

Kansas (Kansas State University) Annual Report - FY2021

Report Status: Approved as of 07/08/2022

Contributing Organizations

Kansas State University

Executive Summary

Overview

K-State Research and Extension (KSRE) is a statewide network of educators sharing unbiased, research-based information and expertise on issues important to Kansans. The KSRE network includes offices in all 105 counties and two off-campus research-extension centers. The Eastern Kansas Research-Extension Center includes the John C. Pair Horticultural Center (Haysville), Northeast Research-Extension Center (Manhattan), Olathe Horticulture Center (Olathe), and the Southeast Research-Extension Center (Parsons). The Western Kansas Research-Extension Center includes the Agricultural Research Center (Hays), Northwest Research-Extension Center (Colby), Southwest Research-Extension Center (Garden City) and the Southwest Research Center (Tribune). In addition, there are four agronomy experiment fields and two horticulture centers.

A unique feature within the K-State Research and Extension organization is the close alignment of research and extension. In 1996, K-State Research and Extension was formed by aligning the Kansas Agricultural Experiment Station (KAES) and the Kansas Cooperative Extension Service. The strategic intent of this alignment was to achieve greater efficiency and synergy between discovery and outreach efforts. One ancillary benefit of this alignment is that basic and applied research lead to rapid Extension programming and application in the field. This alignment also allows more fluid compliance with multi-state and integrated components of AREERA.

During a strategic planning process with our stakeholders, K-State Research and Extension identified five grand challenges facing every Kansan: Global Food Systems, Water and Natural Resources, Health, Developing Tomorrow's Leaders, and Community Vitality. These grand challenges are areas of emphasis for agents, specialists and researchers.

Research awards have more than doubled between 2011 and 2021. The return on investment for research spending has been tremendous. Every \$1 spent on research in the Kansas State University College of Agriculture and K-State Research and Extension returns \$17 to the state's economy. Annual research expenditures have amounted to more than \$100 million since 2014. Research expenditures are the funds spent to conduct research and are the most frequently cited numbers for comparing research levels among colleges and universities.

In 2021, KSRE agents, specialists and volunteers recorded 708,792 direct educational contacts and 1,672,440 indirect educational contacts. Also, in 2021, volunteers invested more than 167,222 hours in helping to extend Extension programs which is equivalent to \$4.2 million worth of service to Kansas communities.

Restructuring: To provide better service and more specialized leadership for research centers and county offices across the state, K-State Research and Extension underwent a regional restructuring that led to more effective management of local units and regional research center issues. From a local unit management perspective, the restructuring split the state into three regions - western, central and eastern - each with a regional director. Two extension research centers were identified to lead cutting-edge research at regional centers.

Filling Position Vacancies: The hiring freeze instituted by Kansas State University in March 2020 was lifted in June 2021 but left K-State Research and Extension with a backlog of more than 30 open agent positions and 15 open regional and state specialist positions in addition to regular position vacancies due to retirements and resignations. A plan was developed to prioritize the search and screen process for these positions. For agents, the decision to refill was based on length of time positions have been open, current local unit staffing, availability of local unit funds and readiness of the local units to hire. Since July 2021, 41 agent positions have been filled and there are currently 21 vacancies yet to fill. For specialists, the decision to refill was based on program priority and need. Approximately 15 regional and state positions experienced vacancies and were filled in 2021.

Demographics: Kansas demographics continue to change which has strong implications for programming. According to the Kansas Health Institute, several population trends have been identified:

- Kansas is aging, with 75.9% of the population 18 years old compared to 74.5% in 2010.
- Kansans are increasingly living in urban counties, increasing from 54.9% in 2010 to 57.3% in 2020.
- 80 of the 105 counties in Kansas experienced a loss in population
- Minority populations grew in all but three Kansas counties

This information is important to extension professionals, program development committees and program focus teams in their consideration of the critical issues that need to be addressed through programming.

Diversity, Equity and Inclusion: The mission of KSRE is to provide research-based information to all the people of Kansas. In doing so, we are committed to providing equal opportunity in our workforce, programs, services, and activities. In January 2021, the KSRE Diversity, Equity and Inclusion Taskforce outlined several goals:

Goal 1: Improve diversity, equity and inclusion competencies of KSRE specialists, agents, program assistants and office professionals.

Goal 2: Improve diversity, equity and inclusion competencies of local unit boards and program development committees.

Goal 3: Embed and enforce policies and practices that adhere to diversity, inclusion and equity principles related to staffing of KSRE employers.

Goal 4: Embed and enforce policies and practices that adhere to diversity, inclusion and equity principles related to program delivery

To increase multicultural competency and sensitivity among our workforce, Extension Operations and the College of Agriculture/KSRE Diversity Programs Office provides regular Navigating Difference training for extension professionals and focuses on cultural awareness, understanding, interaction and sensitivity. The goal of this program is to bring systemic change and diversity to the KSRE team and provide cultural competency awareness and skills that they can practically apply in their day-to-day work.

The Multicultural Undergraduate and Graduate Summer Research Fellowship program targets under-represented populations of students with the goal to establish networking relationships back to their respective home institutions, as well as K-State faculty. This program has a specific goal of growing the minority populations of students within graduate programs in the College of Agriculture and across other partner Colleges represented within K-State Research

Strategic Initiatives: In July, the extension administration team prioritized six initiatives for KSRE that could produce program and system enhancing deliverables within the year. The six initiatives that rose to the top were:

- Career Development and Work Life Balance – Many extension positions in Kansas do not have career ladder opportunities. Work-life balance issues and job stress challenges are also often cited as challenges to having an even more rewarding extension career. The focus of this initiative was to find and/or develop career enhancing opportunities for our system’s extension professionals.
- Diversity, Equity, and Inclusion – The focus of this initiative is to take the strategies identified by the Diversity, Equity and Inclusion Task Force and determine how to best implement them across the system.
- Facilitation - The aim of the facilitation initiative is to provide our extension professionals with facilitation skill enhancing programs and resources to make them more effective at facilitating public meetings no matter the issue, venue or technology.
- Communication, Social Media, and Marketing – the focus of this team is to enhance the system’s marketing, social media and communication capabilities.
- Focused Programming – This team will look at ways to emphasize the importance of focused programming efforts throughout and to develop systems to empower our extension professionals to engage in more focused programming.
- Hybrid Meeting Methods - Conducting hybrid meetings, whether due to a pandemic or due to trying to reach those who do not or cannot attend more traditional meeting formats, will continue to rise in popularity in the future. This team will examine ways to engage in hybrid delivery and develop professional development programs and resources designed to make our system’s extension professionals the best at implementing face-to-face, hybrid and virtual education and meeting delivery methods.

Critical Issue: Community Vitality

Kansas communities face many challenges that demand leadership in an arena of increasing complexity and contention. Research indicates that building community leadership capacity is critical to community viability and sustainability (Flora and Flora, 2008; Green and Haines, 2008). Residents who are connected and invested in their local community are more likely to connect to their community

throughout life. KSRE worked to help citizens and communities - whether rural, suburban or urban - grow and prosper. Program highlights include:

1. Helping communities of all sizes maintain necessary services, such as grocery stores, that hire locally and generate local sales tax.

Examples include:

- 176 participants representing a broad range of rural food access stakeholders including grocery store owners and managers, community and economic developers and funders participated in an 8-week webinar series *Keeping Groceries Alive* to address grocery business transition planning. Webinar topics included: Understanding Grocery Ownership Models, Preparing for Business Transition, Assessing Markets and Community Needs, Planning Your Business, Funding the Transition, Recruiting Store Managers and Mastering Grocery Store Nuts and Bolts. Satisfaction with the webinar series was high. On average, the webinar series achieved a satisfaction rating of **9.38 out of 10**. According to the post-program survey, **29% of webinar participants** indicated taking a meaningful action related to grocery business transition planning since the conclusion of the webinar series.
- As an extension of the *Keeping Groceries Alive* webinar series, the Rural Grocery Initiative developed the *Grocery Business Transition Mentorship Program* so that grocers and community leaders could receive customized one-on-one technical assistance on a range of topics related to grocery business transitions, such as creating a business plan, assessing markets and community needs, establishing a community-owned grocery store, and more. With the support and guidance from business transition mentors, four of ten communities took steps toward a business transition or even enacted a transition. Other actions by store owners included: developing a guidebook to be included in their transition plan, submitting an offer to purchase a grocery store business, developing a presentation for city leadership to discuss their business transition, and completing a business transition plan

2. Working directly with farmers, ranchers and families to develop better financial management practices. Examples include:

- 2,195 producers were engaged with the Kansas Farm Management Association in one-on-one consultations (in-person or remote). Each of these KFMA members increased awareness of the financial performance of their farm operation. Additional producers (non- KFMA members) have also been reached through delivery of radio interviews, news articles, workshops, training sessions and other meetings. Producers who are able to sustain long-term profitability will benefit other community members by increasing the viability of rural communities and their access to a safer and less expensive food supply.
- K-State Research and Extension educated 4,729 Kansans through the process of Medicare plan comparisons and explanation of benefits covered. Participants who completed plan comparisons and changed prescription drug or Medicare advantage plans to a plan that better met their needs saved a total of \$3,774,993. In the past 10 years, agents have educated Kansans about health insurance through more than 67,000 Medicare plan comparisons that resulted in nearly \$37 million becoming available to help beneficiaries reach their financial goals, improve their health outcomes, and support community vitality.

3. Engaging community groups and local businesses by providing leadership, research-based expertise and technical assistance to make communities better places to live and work. Examples include:

- Grant writing workshops were created to help communities find funders to create change. Local extension agents hosted 60 grant writing workshops across the state to 1,714 people. In 2021, 10 online grant writing courses served an additional 248 participants, 95% of those surveyed indicated they had greater confidence to write a successful grant. Of the 533 participants since 2016 who responded to the survey 6-12 months after their grant workshop (36% response), **\$27.9 million of successful grants** came into the community to fund child care, technology, education, prevention programs, emergency assistance to low income families, arts, parks, preventive health, and non-profits.
- The population in rural areas is declining (USDA, 2017). Characteristics of rural communities often pose multiple and intersecting challenges to the economic, physical, and mental well-being of rural residents. These characteristics include geographic isolation, lack of economic diversification, sparse resources, inadequate or insufficient healthcare, and limited social services and childcare providers among others (Burton et al., 2013; Mammen & Sano, 2018; Walker & Manoogian, 2011). Rural communities also present fewer educational opportunities and have lower median household income levels than urban areas (Crockett, Carlo, & Temmen, 2016). Interviews were conducted with community key informants (CKI) investigating the community's capacity to collaborate with other organizations to help build resilience in rural, low-income families. This represents achieving the goal of assessing community capacity to support resilience in diverse, rural, low-income families. Information gleaned from the interviews were shared with extension agents and educators to both teach and learn about rural resilience and capacity.

Critical Issue: Developing Tomorrow's Leaders

The complex global society of the future will require leaders with effective teamwork and communication skills. We need to prepare leaders of all ages, so they may contribute to a vibrant Kansas economy for years to come. Program highlights include:

1. Adding value to the economy, 4-H members are twice as likely to attend college and pursue careers in science, engineering and computer technology. Examples include:

- Ninety-eight community club leaders representing 33 local units conducted six lessons with 4-H club members during the monthly club meetings as part of the educational program time. Communication skill lessons to be learned or developed included exploring their own communication preferences, giving clear instructions and listening, and researching, writing and presenting a speech for their local club or 4-H Day competition. Outcomes as reported by 302 youth who completed an evaluation following their participation in the Club Communications project included:
 - 95% agreed they improved their communication skills
 - 79% agreed they had confidence to speak in front of groups
- Questions have arisen over the past decade around the effectiveness of technology assisted welding instruction. Will welding instruction that includes virtual welding be as effective as welding instruction with actual welding only. Using technology to assist with student instruction leads students to have a stronger relationship with STEM while learning. One group of students was taught with traditional live welding instruction and the second group two was taught with a mix of live welding and a virtual environment system. Both groups met their instructional goals, but the second group had segments in which they progressed quicker along with higher testing scores. Having graduates who understand the impact of STEM on the work environment is important and could lead to more qualified employees.

2. Training Kansans of all ages to be better citizens and leaders.

- Groups organize to provide a service or accomplish a goal. They might be advisory groups, commissions, committees, councils, etc. Understanding how organized groups function and individual roles and responsibilities with a group is critical to its success.

K-State Research and Extension's Welcome A Board Series provides an opportunity to give community-based boards — elected, appointed, or recognized by local units of government — affordable training necessary to be most effective and efficient with their responsibilities. Welcome A-Board! Board Leadership Basics is a 14-part lesson series to provide training to all types of local boards, including Extension Executive Boards. Topics include: Organizing and Leading Productive Meetings, Parliamentary Procedure Basics, Understanding Fellow Board Members, Managing Conflict in Groups, Financial Responsibilities of Boards, Legal and Ethical Issues for Boards, The Importance of Strategic Planning for Your Organization. As a result of participating in the program, participants understood: how to make board meetings more effective; parliamentary procedure and why it was important to use; the skills needed to effectively manage conflict; conflict of interest; and legal and ethical issues.

- Extension Master Gardeners (EMG) greatly expand upon the reach and impact of horticulture programming for K-State Research and Extension. Volunteers answered client questions on hotlines, designed and maintained demonstration gardens showing our clients best horticultural practices and taught horticultural programs to both adults and youth. There were 1,146 Extension Master Gardeners (EMG) that reached more than 87,625 Kansans. EMGs hosted a total of 2,662 public events (both in person and virtual). All together, Kansas Extension Master Gardener volunteers donated over 53,981 hours of service back to their local communities. These contributions of volunteer hours are equivalent to over \$1.54 million dollars in salary savings by the state of Kansas that our volunteers have donated in service to the Kansas community, or the equivalent of 26 full-time Extension staff positions.
- A Virtual Youth Water Advocates Conference (YWAC) was held which provided training on water-related topics and content, how to educate others in the community/school district about water related topics and issues, and basic communication practices for their messages. The major goal of this project is to increase the knowledge and awareness of water related issues by citizens, farmers, ranchers, youth, and educators. In addition to a knowledge change, target audiences should also have a more positive view of how agriculturalists use their water resources. Twenty high school students, 6 high school agriculture teachers, and one high school science teacher attend the Kansas Youth Water Advocates Conference held virtually. Students were allowed to view synchronous and asynchronous sessions to learn more about how they can positively impact the water industry in the state.

Critical Issue: Global Food Systems

To feed and sustain a growing population, K-State Research and Extension is focused on developing innovative practices to help farmers, ranchers, and agribusinesses improve profitability, efficiency and sustainability for Kansas, our nation and the world through cutting-edge research in areas such as genetics, disease prevention, food security and farm bill education. Program highlights include:

1. Developing and testing new crop, vegetable, and tree varieties;

- Wheat is the most important food crop in the world and Kansas is the top wheat producing state in the U.S. New wheat varieties with improved agronomic performance and better end-use quality is critical for Kansas wheat growers and the wheat industry. KSRE continues to develop both hard red and hard white winter wheat varieties with the adaptation to the semi-arid western Kansas. Farmers using the improved wheat varieties, produce more and more wheat grain with less and less cost and therefore make the food in the U.S. more affordable and stabilize the wheat grain (flour) supply.

2. Reducing food waste caused by insects, poor storage, and processing techniques;

- Research in this area strives to mitigate potential damage caused by arthropod pests. This includes continual monitoring for new pests or behavioral changes in established pests. Investigators conducted research projects across the state to monitor pest densities and to delineate the impact those pests have on selected crops. Investigators also conducted several insecticide efficacy trials to determine more efficacious and environmentally safer products.

3. Creating sustainable agricultural systems that intensify productivity;

- As urban centers grow, the demand for locally-grown produce is driving the re-development of fruit and vegetable production in urban and peri-urban areas. Urban food production systems vary from high technology controlled-environments to low technology community and backyard gardens. Research activities found that poly covers in high tunnel systems produce higher yield with better nutrition and aesthetic properties in leafy vegetables and tomato. Other research projects at the Olathe Horticulture Research and Extension Center include: tomato grafting, evaluations of tomato and pepper varieties, utilization of movable tunnels, day-neutral strawberry production, soil management and CBD hemp production.
- In Kansas there are not enough fruit and vegetable farmers to meet the growing demand for locally grown fresh produce. There is a great need for technical expertise and education among aspiring, new and existing fruit and vegetable producers. Kansas Horticulture extension professionals partnered with outside agencies to provide training for fruit and vegetable producers and gardeners on topics relating to production practices, food safety and risk management.
- Volatile grain prices make it difficult for farmers to successfully market their grain. Integrated risk management helps producers utilize crop insurance, grain marketing tools such as forward pricing and hedging and government programs to attain levels of sustainable profitability. In-person, hands-on workshops were conducted at six locations throughout the state with the goal of equipping producers with the information to make appropriate selection of relevant government programs for their farm. This will lead to more competitive producers who are able to sustain long-term profitability.
- Research shows that less than 30% of beef producers have a storage site for vaccines and other pharmaceuticals that maintains a correct temperature range. Even fewer have a system to control temperature at chute-side during administration. Improper storage and administration of vaccines and animal health products reduces efficacy of the products. Effective use of vaccines is an important tool in the effort to reduce the need for antibiotic use in cattle. Extension professionals presented information to producers on the proper storage for livestock pharmaceuticals and appropriate cleaning methods for syringes.

4. Identifying ways to maintain cattle rangeland threatened by variations in climate;

- Resources for cattle producers have been decreasing due to the loss of pasture ground to crop-ground and/or weather events. Producers need options to enhance forage production systems for cow-calf operations through the use of more efficient pasture management, integrated crop-livestock systems and options to maintain cowherds on limited pasture availability. Based on research conducted at KAES, several options are available to producers, range managers and integrated farming operations to increase the quality and quantity of forage including interseeding warm-season annuals into cool-season perennial of crested wheat grass, and interseeding a cover crop to control old world bluestem.

5. Leading national and international teams to solve global food issues;

- The U.S. beef industry is facing a host of complex challenges that can be addressed via multi-disciplinary, integrated research involving participants from agricultural economics, meat science and animal science. A research project is focused on an economic assessment of various beef demand issues and biosecurity policies with the goal of improving knowledge on the inner-workings of U.S. cattle and beef markets.

Critical Issue: Health

Thirty-two percent of Kansas adults are obese, and 21 percent of Kansas children live in poverty. Targeting the diversity of Kansans, our programs address quality of life, healthy development and healthy behaviors across life stages for all socioeconomic groups. Program highlights include:

1. Identifying and implementing practices to help prevent adult and childhood obesity

- Physical inactivity and poor dietary habits have been linked to many chronic diseases and adverse health conditions. KSRE conducts Walk Kansas - an 8-week, team-based health initiative across the state. In 2021, there were 985 teams with 5,467 people participating. Over the 8 weeks, 755,234 miles were recorded. Participants recorded the following outcomes: 84% achieved a minimum of 30 minutes of physical activity 5 or more days per week; 82% were confident they would continue this amount of physical activity over the next six months.
- Childhood obesity continues to be a large health challenge with highest prevalence for racial minorities and families in poverty. Twelve parent-teen dyads were interviewed regarding how parents and teens related to each other around food and eating patterns before and during the pandemic. Qualtrics surveys to a large number of participants provided an opportunity to learn more about family experiences of independent eating occasions during the pandemic.
- Dining With Diabetes, a national extension program has traditionally been offered in person only consisting of four classes with sessions on nutrition education, healthy cooking demonstrations, simple physical activity routines and tasting healthy foods. In response to the pandemic, K-State Research and Extension created Dining with Diabetes Online with educational videos, meal planning and healthy snack ideas, healthy recipes, cooking demonstration videos and optional interactive discussion sessions. In 2021, 93 individuals registered for the online course.

