified by hemoglobin levels, which were measured at 0, 10, and 20 weeks. **RESULTS/FINDINGS:** Consumption of sorghum based FBFs reduced prevalance of anemia by >15 and 35% in children 6-23 and 24-60 months, respectively compared to CSB+. Children aged 6-23 months consuming sorghum based FBFs had significant improvements in anemia at study end, while there was no significant improvement in anemia among CSB+ consumers compared to negative control. **CONCLUSION:** Preliminary raw, unadjusted data suggests that sorghum based FBFs may improve prevalence of anemia compared to CSB+ in children. Our findings suggest that sorghum has potential use in FBFs.

Relevance of Research to State-Related Topic(s)

Kansas is the top producer of sorghum in the US, and thus enhancing the grain's consumption globally, both as an FBF, and an acceptable food for human consumption stands to benefit Kansas producers. This "farm to fork" research focuses on improving the nutritional quality, and common use of a locally grown, drought-tolerant crop for global food aid. Increased demand, and subsequently competitive pricing of sorghum may allow Kansas farmers to grow an alternative crop to corn in the future when water may be more restricted or limited. Additionally, enhanced sorghum use and demand may offer farmers an alternative to the increasingly competitive export market for corn. Beyond food aid, increasing the nutritional quality of sorghum in general may create incentive for creation of sorghum based products for human consumption.

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# CLINICAL FEATURES OF INFECTION WITH PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VIRUS (PRRSV) ISOLATES FROM KANSAS AND IOWA VARY BY OUTCOME AND TIME COURSE

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**BACKGROUND:** Porcine reproductive and respiratory syndrome (PRRS) is an economically devastating swine disease endemic to many Kansas farms. Significant genetic variation exists among circulating PRRS virus (PRRSV) isolates, correlating to a wide range of disease presentations. **OBJECTIVE:** The objective of this study was to compare morbidity and mortality between two distinct PRRSV isolates after experimental infection in 3-week-old pigs. **METHODS:** Two populations of approximately 200 commercial crossbred pigs were infected with either the Iowa isolate NVSL-97-7985 (NVSL) or the Kansas isolate KS-2006-72109 (KS06), and followed for 42 days post-infection (dpi). **RESULTS:** Overall morbidity was significantly higher after infection with NVSL compared to KS06; 39.2 and 21.6%, respectively (p=0.0002). Clinical signs of respiratory disease and reduced body condition were present at a significantly higher rate in pigs after infection with NVSL. However, no significant difference was detected between mortality rates of the two groups. The time course of clinical disease post-infection with NVSL was chronic, with clinical signs occurring throughout the trial. In contrast, clinical disease post-infection with KS06 was acute, with clinical signs peaking between 4-10 dpi. Weight gain was significantly lower and virus replication was significantly higher in pigs infected with NVSL. **CONCLUSION:** Infection with NVSL had significantly higher morbidity, greater pathogen load, and decreased growth due to the chronic duration of disease. However, infection with KS06 resulted in similar mortality due to acute and severe disease within the first week post-infection. These results provide evidence for various clinical disease features and production outcomes that can occur after infection with two Midwest PRRSV isolates.

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

Kansas is tenth in the nation for swine production with approximately 1,000 hog farms throughout the state. In 2015, these Kansas farms produced approximately 3.3 million pigs with sales totaling around $500 million. Porcine reproductive and respiratory syndrome (PRRS) is the most costly disease of swine production worldwide, with recent analyses estimating an annual loss of $664 million to U.S. swine producers alone. PRRS outbreaks can result in devastating economic losses to Kansas swine operations due to increased mortality, decreased reproductive performance, and reductions in growth. The significant variation between PRRS virus isolates creates challenges in disease recognition and production of broadly protective vaccines. By characterizing disease caused by different PRRSV isolates, we increase our knowledge of the potential impacts on swine production in Kansas as well as increase our capacity for early recognition of virus introduction on the farm.

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## PEPTIDE-BASED NANOSPONGES FOR ANTICANCER DRUG DELIVERY

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**BACKGROUND AND PURPOSE:** According to WHO, *Glioblastoma Multiforme* (glioblastoma) is the most common and most aggressive brain tumor found in humans. Recent studies show that perillyl alcohol (POH) have a great potential to combat with this fatal disease. Unfortunately, there is no efficient way to deliver this drug to the tumor cells without ending up in non-targeted sites and unpleasant side effects. Proper delivery of POH would not only helps to maintain effective drug concentrations at the tumor site (even at lower dose) but also lessen the side effects associated with POH. We designed, synthesized and evaluated a novel, biocompatible vehicle called "nanosponges" for delivering POH to the cancer. **METHOD:** Two different peptide chains having one end capped with biotin were synthesized, and the free terminal of each was linked to a trimaleimide scaffold to yield trimeric nanosponges. POH was then covalently bound to these nanosponges to obtain complexes **1** and **2**. In aqueous medium, they readily form nanovesicles with average hydrodynamic diameter of 7 nm. The effectiveness of the complexes against glioblastoma was tested using GL26 cancer cell line. Results were observed 24 hours and 48 hours after drug administration by performing MTT assay. **RESULTS:** These newly synthesized nanosponges, especially nanosponge **1**, showed promising results against GL26 cells (LC50 for 24 hours = 4.44 nmol/L , LC50 for 48 hours = 4.14 nmol/L). Further, 100% eradiation of cancer cells was observed after 48 hours. **CONCLUSION:** Nanosponge **1** is a potential candidate for POH delivery and may have capability to deliver other therapeutics to targeted sites.

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

According to the state cancer profiles published by the National Cancer Institute (NCI), the brain and ONS cancer incident rate in Kansas is higher than the average rate in the United States (6.9 Vs 6.6 cases per 100,000 population per year). Furthermore, statistical studies carried out by NCI revealed that this rate in Kansas had a rising trend from 2009 to 2013. It was the second highest rising rate, compared to incident rates of other cancer types. These data indicates the necessity of proper cancer treatment and prevention methodologies. Efficient drug delivery is critical in brain tumor treatments. This research introduces a novel, biocompatible, drug delivery vehicle for efficient delivery of chemotherapeutics to brain tumors and hence contributes to improving the survival and well-being of cancer patients.

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# STATISTICAL SIMULATIONS OF THE IMPACT OF VARIATIONS IN MARKER RESIDUE TO TOTAL RESIDUE RATIOS OF FOOD ANIMAL DRUGS ON HUMAN FOOD SAFETY

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**BACKGROUND AND PURPOSE:** The use of appropriate withdrawal times of food animal drugs is important to ensure that the animal-derived food is in compliance with the regulatory requirement and safe for human consumption. Currently, US FDA assumes a fixed marker residue to total residue (M/T) ratio determined in healthy animals to establish drug tolerances and withdrawal times in diseased animals, but our recent study demonstrated that the M/T ratio is highly dependent on the measurement time. The aim of this study was to investigate the impact of variations in M/T ratios of representative veterinary drugs (enrofloxacin and flunixin) on withdrawal times. **METHOD:** In this study, we used different statistical distribution simulation approaches and FDA's statistical tolerance method to investigate the impact of variations in M/T ratios. **RESULTS AND CONCLUSION:** The analysis results showed that if the fixed M/T ratio is determined at a time different from the labeled withdrawal time, it could affect the withdrawal times of enrofloxacin by 5 and up to 25 days in swine and cattle, and of flunixin by 6 and 1 days in swine and cattle, respectively. These results suggest that measurement time affects the calculated withdrawal times of studied drugs substantially; and these effects are drug- and species-specific. This research could be used to improve FDA's guidance of determining the tolerance and withdrawal time of food animal drugs to incorporate the dynamic nature of the M/T ratio.

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

My research is related to human food safety assessment. Food safety is one of the important topics at Kansas State University. More specifically, enrofloxacin and flunixin are widely used drugs in food-producing animals and they are among the drugs with most commonly reported violative residues in animal-derived foods. Consumption of animal-derived foods with drug residues at levels higher than have been determined to be safe for daily exposure may cause adverse effects to human health. The withdrawal time is the time needed to assure that the concentration of drug residues in the edible tissue is below safe concentration after drug administration. Currently, the FDA method used to calculate the withdrawal time is based on the incorrect assumption that the ratio of parent drug to metabolites is constant over time. My research can help improve human food safety by influencing policy makers to revise drug approval methods.

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## A NOVEL STATISTICAL TECHNIQUE TO MODEL KANSAS CHILD MORTALITY RATES

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**BACKGROUND AND PURPOSE:** Explaining the health status of Kansas is a difficult task, here we use child mortality rate as indicator of a community health. Child's health holds a strong association with the overall population's health. Identifying factors and trends affecting might be important to understand other health outcomes. Modeling child mortality rates by county require special attention because conventional statistics may not work. A novel statistical models that adapt better to complex phenomena and produce results that are easier to interpret is needed. Here we test the capabilities of Bayesian nonparametric models (BNM) to deal with this complex indicator. **METHOD:** We implement conventional linear models and BNM to identify the relative contribution of different risk factors related to child mortality and compare their predictive power. **RESULTS AND CONCLUSION:** We apply BNM to child mortality and show that BNM has better prediction accuracy than traditional models. Our model found stronger association of child mortality rates with income and population density than with number of hospitals. It also shows that over the time the child mortality is decreasing Kansas. However, once accounting for income and population density some regions of Kansas show less improvement than the rest.

### Relevance of Research to State-Related Topics

There is a potential association between the causes of child mortality and factors that influence the whole population's health. Kansas has the ninth highest child mortality rate among all states in USA. The methods being explored can identify areas of oportunity to reduce child mortality in the State by regions. They can also be extended to other indicators such as poverty or employment.

*GROUP 5*

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## STUDENT UNDERSTANDING OF ELECTRIC AND MAGNETIC FIELDS IN MATERIALS

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**BACKGROUND AND PURPOSE:** Learning to think scientifically is extremely important for Kansas students. All science, technology, engineering, and math (STEM) majors must take physics; thus, research into how students learn physics is important for all STEM students. A primary goal of physics education is to promote the development of students' skills for scientific inquiry. It is important for students to think about causal relationships (mechanistic reasoning) rather than simply memorizing a series of equations and answers. We look for students' mechanistic reasoning when they think about electric and magnetic fields in materials, a core topic in many aspects of materials science and electrical engineering. We use Resource Theory to model their reasoning. A *resource* is a discrete piece of an idea that a student activates when considering or solving a problem. **METHOD:** The data come from students who took an upper-division electricity and magnetism (E&M) course during 2014 and 2015. We analyzed all their written responses and answers to find patterns and trends in the students' use of resources, and we also searched for patterns among the 2015 students' responses during and after they completed the class. **RESULTS/FINDINGS:** After we comparing the result from electric field and magnetic field, we notice with super-atomic structure and mechanistic reasoning 94% of students reason correctly about material in magnetic fields, and 67% of them reason successfully about material in highly strong electric fields. We found evidence to support that thinking mechanistically about polarization inside the atom seems to increase understanding and can give students better intuition about special cases such as dielectric breakdown. **CONCLUSION:** This research suggests students should be directly taught about sub-atomic structures and mechanistic reasoning to reason successfully about fundamental interactions between fields and matter.

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

The results of our study have an important role in science and technology. For instance, dielectrics have numerous practical applications in the home and industry, including: nanotechnology, electronics, photonics, chemical and mechanical systems, and the emerging fields of biology and biochemistry. If Kansas is going to be internationally competitive for technology development, we need to help students develop their mechanistic reasoning at the same time as we cover topics fundamental to many STEM fields. In addition to improving student learning about dielectrics, the results of this research support teaching methods which can improve Kansas students' learning across teaching other STEM topics.

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## "BRINGING OUT" AS A PROCEDURAL RESOURCE WHEN SOLVING PARTIAL DIFFERENTIAL EQUATIONS

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**BACKGROUND AND PURPOSE:** To improve education for Kansas students, we need to study how they think: the knowledge they have, the way they connect it together, and the processes by which they learn more. We model students' ideas as made up of small, reusable "resources" that they connect together to form concepts and arguments. We have investigated students' resource use in solving partial differential equations (PDEs) via the method of separation of variables (SOV). We have identified a new resource, which we believe is an integral part of solving PDEs. **METHOD:** We collected video data from one semester of a senior-level undergraduate quantum mechanics course. We present a case study of two group problem-solving sessions of three students that contain rich information and are theory driven. Careful observation of students' discourse, gesture and whiteboard writing as they worked on a problem enabled us to identify students' resource use in their solutions. **RESULTS/FINDINGS:** We have identified a new procedural resource called *bringing out* with gestural elements. Furthermore, we have represented the internal structure of the SOV resource used to solve the PDEs, finding that the final structure includes three conceptual resources and three procedural. These findings expand the defintion of procedrual resources. Using *bringing out* resource with other conceptual resources helped students to better understand the mechanism of taking partial derivatives (PDs). **CONCLUSION:** Our results can help the instructors to view students reasoning from a new perspective and provide new teaching strategies. We believe that *bringing out* resource can be used across other theory coursework in physics.