2. Providing options to help families and practitioners understand health-care choices for elderly Kansans.

- The majority of consumers feel that they lack the adequate knowledge and skills for obtaining and processing financial information. An important aspect that is not well understood is the link between health care choices (preventive care behavior as well as coverage for various procedures and treatments), and the financial implications on both consumers and the public. Two surveys were completed with the results being analyzed.
- Powerful Tools for Caregiving is a statewide program that empowers caregivers to adopt self-care practices that help manage stress, increase communication and tackle tough situations leading to less caregiver burnout and more successful informal caregiving relationships. More than 100 participants completing ten classes, both in person and virtually. The goal of this program is to reduce the caregiving burden on Kansans and increase utilization of community resources, leading to increased health and overall wellness of the caregiving population in Kansas.

3. Educating consumers on safe food handling with food preparation, food preservation, food service and more.

- K-State Research and Extension extension professional provided in-person ServSafe food safety training for high school students preparing for the food service industry and for community members working as essential workers in food service. In 2021, 13 ServSafe Food Handler classes with 156 participants completing the class. In addition, virtual and in-person food safety trainings were offered throughout Kansas.
- Research on how house flies are able to acquire and transmit bacteria from the surfaces they come into contact. These bacteria, many of which are resistant to anti-microbials pose a threat to both animal and human health and have implications for livestock producers as well as the general public. The goal is that livestock producers will be more aware how flies move and how to limit fly movement reducing pathogen transmission. Knowing what causes flies to move can be used to mitigate the impact of flies as vectors.

Critical Issue: Water

To ensure future generations have a reliable source of clean water, our focus will be to develop and implement programs to help Kansans maintain and improve water quality and quantity. These include pioneering new practices and techniques; researching high-priority water issues; facilitating meetings among local, state and federal officials and effectively communicating research results. Program highlights include:

1. Developing more efficient irrigation and water monitoring systems for home and farm use.

- Kansas is a major irrigated state and the rural economy of western Kansas is heavily supported and sustained through irrigation. Several projects are focused on developing/adapting irrigation methods and irrigation management strategies suitable for profitable and environmentally friendly agricultural production with a focus on crop water management and associated crop cultural management issues, irrigation system design issues, general irrigation water management and irrigation scheduling procedures.
- Blue-Green Algae (BGA) blooms are being reported each summer at an increasing rate for bodies of water throughout Kansas, BGA are a type of cyanobacteria which can produce an array of toxins that effect nerves, the liver or kidneys, and may act as skin or respiratory irritants in livestock, wildlife, pets, and humans. BGA blooms are favored by nutrient-rich, warm, still, clear water, and can develop quickly under favorable conditions. Reducing nutrient loading in surface water to reduce BGA is a complex, long term endeavor. Two treatments appropriate for small ponds were demonstrated, which were the deployment of barley bales and slow sand filters (SSF). A barley straw bale mitigation pilot project in cooperation with the Kansas Department of Health and Environment was also conducted. In addition, KSRE has initiated testing of advance precision measurement technologies for better understanding of harmful algal blooms.
- Zoysiagrass is a low-input turfgrass that is drought resistance and requires few pesticide applications. This project involves screening new zoysiagrass types for their fit in Kansas and the Midwest. To date, 75 top performing zoysia genotypes have been identified. Further research is needed to help identify the top performers that may be eligible for cultivar release. In addition, the project focused on efforts to reduce irrigation in turfgrass systems with the use of soil water sensors and new methods for forecasting turfgrass water use to determine how effective they are in helping to save water.

3. Reducing runoff and sedimentation into reservoirs.

- The KSRE Watershed Specialist program began in 2000, as a partnership with the Kansas Department of Health and Environment and other agricultural groups. The goal of the program is to reduce non-point source pollution from cropland and livestock sources with the priorities of restoration of impaired water resources; abatement of fecal coliform bacteria, atrazine and pesticides; reduced nutrients and sediment loads, protection of water resources and implementation of farm/producer best management practices (BMPs). Through a broad array of educational services, more than 190 BMPs were implemented, involving 78 producers across the state.

Merit and Scientific Peer Review Processes

Updates

None

Stakeholder Input

Actions to seek stakeholder input that encouraged their participation with a brief explanation

None

Methods to identify individuals and groups and brief explanation

None

Methods for collecting stakeholder input and brief explanation

None

A statement of how the input will be considered and brief explanation of what you learned from your stakeholders

None

Highlighted Results by Project or Program

Critical Issue

Biology, Etiology, and Management of Dollar Spot in Turfgrasses

Project Director

Megan Kennelly

Organization

Kansas State University

Accession Number

1021044



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In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Dollar spot of turfgrass is caused by fungi in the genus *Clariireedia*. The disease occurs in many turfgrass species (both warm-season and cool-season) all across the North Central region, the US, and worldwide. Dollar spot can cause extensive damage and managers rely on fungicides, though fungicide resistance is a current and growing problem. More information is needed to optimize the use of less susceptible varieties and to incorporate cultural and biological controls.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The overall multi-state group objectives are:

Objectives

1. Improve our understanding of dollar spot biology and epidemiology through taxonomic analysis, molecular assay development, and host-pathogen interaction research.
2. Assess current dollar spot resistance among bentgrass cultivars and new selections, identify barriers to their utilization in golf course establishment and renovations, and develop strategies for overcoming the identified barriers.
3. Develop cultural-based dollar spot management strategies that combine multiple cultural practices (e.g., fertility, rolling, topdressing, irrigation) to limit dollar spot development in multiple geographic regions.
4. Develop integrated and targeted chemical dollar spot management strategies that maintain current levels of disease control, potentially reduce chemical inputs, and limit development of fungicide resistant populations.
5. Assess the ability of antagonistic organisms to suppress dollar spot when combined with the aforementioned cultural and chemical strategies.

In 2020-2021 KSU conducted a study in putting-green height turfgrass to support objective 3 in collaboration with several other states. In addition we established fairway-height plots to initiate studies in 2022. Data from the 2021 season were sent to the lead organizers at UW-Madison for combined statistical analysis.

Briefly describe how your target audience benefited from your project's activities.

Research results are too preliminary at this point for management recommendations.

Briefly describe how the broader public benefited from your project's activities.

In 2021 the multistate team focused on establishing and conducting experiments. The data are still too preliminary for sharing with the public. At KSU the study and plots were mentioned and displayed at the 2021 KSU Turfgrass Field Day so stakeholders are aware of the project.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

One graduate student and an undergraduate field research assistant were trained in research methods related to the study.

Investigations into the interactions between nutrition, health, and reproductive function in horses

Project Director

Teresa Douthit

Organization

Kansas State University

Accession Number

1020259



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In 2-3 sentences, briefly describe the issue or problem that your project addresses.

We seek to better understand the interaction between nutrition, health, and reproduction in the horse. By taking a holistic approach to understanding the whole picture, we should better be able to provide the nutrition needed to maximize the health and reproductive potential of the horse, as well as mitigating health challenges that negatively impact the reproductive or athletic performance of the equine athlete.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We are among the first to document changes in the hindgut of the live horse that occur in response to a variety of feed ingredients, including microbiome responses and changes in fermentation parameters (including pH and VFA accumulation). This represents an increase in the knowledge base of the general scientific community. Follow-up studies will likely lead to information that should decrease the number of horses affected by laminitis and/or improve our understanding of the interaction between the cecal environment and the feeds we provide. As well, this may enhance our ability to maximize the digestive efficiency of the horse in utilizing poor quality forages.

In addition to the in vivo work that is so critical, we have taken advantage of in vitro technologies available to help us generate valuable information while reducing the number of live animals used for research. First we determined the most appropriate substrate:buffer ratio to use in the Ankom system, thus optimizing our ability to use this technology. Then we documented how high-quality supplemental protein sources impact fermentation of forage by equine cecal microbes. This increase in general knowledge improves our understanding of cecal dynamics, including the importance of protein that reaches the cecum, which may impact the way dietary protein is considered in ration design in the future.

The factors regulating equine reproduction are another area of focus as described in our non-technical summary. Two studies were conducted to further investigate the complex interactions regulating reproductive function. In the first study, results indicated that exposure of anestrus mares to a stallion, whether through direct or indirect contact, failed to elicit the same effects on advancing ovulation that have been observed in short-day breeders. However, the effect of stallion exposure on the

onset of cyclicity in anestrus mares may be dependent on the duration of direct contact based on differences observed in the treatment groups. These results increase our understanding of how stallion and mare management practices might influence reproduction in the horse.

In the second study, we evaluated a novel hormone and its potential to serve as a biomarker of fertility in the mare. In collaboration with veterinarians at the second largest equine hospital in the world, blood samples were collected from mares coming to the hospital for advanced reproductive techniques and analyzed for Anti-Müllerian hormone (AMH). Results from this pilot trial indicated there were age-related changes in AMH concentrations, with higher concentrations observed in mares that yielded a higher number of embryos or oocytes for further processing. Improving embryo and oocyte yield in mares participating in these advanced techniques is a challenge for veterinarians based on the mare's unique physiology. Although further research is needed, these results are encouraging and may lead to an additional tool that can be used to screen mares for participation in these relatively expensive procedures.

Briefly describe how your target audience benefited from your project's activities.

We shared the results of many of our studies with the scientific community by disseminating our results through peer-reviewed manuscripts and oral presentations at scientific conferences. This allows others to utilize this information in teaching their classes and students, designing their own research projects, and in improving their ration formulations.

Briefly describe how the broader public benefited from your project's activities.

A better understanding of microbial fermentation in the hindgut of the horse enables nutritionists to design feeds that better utilize the ingredients available to us, or better support the digestive health of the horse, or both. Finding better ways to incorporate in vitro techniques reduces the need for live animals in research, and this has broad public appeal.

A better understanding of the factors that impact estrous behavior and the production of viable oocytes and embryos in mares allows veterinarians and horse owners to manage their mares more effectively so that there are fewer resources invested in unproductive cycles. This reduces the labor and significant financial resources needed to manage those mares, and for horse owners personally, can reduce the emotional toil that can come from failed reproductive cycles.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Peer-reviewed publications:

Sorensen, R. J., **J. S. Drouillard**, **T. L. Douthit**, Q. Ran, D. G. Marthaler, Q. Kang, C. I. Vahl, J. M. Lattimer. 2021. Effect of hay type of cecal and fecal microbiome and fermentation parameters in the horse. *J. Anim. Sci.* 99: 1-10. doi: 10.1093/jas/skaa407

Ochonski, P., **J. S. Drouillard**, **T. L. Douthit**, C. Vahl, J. M. Lattimer. 2021. Caecal fermentation characteristics of commonly used feed ingredients. *Equine Vet. J.* 53: 1056-1062. doi: 10.1111/evj.13390

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Conrad, C., **J. Drouillard**, C. Kang, P. Ochonski, **T. Douthit**, and J. Lattimer. 2021. Evaluation of substrate:buffer ratios for in vitro cultures inoculated with equine cecal contents. Equine Science Society. Virtual.

C. Sinclair, M. Schnobrich, J. Stevenson, and **J. Kouba**. 2021. A preliminary investigation of anti-Müllerian hormone as a biomarker for fertility in mares. Equine Science Society. Virtual.

Development and Management of Turfgrasses to Reduce Water Inputs and Control Difficult Weeds

Project Director

Jack Fry

Organization

Kansas State University

Accession Number

1014096



Annual Progress Report - 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Our goals are to identify grasses that require less water, identify methods to reduce water need, and evaluate methods for control of difficult weeds. The first two goals continued this fiscal year, whereas the weed control has already been completed.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Goal 1: Development of Cold Hardy Zoysiagrass Cultivars for Use in the Transition Zone Phase II was initiated in 2021 across multiple locations in the U.S. Seventy-five progeny were planted as plugs during summer in plots measuring 5 by 5 ft. Each progeny was replicated three times in a randomized complete block design. These 75 progeny under evaluation in Kansas, Texas, Indiana, Virginia, Florida, Tennessee, and Arkansas. Over the next two years, data will be collected on rate of establishment, turf quality, leaf texture, genetic color, and disease and insect problems. The goal will be to identify the top performing genotypes that may be eligible for cultivar release

Goal 2: Development of Irrigation Scheduling Techniques that Conserve Water using Soil Moisture Sensors and Forecasted Evapotranspiration Data Performance of 'Innovation' zoysiagrass was evaluated under four irrigation regimes: a) routine irrigation (1.2 inches weekly); b) evapotranspiration (ET)-based irrigation (60% of estimated ET); c) soil water sensor (SWS)-based irrigation; and d) no irrigation. The SWS-based irrigation method reduced water application by 72% and 56%, respectively, compared to routine or ET-based irrigation. Visual turf quality of turf receiving SWS-based irrigation remained above the minimal acceptable level throughout the study. Innovation zoysiagrass sustained acceptable quality for more than 21 days with no irrigation, and nonirrigated turf recovered fully within four weeks after irrigation treatments ceased and turf was well irrigated. Soil water sensors are useful for saving irrigation water, and Innovation zoysiagrass demonstrated good drought tolerance and recovery after drought. Similar research was also done on 'Meyer' zoysiagrass, and water saving levels were comparable. Research in these projects has been completed, and publication development is underway.

Briefly describe how your target audience benefited from your project's activities.

The target audience has benefited from accomplished in Goal 1 because 75 top performing zoysia genotypes have been identified. Further research will help identify top performers. Regarding Goal 2, research has demonstrated the significant water savings that can be achieved by using soil moisture sensors.

Briefly describe how the broader public benefited from your project's activities.

The public will benefit when the cultivar(s) to be released are identified. The significant water savings from use of soil moisture sensors in two different projects will be communicated with the public.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to

communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

A graduate student at K-State is reaching out to all other universities to make sure data is collected and submitted regarding Goal 1 - zoyasia genotype evaluation. She is also responsible for writing the annual report. This is good academic training. Results have been presented at scientific conferences, and state field days and conferences. In addition, results have been reported through extension in newsletters, blogs, and web sites.

Social, Economic and Environmental Causes and Consequences of Demographic Change in Rural America

Project Director

Matthew Sanderson

Organization

Kansas State University

Accession Number

7000253



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The project documents nonmetropolitan (rural) population change, examines the dynamics of these changes, and investigates their social, economic, and environmental causes and consequences. The project describes the interrelationships between environmental shocks and stressors and the well-being of rural people, places, and institutions. This project focuses on the issues of rural demographic change (immigration, out-migration, aging, etc.) and rural agricultural and environmental change (soil conservation, water quality preservation, and water conservation) in the U.S., especially in the High Plains-Ogallala Aquifer region.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The project is contributing to a **change in knowledge and awareness** through the construction of a dataset for analysis of demographic and environmental change in the region.

Last year, Sanderson (PI): (1) analyzed the dataset constructed over the past two years in this project; and (2) extended the timeframe for the dataset to allow for longer-term trends in the data; and (3) began extension of the dataset to include environmental data on water and soils and data on farming operations, which required building out the dataset even further.

Analysis of the population data yielded the following key results, including: (A) declining fertility rates across the state, but especially in rural counties; (b) rising mortality rates across the state, but especially in rural counties; and (c) flat net migration levels at the state level with ongoing out-migration across most rural counties in the state. The main result of these trends is general population loss in rural counties (and stagnating population growth at the state level).

I have started publishing the findings from analyses of these data, and last year I was able to publish two articles from this research in peer-reviewed journals. Great Plains Research is a leading journal focused on social and natural sciences in the region I'm working in, and Groundwater is a leading journal read by hydrologists and water scientists.

My article in Great Plains Research was selected as the Leslie Hewes Article of the Year, given for the best social science article published in the 2020 volume of the journal:

Sanderson, Matthew R. "People Pipelines: Occupational Channeling and Economic Incorporation in a Great Plains New Destination Region." Great Plains Research 30(2): 125-136.

Lauer, Stephen, and Matthew R. Sanderson. "Producer attitudes toward groundwater conservation in the U.S. Ogallala-High Plains region." Groundwater 58(4): 674-680.

My work continues to increase our knowledge and to raise awareness of the population challenges facing the state of Kansas, and to the issue of groundwater conservation. The research from this project is laying the groundwork for development of more research articles stemming from the analyses that refine and extend these initial findings.

Briefly describe how your target audience benefited from your project's activities.

My graduate student presented research from this project at the Annual Research and the State Forum in Topeka:

Stephen Lauer and **Matthew R. Sanderson**. "Conserving Kansas Communities Through Voluntary Group Efforts to Manage Ogallala Groundwater" Poster presented at the Annual *Research and the State Forum*, Topeka, KS.

I produced two public-oriented research briefs that summarized findings from this research:

Ray, Chittaranjan, and **Matthew R. Sanderson**. "Virtual water and trade: lightening water footprints." Water International Policy Briefs (Number 17).

Lauer, Stephen, and **Matthew R. Sanderson**. "How do Ogallala region producers value groundwater and groundwater conservation?" Ogallala CAP Resource Guide.

Now that I have returned to KSU following my leave, and now that the Covid-19 pandemic seems to be subsiding, I expect to be able to re-engage stakeholders again. I have presented results from this specific project via talks and testimonies that engaged key stakeholders: the Kansas Legislature (House of Representatives - Rural Revitalization Committee); Flint Hills Regional Symposium; Kansas Humanities Council, Eisenhower Presidential Museum, Finney County Sustainability Summit, Rural Kansas Summit for Kansas Legislators, Seward County Community College, HyPlains Feedyard Research Center, and the Konza Prairie Environmental Education Program.

Briefly describe how the broader public benefited from your project's activities.

My graduate student presented research from this project at the Annual Research and the State Forum in Topeka:

Stephen Lauer and **Matthew R. Sanderson**. "Conserving Kansas Communities Through Voluntary Group Efforts to Manage Ogallala Groundwater" Poster presented at the Annual *Research and the State Forum*, Topeka, KS.

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Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

From 1/1/2020 – 12/31/2020, I was on sabbatical leave from KSU. I did not accept speaking engagements during this time, nor did I take on any students for training and professional development, so my participation and outreach was more limited during this reporting period.

2021 Community Vitality

Project Director

Laurie Chandler

Organization

Kansas State University

Accession Number



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Nonprofits, educational, and government organizations struggle to find the resources to fund priority projects. According to The Foundation Directory (Candid), foundation dollars available for all subjects in Kansas increased 462% from 2014 to 2018. Grant writing workshops were created to help communities find funders to create change. Individuals in every Kansas community want to make a difference; when they come together in grant writing workshops, they discover shared goals and untapped resources.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

From November 2016 to November 2020 local agents hosted 60 grant writing workshops in all four quadrants of the state to 1,714 people. In 2021, 10 online grant writing courses served an additional 248 participants, proving online access gives participants the opportunity to choose a workshop which fit their schedule instead of their geography. Fifty percent of grant workshop participants have never written a grant before; 29% have written local grants, 14% have written federal grants, 7% identified as "other experience." We can document participation from 95 of 105 counties.