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

The result of this study can be used to improve science, technology, engineering, and mathematics (STEM) education as students develop their problem solving activities to make sense of the real world situations. In a broader sense, solving partial differential equations is fundamental to our understanding of physical systems. PDEs are used to model many systems across STEM disciplines, from predator-prey models in biology to materials stress in mechanical engineering, and reaction rates in chemistry to information flow in networks.

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## VARIED REASONING SCHEMA IN STUDENTS' WRITTEN SOLUTIONS

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**BACKGROUND AND PURPOSE:** Mathematics is the language of science and engineering, so it is vitally important to study how students use mathematics when they study more applied topics. As a part of the Mathematization project, we investigate how upper division students use mathematical tools in two core courses in physics: Mechanics and Electromagnetic Fields. We use their homework solutions to build a "fingerprint" of students' mathematical skills used on traditional problems. **METHOD:** We code students' written homework solutions, looking for the steps in their problem solving and the way they connect different ideas and mathematical tools. We use social network analysis to compare patterns among students, among problem statements, and between both classes. **RESULTS/FINDINGS:** We found frequently occurring ideas and connections, and mapped them to different pathways of solving the same problem using social network analysis. The most common ideas relate to students' evaluation of mathematical expressions, followed by their identification of which general cases to use. These results are highly dependent on the exact wording of each homework problem, but are less dependent on the specific topics being studied. In this poster, we present preliminary findings of this ongoing project to find characteristic patterns in Mechanics and Electromagnetic Fields. **CONCLUSION:** This kind of analysis is new in studies of students' problem solving, particularly at the university level and beyond. Our work shows that it is both possible and fruitful, and pushes theoretical and methodological developments in understanding students' problem solving.

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

STEM – Science, Technology, Engineering and Mathematics – education is vital to the future of Kansas**.** A well-educated population is the key to economic growth; **STEM education** has been particularly cited as the most important growth area in **workforce development** for the US as a whole. To best educate STEM students, we need to first understand the fundamental processes of learning STEM subjects. Problem-solving often involves **decision-making**, and decision-making is remarkably important for **management and leadership**. Homework is a key part in every college-level physics courses; it represents the bulk of students' problem solving opportunities. In order to teach students to solve problems correctly, first we must study their problem-solving behaviors in STEM classes.

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## BRINGING COMPUTATIONAL THINKING TO K-12

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**BACKGROUND AND PURPOSE:** The ever-growing popularity of computer science has fostered the need for computational thinking (CT), especially in K-12 education. Creating and delivering content to enhance these skills, as well as evaluation, remain open problems. In recent years, countries have begun to develop and incorporate computing in the K-12 education system. From these curricula and reports, succinct definitions of CT provide broader impacts in terms of education. Currently, the US does not have country wide K-12 CS education standards; however, some organizations, like the CSTA, have been dedicated in creating CS standards that incorporate CT, although their standards are not widely officially adopted. The focus of this study is creating accessible material for teaching and assessing CT as part of local K-12 outreach efforts. **METHOD:** By using low overhead teaching methods, interventions based on micro controllers, computer programming, and pop culture were created. Data collected through a newly designed self-efficacy instrument is used to determine effectiveness of these interventions at improving confidence in CT and problem solving skills. **RESULTS AND CONCLUSION:** From the initial experiment, positive trends in relation to student self-efficacy was prominent in the all grade levels for students who had previously participated in STEM outreach programs. Overall, interventions showed a statistically significant ($p < .001$) positive gain in CT concepts from the pre-survey ($M = 52.39, STD = 27.7$) to the post-survey($M = 64.76, STD = 21.3$).

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

Computer science has become one of the most relevant and fastest growing fields; however, Kansas is behind the curve for being an advocate of computer science. According to Code.org, 9 out of 10 parents want their children to study CS, but only 1 in 4 schools teach computer programming. There are 2,730 open computing jobs in Kansas, but in 2014, there were only 290 CS college graduates. A core problem in Kansas is that CS is not widely offered in K-12 schools (only 48 students took the AP CS exam last year), where there are no CS curriculum standards and CS does not count towards high school graduation. There are many active STEM outreach programs in Kansas. Through these, my research shows the viability of using low-cost, low-overhead teaching methods for incorporating computational thinking into the K-12 environment, providing students and educators a fundamental understanding of computer science.

*GROUP 6*

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## FOOD SAFETY KNOWLEDGE AND HEALTH EQUITY

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Saline County Health Department is located in Saline, Kansas, the population of the county that the health department serves is 55,740 people and it is 79.4% white and 11.4% Hispanic. The median income of this area is $7,000 lower than that of the state of Kansas. The health department offers vaccination, WIC, maternal and child health, home health, and reproductive services. **BACKGROUND AND PURPOSE**: Health equity as defined by WHO is the absence of differences in health care among groups of people. Health inequities may lead to a lower food safety knowledge and put the individual at risk of contracting a foodborne illness. **METHOD**: A survey was utilized to determine if there was a relationship between health equity/inequity and food safety knowledge. The survey was designed from data retrieved from other studies that evaluated food safety knowledge. The survey was dispersed via email to the health department employees and through social media to people in the community. **RESULTS/FINDINGS**: The survey had 140 participants from Saline County and 13.57% of the participants were below the poverty level. The mean number of questions answer incorrectly for the participants above the poverty level was 1.8, and the participants below the poverty level was 2.2. **CONCLUSION**: This information could be used to educate people about the proper way to handle and prepare food and to reduce foodborne illness in the state by developing educational material for people in similar communities. This information also could be used to distribute resources such as meat thermometers and cleaning supplies to low-income homes.

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

Food safety is important for the people of Kansas who are just trying to raise their children. There are over 1200 reported illnesses per year in Kansas, 7 of those cases resulted in death. Food safety can be linked to the distance from farm to fork, generally as that distance increases so does the risk for contamination and mishandling. Providing education and access to farmers markets through government assistance can help reduce the risk for foodborne illness. Young children and the elderly are most severely affected by foodborne illness and education about foodborne illness through after school programs, extension offices, and schools would help to prevent foodborne illnesses in children by improving practices at home. These projects could be part of community development by bringing people together and helping form farmers markets and food safety seminars, where low income families could receive food and education.

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# ACCEPTANCE OF NOVEL FORTIFIED BLENDED FOODS IN TANZANIA: PREFERENCE TESTING WITH CHILDREN AND HOUSEHOLD PREPARATION BY CAREGIVERS

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**BACKGROUND AND PURPOSE:** Fortified blended foods (FBFs) are used worldwide in supplementary feeding programs. Corn-soy blend (CSB+) currently is the most wildly used FBF, but is criticized for its limited ability to enhance nutrition in young children. Novel fortified blended foods, including sorghum-based FBFs, have been developed to deliver sufficient nutrients for children's growth and development. Novel FBFs must be acceptable to the target population: children who eat the food and caregivers who prepare it. This study was conducted to determine the preference of novel FBFs compared to CSB+ with children and to measure actual preparation time and additional ingredients that caregivers added to make porridges from each product acceptable to their children. **METHOD:** Five extruded FBFs in addition to CSB+ were made. Paired preference tests of porridge made from CSB+ compared to each novel FBF among infants and young children were conducted in Mwanza region, Tanzania. A household visit was conducted to collect information on preparation of FBFs. **RESULTS/FINDINGS:** Preference testing showed that novel FBF porridges were either as preferred or more preferred by children compared to CSB+. Porridges prepared from all novel FBFs required less cooking time than CSB+ and no ingredients needed to be added compared to CSB+ where sugar and milk were common additions. **CONCLUSION:** Novel FBFs have potential to be used as supplementary foods with higher or comparable preference to currently used CSB+. Moreover, the simple cooking for the novel FBFs make them valuable to caregivers with limited time and access to energy sources.

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

Sorghum, which is widely grown in Kansas, is viewed as a potential alternative to wheat- and corn-based products that currently are used as FBFs. Sorghum is mostly a non-GMO crop, which allows it to be used in many countries that have banned the use of GMO products. This blend provides good nutrition and requires lower fuel to prepare the porridge products, which can increase its local cost competitiveness compared to FBFs currently used in feedings programs. Results from this study show that sorghum-based FBFs have a potential to be used successfully as supplementary food in food aid programs, which could be a huge boost for Kansas sorghum farmers. Products made from similar technologies, such as bars and ready-to-eat cereals, also can increase the demand for using a Kansas grown commodity – sorghum - for value-added food application and for producers of equipment, such as extruders, that are manufactured in Kansas.

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## CHANGE IN FUNCTIONAL CHARACTERISTICS OF HEALTH-FOCUSED COMMUNITY COALITIONS

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**BACKGROUND AND PURPOSE:** In response to a White House Task Force report on childhood obesity the North Central region of extension collaborated to obtain a 5 year USDA-AFRI grant to implement a community development model of intervention to prevent childhood obesity from an ecological perspective. The overarching goal of this grant was to create and sustain an environment and culture of healthy eating and physical activity. Community coaching (the use of an external guide who supports groups in identifying an acheiveing their goals) was employed as a means to improve and direct the capacity of community health coalitions. PURPOSE: A study was conducted to to evaluate how two Kansas coalitions changed over time based on their functional characteristics. **METHOD:** Two communities in Kansas (Cowley & Cherokee Counties) were selected to participate in the 5 year USDA-AFRI grant. Communities were divided as coached or non-coached groups and completed a Coaltion Self Assessment Survey each year of data collection. Survey data was then use in a factor analysis to form functional charateristic indice groups and a weighted sum score for each indice were created. Weighted sum scores were then compared between years of collection. **RESULTS AND CONCLUSION:** Baseline values were similar for both coached and non-coached communities. The coached community had positve improvements for 7 out 8 eight functional characteristics while the non-coached community had no improvements baseline to follow-up. Results suggest that community coaching in coalitions is an effective way to increase coalition capacity. Future research should investigate the realitionship between coalition capacity and long-term community change.

Relevance of Research to State-Related Topic(s)

Community coaching is an effective of mobilizing capacity in rural communities to create and sustain an environment and culture of healthy eating and physical activity to combat the rise health disparities in these areas. Research using community coaching to improve and direct the capacity is limited, however this innovative approach is a promising means of extending the reach of Extension and Community Development in Kansas to create lasting change in its rural communities.

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## DIET-INDUCED IMPULSIVITY: THE EFFECT OF HIGH-FAT AND HIGH-SUGAR DIETS ON THE MECHANISMS OF IMPULSIVE CHOICE

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**BACKGROUND AND PURPOSE:** Americans typically consume a diet high in processed fat and sugar, which has contributed to the obesity epidemic. There is an established relationship between obesity and impulsive choice, and recent research suggests that people who consume diets high in fat and sugar exhibit more impulsive behavior. In fact, a study in rats depicted that diets high in fat and sugar can induce impulsive behavior. The present study sought to understand how high-fat and high-sugar diets affect the mechanisms of impulsive choice to determine which deficits (timing or reward sensitivity) could be targeted to improve impulsive behavior through behavioral interventions. **METHOD:** Rats were split into three groups (high-fat, high-sugar, and chow). Following 8-weeks of diet exposure, impulsive choice behavior was assessed. Rats were given a choice between a small reward available after a short delay and a larger reward after a longer delay. Deficits in timing and reward sensitivity were assessed through separate discrimination tasks that tested how diet affected the rats ability to discriminate between different delays to reward and different reward amounts. Finally, the effects of diet on body composition (percent body fat) was investigated. **RESULTS AND CONCLUSION:** There was no relationship between body fat percentage and impulsive choice, as is seen in humans. However, diets high in fat and sugar resulted in increased percent body fat and induced more impulsive behavior possibly due to the deficits the rats exhibited in timing. Deficits in timing could be targeted through time-based behavioral interventions to improve impulsive behavior that results from poor diet consumption.

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

Obesity is greatly impacting the health of Kansans. This research suggests unhealthy diets consumed by most Americans could be inducing impulsive behavior. Diet-induced impulsivity has important implications for obesity because consumption of diets high in fat or sugar appears to cause more impulsive behavior (e.g., poor food choices) while also increasing body fat, which could eventually result in obesity. Improving timing has been found to reduce impulsive behavior, and time-based interventions could help reverse the impulsive behavior induced by poor diet. These behavioral interventions could be adapted and integrated into obesity treatment programs to help promote self-control and result in healthier food choices and potentially address the obesity epidemic.