Briefly describe how your target audience benefited from your project's activities.

Participants at grant workshops reported:

- 95% have greater confidence to write a successful grant.
- 99% learned new sources of data to document community need.
- 99% learned new sources for finding grants.
- 93% have greater confidence to evaluate and measure their grant success.
- 89% gained confidence at writing a grant budget.

Of the 533 participants who responded to the survey 6-12 months after their grant workshop (36% response), 55% said they had made new partnerships as a result of the workshop, \$51.6 million of grants were written, and **\$27.9 million of successful grants** (54% success) came into the community to fund child care, technology, education, prevention programs, emergency assistance to low income families, arts, parks, preventive health, and non-profits. To put the success rate into perspective, one grant expert predicted "An organization should expect a success rate of between 50 and 60 percent if submitting applications to a combination of existing and new funders. This will be much lower if it is funding to a new source or an organization with less structural or fiscal soundness."¹

1) Lipten, David, PhD Retrieved from internet 8-8-19: <https://fundingforgood.org/about-grant-writer-success-rates/>

Success Stories

- Julie Kent's grant writing efforts were covered in an article in the Parson's Sun titled, "Grants Help Erie City Public Library Expand Its Services." Erie's population is 1,150. Kent wrote, "Just wanted to thank you for the great grant writing program that I attended in 2018. I have to admit that I was still a bit overwhelmed with writing a grant but [in] November 2020, I bit the bullet and wrote a Neosho County grant for the Erie City Public Library to purchase a greenhouse for the library to help with "food insecurity" in our town. Amazingly I followed your grant worksheet and

wrote a narrative that I have used for subsequent successful grants in the past 6 months. We have been approved for nearly \$45,000 in grants for this greenhouse, a mobile kitchen for the library, exercise equipment for the Senior Center, a pavilion for the library to use for outside programming, and equipment to complete these projects.” Kent says she is amazed when people walk into the library and say, “You’re that lady who is good at grants.”

- o Donna Jackson, a Burden (population 535) PRIDE member attended the grant workshop once and brought others back with her the next year. When grant workshops came online, she attended a third time. Jackson wrote grants that would enable playground enhancements at the elementary school and worked hard on a \$580,000 afterschool grant that the school ultimately didn’t pursue. Jackson writes, “...as much as I enjoyed helping the local school district, I am most thrilled to know that I have prompted others to seek and make grant applications. After I substantially completed a major grant application for the local school district last year, they took the initiative this year to complete the application themselves. This happened again with the local Kansas Pride-Burden organization. After I completed the very first grant application for them, they stepped up and did another grant application that got funded! I have also worked with the local fire chief and police chief individually for grants for their departments that they themselves have completed successfully! I am continuing to look for bigger needs in my community--think housing, businesses, etc.--for which grant funding is available and make the proper grant application. And, I continue to use what I have learned from your grant writing workshop.”

Briefly describe how the broader public benefited from your project's activities.

Individuals in every Kansas community want to make a difference; when they come together in grant writing workshops, they discover shared goals and untapped resources.



Grocery Business Transition Mentorship Program

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Grocery stores face many uphill battles, from competition with dollar stores, to slim profit margins, to high operating costs. But there’s another often-overlooked challenge that affects not only grocers, but also entire communities: business transition planning. In other words, who will take over the grocery store once the owner is ready to move on or retire? Creating a transition plan helps ensure that the grocery store continues operating, even after the owner exits the business. According to the Small Business Development Center, these plans take at least three to five years to complete. All too often, however, without a strong exit strategy, grocery stores abruptly close and communities are left with limited access to food.

According to a recent survey conducted by the Rural Grocery Initiative, nearly 40% of rural grocers plan to transition out of their store in the next five to ten years. Yet, a staggering 81% of rural grocers do not have a plan for the future ownership of their store. These findings highlight the critical need for more technical assistance on this issue.

In early 2021, the Rural Grocery Initiative hosted an eight-part webinar series, *Keeping Groceries Alive*, which covered a wide range of topics related to business transition planning. While the webinar series reached a wide audience and provided high quality information, it was limited in its ability to deliver nuanced guidance, since all business transitions are unique with differing needs and assets.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

As an extension of the *Keeping Groceries Alive* webinar series, the Rural Grocery Initiative developed the Grocery Business Transition Mentorship Program so that grocers and community leaders could receive customized one-on-one technical assistance on a range of topics related to grocery business transitions, such as creating a business plan, assessing markets and community needs, establishing a community-owned grocery store, and more.

The program paired grocers and leaders from ten rural communities with mentors, including advisors from the Small Business Development Center, a grocery store owner, and others with specialized knowledge in the grocery industry. Given that program participants were at different places on their path toward a business transition – from preparing for transition to enacting a transition – these mentors were able to provide targeted support by identifying needs, clarifying goals, and sharing information and resources.

Participants and mentors met at least four times, which proved to be productive and positive: participants overwhelmingly reported that the program led to concrete action steps that advanced their business transitions and other grocery-related goals; likewise, all mentors indicated an interest in joining future iterations of this program.

Briefly describe how your target audience benefited from your project's activities.

Mentorship program participants took tangible steps toward their business transition during the mentorship program. The following actions occurred with support and guidance from business transition mentors:

- Four of ten communities took steps toward a business transition or even enacted a transition.

- One store owner developed a guidebook that will be included in their transition plan when the owner is ready to move on (estimated five to ten years down the road).

- One store submitted an offer to purchase a grocery store business.

- One store developed a presentation for city leadership to discuss their business transition.

- One store recently opened and completed a business transition. Instead of writing a transition plan, the current owner and previous owners worked together for several weeks before and after the transition to train and answer questions in person.

Success Story

In early 2020, the owner of a grocery store in rural Kansas started making plans to retire. With the grocery store building under contract, the owner realized that he needed to purchase and remodel the building in order to add value to his business and create a succession plan. In Spring 2020, the grocery owner applied for funding from the Kansas Healthy Food Initiative with plans to upgrade and renovate the store. The project was deemed eligible. However, as is often the case, questions arose concerning the owner's vision and financial plan. The project remained in limbo.

To move his plan forward, in April 2021, the owner joined the Grocery Business Transition Mentorship Program and was paired with an advisor from the Small Business Development Center. The mentor conducted a financial vetting of the project by reviewing tax returns and, ultimately, developed a revised three-year projection. Together, the pair updated the original project plan and acquired a financing commitment from the local bank. Then, in June 2021, the owner submitted a revised financial application to the Kansas Healthy Food Initiative, which was approved.

With this final financing piece in place, the owner will be able to purchase and renovate the building so that when he retires, he can make a return on his investment. He is also beginning to train a successor to take over the business at that time – about six years from now.

The mentorship program helped this grocer focus and make changes to his initial plan, which ultimately led to the successful financing of his project. Without this assistance moving the grocer forward, it is likely that the future transition of this store would still be uncertain.

Testimonial: "After a long vetting process and with the assistance of the Rural Grocery Initiative, which provided us some direct and more timely financial planning assistance, I believe [the grocery store] has now been able to prove a sustainable plan for their expansion and remodel of the store in [the community]." – Economic developer who supported the project

Briefly describe how the broader public benefited from your project's activities.

The Rural Grocery Initiative, housed within K-State Research and Extension, aims to sustain locally-owned rural grocery stores to enhance community vitality and improve access to healthy foods by identifying, developing, and sharing resources that support grocers and rural communities.



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Health insurance choices affect all Kansans. Every day 10,000 Americans become Medicare eligible. Many do not understand health insurance or Medicare. Insufficient or inaccurate information can lead to late enrollment penalties, gaps in coverage, strained finances, and delayed health care treatment for those who are newly eligible for Medicare. For all Medicare beneficiaries, and particularly for those living near or below the poverty level, making sound financial decisions related to health insurance can alleviate stress. It can also free up income to meet other goals, improve health outcomes, and support community vitality when that money stays in the local area.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Health insurance education is provided via telephone, zoom, and one-one-one in-person sessions in local Extension offices and at events, in addition to public education presentations presented all over the state.

Face-to-face delivery methods are especially important for the significant number of Medicare beneficiaries with cognitive illness or other chronic conditions that make it more difficult to process the complicated information. Extension professionals who provide SHICK Counseling provide assistance with fraud and abuse issues, billing problems, appeal rights, and enrollment in low-income protection programs. Nationally, 29% of enrollees are vulnerable beneficiaries with incomes below 150% of the federal poverty level, who qualify for financial assistance. Many of those who qualify do not know that help is available until screened by a counselor who can help them apply for the programs.

During the 2020-2021 program year, extension professionals in 21 local units reported covering 40 Kansas counties provided health insurance education, in both one-on-one and group-settings, for soon-to-be eligible, newly-eligible, and long-time Medicare beneficiaries. In addition to learning how to navigate the Medicare maze, beneficiaries are educated about the availability of the low-income subsidy and the Medicare Savings program as well as other resources available in their communities. This opens the door to services such as the supplemental nutrition program, utility assistance, food pantry, and food commodity program.

Briefly describe how your target audience benefited from your project's activities.

During the fall 2020 open enrollment period, K-State Research and Extension educated 4,729 Kansans through the process of Medicare plan comparisons and explanation of benefits covered. Participants who completed plan comparisons and changed prescription drug or Medicare advantage plans to a plan that better met their needs saved a total of \$3,774,993. In addition to the plan comparisons, older Kansans were educated through office visits or telephone consultations. In the past 10 years, agents have educated Kansans about health insurance through more than 67,000 Medicare plan comparisons that resulted in nearly \$37 million becoming available to help beneficiaries reach their financial goals, improve their health outcomes, and support community vitality. Relationships are built with a trusted educator who can provide additional information about financial resource management and related topics.

Success Story: A Medicare beneficiary from River Valley District completed a SHICK counseling session via phone due to COVID-19. The beneficiary had recently been approved for both Extra Help and the Medicare Savings Program. Previously, she had lost Part D because she been unable to pay for the monthly premium. When she lost Part D coverage, she was no longer able to pay for her prescription medication. Through the counseling session, the K-State Research and Extension agent assisted her with paperwork required for Medicare Secondary Payer and Extra Help benefits, then helped her get enrolled in a drug plan that cost approximately \$50 a month resulting in a savings of over \$12,000 from her previous plan. The Medicare beneficiary cried tears of joy!

Briefly describe how the broader public benefited from your project's activities.

Participants achieve financial well-being because their financial situation and money choices provide them with security and freedom of choice.



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Grocery stores are anchor businesses in rural communities. These businesses are important sources of healthful food, providing residents with fruits, vegetables, dairy, grains, and meats. They are important to the economic engine driving rural regions through jobs created, tax contribution, and their local economic multiplier effect, and they serve as community hubs where community members gather to build social capital and cultural identity. Rural communities particularly in the Midwest, have experienced “stagnant economies” in part due to hometown businesses like grocery stores closing due to retirement, shrinking markets, and lack of access to capital.

In rural communities the need for business transition planning assistance is especially critical where the closure of a single business can dramatically impact economic development and quality of life for residents. Nationally, Baby Boomers, who are now of retirement age, own roughly 2.34 million small businesses. Thus, an enormous shift in business ownership from one generation to the next is currently underway. In a 10-year period between 2008 and 2018, the Rural Grocery Initiative tracked the closure of 54 rural grocery stores in Kansas. Once a store closes, it is that much harder to reopen as shoppers start to change behavior and shop out of town. According to a recent survey conducted by the Rural Grocery Initiative, nearly 40% of rural Kansas grocers indicated that they intend to retire in the next five to 10 years, but 80% do not have a plan in place for future ownership of their store.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

In partnership with the Kansas Center for Business Transition, Kansas Rural Center, NetWork Kansas, and the Food Co-op Initiative, the Rural Grocery Initiative developed and hosted an 8-part webinar series focused on rural grocery business transition planning. The webinar series was held weekly on Thursday afternoons between January and March 2021. Each webinar featured subject matter experts and case studies with guest presenters including grocers, community members, funders and more. Webinar topics included grocery ownership models, business planning, funding, recruiting staff, grocery operations and more.

Briefly describe how your target audience benefited from your project's activities.

Over the course of the 8-week *Keeping Groceries Alive* webinar series, 176 unique individuals participated in the webinar series, representing 35 states and Canada. Participants included a broad range of rural food access stakeholders including grocery store owners and managers, extension professionals, community and economic developers, funders and more. Grocery Business Transition Planning webinar topics included: Understanding Grocery Ownership Models, Preparing for Business Transition, Assessing Markets and Community Needs, Planning Your Business, Funding the Transition, Recruiting Store Managers and Mastering Grocery Store Nuts and Bolts.

On average, each webinar had 68 participants in attendance. Fifty-three percent of webinar series participants joined more than one live webinar and 13 individuals attended all 8 webinars in the series. Within the first 6 months of listing these webinars on YouTube, the recordings have had a total of 227 views.

Satisfaction with the webinar series was high. On average, the webinar series achieved a satisfaction rating of **9.38 out of 10**. According to the post-program survey, **29% of webinar participants** indicated taking a meaningful action related to grocery business transition planning since the conclusion of the webinar series. At the conclusion of the webinar series, **17% of participants** indicated they had started writing a business transition plan. This represents an **increase of 12%** from the start of the webinar series.

Success Story: Quotes from webinar series participants illuminates the variety of impacts the series sparked – from sharing the resource with other grocers, to providing relevant and timely content.

- o *“GREAT INFORMATION!! You can't find this info anywhere so appreciate this group having it all organized! It was excellent info that's so hard to find guidance on! Thank you for putting this on, your webinars were extremely organized, down to the presenters, cc at the bottom of the screen and Q&A versus question dumping in the chat box.”*

- o *"Very beneficial, and just what I need, when I need it. Great information and very timely for us."*

- o *"Love it all!! Have been to 2 of your "live conferences" and except for the "networking" advantage of being in person this is almost better! => I thought it was pretty awesome! I don't know how you'd improve!"*

Briefly describe how the broader public benefited from your project's activities.

The Rural Grocery Initiative, housed within K-State Research and Extension, aims to sustain locally-owned rural grocery stores to enhance community vitality and improve access to healthy foods by identifying, developing, and sharing resources that support grocers and rural communities.

Critical Issue

Developing Tomorrow's Leaders

Multistate Agricultural Literacy Research

Project Director

Gaea Hock

Organization

Kansas State University

Accession Number

1021548



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Kansas is one of several states in need of more water conservation and education efforts. Also, agriculture is Kansas' largest economic driver. It is essential that water resources are conserved for the vitality of families and communities across the state. K-State Research and Extension identified five grand challenges facing every Kansan: global food systems, water, health, community vitality and developing tomorrow's leaders. This project will focus on four of those grand challenges: water, community vitality, global food systems and developing tomorrow's leaders.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

This project will focus on Kansas, but the program, curriculum, and model will be shared with other states in an effort to help them address their own water-related challenges. A Virtual Youth Water Advocates Conference (YWAC) was held in November 2020. The training included lessons on water-related topics and content, how to educate others in the community/school district about water related topics and issues, and basic communication practices for their messages.

While we would have liked to have hosted the conference in person (as in previous years), we were not able to hold it in person. This severely affected students participation when compared to previous years.

The major goal of this project is to increase the knowledge and awareness of water related issues by citizens, farmers, ranchers, youth, and educators. In addition to a knowledge change, target audiences should also have a more positive view of how agriculturalists use their water resources.

Briefly describe how your target audience benefited from your project's activities.

We had at least 20 high school students, 6 high school agriculture teachers, and one high school science teacher attend the Kansas Youth Water Advocates Conference held virtually November 2020. Students were allowed to view synchronous and asynchronous sessions to learn more about how they can positively impact the water industry in the state. (Since we offered pre-recorded sessions, we are not able to accurately state the specific number of participants.)

Briefly describe how the broader public benefited from your project's activities.

The Virtual Kansas Youth Water Advocates conference, held in November 2020, allowed stakeholders from across the state to contribute to this project. Students in agricultural education at KSU wrote and recorded virtual lessons that were shared during the conference (and after). A 4-H professional also participated in the virtual conference and offered to host additional workshops for attendees.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The need to host the conference virtually severely impacted the attendance/participation and ability to accurately track attendees. This program will be reviewed to determine what the best route will be in the future to reach more students/stakeholders.

[A framework for secondary schools agriscience education programs that emphasizes the STEM content in agriculture](#)

Project Director

Jonathan Ulmer

Organization

Kansas State University

Accession Number

1018846



The impact of a virtual welding environment of welding instruction

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Traditionally the instruction of welding skills has been conducted with actual welding and consumable supplies that can become expensive. Questions have arisen over the past decade around the effectiveness of technology assisted welding instruction. Will welding instruction that includes virtual welding be as effective as welding instruction with actual welding only.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Using technology to assist with student instruction leads students to have a stronger relationship with STEM while learning. While students are not learning STEM content they are using STEM technology to learn, creating an exposure that is unique and could lead to greater STEM interest in many students. Students were put into two groups for this study. Group one was taught with traditional live welding instruction and group two was taught with a mix of live welding and a virtual environment system. Both groups met their instructional goals, but group two had segments in which they progress quicker. Group two also had higher testing scores.

Briefly describe how your target audience benefited from your project's activities.

My target audience is agriculture teachers and teachers of power, structural and technical systems. The inclusion of a virtual environment in the instruction of welding can have an impact on the knowledge level required of teachers, efficiency of instruction and the long term expenses for instructional consumables. Additionally, if the ultimate outcome is employed program graduates, the inclusion of a virtual environment could lead to more qualified employees.

Briefly describe how the broader public benefited from your project's activities.

As technology progresses, mechanical industries also progress. Having graduates who understand the impact of STEM on the work environment is important. When graduates are allowed to experience virtual environments they have a new training environment and are exposed to changing technology. Students being taught welding instruction in a virtual environment is one of many new instructional methods that are being introduced. Studying them early can lead to other instructional innovations.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The past two years have made it challenging to connect with agricultural mechanics business leaders and schools have only recently been approving teachers to attend in person meetings and trainings. These two COVID related issues have made it difficult to progress through my project as proposed. To continue to do some work on STEM in PSTS I worked with Wichita State Technical College and Lincoln Electric Inc, to study the virtual environments in welding instruction.

A virtual poster is to be presented to the National Agricultural Mechanics Professional Development Blue Ribbon Research Conference in October of 2021.

The 2022 goals are to create a sense of agreement into the desired skills for future employees and to connect to teachers about their ability to teach those skills.

2021 Developing Tomorrow's Leaders

Project Director

Laurie Chandler

Organization

Kansas State University

Accession Number

7001731



Extension Master Gardeners

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Extension Master Gardeners (EMG) expand upon the reach and impact of horticulture programming for K-State Research and Extension. Each volunteer completes more than 40 hours of Basic Training to become an EMG, along with annual requirements for volunteer hours and additional training. Once trained, local unit agents work with their EMG volunteers to create educational opportunities, plan events, partner with local organizations and work to better their individual communities with research-based horticulture programs. Volunteers answer client questions on hotlines, design and maintain demonstration gardens showing our clients best horticultural practices and teach horticultural programs to both adults and youth in communities across Kansas.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

As a result of the global pandemic, agents and specialists worked together to provide the first ever statewide online Extension Master Gardener Basic Training in fall of 2020. The course covered topics ranging from plant growth and development to pesticides, fruits and vegetables, flowering plants, trees and shrubs, and plant pathology. This online course allowed 256 participants to safely participate in training, while being socially distant from the safety of their homes. The live and recorded trainings added flexibility for working volunteers to participate in the program, and allowed for volunteers to go back and review parts of the presentation they may have initially found confusing. The online courses also allowed for interaction and connectivity of EMGS throughout the state, through the use of breakout rooms and other interactive activities.

Briefly describe how your target audience benefited from your project's activities.

There were 1,146 Extension Master Gardeners volunteering across the state of Kansas. These Extension Master Gardeners completed 17,260 hours of Advanced Training hours and shared that knowledge with over 87,625 people of Kansas. EMGs further took that training, and hosted a total of 2,662 public events (both in person and virtual), despite the limitations of COVID-19 pandemic. All together, Kansas Extension Master Gardener volunteers donated over 53,981 hours of volunteer service back to their local communities. These contributions of volunteer hours are equivalent to over \$1.54 million dollars in salary savings by the state of Kansas that our volunteers have donated in service to the Kansas community, or the equivalent of 26 full-time Extension staff positions.

Success Story: In a post-participation survey, newly trained EMG volunteers were asked to rate their knowledge on twenty core competencies of the Basic Training program. Before participating in this program, 39% of surveyed participants indicated that they either “somewhat disagreed” or “strongly disagreed” that they knew how to do each of the twenty competencies. 17% indicated they “neither agreed nor disagreed” with only 44% of participants indicating they “somewhat agreed” or “strongly agreed.”

After participating in the program 93% of participants indicated that they “somewhat agreed” or “strongly agreed” that they were knowledgeable on those same competencies. 5% indicated they “neither agreed nor disagreed”, with only 2% selecting “somewhat disagree” that they were knowledgeable. No one on the survey indicated they “strongly disagreed.”

Below are just a few comments shared with us by participants:

- *“Excellent program! You all did a great job of shifting to a Zoom-based format. Speakers were clearly knowledgeable and leaders/facilitators did a great job during the weekly sessions.”*
- *“Wonderful online program! So much information and wonderful people hosting, speaking and assisting. Feel like Kansas is heart of horticulture and I am excited to get my hands dirty. Thank-you all for putting this together.”*
- *You made it fun for us and it was creative:-) I actually enjoyed connecting with a larger, state-wide community of EMGs in training. That was a hidden plus. Thank you for everything!”*

Briefly describe how the broader public benefited from your project's activities.

Nearly 1,300 Kansas Extension Master Gardener volunteers donated over 99,000 hours (76 hours each, on average) during 2019 for a total value of over \$2.6 million. This is equivalent to about 48 full-time Extension staff positions. More than 110,000 Extension contacts were reported by EMG volunteers and coordinators across the state.



Kansas 4-H Introduces Club Communications Project

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

As communities seek to improve the opportunities for young people to develop life skills, reduce risk factors, and build assets, they are turning to quality programs like 4-H youth development, designed to extend in-school learning to out- of-school opportunities for youth, and resources for adults who support children and youth. These programs take place both in schools and in the community. They provide children and youth with an opportunity to develop skills and interests in a wide range of areas by offering high interest activities designed to extend the learning day for participants and provide opportunities to apply in-school learning to real life situations.

COVID 19 and virtual meeting protocols necessitated identifying the needs of 4-H club leaders to provide quality programs. A survey was made available to all club leaders to gather data during the pandemic about the level of engagement of 4-H clubs and ask what resources were needed. There were 327 responses to the survey which represented 47% of Kansas clubs and 76% of extension units. The greatest need for resources included helping leaders provide hands-on learning activities to enhance virtual and face-to-face club meetings.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Recognizing the need for project learning in the absence of project volunteer leaders and the changing schedules of today's families, a group of Kansas 4-H professionals developed the Club Communications Project. Ninety-eight leaders representing 33 units registered for the project. Using National 4-H Council's 4-H Communications Curriculum, Module 1, leaders were asked to conduct six lessons with 4-H club members during the monthly club meetings as part of the educational program time. Communication skill lessons to be learned or developed included exploring their own communication preferences, giving clear instructions and listening, and researching, writing and presenting a speech for their local club or 4-H Day competition.

Briefly describe how your target audience benefited from your project's activities.

Outcomes as reported by 302 youth who completed an evaluation following their participation in the Club Communications project included:

- o 95% strongly agreed or agreed: I have improved my communication skills

- o 95% strongly agreed or agreed: I ensure that others understand the message

- o 89% strongly agreed or agreed: I have used the communication skills I have learned in a leadership role

- o 88% strongly agreed or agreed: I can use technology to help me express my ideas

- o 81% strongly agreed or agreed: I am comfortable sharing my thoughts with other

- o 79% strongly agreed or agreed: I have the confidence to speak in front of groups

- o 89% reported yes: As a result of being in 4-H, I have given a prepared presentation at a 4-H club meeting

- o 69% reported yes: As a result of being in 4-H, I have given a prepared presentation at school

Success Story: When asked to describe the impact from participating in the Club Communications project, a teen participant from the Chisholm Trail Extension District said, *“The focus on communications has expanded my knowledge of different styles of communication and has given me new ways to strengthen my skills. I have learned how to have conversations with people no matter if it’s a business professional conversation or just with friends.”*

Participation in 4-H hands-on learning experiences develops skills not only as youth participate in 4-H, but also in other areas of their lives. When asked to describe a 4-H experience that has had the greatest impact on their ability to speak in front of others, or describe the 4-H experience that had the greatest impact on their ability to speak in front of others, responses given were:

- o *“I think the greatest impact on me would be the project talks and demonstrations. They really helped me be more confident when speaking.”* 16-year-old from Chisholm Trail Extension District

- o *“The greatest impact was mostly public speaking at the 4-H contests. So, at school events or other contests, I am confident with my skills to present to judges.”* 14-year-old from the Central Kansas District

- *“Communication skills have helped me be a leader on my football team as a quarterback.”* 16-year-old from Central Kansas District

4-H members reported using the communication skills developed in many ways outside of their 4-H activities. Examples include writing letters to pen pals, making videos for other organizations, presenting in school classes and activities, speaking in front of community organizations, meeting new people, being interviewed, serving as a successful yearbook editor, serving in FFA officer roles, talking on the radio, talking with customers as an entrepreneur, and interviewing for a job.

Briefly describe how the broader public benefited from your project's activities.

4-H participants will be able to effectively communicate and share their thoughts and ideas in any setting.



Welcome A Board! Board Leadership Basics

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Generally, groups organize to provide a service or accomplish a goal. They might be advisory groups, commissions, committees, councils, etc. These bodies might be created by another board, appointed by public officials, or set up informally in a community. Understanding how organized groups function and individual roles and responsibilities with a group is critical to its success.

K-State Research and Extension’s Welcome A Board Series provides an opportunity to give community-based boards — elected, appointed, or recognized by local units of government— affordable training necessary to be most effective and efficient with their responsibilities.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Welcome A-Board! Board Leadership Basics is a 14-part lesson series to provide training to all types of local boards, including Extension Executive Boards. The lessons can stand alone and are suitable for teaching through a video-conferencing format like Zoom, or face-to-face. Each lesson includes PowerPoint presentations, handouts, leader notes and suggested additional activities. Most lessons can be taught in 30 minutes but can also be extended by utilizing the included handouts or suggested activities. Topics include:

- Organized Groups –How do they function and what is your role?
- Duties and Responsibilities of Non-Profit Board Members
- Organizing and Leading Productive Meetings
- Agendas to the Rescue
- Parliamentary Procedure Basics
- Understanding Fellow Board Members: Behavioral Styles
- Understanding Fellow Board Members: Understanding Volunteers of Different Generations
- Managing Conflict in Groups

- Financial Responsibilities of Boards
- Fundraising and Managing Grant Revenue
- Legal and Ethical Issues for Board
- The Importance of Strategic Planning for Your Organization
- Designing a Strategic Plan: Part 1
- Designing a Strategic Plan: Part 2

Briefly describe how your target audience benefited from your project's activities.

Strategic Planning

- Attendees who strongly agreed in their understanding of the steps in a strategic planning process increased from 5.3% before the program to 71.2% after the program completed.
- Participants in this program who strongly agreed that they understood the importance of organizational goals to help them move into the future improved from 51.8% to 93.2%.
- Before the session 28.3% of attendees strongly believed they could help their organization move forward with a strategic planning process to 78% after the session.

Understanding Members/Conflict Management

- 44.7% of attendees before the program strongly believed they understood personality styles and how this helped board members to work together more effectively, but that increased to 89.4% afterwards.
- Participants before this program who strongly agreed they could see how each generation had assets that are of benefit to their board, nearly doubled from 51% to 89.4%.
- Only 2.1% attendees before this program had a knowledge of the six sources of conflict, but this improved to 72.3% after the session.
- Before this program 6.4% of participants strongly agreed that they understood the skills needed to effectively manage conflict. This increased to 63.8% after the session.

Financial Responsibilities/Fundraising/Legalities/Ethics

- The percentage of attendees who strongly agreed that they understood legal and ethical issues which affect boards increased from 8.5% to 48.3%. The understanding of a conflict of interest for those who strongly agreed improved from 22.4% to 62%.

- 8.8% of participants who believed strongly that they knew how to ask the questions that maintain accountability in their organization rose to 44%.

Roles and Responsibilities/Effective Meetings

- Board Leadership attendees who strongly agreed that they felt prepared to help their board have more effective meetings before the training improved from 8% to 51.6% after the training.
- 14.5% of attendees strongly agreed they understood parliamentary procedure and why it was important to use; this increased to 53% in understanding after the session.
- Only 35.4% of participants strongly felt they could make a motion in a meeting, but after this session 71% strongly agreed.

Success Stories:

Johnson County Extension offered two sessions of the Welcome-A-Board Leadership series. Each session consisted of community volunteers from local Extension programs, city commissions, non-profits and citizens wanting to take the leap into joining a board. All 2020-2021 sessions were held virtually, and participants contributed to vibrant discussions around conflict management, understanding finances, and parliamentary procedures 101! Here are what some participants had to say:

- *"This opportunity will help me better understand how to contribute to a board meeting. I had no real-life experience with true parliamentary procedures or Robert's Rules of Order."*
- *"After attending this class, I realized how much I didn't know. Lots of very good information from the mechanics of running a meeting to the soft skills of understanding thinking styles and conflict resolution. Very much enjoyed and appreciate this class."*

The **Meadowlark Extension District** offered the Board Leadership Basics mini-series via zoom this year with 32 participants. The four-week course served as a good "refresher" for current community leaders and some basic training for those new to serving on a board. Participants learned about the roles and responsibilities of board members and how to conduct an effective meeting, financial and risk management of non-profits, open records and open meeting law, ethics, and strategic planning with opportunities for feedback, group discussion and problem solving.

All survey respondents reported gains in knowledge and felt better prepared to:

- serve as an effective board member
- identify ways to support the teamwork of their board identify the 10 key responsibilities of a board
- recognize the top 10 meeting problems that prevent a successful meeting
- understand the importance of strategic planning when serving on a board
- understand why parliamentary procedure is important to the success of a meeting

- o understand open meeting law.

One participant reported that *"all prospective board members should take this training and it should be a requirement!"*

The **Wildcat and Southwind districts** collaborated to create an online "lunch and learn" board leadership series for two weeks on Tuesdays and Thursdays. 15 participants with a variety of board leadership experience participated. 100% of survey respondents found the material valuable and would be interested in taking a similar course in the future. Participants also reported greater confidence in their skills and ability to contribute to a board and increased understanding of the roles and responsibilities of a board member.

Briefly describe how the broader public benefited from your project's activities.

Welcome A Board Community Leadership Development programming helps participants learn how to be better leaders, increase their effectiveness on community boards and committees, and increase citizen involvement across the whole community. All result in greater civic engagement by a more diverse group of community members, to the benefit of all residents through increasing the community, economic and social viability.

Critical Issue

Global Food Systems

[Ecological research to improve tallgrass prairie management and conservation: Konza Prairie Biological Station](#)

Project Director

John Blair

Organization

Kansas State University

Accession Number

1020525



Annual report for Konza Prairie Biological Station capacity project

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This capacity project supports a broad array of research and training activities at the Konza Prairie Biological Station (KPBS), a grassland research station located in the Flint Hills ecoregion of northeastern Kansas. The overall mission of the research station is to provide a platform for research focused on the ecology and management of tallgrass prairie ecosystems. We aim to build a comprehensive and detailed understanding of ecological processes in tallgrass prairie and other mesic grasslands, while contributing to broad synthetic and conceptual advances in ecology and related disciplines. KPBS also provides education and training (K-12 to postgraduate), public outreach, and knowledge to support more effective grassland management and conservation. The station supports the activities of researchers and students in multiple departments at Kansas State University, as well as visiting researchers from other institutions, government agencies, and non-governmental organizations. In this report, we focus specifically on the activities of KAES-supported faculty members and their students. The reporting sections below are broken to reflect activities and accomplishments of those research groups.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Blair lab has been assessing tallgrass rangeland responses to climate. Responses to climate variability and climate change can be modulated by the effects of climate history on plant communities, soil microbial activity, and nutrient cycling (i.e., climate legacies). Long-term manipulative climate experiments are needed to assess how such climate legacies shape ecosystem functioning and sensitivity to future climate changes (e.g., drought). To study the effects of climate legacies, we reversed a subset of irrigated and control (ambient precipitation) treatments in the long-term Konza Prairie Irrigation Transect Experiment, which has simulated a wetter climate for >25 years. The new treatments also include experimentally-imposed drought in plots with a history of either irrigation or ambient rainfall to assess how climate legacies affect ecosystem responses. Here we report results from the first three years of the new treatment structure. Legacy effects of elevated precipitation (irrigation) included enhanced C fluxes and altered labile soil C pools, and altered sensitivity to new climate treatments. Decades of irrigation reduced the sensitivity of both ANPP and soil respiration to drought compared to controls. Positive legacy effects of irrigation on ANPP were evident under both ambient rainfall and drought conditions and persisted

for at least 3 years following treatment reversal. These legacies were associated with altered plant functional composition. Legacy effects on soil respiration were short-lived and only occurred under natural or experimentally-imposed “dry years”, suggesting that legacy effects on CO₂ efflux are contingent on current conditions. A manuscript summarizing these was submitted to *Global Change Biology* and we are currently analyzing N cycling responses to the same treatments.

The Johnson lab's research focuses on Big bluestem *Andropogon gerardii*, a dominant forage grass in the Flint Hills that also grows across a strong precipitation gradient spanning 400 to 1200 mm of annual rainfall spanning the Great Plains. Grasslands are a critical national natural resource, accounting for \$8 billion annually in agricultural production in Kansas alone. These grasslands are dominated by one of the most palatable forage grasses, Big Bluestem or *Andropogon gerardii* which comprises up to 70-80% of aboveground biomass. Understanding how ecotypic and genetic variation of Big Bluestem will respond to increased temperature and drought is essential to preserving rangeland productivity and informing prairie conservation. We are using ecotypes of *A. gerardii* collected from regions with historically different average precipitation and growing them in common gardens at several locations across a natural precipitation gradient to study the genetic and phenotypic responses of *A. gerardii* to drought across the Great Plains. This work is critical to understanding the basis of a significant portion of this region's agricultural production.

The Ratajczak lab is developing spatial models that can predict landscape scale changes in vegetation communities. Using ground-based approaches and remote sensing, we quantified the large-scale extent of woody plant expansion across different fire frequencies. In the absence of bison, we see clear evidence of a threshold; areas with a fire return interval (FRI, the average number of years between fires) of one- to three-years maintained shrub areas below 10% and negligible woody plant biomass, whereas areas with a slightly higher FRI of 3.5 years had a shrub area of 45% average shrub cover with similar increases in shrub density and biomass. Areas with bison also saw increases in shrub dominance with higher fire return intervals, but relationship between fire and woody plant expansion was linear. We attribute this change to a negative feedback between fire frequency and fire intensity when bison are present. These results suggest that reducing biological complexity—in this case removing a megagrazer—can result in ecological thresholds. As a next step, we are developing simulation models to explore how bison behavior might smooth out otherwise non-linear vegetation changes.

The Dodds lab is working to understand how anthropogenic pressures influence quantity and quality of water, and the ecology of grassland streams. We use long-term hydrology and chemistry records coupled with experimental manipulations to assess the effects of 1) cattle versus bison, 2) effects of woody expansion, and 3) long term trends in water quality and hydrology as baselines for regional management. The Dodds lab continued to oversee the hydrology and water chemistry monitoring of Kings Creek, Shane Creek, and several groundwater wells at the Konza Prairie Biological Station. We also developed a new method for testing how rain falling next to streams moves materials into those streams (e.g., sediments, ammonium, inert salts). We also did streamside vegetation (riparian) surveys to assess the relative effects of cattle, bison, and no grazing on vegetation structure.

Trevor Hefly continued collaborative research with Alice Boyle to develop new methods and analytical approaches to better understand the demographic consequences and mechanistic basis of population responses to rainfall variability for three species of declining, grassland-dependent birds. This research is combining long-term data on climate and grassland bird population dynamics at Konza Prairie with novel statistical approaches, including new methods that allow improved accounting for location uncertainty in the distance sampling data often used to monitor birds and other populations of mobile consumers. Species distribution models (SDMs) are increasingly used in ecology, biogeography, and wildlife management to learn about the species-habitat relationships and abundance across space and time. Distance sampling (DS) and capture-recapture (CR) are two widely collected data types to learn about species-habitat relationships and abundance; still, they are seldomly used in species distribution models due to the lack of spatial coverage. However, data fusion of both data sources can increase spatial coverage, reduce parameter uncertainty, and create more accurate predictions for species distribution modeling. We developed a model-based approach for data fusion of DS and CR data that accounts for common missing data issues. Using a simulation experiment, we evaluated the performance of this modeling approach and compared it to existing approaches using data for Grasshopper Sparrow (*Ammodramus saviarum*) populations at Konza Prairie Biological Station. Our approach provided unbiased parameter estimates with increased efficiency compared to other current approaches. In addition, Hefly provided statistical consulting to faculty across campus, enabling faculty members to be more productive and to use novel statistical approaches for modern data to address scientific questions of interest. He conducted approximately 45 statistical consulting meetings with faculty, staff and students during the reporting period. His efforts resulted in 5 peer-reviewed publications where KSU students or researchers served as the first author and he served as a co-author.

The KC Olson lab continued to work with other Konza Prairie investigators to assess the economic and ecological benefits of patch-burn rotational cattle grazing in the Flint Hills. Replicate patch-burn grazing treatments have been maintained for over a decade now, and recent USDA funding has allowed Konza researchers to begin addressing responses in plant and soil

communities, as well as a suite of ecological processes, including plant productivity, nutrient cycling, and soil carbon sequestration. This new research project began in summer 2021, and will continue over the next three years.

Briefly describe how your target audience benefited from your project's activities.