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## IMPROVING CLIMATE VISUALIZATIONS TO MOVIVATE CONSIDERATION OF CLIMATE CHANGE ADAPTATION STRATEGIES BY KANSAS AGRICULTURAL PRODUCERS

**Kathy Mulcahy** and Shawn Hutchinson
*Department of Geography, College of Arts and Sciences*

**BACKGROUND AND PURPOSE:** Kansas agricultural producers face the challenging tasks of increasing food production and maintaining the viability of their operations in a changing climate. Climate data informs farm management plans and can be used to evaluate plan operations under different precipitation and temperature regimes. However, the specific climate variables needed for decision-making, the preferred sources of climate data, and the effectiveness of various graphic representations of climate remains largely unknown. This research examines, and seeks to reduce, communication gaps between scientists and agricultural producers resulting in uncertainty or pessimism about climate change which thereby limits their motivation for adopting agricultural adaptation strategies. **METHOD:** This study integrates elements of communication theory, scientific visualization, and Geographic Information Systems (GIS) to better understand the use of climate data by agricultural producers. Primary data will collected via surveys to evaluate the importance of various climate variables on farm decisions, what data is trusted, and which graphic formats are most effective at communicated climate changes. **RESULTS/FINDINGS:** Initial findings suggest that producers access climate information mainly from commercial organization via the Web and that data and information made available by land grant universities is trusted. Further insights from surveys will be translated into specific recommendations to improve the effective use of climate data in agricultural decision-making and to indirectly enhance producer's practical understanding of climate change. **CONCLUSION:** This study will results in a GIS-based Climate Decision Support System accessible via the Web to motivate consideration of climate change adaptation strategies by agricultural producers.

Relevance of Research to State-Related Topic(s)

Climate literacy in the United States is an enormous educational challenge. Within the scientific community, there are widely acknowledged changes occuring with our current, and future climate. However, when it comes to incorporating climate change information into farm management decisions and evaluating adaptation strategies, there is a perceived lack of importance or relevance among many agricultural stakeholders. This study seeks to improve our understanding of how producer's use climate data in managing their operations, what data is trusted, and which climate variables are most important. Also evaluated is the effectiveness of different graphics forms of data which producers can best understand and use. Results of this analysis will be used to design a prototype Climate Decision Support system web application to better motivate producers to consider adaptation strategies.

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## EFFECT OF IMPERFECT INFORMATION ON KANSAS ARC-CO ENROLLMENT

**Candice Wilson** and Mykel Taylor
*Department of Agricultural Economics, College of Agriculture*

**BACKGROUNG AND PURPOSE:** The 2014 Farm Bill required Kansas producers to make a one-time enrollment decision between three programs that would serve as the primary safety net for poor crop prices or yields over the five-year life of the legislation. Analyzing the effects of incomplete information on these producers and the role that program knowledge played in their decision provides an opportunity to identify potential problems associated with the shift from a fixed annual payment used in previous farm bills to a one-time enrollment that would affect them for the following five years. **METHODS:** Estimated payment calculations and data analyzing other enrollment factors potentially affecting producers in their program selection choice will be utilized in an econometric model to predict enrollment in the Agricultural Risk Coverage program at the county level for Kansas producers. **RESULTS:** Predicted enrollment will be compared to actual enrollment figures obtained from the Farm Service Agency to illustrate the effect that first year predicted payments had on enrollment decisions across counties in Kansas. Additionally, comparing enrollment predictions to actual program enrollment will help to illustrate a potential pattern of myopic behavior among producers. **CONCLUSIONS:** It is important to identify behavioral patterns caused by incomplete information to design future farm legislation that meets the goals of policy makers and their constituents.

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

Agriculture is the largest sector of the Kansas economy (constituting over $62 billion in annual revenue and 43% of the total economy). Therefore, it is imperative that farm policy programs affecting Kansas producers function efficiently. External factors such as weather, prices, and natural disasters can greatly shape the prices or yields a producer receives in any given year. As such, there is great uncertainty associated with Farm Bill commodity protection programs that plan in five year intervals. The purpose of this research is to illustrate how and why producers enrolled in their respective Farm Bill programs in order to inform future farm policy programs as well as highlight the dilemma many producers were presented with as a result of incomplete information available at the enrollment deadline for 2014 Farm Bill programs.

*GROUP 7*

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## DETERMINING SURFACE ROUGHNESS IN EROSION TESTING USING PHOTOGRAMMETRIC METHOD

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**BACKGROUND AND PURPOSE:** Surface roughness is an imporant characteristic in numerical and physical geotechnical soil models. The methods for measuring surface roughness are currently operator dependent, time consuming, or require highly specialized equipment. Therefore, there is a need for a method that can quickly measure surface roughness accurately and cost effectively. The primary goal of this study was to develop a photogrammetric method to measure surface roughness of soil samples. **METHOD:** A stereophotogrammetry computational program was developed to calculate the surafce roughness of soil samples. Using a digital camera, two photos for each soil sample were taken and processed in the program. The technique was validated by comparing the roughness measurements of a three dimensional printed disk using photogrammetric method to a structured light scanner and hand measurements with calipers. **RESULTS AND CONCLUSION:** The results of this study show that the stereophotogrammetry computational program was able to measure the surface roughness of the soil samples equatable with the other methods. This model improves the accuracy of the roughness measurement, reduces the operator dependence and reduces the time required to measure roughness of soil samples.

Relevance of Research to State-Related Topic(s)

Surface erosion is a world-wide environmental problem. With regards to infrastructure, 60% of all bridge failures in the U.S are due to erosion. As such, predicting the soil erosion potential is critical for design of new and maintenance of existing infrastructure. For this purpose, shear stress calculation is needed and surface roughness is an important parameter to obtain shear stress. Therefore, photogrammetric method was developed to measure surface roughness of soil samples after erosion tests. This method can be used for other applications where a measurement of the soil surface is required. Moreover, this technique can also be applied in different areas, such as material testing and structure monitoring in civil engineering, architecture, geology, and transportation.

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## SAFETY EVALUATION OF RAISED SPEED LIMITS ON KANSAS FREEWAYS

**Reza Shirazinejad**
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**BACKGROUND AND PURPOSE:** Many roadway crashes happen due to several reasons and speed limit change is an important factor that lead to crash occurrence. In 2011,Kansas legislature passed the new maximum speed limit law accordingly, effective from July 1st. More than 800 miles of limited access highways in Kansas saw a speed limit increase from 70 mph to 75 mph as the maximum speed limit on these sections. The main purpose of this study is to evaluate the safety effects of raising speed limits on Kansas rural freeways in order to get a better understanding of the safety. **METHOD:** After identifying the sections where the speed limit has been changed with the assistance of KDOT, details of the crashes (number, severity, and type, etc.) for before and after the change in the speed limit are collected by using the crash database named as Kansas Crash Analysis and Recording System (KCARS) maintained by KDOT. There are some safety evaluation methods used for this purpose such as before after Empirical Bayes. There are 39 sites affected by speed limit change (70 mph to 75 mph) and all are counted as freeways. **RESULTS/FINDINGS:** After utilizing the method named, the crash modification factor is estimated and it represented that the crashes according to their severity level have increased by a certain percentage as the speed limit changed from 70 mph to 75 mph. **CONCLUSION:** In summary, raising speed limit has caused more fatal and injury crashes although the total number of crashes have decreased.