One of our main audiences is the broader scientific community. We presented Konza-based research findings at numerous scientific society meetings and published results in peer-reviewed journals. Konza researchers also regularly provide science-based tours to state and national policy-makers and lawmakers. Because of the widespread use of prescribed fire for both grassland conservation and agriculture, KPBS research on ecological responses to contrasting long-term fire regimes and different seasons of fire has taken on new importance. At the regional level, Konza scientists advised EPA scientists on the ecological benefits of fire in maintaining native tallgrass prairie habitat and diversity. Our data helped guide the development of the Flint Hills regional smoke and management plan. The issue of smoke management coupled with concerns about woody plant expansion has provided Konza investigators additional opportunities to interact with land managers, producers, and private organizations in linking basic research with management goals. Our research concerning the role of seasonal burning and fire intensity on woody encroachment is being used to inform the Great Plains Fire Science Exchange and the Tallgrass Prairie and Oak Savanna Fire Science Consortium. Both of these are non-profit groups focusing on conservation issues and land management of Midwestern grasslands. Konza investigators have a strong working and advisory relationship with the Kansas chapter of The Nature Conservancy. Recent Konza-based research by Dodds and Boyle also led to a new partnership with The Nature Conservancy, the Tallgrass Preserve, and Mushrush Ranch to explore the management and ecological implications of virtual fencing of cattle.

Briefly describe how the broader public benefited from your project's activities.

KPBS scientists and graduate students participated in numerous public outreach events to enhance public understanding of the value of research for conserving and managing tallgrass prairie and other grasslands. For example, John Blair participated in an "Ask the Expert" Facebook live session, sponsored by the Flint Hills Discovery Center. Blair answered questions about Konza Prairie and our research. Zak Ratajczak discussed the future of prairie ecosystems during an online webinar hosted by the KSU Beach Museum's Prairie Studies Initiative. Konza scientists also serve as consultants for the Flint Hills Discovery Center, and we participate in Kansas Agricultural Experiment Station public education events by providing information on the ecological consequences of various grassland management practices (e.g., fire frequency and grazing). Data from KPBS also is used to address issues relevant to regulatory policy, such as air and water quality. Long-term data on Konza Prairie stream water quality provides a baseline for regional water quality in the absence of agricultural practices or other disturbances. LTER data on soil chemistry is being incorporated into studies to evaluate the potential of grassland management practices to increase soil carbon sequestration to offset atmospheric CO₂ loading.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There are no major changes or problems and no anticipated changes in approaches in the next fiscal year.

All of the capacity project investigators provided opportunities for professional training of research staff, graduate students, and undergraduate students in their laboratory groups.

Below are some selected publications from the 21 fiscal year related to this capacity project:

Collins, S.L., J.B. Nippert, J.M. Blair, J.M. Briggs, P. Blackmore, and Z. Ratajczak. 2021. Fire frequency, state change and hysteresis in tallgrass prairie. *Ecology Letters* 24:636-647. doi:10.1111/ele.13676.

Connell, R.K., L.H. Zeglin, and J.M. Blair. 2021. Plant legacies and soil microbial community dynamics control soil respiration. *Soil Biology & Biochemistry* 160: 108350. doi.org/10.1016/j.soilbio.2021.108350.

Connell, R.K., O'Connor, R.C., Nippert, J.B., and J.M. Blair. 2021. Spatial variation in soil microbial processes as a result of woody encroachment depends on shrub size in tallgrass prairie. *Plant and Soil* 460: 359-373. doi:10.1007/s11104-020-04813-9.

Dodds, W. K., J. Guinnip, A. E. Schechner, P. J. Pfaff, and D. J. Smith. 2021. Fate and toxicity of engineered nanomaterials in the environment: A meta-analysis. *Science of the Total Environment* 796:148843.

<https://doi.org/10.1016/j.scitotenv.2021.148843>

Johnson, L.J. M. Galliard, J. Alsdurf, B.R. Maricle, S.G. Baer, N.M. Bello, D.J. Gibson, and A.B. Smith. Reciprocal transplant gardens as gold standard to detect local adaptation in grassland species: New opportunities moving into the 21st century. *Journal of Ecology*. doi: [10.1111/1365-2745.13695](https://doi.org/10.1111/1365-2745.13695)

Rossini, P., I.A. Ciampitti, T.J. Hefley, A. Patrignani. (2021) A soil moisture-based framework for guiding the number and location of soil moisture sensors in agricultural fields. *Vadose Zone Journal* 20:e20159

Veenstra, R.L., C. Messina, D. Berning, L. Haag, P. Carter, T. Hefley, V. Prasad I. Ciampitti. (2021) Effect of tillers on corn yield: Exploring trait plasticity potential in unpredictable environments. *Crop Science* 61:3660–3674

Correndo, A.A., T.J. Hefley, D. Holzworth, D., I.A. Ciampitti. (2021) Revisiting linear regression to test agreement in continuous predicted-observed datasets. *Agricultural Systems Journal* 192:103194

Lacasa, J., T.J. Hefley, F. Curin, M.E Otegui, I.A. Ciampitti. (2021) A practical guide to estimating the light extinction coefficient with nonlinear models – an example in maize. *Plant Methods* 17:60.

Munaro L.B., T.J. Hefley, E. DeWolf, S. Haley, A.K. Fritz, G. Zhang, L.A. Haag, A.J Schlegel, J.T. Edwards, D. Marburger, P. Alderman, S.M. Jones-Diamond, J. Johnson, J.E. Lingenfelter, S.H. Unêda-Trevisoli, R.P. Lollato. (2020) Exploring long-term variety performance trials to improve genotype, management, and environment recommendations: a case-study for winter wheat. *Field Crops Research*. 255:107843.

Novel Strategies To Improve Thermotolerance In Reproductive Stage Of Tomato

Project Director

Sunghun Park

Organization

Kansas State University

Accession Number

1019632



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Climate change and food security are preeminent global concerns. The last several years were the warmest ever recorded thus challenges resulting from climate change/global warming will critically increase. Given the inverse relationship between rising temperatures and crop yield, solutions must be found to address protecting and even increasing food productivity in unprecedented warming global conditions. Though CGFS-type glutaredoxin (*GRX*) genes are important regulators of ROS homeostasis and heat stress adaptation, each of their functions in crop plants have not yet been well understood. In this study, we demonstrated that *GRXS14* and *GRXS17* are ideal candidates to be overexpressed in important food crops to improve their tolerance to heat stress.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Though CGFS-type glutaredoxin (*GRX*) genes are important regulators of ROS homeostasis, each of their functions in crop plants have not yet been well understood. To better understand the mechanisms of glutaredoxin (*GRX*)-mediated heat tolerance in tomato, the targeted mutagenesis of *Solanum lycopersicum* class II glutaredoxins (*SIGRXS14*, *SIGRXS15*, *SIGRXS16*, and *SIGRXS17*) has previously been generated using a multiplex CRISPR/Cas9 system. To examine the importance of CGFS-type *SIGRXs* for a tomato's response to high temperatures, *s14*, *s16*, and *s17* single mutants, *s14;s16* double mutants, *s14;s16;s17* triple mutants, and wild-type plants were exposed to high temperatures. Under normal growth conditions, 18 individuals of each mutant line and wild-type did not show any visually phenotypic differences, while all single, double, and triple mutant lines showed impaired growth under heat stress conditions. *s14* and *s17* single mutants were severely affected by heat stress and showed severe heat stress symptoms such as burned leaves and slowed growth, whereas *s16* single mutants and wild-type plants were less affected. Due to the additive impact of *s14*, *s16*, and *s17* mutations, triple mutant plants appeared to be the most severely damaged. *s14s16* double mutants did not show additive symptoms of *s14* and *s16* single mutants and were less damaged than *s14* single mutants. After two weeks of recovery under normal growth control conditions, wild-type and *s16* single mutants completely recovered, while *s17* single mutants and *s14;s16;s17* triple mutants

failed to recover and died. *s14* single mutants and *s14;s16* double mutants recovered, however, they still showed some stress symptoms. Heat stress is accompanied by the formation of ROS, including H₂O₂, which is the most general indicator of oxidative damage to plants. H₂O₂ content of wild-type and all mutant lines was similar under normal growth control conditions. Under heat stress conditions, H₂O₂ significantly accumulated in *s14* and *s17* single mutants when compared with wild-type plants, while H₂O₂ accumulation in *s16* single, *s16;s14* double and *s14;s16;s17* triple mutants was similar with that in wild-type plants, indicating that *S14* and *S17* are ideal candidates to be overexpressed in important food crops to improve their tolerance to heat stress.

Briefly describe how your target audience benefited from your project's activities.

The primary target audiences for this foundational research project are scientists and tomato breeders to develop heat tolerant cultivars, as well as communities studying genome-editing technologies. In addition to scientists, the target audience includes farmers in the US to be exposed to current genome editing technologies and information, as well as the general public with a need to better understand the impact of genome editing on global food production.

Briefly describe how the broader public benefited from your project's activities.

A graduate student was invited to present a talk on this work at the 2021 World Congress on In Vitro Biology Virtual Meeting (2021 World Congress SIVB, the Society for In Vitro Biology, Conference).

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

No major changes or problems.

One graduate student, one undergraduate student, and one assistant scientist were involved in this project. An assistant scientist gained extensive expertise in tomato genome-editing techniques and expanded her knowledge of CRISPR/Cas9 technology. A graduate student gained extensive expertise of phenotyping of tomato plants under multiple abiotic stresses. They obtained the opportunity to participate in professional and national conferences to present the results from this project (e.g., oral presentation in a conference, the Society for In Vitro Biology). Additionally, an undergraduate student gained extensive experience in growing tomato plants in the greenhouse, analyzing tomato phenotypes, and collecting data.

Whether *GRXS17* has a conserved heat tolerance function in cereal crops and whether ectopic expression of *AtGRXS17* in maize affects heat tolerance capacity during reproductive stages are unknown. We will continue working on *AtGRXS17* in the maize inbred line B104, which is sensitive to heat stress throughout the reproductive stages, to determine if *AtGRXS17* affects heat tolerance of the reproductive stages and the potential of *AtGRXS17* benefits under field conditions. We will also explore the functions of *AtGRXS17* in response to heat stress using transcriptomics and protein activity and oxidation assays.

Products:

T. Kakeshpour, T.M. Tamang, G. Motolai, Z. Fleming, J. Park, Q. Wu, and S.H. Park (2021) CGFS-type glutaredoxin mutations reduce tolerance to multiple abiotic stresses in tomato. *Physiologia Plantarum*. 173: 1263-1279

G. Lin, C. He, J. Zheng, D.H. Koo, H. Le, H. Zheng, H. Le, H. Zheng, T.M. Tamang, J. Lin, Y. Liu, M. Zhao, Y. Hao, F. McFarland, B. Wang, Y. Qin, H. Tang, D.R. McCarty, H. Wei, M.J. Cho, S.H. Park, H. Kaeppler, S. Kaeppler, Y. Liu, N.M. Springer, P.S. Schnable, G. Wang, F.F. White, and S Liu (2021) Chromosome-level genome assembly of a regenerable maize inbred line A188. *Genome Biology*. 22: 175

M. Zhao, Z. Peng, Y. Qin, L. Zhang, B. Tian, Y. Chen, Y. Liu, G. Lin, H. Zheng, C. He, K. Lv, H.N. Trick, Y. Liu, M.J. Cho, S.H. Park, H. Wei, J. Zheng, F.F. White, and S Liu (2021) Bacterium-enabled transient gene activation by artificial transcription factor for resolving gene regulation in maize. *bioRxiv*. <https://doi.org/10.1101/2021.02.05.429970>

G. Lin, C. He, J. Zheng, Y. Liu, H. Le, T.M. Tamang, M. Zhao, Y. Hao, F. McFraland, B. Wang, H. Wei, M-J. Cho, S.H. Park, H. Kaeppler, S.M. Kaeppler, Y. Liu, P.S. Schnable, F.F. White, and S. Liu (2021) Genome Assembly of A188 and Genetic Mapping of Regeneration. Annual Maize Genetics Conference – Maize GDB, March/2021. Saint Louis, MO

T.M. Temang and S.H. Park (2021) Ectopic Expression of a Monothiol Glutaredoxin, *AtGRXS17*, Improves the Maize Yield Under Combined Heat and Drought Stress. 2021 World Congress SIVB, June/2021.

Improving Meat Quality and Safety

Project Director

Elizabeth Boyle

Organization

Kansas State University

Accession Number

1018004

**Annual Progress Report 2020-2021**

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Fresh meat palatability, tenderness, and color, processed meat quality, and shelf life assessment are important to delivering quality consumer products. The research undertaken in this project is aimed at addressing these areas.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Palatability

The palatability of meat products is comprised primarily of tenderness, juiciness, and flavor. Overall eating quality can fail as a result of the failure of any one of these traits or as a result of the failure of a combination of traits (O'Quinn et al., 2018). As a result, no single trait is "most important" and an understanding of the underlying mechanisms impacting each trait is critical to ensuring a satisfactory eating experience for meat consumers. Though much research over the past several decades has helped the scientific community move closer to an understanding of the factors impacting meat palatability, there is still much that is unknown and unexplored. Additionally, constant changes in animal production techniques and meat processing technologies have a large impact on meat palatability. This presents an ever growing need to evaluate such practices and the impact they have on end-product quality. Meat quality factors including color, pH, water activity, muscle fiber type and size, marbling level, collagen content, lipid and moisture content, fatty acid profile, and countless other factors can impact consumer purchasing intent and meat palatability. It is therefore the objectives of this portion of the project to evaluate such factors and further develop an understanding of the biological systems impacting meat tenderness, juiciness, and flavor.

Shelf life

Novel shelf life assessment technologies were explored in this objective. One such technology, bioelectrical impedance (BIA), a non-destructive analysis, was first documented in the medical sciences at the beginning of 1900s (Morse, 1925). Later, Callow (1936) was one of the first meat scientists who studied the electrical characteristics of meat. Following his work, Swatland (1985) used electrical impedance to evaluate the relationship between the quality of pork carcasses and its electrical properties. Additionally, an accurate fat content determination was demonstrated in different grinds of pork and beef using BIA, however, Marchello et al. (1999) reported that the smaller the grind size (0.32-cm plate), the more accurate BIA was to predict fat content. To visually illustrate how electrical impedance is applied to meat products, two electrodes are placed onto a meat surface to induce a current flow, which then measures the voltage.

The Seafood-CQR is a non-invasive electronic device, developed by Seafood Analytics, currently used to measure the freshness of seafood products, including both whole fish and fillets. The device sends a low frequency electrical current through the fish and collects data based on its relative conductivity. Once conductivity is measured, the reader assigns a Certified Quality Number (CQN) to the seafood product, which is an indicator of freshness. In general, a higher CQN correlates to a fresher, and therefore higher-quality, fish (Seafood Analytics, 2018). Currently, to our knowledge, there was no published data correlating the use of this technology with predicted shelf life of red meat products.

Additionally, meta-analysis of available literature data was used to assess fresh red meat shelf life.

Quality

We employed traditional and cutting-edge tools to investigate the contributions to collagen degradation in beef, woody breast in poultry, and biochemical factors influencing meat tenderness. The results from this objective may improve the tenderness and value of U.S. beef by better understanding pre- and post-harvest factors affecting the biology of beef and poultry tenderization and quality.

Briefly describe how your target audience benefited from your project's activities.

In the face of economic and environmental pressures, the United States must rely on the ability to produce a higher quality beef product that meets consumer demands while remaining competitive in the global beef market and having a limited impact on the environment. The outcomes of this research benefits producers, processors, and consumers by gaining an understanding of the biochemical factors that drive tenderness, consumer perceptions of products, and rapid methodologies that assess red meat shelf life.

Briefly describe how the broader public benefited from your project's activities.

Producers and processors will gain knowledge and a more comprehensive understanding of the factors impacting meat palatability, tenderness, and marketability to make them more competitive in a global market. Consumers benefit by access to high quality meat and poultry products.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Journal Articles:

LaRoche, E. M., W. J. Wu, P. Garcia, B. Song, C. K. Y. Chun, C. K. Jones, A. R. Crane, T. G. O'Quinn, and M. D. Chao. 2022. Evaluation of skin-on goat meat processing on processing efficiency, carcass yield, meat quality, and sensory attributes. *Meat Sci.* 184:108675. doi:10.1016/j.meatsci.2021.108675

Shen, Y., S. Hong, Z. Du, M. Chao, T. O'Quinn, and Y. Li. 2022. Effect of adding modified pea protein as functional extender on the physical and sensory properties of beef patties. *LWT* 154:112774. doi:10.1016/j.lwt.2021.112774

Davis, S. D., K. M. Harr, K. J. Farmer, E. S. Beyer, S. B. Bigger, M. D. Chao, A. J. Tarpoff, D. U. Thomson, J. L. Vipham, M. D. Zumbaugh, and T. G. O'Quinn. 2021. Quality of plant-based ground beef alternatives in comparison with ground beef of various fat levels. *Meat Muscle Biol.* 5:1-15. doi:10.22175/mmb.12989

Beyer, E. S., K. M. Harr, B. A. Olson, E. A. Rice, C. K. Jones, M. D. Chao, J. L. Vipham, M. D. Zumbaugh, and T. G. O'Quinn. 2021. Palatability traits of sirloin cap steaks from four USDA quality grades. *Meat Muscle Biol.* 5:1-10. doi:10.22175/mmb.12424

Matney, M. J., M. E. Gravely, T. G. O'Quinn, J. S. Drouillard, K. J. Phelps-Ronningen, T. A. Houser, A. W. Hobson, H. M. Alcocer, and J. M. Gonzalez. 2021. Effects of extended postmortem aging and intramuscular location on protein degradation, muscle fiber morphometrics, and tenderness of beef longissimus lumborum and semitendinosus steaks. *J. Anim. Sci.* 99. doi:10.1093/jas/skab263

Pozuelo, K. C., D. Vega, K. Habib, F. Najar-Villarreal, Q. Kang, V. Trinetta, T. G. O'Quinn, R. K. Phebus, and S. E. Gragg. 2021. Validation of post-harvest antimicrobial interventions to control Shiga toxin-producing *Escherichia coli* (STEC) on market hog carcass surfaces. *Int. J. Food Microbiol.* 358:109421. doi:10.1016/j.ijfoodmicro.2021.109421

Wu, W. J., A. A. Welter, E. A. Rice, B. A. Olson, T. G. O'Quinn, E. A. Boyle, G. Magnin-Bissel, T. A. Houser, M. D. Chao, and T. G. O'Quinn. 2021. Biochemical factors affecting East Asian consumers' sensory preferences of six beef shank cuts. *Meat Muscle Biol.* 5:1-18. doi:10.22175/mmb.11626

Musa, A. A., Y. Y. Mammed, M. Y. Kurtu, M. Temesgen, and T. G. O'Quinn. 2021. Carcass and meat characteristics of bulls from Arsi, Boran, Harar and Holstein Frisian crosses cattle breeds finished under similar level of concentrate supplementation. *Open J Anim Sci* 11:11-30. doi:10.4236/ojas.2021.111002

Villatoro, K.M., F. Yang, T. Lew, C.R. Phillips, D.R. Woerner, **M. D. Chao** and X. Yang (2021). Quality, proximate composition, and sensory of dorper, domestic commercial crossbred and Australian lamb meat: a comparative study. *Translational Animal Science*, txab024. <https://doi.org/10.1093/tas/txab024>

Tefera, T. D., Y. Y. Mammed, M. Y. Kurtu, M. U. Letta, T. G. O'Quinn, and J. L. Vipham. 2021. Eating quality of beef from Arsi, Borana, and Harar cattle breed, Oromia national region, Ethiopia. *Open J Anim Sci* 11:255-268. doi: 10.4236/ojas.2021.112020

Tefera, T. D., Y. Y. Mammed, M. Y. Kurtu, M. U. Letta, T. G. O'Quinn, and J. L. Vipham. 2021. Proximate composition and profile of fatty acid of beef from Arsi, Borana, and Harar cattle breeds in Oromia national regional state, Ethiopia. *Open J Anim Sci* 11:139-156. doi: 10.4236/ojas.2021.112011.

Najar-Villarreal, F., E.A. Boyle, C. I. Vahl, Q. Kang, J.J. Kastner, J. Amamcharla, and M.C. Hunt. 2021. Determining the longissimus lumborum and psoas major beef steak color life threshold and effect of postmortem aging time using meta-analysis. *Meat and Muscle Biology* 5(1): 41, 1-11. doi: <https://doi.org/10.22175/mmb.12526>.

Najar-Villarreal, F. E.A. Boyle, C.I. Vahl, Q. Kang, T.A. Houser, J.M. Gonzalez, J. Amamcharla, D. Vega, J.J. Kastner, and M. Cox. 2021. Correlation of bioelectrical impedance with freshness quality attributes of beef longissimus lumborum steaks. *Meat and Muscle Biology* 5(1): 9, 1-11. doi: <https://doi.org/10.22175/mmb.11704>.

Journal Articles In review:

Welter, A. A., W. Wu, T. G. O'Quinn, E. R. Geisbrecht, S. D. Hartson, B. C. Bowker, H. Zhuang and **M. D. Chao** (2022) An integrative omics approach to understand sarcoplasmic reticulum's role in elevated levels of free calcium in broiler woody breast. *Poultry Science* – in review

Hammond, P. A., C. K. Y. Chun, W. Wu, A. A. Welter, T. G. O'Quinn, G. Magnin-Bissel, E. R. Geisbrecht and **M. D. Chao** (2022). An investigation on the influence of various biochemical tenderness factors on eight different bovine muscles. *Meat and Muscle Biology* – in review

Welter, A. A., W. Wu, T. G. O'Quinn, D. L. Boyle, B. C. Bowker, H. Zhuang and ***M. D. Chao** (2022). A proposed mechanism for the altered textural property of woody breast in broilers. *Poultry Science* – in review

Abstracts:

Welter, A. A., Koulicoff, L. A., Verrill, E. and **Chao, M. D.** (2021). Native beef MMP-2 may contribute to postmortem collagen degradation in extended aged beef *Proceedings of 67th International Congress of Meat Science and Technology*, Krakow, Poland.

Farmer, K. J., E. A. Rice, A. B. Lerner, A. A. Welter, D. L. Boyle, M. D. Chao, J. L. Vipham, M. D. Zumbaugh, and T. G. O'Quinn. 2021. Effects of increased pork hot carcass weights on biochemical factors impacting tenderness. Presented at the Reciprocal Meat Conference, Reno, NV.

Farmer, K. J., E. S. Beyer, S. G. Davis, K. M. Harr, M. D. Chao, J. L. Vipham, M. D. Zumbaugh, and T. G. O'Quinn. 2021. Trained sensory panel evaluation of the impact of bone-in vs. boneless cuts on beef palatability. Presented at the Reciprocal Meat Conference, Reno, NV.

Harr, K. M., E. S. Beyer, K. J. Farmer, S. G. Davis, M. D. Chao, M. D. Zumbaugh, J. L. Vipham, and T. G. O'Quinn. 2021. Change in evaluation of 80/20 ground beef when additional labeling information is provided. 2021. Presented at the Reciprocal Meat Conference, Reno, NV.

Harr, K. M., E. S. Beyer, K. J. Farmer, S. G. Davis, M. D. Chao, M. D. Zumbaugh, J. L. Vipham, and T. G. O'Quinn. 2021. Changes in consumer sensory evaluation of ground beef when information is provided about the primal source. 2021. Presented at the Reciprocal Meat Conference, Reno, NV.

Davis, S. G., K. J. Farmer, E. S. Beyer, K. M. Harr, S. Bigger, D. U. Thomson, M. D. Chao, J. L. Vipham, M. D. Zumbaugh, M. Apley, D. A. Blasi, S. Ensley, M. Haub, M. Miesner, A. J. Tarpoff, K. C. Olson, and T. G. O'Quinn. 2021. Trained sensory evaluation of plant-based ground beef alternatives in comparison to ground beef of various fat percentages. Presented at the Reciprocal Meat Conference, Reno, NV.

Beyer, E. S., K. M. Harr, S. G. Davis, K. J. Farmer, M. D. Chao, J. L. Vipham, M. R. Zumbaugh, and T. G. O'Quinn. 2021. Changes in the perception of ground beef quality as a result of price per pound labeling. Presented at the Reciprocal Meat Conference, Reno, NV.

Koulicoff, L. A., C. K. Chun, T. G. O'Quinn, and M. D. Chao. 2021. Native beef collagenase may contribute to postmortem collagen degradation and alteration of connective tissue texture. Presented at the Reciprocal Meat Conference, Reno, NV.

Velasco Ayala, C., P. A. Hammond, A. A. Welter, C. Chun, T. G. O'Quinn, E. A. E. Boyle, E. Geisbrecht, and M. D. Chao. 2021. An investigation of the relationship between sarcomere length and meat tenderness and a novel way to measure sarcomere length. Presented at the Reciprocal Meat Conference, Reno, NV.

Mushrush, M., K. M. Harr, E. S. Beyer, S. G. Davis, K. J. Farmer, M. D. Chao, J. L. Vipham, M. D. Zumbaugh, and T. G. O'Quinn. 2021. The impact of fat content labeling on consumer sensory evaluation of 80/20 ground beef. Presented at the Reciprocal Meat Conference, Reno, NV.

Hammond, P. A., M. D. Chao, C. K. Chun, W. Wu, A. A. Welter, T. G. O'Quinn, and G. Magnin-Bissell. 2021. An investigation on the influence of various biochemical tenderness factors on eight different bovine muscles. 2021. Presented at the Reciprocal Meat Conference, Reno, NV.

Chun, C. K. Y., Welti, R., Roth, M., Richards, M. and **Chao, M. D.** (2021). Exploring the potential effect of anti-phospholipase A2 antibody to extend beef shelf-life in a beef liposome model system. *Proceedings of 74th Reciprocal Meats Conference*, Reno, NV.

McDonald, F. B., Rimmer, L., Chun, C. K. Y., Jones, C. K., Crane A. R. and **Chao, M. D.** (2021). A proposed reevaluation on the impact of feeding distillers grains plus solubles on meat quality using a goat meat model. *Proceedings of 74th Reciprocal Meats Conference*, Reno, NV.

Verrill, E, Wu, W. J., and **Chao, M. D.** (2021). A proposed ELISA method to evaluate elastin content in beef shank and understanding elastin contents effect on beef shank tenderness. *Proceedings of 74th Reciprocal Meats Conference*, Reno, NV.

Pozuelo, K., D. Vega, C. Kang, K. Habib, F. Najjar, V. Trinetta, T. G. O'Quinn, R. Phebus, and S. E. Gragg. 2021. Validation of post-harvest antimicrobial interventions to control Shiga toxin-producing Escherichia coli (STEC) on market hog carcass surfaces. Presented at the International Association for Food Protection Annual Meeting, Phoenix, AZ.

Closing Out (end date 09/07/2023)

[Improving efficiency of beef production through nutrition and management strategies](#)

Project Director

James Drouillard

Organization

Kansas State University

Accession Number

1018307



Results from FY21

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project aims to evaluate nutrition and management factors that influence efficiency of beef production. Nutritional inputs, alteration of gut microorganisms, management of rangelands through prescribed burning, and evaluation of castration methods were among the areas evaluated by our team.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

An experiment was conducted to evaluate effects of modulating nutritional inputs in growing steers fed corn-based diets. More specifically, methyl group availability was altered through post-ruminal provision of creatine, guanidinoacetic acid, and choline. Creatine was provided to reduce the use of methyl groups for creatine synthesis. Guanidinoacetic acid was provided to consume methyl groups as it is methylated to form creatine. Choline synthesis is a significant consumer of methyl groups, and it was provided to reduce choline synthesis and spare methyl groups. Supplementation of guanidinoacetic acid increased use of methionine in methylation reactions, presumably to support the conversion of guanidinoacetic acid to creatine. Cattle receiving guanidinoacetic acid also had more homocysteine remethylated to methionine, which allowed them to deposit more methionine in body tissues. In contrast to our hypothesis that choline supplementation would reduce use of methionine for methylation reactions, supplementation of choline increased consumption of methionine for methylation

reactions. However, choline also increased remethylation of homocysteine to methionine, which prevented the increased use of methionine for methylation reactions from reducing methionine availability for protein deposition in the body. Under our experimental conditions, efficient capture of homocysteine through remethylation prevented a net loss of methionine from the body in response to modifications in methyl group metabolism.

An experiment was conducted to evaluate impact of administering the probiotic organisms, *Megasphaera elsdenii*, on performance of feedlot cattle subjected to an accelerated transition to high-concentrate diets. A control group was transitioned to high-grain diets over a period of 21 days using a series of 5 diets that contained progressively greater proportions of concentrate and less roughage. Performance of these cattle was compared to those transitioned to the same high-concentrate finishing diet, but diet transition consisted of daily dosing with *Megasphaera* and transition to the finishing diet over a period of only 10 days. Ruminal pH measurements recorded from indwelling pH boluses indicated that *Megasphaera* groups maintained elevated ruminal pH, and thus were at less risk for development of ruminal acidosis, which is a key metabolic disorder associated with use of high-concentrate diets in cattle. Feedlot performance and carcass traits were similar for animals in control and accelerated groups, indicating it is possible to transition cattle over shorter periods of time without inducing metabolic disturbances.

The second year of data from our six-year prescribed burning study was interpreted to indicate that prescribed fire timing influenced stocker cattle performance. Bodyweight gain data from 2019, 2020, and 2021 were analyzed using a mixed model, considering the effects of year, pasture, and treatment. The year by treatment interaction was not significant; therefore, the main effects of treatment were reported. No differences in average daily gain were observed between spring and summer prescribed-fire treatments. Conversely, average daily gain was greater for calves that grazed the spring and summer fire treatments compared with calves that grazed the fall-fire treatment. As a result, final bodyweight was greater for calves that grazed the spring- and summer-burn treatments compared with calves that grazed the fall burn treatment. Prescribed-fire timing was associated with small changes in range-plant composition; however, root carbohydrate concentrations in key native forage plants were not affected by treatment. Beef producers are encouraged to compare potential revenue shortfalls resulting from changes to yearling growth performance reported here with the cost of chemical methods for sericea lespedeza control.

A 56-day receiving field study was conducted utilizing 99 intact bull calves weighing ~700lbs to compare 4 separate castration techniques (Band, Band plus splitting of the distal scrotum, burdizzo clamp, surgical castration with a Henderson tool) to a sham negative control group during January and February of 2021. Weights were obtained on Day 7, 14, 21, 35, 49, and 56. Digital Thermography images were taken during weigh days. Blood samples were taken to measure testosterone levels at the end of the trial. Feeding behavior and activity was also recorded via SCR electronic ear tags and feeding time behavior scoring. Thermography images gave insight to healing and inflammation differences between treatment groups. Control groups did have increased activity levels compared all other treatment groups, however all animals exhibited similar diurnal activity patterns. Surgical castration had a trend of decreased Average Daily Gain compared to other less invasive techniques.

Briefly describe how your target audience benefited from your project's activities.

Target audiences for these studies include peer scientists, extension personnel, industry consultants, and livestock producers. Studies with methyl donors are of a more fundamental nature, and were designed to improve our understanding of the complexities of post-absorptive metabolism. As such, the results are most relevant to peer scientists. Revealing the application of *Megasphaera elsdenii* in feedlot production systems to manage metabolic disorders is very useful to industry consultants and livestock producers, providing a path to improvements in production efficiency and management of animal well-being. Prescribed burning remains an important tool for rangeland management, and when appropriately applied provides means for improving rangeland ecology and animal performance, and thus directly impacts profitability and sustainability of livestock operations in the Flint Hills region. The evaluation of castration methods will facilitate decision-making by veterinarians and livestock producers, and demonstrates means of capturing performance improvements.

Briefly describe how the broader public benefited from your project's activities.

Factors that contribute to efficiency of beef production, such as those described herein, conserve precious natural resources, including land, water, and air. This directly impacts cost of production, and thus cost of goods to consumers. Growing interest by the broader public in animal well-being and sustainability of agricultural practices are directly addressed by these results.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

No significant modifications or problems were encountered in the conduct of these studies. Results were disseminated through peer-reviewed publications, livestock field days, tours hosted at university livestock facilities, through youth programs, and via radio programs and podcasts. Activities in the current fiscal year include laboratory work to allow completion of research investigating methyl group metabolism in cattle. New research will be initiated utilizing omega-3 fat sources to enhance growth efficiency and cattle health. Research with grain hybrids will be conducted, with an emphasis on improving efficiency of nitrogen use and reducing ammonia emissions from feedlots. Additional work is planned that will focus on applications of the probiotic organism, *Megasphaera elsdenii*, with emphases on decreasing methane production in feedlot cattle and understanding possible application in growing cattle fed forage-based diets. The prescribed burning component of our work will continue with an additional year of data collection, as this was designed as a 6-year study.

Closing Out (end date 09/07/2023)

Managing Plant Microbe Interactions in Soil to Promote Sustainable Agriculture

Project Director

Gretchen Sassenrath

Organization

Kansas State University

Accession Number

1018005



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Soil-borne diseases severely impact agronomic production, reducing the yield and quality of crops. Our research is designed to identify the modes of infection of disease organisms, and develop and implement alternative methods to manage these disease organisms. The research examines the soil microbiome, and changes in the soil biology with alternative management practices, such as cover crops. Results are transferred to producers, landowners, and the general public through training, education, and extension outreach.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Objective 1 To identify and characterize new biological agents, microbial community structure and function, naturally suppressive soils, cultural practices, and organic amendments that provide management of diseases caused by soilborne plant pathogens.

Crop production fields with disease pressure were identified. Soil samples were taken and tested for diseases (phytophthora root rot and charcoal rot) and nematodes (soybean cyst nematodes). Soil biological activity was assessed using PLFA and background nutrient status was measured. Charcoal rot was identified to be a much more pervasive disease in southeast Kansas than other diseases or SCN.

Objective 2. To understand how microbial populations and microbial gene expression are regulated by the biological (plants and microbes) and physical environment and how they influence disease.

Objective 3 Implement sustainable management strategies for soilborne pathogens that are biologically based and are compatible with soil health management practices.

Cover crops were planted in four replicated blocks in the fields in the fall and included: control (fallow with herbicide, no cover crop); wheat; Graza radish; annual ryegrass; spring oats; winter oat; forage collards; commercial cover crop mix; and a mix of radish+ ryegrass planted both drilled and broadcast methods. Spring oats had the highest levels of NO₃-N remaining, but lower levels of NH₄-N. No consistent changes in nutrient levels for the different cover crops could be related to the measured difference in soybean yield. Bacterial percentage was the highest in all cover crop plots, with a similar pattern in percentage of actinomycetes and fungi.

Objective 4. Provide outreach, education, extension and technology transfer to our clients and stakeholders- growers, biocontrol industry, graduate and undergraduate students, K-12 students and other scientists.

The Spring Crops Field day was held on May 19, 2021 at the SEREC in Parsons, KS. Presentations on wheat production, crop management and “Cover Crops, Soil Health, and Weed Control” were shared with 105 attendees. A Soil Health webinar series was presented in February, 2021. Four presentations were made by experts on soil-borne diseases, agroecological system functions, soil structure, and soil biology. In addition to the 37 participants to the webinars, the videos have been accessed multiple times on the K-State Southeast Research and Extension Center YouTube channel (<https://www.youtube.com/channel/UC0aJYslMCyX9gVRgH10Zwtg>).

Briefly describe how your target audience benefited from your project's activities.

Farmers gained information on soil health through the online webinar series. Information on crop production and soil health management were taught during the in-field extension training. Information on disease presence (Phytophthora stem/root rot, charcoal rot *M. phaseolina*), soybean cyst nematodes, and Sudden Death Syndrome (SDS) were identified in field samples. Results were presented to collaborating farmer and discussed, including conventional control methods and alternative production management options.

Briefly describe how the broader public benefited from your project's activities.

One graduate student was trained in plant and soil sampling and data collection and analysis. One high school student was training in soil and plant sampling and preliminary analysis.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Increasing use of online meetings has enhanced our outreach to farmers and the general public. This is an excellent opportunity to expand our audience and present our research activities and results to the public.

Closing Out (end date 09/07/2023)

Marketing and Delivery of Quality Grains and BioProcess Coproducts

Project Director

Kaliramesh Siliveru

Organization

Kansas State University

Accession Number

1018087



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

To improve management and operational systems to increase efficiency, retain quality, enhance value, and preserve food safety in the farm-to-user supply chain. Research in 2021 studied improved methods to detect and monitor stored product pests in various habitats, evaluate the efficacy and practicality of fumigant alternatives to phosphine and methyl bromide as well as the efficacy and practicality of food safe materials to protect these commodities.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Fumigants studied included phosphine (PH3) with regard to diagnosis of resistance in lesser grain borer, *Rhyzopertha dominica* (Afful et al. 2021), and sulfuryl fluoride (SF) for efficacy against both the red-legged ham beetle, *Necrobia rufipes* and the mold mite, *Tyrophagus putrescentiae*. SF was easily effective for all life stages of *Necrobia* within the label rate, but as with many other insects, we did not get satisfactory control of mite eggs at a very high dose, one that was equal to about 3-times the allowable label rate (Hasan et al., 2021). We began work on the so-called liquid fumigants, propylene oxide (PPO) and ethyl formate (EF) as relatively safer fumigant alternatives to the more dangerous SF and PH3.

Briefly describe how your target audience benefited from your project's activities.

Work with PPO and EF are still ongoing, but an initial study using PPO in combination with SF was able to give good control against the most serious stored product quarantine pest, khapra beetle (KB), *Trogoderma granarium*, when applied in combination with SF (Myers et al. 2021). It is critical that KB be kept out of the USA; methyl bromide (MB) was the only fumigant used over many decades. Since the post-harvest uses of MB are now banned under the US Clean Air Act and the international Montreal Protocol, quarantine regulators face the possibility that MB may soon be unavailable for quarantine. The finding that PPO + SF combined are effective for KB is very important. Work on quarantine treatments at KSU in collaboration with USDA APHIS PPQ will continue into 2022 to 2023.