Relevance of Research to State-Related Topic(s)

The 70 mph maximum speed limit on the sections affected by the change had prevailed since 1995 in the state of Kansas and there were both supporters and critics of the change. Supporters pointed out that the drivers were already driving 5-10 mile above the posted speed limit and therefore it made sense to make it formal. It had also been mentioned that the increased speed limit would help the economic development of Kansas. On the other hand, opponents were saying that drivers would not change their behavior and still would drive 5-10 mile above the posted speed limit bringing the actual speeds to even higher values. The main concern in this case was the safety, as crash severities tend to increase with increased speed and some advocates wondered whether the increased speed limit is going to enhance the number of fatalities and more sever crashes in Kansas or not.

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## CRASH MODIFICATION FACTORS TO EVALUATE THE SAFETY EFFECTIVENESS OF RUMBLE STRIPS AND PAVED SHOULDERS

**Uditha Galgamuwa** and Sunanda Dissanayake
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**BACKGROUND AND PURPOSE:** Crash Modification Factors (CMFs) are used to evaluate the safety effectiveness of a treatment which was implemented on a roadway to reduce specific crash type(s).It can be defiend as a multiplicative factor used to compute the expected number of crashes after the specific countermeasure has been implemented. Before-after, case-control and cross-sectional studies are the commonly used methods to develop CMFs. However, those methods have their inherited limitations. **METHOD:** Lane departure crashes in two-lane, rural, undivided road segments were considered for this research. Curved and tangent road segments were considered separately and the crashes were divided into two categories when developing models as all severity and fatal & injury crashes. Safety effectiveness of centerline rumble strips, shoulder rumble strips, both centerline & shoulder rumble strips and 2-ft paved shoulders were measured in Kansas. Cross-sectional and case-control methods were used in this research because the date of implementation of the countermeasures were not know. Linear and logistic regression methods were used to develop models respectively for the two methods. **RESULTS/FINDINGS:** Based on the CMFs calculated, three countermeasures were found to be effective in reducing all crashes and fatal & injury crashes except shoulder rumble strips in curved road segments. **CONCLUSION:** Even though the same countermeasures were found to be effective in reducing lane departure crashes in both cross-sectional and case-control methods, CMFs developed using the cross-sectional method demonstrated a narrower range than CMFs developed using the case-control method indicating results from the cross-sectional method can be much accurate and reliable than case-control method.

Relevance of Research to State-Related Topic(s)

Lane departure crashes are the predominant cause for fatal and injury crashes in Kansas, which accounted approximately 60% of total fatalities and disabling crashes from 2009 to 2014. Out of the several countermeasures implemented by Kansas Department of Transportation (KDOT), rumble strips and paved shoulders can be identified as the commonly used countermeasures in Kansas. Although several studies have been conducted in Kansas, more accurate CMFs for Kansas have not yet been fully accomplished. CMFs that are available in other regions or national-based studies are difficult to be used in Kansas due to variations in spatial and temporal characteristics. Accordingly, having more localized CMFs is going to be an advantage in addressing lane departure crashes. Developed CMFs could be used to guide the decision-making process when implementing lane departure countermeasures in Kansas.

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## FACTORS AFFECTING SEVERITY OF SINGLE-VEHICLE CRASHES INVOLVING OLDER DRIVERS

**Sameera Koththigoda** and Sunanda Dissanayake
*Department of Civil Engineering, College of Engineering*

**BACKGROUND AND PURPOSE:** In 2010 13.2% of the population in Kansas was 65 years or older, with an estimated 14.6% in 2015.This study identified factors affecting the severity of crashes involving drivers aged 65 years or older. **METHOD:** Two binary logistic regression models were developed to identify the influence of environmental, roadway, driver, and vehicle-related factors on crash severity by treating crash severity as a dichotomous variable. Crash severity, the dependent variable for each model, was categorized as injury and fatal (event = 1) in one category and Property Damage Only (PDO) or no injury (non-event = 0) in the other category. The first model was developed for single-vehicle crashes involving an older driver only, and the second model was developed for modeling single vehicle crashes involving an older driver with at least one passenger, to identify attributes of passengers, if any. **RESULTS/FINDINGS:** Variables such as safety equipment use, day of the week, speed, crash location, light condition, accident class, maneuver, driver ejected or trapped, and weather condition distinguished crash severity for older drivers involved in single vehicle crashes. For single vehicle crashes involving an older driver with at least one passenger, accident class, safety equipment use, light condition, driver ejected or trapped, accident location, surface type, vehicle type, and weather condition distinguished the crash severity. **CONCLUSIONS:** Older drivers involved one in five fatal injury crashes in Kansas. Gender of the older driver is not significant in any model. Findings of this study provided insight on older driver crashes and associated factors.

Relevance of Research to State-Related Topic(s)

The increasing older population has resulted in greater numbers of drivers aged 65 years or older in Kansas. Transportation activity is an important component of the aging population because it allows older people to maintain their independence and mobility. The natural aging process results in slower perception reaction times and physical difficulties. When driving capabilities are reduced, drivers may be more likely to become victims of motor vehicle crashes. Understanding which circumstances increase crash severity for older drivers is essential for identifying age-related factors and consequently improving the overall safety of all road users in Kansas.

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# THE EFFECT OF DISTRACTIONS ON THE CRASH TYPES OF YOUNG DRIVERS IN KANSAS

**Ibrahim Alfallaj** and Sunanda Dissanayake
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**BACKGROUND AND PURPOSE:** Teenage and young adult drivers are overrepresented in crashes when compared to other age group drivers. The main cases of increase the traffic crashes of teen and young adult drivers were caused by distracted driving. Distracted driving can be simply defined as driving while doing another activity that takes driver's attention away from driving. The objective of this study is assess the hazards of distracted among teen (15-20 years old) and young adult (21-26 years old) drivers in Kansas. **METHOD:** A multinomial logit model was used to identify the odds that a driver with a certain type of distraction would be involved in one of the most common crash types: a rear end with single-vehicle collision, an angular with single-vehicle collision, and a rear-end with an angular collision. This study used a 5-year crash data from the Kansas Crash and Analysis Reporting System (KCARS) database from 2011 to 2015. **RESULTS/FINDINGS:** Results showed that most distraction types for teenage and young adult drivers are more likely in rear-end and angular collisions. Teenage drivers that were distracted on road with speed limit more than 60 mph by cell phone or other electronic device were more likely to be involved in single-vehicle and angular collisions when compared to rear-end collisions. Young adult drivers that were distracted at a curved roadway by cell phone were more likely to be involved in single-vehicle and angular collisions when compared to rear-end collisions. **CONCLUSION:** More study need to conduct young drivers' survey to understand the culture of distracted driving.