Several research projects looked at safe methods for use in integrated pest management of storage pests. Contact toxicity and repellent activity of safe plant-based compounds were analyzed. The mosquito repellent DEET and the fatty acid mixture of octanoic, nonanoic, and decanoic (C8910) acids were also evaluated as safe repellents and toxicants. These food-safe compounds were repellent to *R. dominica* and the cigarette beetle, *L. serricornis*, and showed promise for commercial application as organic insecticides for several pests (Manu et al. 2021). The life history and general biology of *Necrobia rufipes* was documented in more detail than in the past, and gave information useful for pest management of this beetle in the future (Hasan et al., 2021). Insect trapping is very important for detecting and monitoring stored product pests for relative numbers over time and locations in a building. Doud et al. (2021) showed how traps could be used to monitor grain pests in flour mills before and after structural fumigation to determine fumigation efficacy. Results confirm that fumigation may not be full-proof as flour mill traps detected insects within a few weeks of treatment. Our work with food safe methods to keep the insidious mite *T. putrescentiae* off of high value commodities found one more food-safe compound, chitosan, for addition to anti-mite nets (Shao et al., 2021).

We are also evaluating the effect of two new silica dusts supplied by Imerys Chemicals, Lompoc, California, in managing insects on concrete surfaces (to simulate farm bins) and on various stored commodities (example, wheat and corn) against damaging stored product insects. Prior to testing the efficacy of the silica dusts, the particle size analysis of the two silica dusts was carried out by using Morphologi G3-ID morphologically directed Raman system (Malvern Instruments, Worcestershire, UK). The particle size and shape of the two silica dusts was assessed by considering the CE mean diameter of number of particles distributed, HS circularity and aspect ratio. The mean CE diameter (2.59 μm) of the silica 1 dust particles was higher compared to silica dust 2 (1.98 μm). On the other hand, the mean HS circularity (0.602) and aspect ratio (0.568) of the silica dust 1 was comparatively lower than silica dust 2 with 0.606 and 0.634 as their respective mean HS circularity and aspect ratio. The results suggested that among the two silica dusts analyzed for particle size and shape, the silica dust 2 had smaller size distribution and had more circular particles compared to silica 1 and anticipated to have better insect mortality. The efficacy of the two silica powders have been evaluated against four stored product insect species namely, the red flour beetle (*Tribolium castaneum*), confused flour beetle (*Tribolium confusum*), lesser grain borer (*Rhyzopertha dominica*) and sawtoothed grain beetle, (*Oryzaephilus surinamensis*). The results of the experiments conducted with the two amorphous silica powders are encouraging and showed species specific responses. The adults of *T. confusum*, *R. dominica* and *O. surinamensis* were found to be more susceptible to silica 2 dust with concentrations above 4.0 g/m² exposed for 24 h in the concrete treated arena experiments. On the other hand, the adults of *T. castaneum* were more susceptible to silica 1 dust leading to complete mortality at concentrations above 3 g/m² exposed for 24 h. Complete inhibition of progeny production was observed over treatment to silica dust 1 at concentrations above 2 g/m² for 24 h in *T. castaneum* as compared to silica dust 2 which required a concentration of 2.5 g/m² and an exposure time of 36 h. For tests with *R. dominica*, silica dust 2 was found to be more effective to inhibit the progeny production, requiring concentrations of 3.5 g/m², and an exposure time of 24 h. Similar results were observed for the experiments involving *T. confusum* and *O. surinamensis* where silica dust 2 inhibited the progeny production at a lower concentration of 3.0 g/m² exposed for 24 h respectively. In continuation to the experiments to evaluate the efficacy of silica dust against stored-product insects on concrete treated arenas, the efficacy of the silica dust on stored product insects will be evaluated by admixing with stored food grains. The present experiments will show the efficacy of two amorphous silica powders on major stored grain insects on concrete surfaces and as on commodities, and we will document any adverse effects on grain physical properties at various concentrations.

Briefly describe how the broader public benefited from your project's activities.

The evaluated silica dusts and chemicals could be used as alternative fumigants to phosphine.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The results have been disseminated through research publications and workshops.

Workshops:

Kansas State University, International Grains Program. Dr. Siliveru and Dr. Campabadal presented a training seminar on "Grain Quality Characteristics" and "Temporary Storage Options" and Dr. Phillips presented on "Grain Fumigation" to a group of 22 grain elevator managers held at the International Grains Program center in person on May 25-28, 2021.

Degeche America Fumigation Co. Podcast. Dr. Phillips was interviewed in a podcast aired June 10th, 2021 on the topic of "Potential for Phosphine resistance." Degeche-America is part of one of the world's larger producer of phosphine fumigant products, Detia Degeche GmbH, Laudenbach, Germany The podcast can be heard at this link:
<https://drive.google.com/file/d/1Xlxr9Ksnj1dN2XsleR8TEllyWce54z13/view?usp=sharing>

American Peanut Sheller's Association. Dr. Phillips was part of an IPM Training Program for managing Farmers' Stock Peanuts, and presented "IPM for Stored Product Pests: Phosphine, Phosphine Resistance and Alternatives" via Zoom on August 18, 2021.

Minnesota Grain and Feed Association. Dr. Phillips delivered a talk via Zoom titled "Fumigation Resistance on the Rise: Dealing with Re-occurring Infestations" to a group assembled in St. Cloud, MN on November 18, 2021.

Kansas Grain and Feed Association. Dr. Phillips gave two presentations for the KGFA this year, both titled "Fumigation: Challenges and Alternatives". The first was in person on November 17, 2021 to a large audience of nearly 100 in Wichita. Dr. Siliveru and Dr. Bhadriraju also presented lectures on fumigation strategies on November 30, 2021 at Garden City, KS

North Carolina State University. Dr. Phillips helped in the review and revision of a draft training document titled "Commodity Fumigation: A Certification Manual for North Carolina." This book may serve as a model for a similar manual I hope to write for KSU Cooperative Extension.

PUBLICATIONS

1. Afful E, Cato, A., Nayak, M. K., Phillips, T. W. 2021. A rapid assay for the detection of resistance to phosphine in the lesser grain borer, *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae). J. Stored Prod. Res. Vol. 91.
<https://doi.org/10.1016/j.jspr.2021.101776>
2. Doud, C.W.; Cuperus, G.W.; Kenkel, P.; Payton, M.E.; Phillips, T.W. 2021. Trapping *Tribolium castaneum* (Coleoptera: Tenebrionidae) and other beetles in flourmills: evaluating fumigation efficacy and estimating population density. Insects, 12, 444. <https://doi.org/10.3390/insects12020144>
3. Hasan, M. M., Aikins, M. J., Schilling, M. W. and Phillips, T. W. 2021. Sulfuryl fluoride as a methyl bromide alternative for fumigation of *Necrobia rufipes* (Coleoptera: Cleridae) and *Tyrophagus putrescentiae* (Sarcoptiformes: Acaridae), major pests of animal-based stored products. J. Stored Prod Res. Vol 91 online <https://doi.org/10.1016/j.jspr.2021.101769>
4. Manu, N., Schilling, M. W. and Phillips, T. W. 2021. Natural and synthetic repellents for pest management of the storage mite *Tyrophagus putrescentiae* (Schrank) (Sarcoptiformes: Acaridae). Insects. 12, 711.
<https://doi.org/10.3390/insects12080711>
5. Myers, S.W., Ghimire, S. N., Arthur, F. H. and Phillips, T. W. 2021. A Combination sulfuryl fluoride and propylene oxide treatment for *Trogoderma granarium* (Coleoptera: Dermestidae). J. Econ. Entomol. 114: 1489-1495

6. Hasan, M. M., Aikins, M. J., Mahroof, R. M. and Phillips, T. W. 2021. Effects of diet and temperature on the life history of the red-legged ham beetle, *Necrobia rufipes* DeGeer (Coleoptera: Cleridae). *Environ. Entomol.* 51: 278–285
<https://doi.org/10.1093/ee/nvab116>
7. Shao, W., Campbell, Y. L., Phillips, T. W., Freeman, C., Kundu, Crist, C. A., Williams, J. B. and Schilling, W. M.. 2021. The application of chitosan in food-grade coatings to control *Tyrophagus putrescentiae* on dry-cured hams and the effects on sensory properties. *J. Stored Prod. Res.* 94:101899. <https://doi.org/10.1016/j.jspr.2021.101899>
8. Yao, K. D., Bh. Subramanyam, and R. G. Maghirang. 2021. Moisture content and application rates of inert dusts: Effects on dust and wheat physical properties. *Food Research* (in press).
9. Yao, K. D., Bh. Subramanyam, K. Siliveru, J. Anthony, and R. G. Maghirang. 2021. Using the FT4 Powder Rheometer to characterize bulk and dynamic flow properties of Hard Red Winter wheat (HRW) treated with three amorphous silica dusts. *Journal of Stored Products Research* (in press).
10. Pulivarthi, M.K., E. Nkurikiye, J. Watt, Y. Li, and **K. Siliveru**. 2021. Comprehensive understanding of roller milling on the physico chemical properties of red lentil and yellow pea flours. *Processes* (Accepted for publication).
11. Zhang, Y., R. Hu, M. Tilley, **K. Siliveru**, and Y. Li. 2021. Effect of pulse type and substitution level on dough rheology and bread quality of whole wheat based composite flours. *Processes*, 9 (9), 1687.
12. Barretto, R., R. M. Buenavista, R. Pandiselvam, and **K. Siliveru**. 2021. Influence of milling methods on the flow properties of ivory teff flour. *Journal of Texture Studies*, 1-14.
13. Yoganandan, M., S. R. Bean, R. Miller-Regan, H. Dogan, M. K. Pulivarthi, and **K. Siliveru**. 2021. Effect of tempering conditions on white sorghum milling, flour, and bread properties. *Foods*, 10, 1947.
14. Rivera, J. D., A. Deliephan, J. Dhakal, C. G. Aldrich, and **K. Siliveru**. 2021. Significance of Sodium Bisulfate (SBS) tempering in reducing the *Escheria coli* O121 and O26 load of wheat and its effects on wheat flour quality. *Foods*, 10 (7), 1479.
15. Buenavista, R. M. E., **K. Siliveru**, and Y. Zheng. 2021. Utilization of dried distiller's grain with solubles: A review. *Journal of Agriculture and Food Research*, 5, 100195.
16. Kheiralipour, K., H. Ahmadi, A. Rajabipour, S. Rafiee, M. Javan-Nikkhah, D. S. Jayas, **K. Siliveru**, and A. Malhipour. 2021. Processing the hyperspectral images for detecting infection of Pistachio kernel by R5 and KK11 isolates of *Aspergillus flavus* fungus. *Iranian Journal of Biosystems Engineering*, 52 (1), 13-25.
17. Raj, A. S., R. Martin, B. Zaitoun, and **K. Siliveru**. 2021. Influence of particle size on baking characteristics of hard wheat flour. *Cereal Technology*, 61-68.

18. **Siliveru, K.**, and R. P. K. Ambrose. 2021. Predicting the particle separation and sieve blinding during wheat flour sifting. *Transactions of the ASABE*, 64(3), 1103-1112.

19. Barretto, R., R. M. Buenavista, J. Rivera, S. Wang, P. V. Vara Prasad, and **K. Siliveru**. 2021. Teff (*eragrostis tef*) processing, utilization, and future opportunities: a review. *Invited Review Paper. International Journal of Food Science and Technology*, 56, 3125-3137.

Closing Out (end date 09/07/2023)

Development of Wheat Varieties with High Yield, Good Quality, Drought Tolerance, and Disease Resistance

Project Director

Guorong Zhang

Organization

Kansas State University

Accession Number

1017084



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Wheat is the most important food crop in the world and Kansas is the top wheat-producing state in the USA. New wheat varieties with improved agronomic performance and better end-use quality will be critical for Kansas wheat growers and wheat industries. This project will integrate the conventional breeding method with advanced technologies to develop both hard red and hard white winter wheat varieties with the adaptation to the semi-arid western Kansas.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

To address our project objectives, we were continuing the testing and selection in our current breeding cycles and starting the new breeding cycles through making new crosses as well. The major activities during this report period have been conducted as following:

- (1) made 383 new crosses to start new breeding cycles;
- (2) advanced 348 F1 and 276 F2 populations;
- (3) selected a total of 658 lines from doubled haploid lines and F4 or F5 head rows for next year's preliminary yield trials;
- (4) a total of 4287 yield plots were planted and tested; after testing, we selected 183 lines for continued testing in their second year's preliminary yield trials, 48 lines for continued testing in the advanced yield trials; and 28 lines for continued testing in the elite yield trials;
- (5) Selected 4 elite lines for half-acre seed increase and 2 elite lines for foundation seed production.

Briefly describe how your target audience benefited from your project's activities.

Wheat farmers have benefited from improved yield and disease resistance in our released wheat varieties, which increased their income and reduced their production cost. Wheat industries have benefited from improved milling and baking qualities in our released wheat varieties, which increased their profits and increased their competitiveness in both domestic and international markets. In 2021, a total of over 471 thousand acres (about 15% of the wheat acreage in western Kansas) has been grown wheat varieties produced from this project. Five varieties released from this project have been selected to be on the preferred variety list for excellent milling and baking qualities by the nation's largest flour milling company, GrainCraft.

Briefly describe how the broader public benefited from your project's activities.

Using our improved wheat varieties, farmers were producing more and more wheat grains with less and less cost and therefore made the food in the USA more affordable and stabilized the wheat grain (flour) supply in the market, which has benefited the generic public. The disease resistance in our wheat varieties also helped on reducing pesticide usage during the production, therefore reduced the environment pollution and benefited the generic public.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

During this report period, the project suffered a severe hail damage in May 2021, in our main breeding site at Hays, KS. The hail not only ruined all our yield trials (thousands of plots) at Hays, but also damaged our early breeding populations including F2, F3 and F4 generations, which were only planted at Hays. About 70% of F3 and 100% of F4 (about 25000 head rows) were lost. We salvaged as much as possible. We are replanting the preliminary breeding lines next year since they were only planted at Hays. We also picked one head each from about 10000 F4 head rows for replanting next year. In order to minimize the hail damage impact, we also introduced about 400 breeding lines and 5000 F4 heads from K-State Manhattan and Oklahoma State University wheat breeding programs.

During this report period, I had the opportunity to serve on graduate student committee of five PhD students, serve as associate editors for two peer-reviewed journals, conduct peer review of seven journal manuscripts and two PhD dissertations from Pakistan.

Our research results have been disseminated through papers, presentations, Youtube video, and other activities. During this report period, we published a total of 6 peer-reviewed journal papers, 4 non-referred journal papers or extension papers, 3 Plant Variety Protection (PVP) certificates, one Youtube video, and 5 presentations.

Publications

Peer-reviewed journal publications:

- 1. Zhang G.**, A.K. Fritz, S.D. Haley, Y. Li, G. Bai, R.L. Bowden, M.S. Chen, Y. Jin, X. Chen, J.A. Kolmer, B.W. Seabourn, R.Y. Chen, and D. Marshall. 2021. Registration of 'KS Western Star' hard red winter wheat. *Journal of Plant Registrations*. 15:140-146. DOI: 10.1002/plr2.20104.
- 2. Zhang G.**, T.J. Martin, A.K. Fritz, R.L. Bowden, Y. Li, G. Bai, M.S. Chen, Y. Jin, X. Chen, J.A. Kolmer, B.W. Seabourn, R.Y. Chen, and D. Marshall. 2021. Registration of 'KS Silverado' hard white winter wheat. *Journal of Plant Registrations*. 15:147-153. DOI: 10.1002/plr2.20106.
- 3. Zhang G.**, R.Y. Chen, *M. Shao, G. Bai, and B.W. Seabourn. 2021. Genetic analysis of end-use quality traits in wheat. *Crop Science*. 61:1709-1723. <https://doi.org/10.1002/csc2.20411>.
- 4. Tian W.**, G. Chen, **G. Zhang**, D. Wang, M. Tilley, and Y. Li. 2021. Rapid determination of total phenolic content of whole wheat flour using near-infrared spectroscopy and chemometrics. *Food Chemistry*. 344. <https://doi.org/10.1016/j.foodchem.2020.128633>.
- 5. Tian W.**, G. Chen, Y. Gui, and **G. Zhang**, and Y. Li. 2021. Rapid quantification of total phenolics and ferulic acid in whole wheat using UV-Vis spectrophotometry. *Food Control*. 123. <https://doi.org/10.1016/j.foodcont.2020.107691>.
- 6. Zhang P.**, M Tilley, G. Bai, S. Harmer, S. Duke, B.W. Seabourn, and **G. Zhang**. 2021. Effect of wheat quality traits and glutenin composition on tortilla quality from the USDA Southern Regional Performance Nursery. *Cereal Chemistry*. 00:1-11. DOI: 10.1002/ccche.10475.

Non peer-reviewed or extension publications:

- 1. Zhang G.**, A.K. Fritz, R.P. Lollato, E. De Wolf, and J. Rupp. 2021. KS Western Star hard red winter wheat. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. L943.
- 2. Zhang G.**, A.K. Fritz, R.P. Lollato, E. De Wolf, and J. Rupp. 2021. KS Silverado hard white winter wheat. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. L942.
- 3. Zhang G.**, A.K. Fritz, R.P. Lollato, E. De Wolf, and J. Rupp. 2021. KS Dallas hard red winter wheat. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. L941.

4. Ranabhat N.B., M. Bruce, M.A. Davis, A.K. Fritz, **G. Zhang**, and J.L. Rupp. 2021. Reaction of selected Kansas winter wheat cultivars to Barley yellow dwarf, 2020. Plant Disease Management Report. 15: CF094.

Plant variety protection(s) (PVPs):

1. Wheat “KS Silverado”, Certificate No. 202000289, Issued on 07/02/2021.
2. Wheat “KS Western Star”, Certificate No. 202000288, Issued on 07/02/2021.
3. Wheat “KS Dallas”, Certificate No. 202000287, Issued on 07/02/2021.

Other Products

Products:

YouTube video, 2021: KS Hamilton wheat variety from Kansas Wheat Alliance.

Events:

1. Presented wheat varieties at the Ellis County Field Day in Victoria, KS on May 25, 2021.
2. Presented wheat varieties at the Decatur County Field Day in Decatur, KS on June 15, 2021.
3. Presented wheat breeding lines to seed farmers at Kansas Wheat Alliance summer meeting on July 29, 2021.
4. Gave a talk during US senator Moran’s station tour at Hays, KS on 11/19/2020.
5. Gave a talk during Kansas Governor Laura Kelly’s group tour in Healy, KS on 7/27/2021.
6. Attended virtual Wheat Quality Council Meeting on Feb. 16-19, 2021.
7. Attended virtual 2021 Hard Winter Wheat Rust Symposium on April 6 & 8, 2021.

Regulation of virus replication in insects

Project Director

Rollie Clem

Organization

Kansas State University

Accession Number

1016739



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

We are studying insect virus replication in insect hosts and insect vectors. Insect hosts or vectors are pests to agricultural plants or cause disease in livestock and humans, respectively. Studying these insect virus systems will allow us to 1) produce improved biological pest control agents to manage insect pests and 2) improve methods of controlling vector borne diseases.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

1) We have developed a method that allows us to identify viral proteins that may be stabilizing the viral particle (substrates of a viral sulfhydryl oxidase). Stability of the virus is important to preserve its integrity as a bioinsecticide or a foreign gene expression system.

2) We have defined the role and requirement of a viral protein called cathepsin in releasing virus (occluded form of baculoviruses) from infected cells and insect cadavers. Knowing the mechanisms of virus release from infected insect hosts will allow us to design improved biopesticides that self-disseminate.

3) We completed a study that examined the importance of virus replication in the gut during infection of the mosquito vector. Understanding the role of virus replication in the gut will help in the development of novel disease control strategies.