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

In Kansas, in year 2012 alone there were 523 crashes where cell phone use while drive, 233 crashes where other electronic devices use and 1,411 crashes were engaged in personal grooming. In 2013, Manhattan's ban on use of handheld cell phones yielded about 2,000 tickets as the city neared the third anniversary of the law which about 450 tickets were handed out for texting while driving, police say.

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## SURVEYING THE PERFORMANCE OF ALUMINIZED AND GALVANIZED DRAINAGE PIPE AGAINST CORROSIVE EFFECTS

**Andrew Crowder** and Stacey Kulesza
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**BACKGROUND AND PURPOSE:** Metallic drainage structures have been utilized by the Kansas Department of Transportation (KDOT) to facilitate proper drainage of highway systems across the state. Several studies have been done to determine the durability of different pipe materials against the deterioration that occurs due to the electrochemical process of corrosion. These past studies have influenced state policy regarding pipe material, specifically a 2001 change in policy shifting away from the use of hot-dipped galvanized steel pipe, in favor of the aluminized type 2 steel pipe. **METHOD:** There is now a need to perform a field evaluation to determine the performance of both materials. A survey of observed pipe conditions has been done for several sites across KDOT districts 1 and 4. Along with observational data, field measurements of soil and water characteristics affecting corrosions processes, specifically pH and resistivity, were taken. **RESULTS/FINDINGS:** Preliminary findings have shown that the invert of galvanized drainage pipe is the area most susceptible to corrosion. Other areas of galvanized pipe have shown to be less dependent on field conditions, deteriorating as a function of age. **CONCLUSION:** The goal of this study is to determine the performance of both pipe materials, and make recommendations on which material is a more economically sustainable option for future KDOT drainage projects.

Relevance of Research to State-Related Topic(s)

Due to the continuous need to channel water away from roadway infrastructure, it is necessary to invest in the research of more sustainable materials to facilitate drainage. Research, such as this, may save the the state millions of dollars in life cycle costs if a drainage pipe that is better able to withstand deterioration from corrosion is utilized in future construction. This research would be of particular interest to the House Standing Committee on Transportation and Public Safety Budget, along with the Senate Standing Committee on Transportation.

*GROUP 8*

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## ANALYTICAL AND FINITE ELEMENT BUCKLING SOLUTIONS OF SIMPLY SUPPORTED ANISOTROPIC LAMINATED COMPOSITE COLUMNS UNDER AXIAL COMPRESSION COMPARED WITH EXPERIMENTS

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**BACKGROUND AND PURPOSE:** The use of laminated composites in aerospace, automotive, and civil engineering applications is ever growing due to their distinguished properties (High stiffness-to-weight ratio, high strength-to-weight ratio, fatigue and corrosion resistance). This growth has resulted in increasing the demand for better understanding the mechanics of laminated composites. Composite columns, like any traditional members subjected to axial compression, undergo stability issues prior to failure. Not many research studies have focused on the buckling of columns. **METHOD:** Analytical formula for the buckling load of generally anisotropic laminated composite simply supported thin columns is derived using the Rayleigh Ritz displacement field approximation. The effective axial, coupling and flexural stiffness coefficients of the anisotropic layup is determined from the generalized constitutive relationship using dimensional reduction by static condensation of the 6x6 composite stiffness matrix. The resulting explicit formula has an additional term which is a function of the effective coupling and axial stiffness. This formula reduces down to Euler buckling formula once the effective coupling stiffness term vanishes for isotropic and certain classes of laminated composites. **RESULTS AND CONCLUSION:** The analytical results are verified against finite element Eigen value solutions for a wide range of anisotropic laminated layups yielding high accuracy. Comparisons with experiments are also performed showing good correspondence. A brief parametric study is then conducted to examine the effect of ply orientations and material properties including hybrid carbon/glass fiber composites. Relevance of the numerical and analytical results is discussed for all these cases.

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

One of the main aspects to consider in structural members is the stability specially in columns. Limited amount of research has focused on the buckling of columns since Euler (1757). This research investigates the stability of anisotropic laminated composite simply supported columns by developing a generalized analytical buckling formula. The use of laminated composites is important in weight sensitive applications such as aerospace, automotive, marine, and civil engineering. The use of this material is ever growing due to their distinguished properties (High stiffness-to-weight ratio, high strength-to-weight ratio, friendly environmentally material, fatigue, and corrosion resistance). The results showed an excellent agreement between the analytical, numerical, and experimental results. Accordingly, the developed formula may be considered as an extension to Euler and it is the first of its kind since 1757.

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## CHARACTERIZING SOIL EROSION POTENTIAL USING ELECTRICAL RESISTIVITY

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**BACKGROUND AND PURPOSE:** The erosion rate, or erodibility, of soil depends on many soil characteristics including: plasticity, water content, grain size, percent clay, compaction, and shear strength. Many of these characteristics also influence soil in situ bulk electrical resistivity (ER) measurements. The objective of this study was to characterize soil erosion potential by correlating the in situ ER of soil with erodibility measured in the Kansas State University Erosion Function Apparatus (KSU-EFA). **METHOD:** ER surveys were conducted at 11 bridges selected by the Kansas Department of Transportation (KDOT). Five soil samples were also collected at each site with a drill rig from the surface to three meters. The soil samples were tested in the KSU-EFA and analyzed for plasticity, mean grain size, and water content. **RESULTS AND CONCLUSION:** Analysis showed that an ER over 100 Ω-m is correlated with a highly erodible soil. As such, ER surveys may be used to characterize the soils at future bridge sites or prioritize existing bridges for additional testing to measure the scour potential. Analytical models to predict critical shear stress were also developed. The final model predicts critical shear stress using ER, plasticity, and mean grain size with an $R^2$ of 0.72 when compared with the measured critical shear stress.

Relevance of Research to State-Related Topic(s)

According to the National Bridge Inventory, Kansas has over 25,000 bridges which is fifth in the nation for the number of bridges per state. Over 400 of these bridges are identified as scour critical by the Federal Highway Administration (FHWA). As recommended by the FHWA, KDOT must implement a plan of action for these scour critical bridges to avoid damage to the structures or catastrophic bridge failures during floods. However, current erosion testing methods are time consuming and testing all 400 is unrealistic at this time. Therefore, a rapid method is required to determine the erosion potential. Electrical Resistivity (ER) surveys enable rapid sub-surface data collection. Our research findings have shown ER surveys can be used as a viable tool not only to prioritize KDOT's plan of action but also to predict the initiation of erosion during a flood event.

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## HEXAGONAL BORON NITRIDE: A NEW SEMICONDUCTOR FOR ULTRAVIOLET EMISSION

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**BACKGROUND AND PURPOSE**: Hexagonal boron nitride (hBN) has been envisioned for new ultraviolet light emitter due to its unique optical properties. For this application, control of the thickness, area, crystal perfection, crystallographic orientation and purity of the hBN crystals is essential. **METHOD**: We are producing high purity, low defect density hBN crystals at atmospheric pressure by cooling a molten Ni-Cr flux saturated with boron and nitrogen from 1550 °C to 1500 °C at a slow rate (1 °C/h). Single crystals up to 4 $mm^2$ in area, some of the largest ever produced, were grown. With the goal of growing larger crystals, theoretical methods, including density functional theory (DFT) and reactive molecular dynamics (rMD) simulations, were performed to understand and control the growth process. **RESULTS/FINDINGS**: DFT calculations show that the Ni surface steps are responsible for initial nucleation. Elemental B diffuse on surface and in the sublayer, but elemental N only diffuses on the surface. Large scale rMD simulations revealed a full scheme of hBN evolution from the linear configuration, to the branched, then to the hexagonal geometry, which is consistent with the paths predicted by DFT calculations. Different temperatures (900 – 1500 K) have been considered to investigate the thermal influence on hBN quality. A continuous h-BN network was only observed above 1300 K. **CONCLUSION:** Large scale hBN has been formed by Ni-Cr flux, and the theoretical method investigated the growth mechanism.

Relevance of Research to State-Related Topic(s)

Many diseases can be eliminated by using ultraviolet light to destroy the pathogenic microorganism contained in contaminated water. We are currently developing hexagonal boron nitride (hBN) to be a semiconductor for solid-state ultraviolet light emission. Such devices would be more efficient, portable, and use less power than currently available UV sources.

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## GLOBAL MICROWAVE ENDOMETRIAL ABLATION FOR HEAVY MENSTRUATION BLEEDING TREATMENT

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Microwave ablation (MWA) is a minimally-invasive intervention in clinical use for treatment of cancers in the liver, lung, kidney, and other organs. Microwave energy delivered during MWA is used to raise the tumor temperature to cytotoxic levels. Because of the advantages of MWA like deep penetration within tissue in short times, researchers continue to expand MWA to other healthcare applications. We report on a preliminary study investigating the efficacy of MWA of endometrial tissue for treatment of heavy menstrual bleeding. **BACKGROUND AND PURPOSE:** Previous studies have demonstrated the use of microwave endometrial ablation, but require the ablation device to be translated within the uterine cavity in a point to point manner which complicates the treatment. Our objective is to develop a device capable of performing a global ablation in order to simplify the procedure. **METHOD:** By 3D computational electromagnetics models, we first designed an antenna with the goal of achieving an ablation pattern matched to the shape of the uterus. The unique triangular geometry of the uterus limits the acceptable overall diameter of candidate devices. **RESULTS/FINDINGS:** We investigated microwave antenna designs in a retracted state and deployed inside the uterus. The impact of microwave frequency, power level, and ablation duration on treatment outcome was investigated. Experimental results evaluated in ex vivo tissue demonstrate proof-of-concept. We were able to form a triangular ablation zone which conforms to the uterine cavity. **CONCLUSION:** Further investigation of the device in vivo is required along with developing a criterion for determining the procedure end point.

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

We investigated the technical feasibility of using microwave energy for global endometrial ablation to treat heavy menstrual bleeding. If successful, this research will lead to the development of a low-cost and minimally-invasive procedure which improves women healthcare and life quality.

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## AN EVALUATION OF FLUORESCENCE SPECTROSCOPY AS A MONITORING TECHNIQUE FOR A MEMBRANE BIOREACTOR WATER RECLAMATION SYSTEM

**Jeffrey Scott**

*Department of Biological and Agricultural Engineering, College of Engineering*

**BACKGROUND AND PURPOSE:** The shortage of clean, usable water is a global problem. The Millennium Ecosystem Assessment has identified water supply as an ecosystem service that has become increasingly pressured over the last 40 years. In this time, water withdrawals from rivers and lakes have doubled and reservoir storage capacity has quadrupled. It is estimated that humans now use 40-50% of accessible fresh water running off land. These conditions are exacerbated by our changing climate and variable rainfall events that accompany it. The treatment technology implemented to meet our clean water needs must be accompanied by monitoring technology capable of insuring treatment quality. **METHOD:** Fluorescence spectroscopy has shown tremendous promise in wastewater treatment monitoring due to its sensitivity, selectivity, and its ability to be employed in-line in treatment systems. A series of treated, untreated water dilutions will be used to determine the method detection limit (MDL) of various fluorescence spectroscopy techniques. **RESULTS/FINDINGS:** This research will provide detection limits for three potential monitoring techniques for a pilot scale membrane bioreactor; the commonly used PARAFAC analysis technique, fluorescence peak intensities, and two online monitoring wavelengths. **CONCLUSION:** MDLs from a pilot scale membrane bioreactor treating a real and variable wastewater stream will be invaluable for public safety and confidence in our water treatment systems as our technology moves toward more advanced treatment systems. With the implementation of fluorescence technologies, treatment failure will be detected at lower breakthrough concentrations and responded to more quickly.

Relevance of Research to State-Related Topic(s)

The security and sustainability of our water supply in Kansas are becoming pressing issues as climate change continues to pressure our water supply. The current research can bolster the security of Kansas water supplies and also has implications for our military. The Net Zero initiative by the EPA and U.S Military is to reduce military ties to local infrastructure. Reliable water treatment technologies are paramount to achieving this goal. House: Energy and Environment, Agriculture and Natural Resources, Health and Human Services
Senate: Agriculture, Natural Resources, Public Health and Welfare

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