4) We studied the causes of variability in virus replication between individual mosquitoes. Variation between mosquitoes impacts the spread of viruses, so understanding the basis for this variability may lead to increased ability to limit virus spread.

Briefly describe how your target audience benefited from your project's activities.

Target audiences include research scientists at several levels, including graduate students, undergraduate students, and research assistants, which have been part of the project. Results from the project have been published and discussed at annual scientific meetings and at invited seminars. Thus, those attending these meetings, students, other trainees, and faculty, have also been target audiences.

Briefly describe how the broader public benefited from your project's activities.

The public is benefiting from improved methods of pest insect control and insect-borne disease mitigation.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Publications:

Hodgson, J. J., P. J. Krell, and A. L. Passarelli. 2021. Mature viral cathepsin is required for release of viral occlusion bodies from *Autographa californica* multiple nucleopolyhedrovirus-infected cells. *Virology* 556:23-32.

Carpenter A, Bryant WB, Santos SR, Clem RJ. 2021. Infection of *Aedes aegypti* Mosquitoes with Midgut-Attenuated Sindbis Virus Reduces, but Does Not Eliminate, Disseminated Infection. *J Virol.* 95(13):e0013621. doi: 10.1128/JVI.00136-21.

Food Quality and Safety Post Harvest

Project Director

Joseph Smith

Organization

Kansas State University

Accession Number

7000240



Food Quality and Safety Post Harvest

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project is a comprehensive approach to address food safety challenges including development of methods for chemical and biological hazard detection; intervention strategies to control those hazards; information transfer of technologies to the scientific community, the federal government, the food industries, and consumers; and related economic, policy, and trade implications.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The primary focus of this work will continue methods development for the isolation, detection, and quantification of microbial and chemical hazards and the elimination of those hazards. Collaborating with other microbiologist, food chemists and engineers, the research has investigated several non-thermal technologies (e.g. active packaging and UV light) to reduce and control forborne pathogens, ensuring safety and improving quality. Major research and accomplishments are the detection and quantification of irradiation markers in irradiated pet food products. There have been concerns for the safety of

the irradiated pet foods, especially due to multiple reports of serious illnesses and deaths in pets after consumption of jerky treats and cat foods in the last decade. This project elucidates the formation of irradiation-specific markers in various pet food products, such as chicken jerky treats, sweet potato treats, pig ears.

The proposed project generally aims to systematically study the nature and importance of micro-scale interactions that determine the behavior of small molecules in a complex food system by using various novel and suitable characterization techniques. This knowledge will be used in designing active environmental-controlled delivery systems to enhance the effectiveness and efficiency of natural small molecules in foods (e.g., phytochemicals) with antioxidant properties, and related beneficial health effects (e.g., against cancer formation). In conjunction with this research the formation of toxic compound produced during the cooking process will be evaluated. The research will focus on products of the common non-enzymatic browning reactions, Maillard and caramelization. It is know there are health concerns with heterocyclic amines (HCAs), 4-methylimidazole and the advanced glycation end products (AGEs). It is thought that these type compound are involved in promoting metabolic diseases such as diabetes and heart disease. Thus efforts are underway to control their formation and inhibition with naturally occurring antioxidants present in a variety of fruits, vegetables and spices.

Generic Escherichia coli inoculated onto cleaned wheat kernels was used to profile the spread of potential microbial contamination throughout a representative milling process to support industry decision-making for necessary sanitation programs. Food safety research was conducted to validate enteric pathogen survival in wheat kernels, wheat flour, and flour-based bakery products after application of antimicrobial protocols (food-grade chemical and/or thermal schedules). Further evaluation of the impact of these applications on ingredient and finished product quality were performed. Meat safety research continues to address the application of common and/or novel technologies to control the microbiological quality and safety of raw meat products during manufacturing. A USDA-NIFA-AFRI grant to characterize the survival of infectious SARS-CoV-2 virus within meat and poultry processing facilities was initiated and studies were performed to develop virus recovery and quantification methodology from meat-associated samples. Aerosol-based distribution of infectious virus in a simulated processing room was evaluated.

Completed a study on the production of gluten-free cookie inclusions for ice cream use. Part of the work was used for an abstract to submit to IFT. Initiated a study on the use of social marketing theory to influence the purchasing and consumption of dairy foods. Results have been collected and resulted in an abstract submission for ADSA.

Briefly describe how your target audience benefited from your project's activities.

1. Assess biological and chemical risks in agriculture systems
2. Develop science-based interventions to prevent and mitigate threats
3. Resolve safety and quality issues for processors by providing process and packaging solutions
4. To evaluate the potentiality of fluorescence spectroscopy for the prediction of instrumental texture attributes and melting characteristics of process cheese.
5. Evaluation of the micro-scale interactions in complex food systems that determine the stability, and bioavailability of behavior of small molecules (e.g., reactivity, phase distribution, bioavailability) in relation to food quality and functionality
6. Design and characterization of novel delivery systems (i.e., nano-structured lipid composites, solid lipid nanoparticles, colloidosomes) for natural and functional food ingredients
7. Evaluation of the antioxidant and anticarcinogenic properties of the designed delivery systems to control formation of heat-induced compounds
8. To conduct scholarly activities related to food product development. This will encompass determination of sensory, safety, and quality parameters in new food products developed by students in the FDSCI 740 course: Research and Development of Food Products and students developing food products for Product Development Competitions.

Briefly describe how the broader public benefited from your project's activities.

1. The Kansas food and meat processing industry will adopt technologies and intervention strategies that will result in a safer, more wholesome food supply.
2. Industry/commodity groups, meat and food processors, regulatory agencies (FDA, FSIS), and consumer groups will increase knowledge and understanding of food safety principles to support enhancement of their respective roles in assuring a safe, wholesome food supply.
3. Food processing operations will reduce spoilage and potential food borne pathogens as a result of sanitation and HACCP training and implementation

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Results have been disseminated via traditional avenues of peer-reviewed manuscripts, professional meeting abstracts and presentations, and trade-level workshops and presentations. Studies and data on the irradiation markers, such as 2-dodecylcyclobutanone, have been shared with the FDA Center for Veterinary Medicine for possible uses in monitoring pet food treatment levels.

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Antimicrobial Resistance

Project Director

Raghavendra Amachawadi

Organization

Kansas State University

Accession Number

1014385



Antimicrobial Resistance

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Our project mainly addresses these two goals:

- Evaluated alternative to antibiotics and their impact on development/propagation of antimicrobial resistance in both cattle and swine production systems.
- Improved understanding and or the knowledge on antibiotic alternatives and their use in food animals.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The dissemination of antibiotic resistance among gut bacteria can yield vast pools of resistance elements which may then be transferred to pathogens. If pathogenic bacteria resistant to antibiotics enter the food chain, treatment of humans can be complicated. Our overall goal is to identify, evaluate, and implement practical interventions for managing antibiotic resistance in swine and turkey production systems. We focus on the longstanding problem of resistance emergence, dissemination, and persistence among commensal enteric bacteria; that is, among beneficial and non-pathogenic bacteria naturally present in the gut of healthy livestock. We will employ a variety of methods to assess and then improve the quality of evidence contained in education and extension materials such as veterinary curricula and commodity specific prudent-use guidelines. We will improve the research base of this knowledge through a series of laboratory and field studies built on a framework of theoretical, basic and applied research. Our systems-based approach for achieving practical and proven interventions against this pressing problem will address a highly significant applied food safety problem

Briefly describe how your target audience benefited from your project's activities.

Our research results will be disseminated to inform stakeholders, including policymakers, producers, scientists, pharmaceutical and health industry partners, and consumers on issues concerning the usefulness of antibiotic alternatives to prevent antimicrobial resistance across the food chain. Results will be presented at meetings, such as the American Society of Animal Science/ American Dairy Science Association (ASAS/ADSA) joint meeting and the Conference of Research Workers in Animal Diseases (CRWAD); in addition, the results will be shared with Kansas State University (KSU) colleagues at Phi-Zeta research day in the College of Veterinary Medicine, KSU swine day and Cattlemen's day reports. Results will be disseminated to an even wider audience via peer-reviewed scientific journals (*Journal of Food Protection*, *Applied and Environmental Microbiology*), directly shared with key industry contacts, and presented at local and regional conferences to beef and pork

producers, feed industry, and additional scientific audiences. The dissemination strategies proposed here will reap rich benefits because they utilize time-tested methods (seminars, symposiums, and scientific and lay publications) as well distance education tools (webinars and online forums) to provide convenient access for both education and engagement.

Briefly describe how the broader public benefited from your project's activities.

Our research results will be disseminated to inform stakeholders, including policymakers, producers, scientists, pharmaceutical and health industry partners, and consumers on issues concerning AMR development, spread, and mitigation strategies. The dissemination strategies proposed here will reap rich benefits because they utilize time-tested methods (seminars, symposiums, and scientific and lay publications) as well distance education tools (webinars and online forums) to provide convenient access for both education and engagement.

The mission of the Extension Beef and Swine Group is to provide educational tools and outreach opportunities through online resources and annual meetings to address current topics to engage and support a welfare-centered, economically sustainable, and environmentally responsible beef and swine industry in its mission to produce safe and wholesome beef and pork products.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Publications

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11. Dixon, A., N. Cernicchiaro, **R. G. Amachawadi**, C. A. Cull, X. Shi, and D. G. Renter. **2020**. Longitudinal characterization of prevalence and concentration of Shiga toxin-producing *Escherichia coli* serogroups in feces of individual feedlot cattle. **Foodborne Pathogens and Disease**. **17**(10): 631-639.
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4. Roubicek, C., **R. G. Amachawadi**, H. Salih, J. Wang, Y. Li, and T. G. Nagaraja. **2021**. Evaluation of antimicrobial activities of phytophenols against bacterial pathogens that cause liver abscesses in feedlot cattle. Midwest ASAS meeting, March 8-10, 2021. Virtual meeting.
5. Chance, A. J., J. T. Gebhardt, J. M. DeRouche, **R. G. Amachawadi**, V. Ishengoma, T. G. Nagaraja, H. I. Calderon, M. D. Tokach, J. C. Woodworth, R. D. Goodband, and J. Loughmiller. **2021**. Live yeast and yeast extracts with and without pharmacological levels of zinc on nursery pig growth performance and antimicrobial susceptibilities of fecal *Escherichia coli*. Midwest ASAS meeting, March 8-10, 2021. Virtual meeting.
6. Salih, H., **R. G. Amachawadi**, C. Roubicek, S. Sexton-Bowser, J. Wang, Y. Li, and T. G. Nagaraja. **2021**. Evaluation of sorghum phenolic compounds for their antimicrobial activities against liver abscess causing pathogens in feedlot

cattle. Midwest ASAS meeting, March 8-10, 2021. Virtual meeting.

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8. Ishengoma, V., **R. G. Amachawadi**, X. Shi, T. Mahmood, W. M. Hutchens, M. D. Tokach, S. S. Dritz, J. C. Woodworth, R. D. Goodband, J. M. DeRouchey, and T. G. Nagaraja. **2021**. Oral antimicrobial administration did not influence the fecal prevalence and antimicrobial susceptibility profiles of *Salmonella* in piglets. 2021 Phi Zeta Research Day. March 2nd, 2021. College of Veterinary Medicine, Kansas State University.
9. Roubicek, C., **R. G. Amachawadi**, H. Salih, J. Wang, Y. Li, and T. G. Nagaraja. **2021**. Evaluation of antimicrobial activities of phytophenols against bacterial pathogens that cause liver abscesses in feedlot cattle. 2021 Phi Zeta Research Day. March 2nd, 2021. College of Veterinary Medicine, Kansas State University.
10. Salih, H., **R. G. Amachawadi**, C. Roubicek, S. Sexton-Bowser, J. Wang, Y. Li, and T. G. Nagaraja. **2021**. Evaluation of sorghum phenolic compounds for their antimicrobial activities against liver abscess causing pathogens in feedlot cattle. 2021 Phi Zeta Research Day. March 2nd, 2021. College of Veterinary Medicine, Kansas State University.
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Conservation, Management, Enhancement and Utilization of Plant Genetic Resources

Project Director

Michael Stamm

Organization

Kansas State University

Accession Number

1013406



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project contributes to the advancement of the U.S. National Plant Germplasm System (NPGS) and the North Central Region through utilization of germplasm stored within the system and placement of new germplasm within the system for future exploitation. For example, the germplasm stored at the North Central Regional Plant Introduction Station in Ames, IA is a critical resource for breeding canola-quality winter cultivars for adaptation to the southern Great Plains. Other important crops on this project using, evaluating, and characterizing NPGS germplasm include sorghum, soybean, and wheat.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

During the project period, the winter canola cultivar, KSR4848, was approved for seed increase. KSR4848 is resistant to glyphosate herbicide and carries a maturity date that is 2 to 3 days later than commercial checks. Future release of this high-yielding cultivar will add diversity in maturity date to the current group of commercial glyphosate-resistant cultivars. Seeds

for cultivar KS4719, a new winter canola cultivar with greater lodging tolerance, were deposited in the NPGS with submission of a Plant Variety Protection certificate (PVP #202100186). Cultivars partially supported by this project are making an impact on the winter canola industry with roughly 7,000 planted acres in Kansas and 12,000 planted acres in Oklahoma in 2021 (NASS Crop Production, 2021). Cultivars containing a genetic component supported by this project make up a majority of these acres. Introducing winter canola improves the overall sustainability and profitability of cropping systems through crop rotation and diversification.

A project team member tested herbicide-tolerant sorghum genotypes for their performance under field conditions. The tolerant genotypes did not show any yield penalty upon treatment with herbicides in comparison to herbicide-sensitive genotypes. Biochemical experiments indicated that the herbicide-tolerant genotypes showed a rapid metabolism of herbicide. Genetic analyses suggested that the herbicide tolerance is inherited as a single dominant trait in grain sorghum. These herbicide-tolerant sorghum genotypes were crossed with sensitive genotypes as well as some widely used breeding lines to assess the combining ability of the tolerant genotypes. Using conventional breeding methods the trait can be easily introgressed into breeding lines. The availability of herbicide tolerant technology is valuable for weed management, which is a challenging constraint in grain sorghum production throughout the US. Investigation of the markers linked to herbicide tolerance will enable future use in a breeding program.

Current wheat germplasm and its interaction with environment and management are being evaluated for traits associated with increased yield. Long-term variety trial data has been scrutinized for a range of agronomic and disease resistance traits. Experiments are investigating physiological traits for increased yield, increased grain protein concentration, and genetic gain in yield.

Wild relatives of wheat have been used to broaden the gene pool of *Triticum aestivum*. Patterns of introgression from *Aegilops tauschii* have been explored. Wild materials, including *Ae. tauschii*, *Ambylopyrum mutica*, *Triticum dicoccoides*, and *Ae. ventricosa* continue to be evaluated and transferred to adapted backgrounds for the purposes of addressing biotic and abiotic stresses and explore the potential of improving wheat quality and nutritional traits.

Genetically diverse soybean association panels are being phenotyped for response to heat and drought stress. Accessions characterized as heat or drought tolerant are being used as parents to develop germplasm with the goal of sustaining yield, quality and composition under heat and drought stress conditions while increasing genetic diversity in the US elite soybean germplasm.

Briefly describe how your target audience benefited from your project's activities.

The target audience will benefit from new winter canola cultivars and germplasm, characterization of herbicide tolerance in sorghum, identification of traits important to wheat yield and quality, introgression of genetic diversity from wheat wild relatives, and improved drought and heat stress tolerance in elite soybean germplasm.

Briefly describe how the broader public benefited from your project's activities.

The general public will benefit from new cultivars of canola, soybean, sorghum, and wheat that will enable enhanced food production and greater resiliency to ever changing climatic conditions.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The project team shares results with constituents through field days, extension meetings, agronomy production updates, refereed journal articles, professional society meetings, radio and television interviews, and participation in social media.

Students in Agronomy 630, Crop Improvement and Biotechnology, were presented a guest lecture on winter canola variety development, from the initial cross to variety release, in May 2021. An emphasis was placed on the importance of using diverse plant genetic resources housed within the NPGS.

Closing Out (end date 09/07/2023)

[Enhancing the Competitiveness and Value of U.S. Beef](#)

Project Director

Glyndall Tonsor
Organization
Kansas State University
Accession Number
1014346



Enhancing the Competitiveness and Value of U.S. Beef

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project includes economic and meat science efforts to enhanced the competitiveness and value of U.S. beef.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The economic and meat science research, coupled with active engagement and outreach to industry stakeholders and policymakers, allowed us ot make significant progress towards the project's goals.

Briefly describe how your target audience benefited from your project's activities.

Improved knowledge on the inner-workings of U.S. cattle and beef markets.

Briefly describe how the broader public benefited from your project's activities.

Improved knowledge via research, direct engagement in governmental hearings leveraging related research.

Closing Out (end date 09/07/2023)

Plant and Insect Biodiversity Research

Project Director
Carolyn Ferguson
Organization
Kansas State University
Accession Number
7000249



1. Maintain and enhance the K-State Herbarium

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project will maintain and enhance the K-State Herbarium, a research natural history collection of preserved plant specimens used for research, extension, and outreach. The Herbarium, housed in the Division of Biology, is a significant collection comprising specimens from throughout the world but with well-documented strengths in the flora of the Great Plains, historical specimens from North America, and material of relevance to agriculture in the Midwest. Maintenance and continued enhancement are needed to ensure resources for understanding plant diversity, particularly in the Great Plains region.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Major activities with respect to Objective 1 include: field collection of specimens; mounting, repair, and accessioning of specimens; and digitization, maintenance and improvement of accessibility of databased information. All of these activities continued during the reporting period, with increased activity focused on ongoing work to migrate the database to the newest version of *Specify* software (in collaboration with a colleague in the KSU Libraries).

Briefly describe how your target audience benefited from your project's activities.

The target audience for this project includes the scientific community interested in plant and insect diversity and population and community dynamics. As a result of activities for this objective, the target audience gains access to the resources of the K-State Herbarium. In addition to the resources of the physical holdings and the digital database, the Herbarium re-opened for visits during the reporting period (following initial hibernation in the early states of Covid-19), with some visits from scientists, and tours for classes and extension agents.

Briefly describe how the broader public benefited from your project's activities.

The K-State Herbarium is open to the public, and the database is publicly available over the web. These resources form the foundation of our understanding of documented plant diversity, benefiting all by contributing to an improved understanding of the natural world.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There are no current changes with respect to this objective. One undergraduate student worked in the Herbarium (general curatorial work, specimen preparation and mounting, and research relating to specimen data) during the reporting period (with funding from other sources).



2. Maintain and enhance the K-State Museum of Entomological and Prairie Arthropod Research

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project will maintain and enhance the K-State Museum of Entomological and Prairie Arthropod Research, a research natural history collection of preserved insect specimens used for research, extension, teaching, and outreach. This museum, housed in the Department of Entomology, is a large and important collection of insect and arthropod specimens with noteworthy strengths in historical specimens from the Great Plains region and extensive recent collections from the tallgrass prairies of Kansas. Maintenance and continued enhancement are needed to ensure resources for understanding entomological diversity, particularly in the Great Plains region.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Major activities with respect to Objective 2 concentrated on ongoing regional collection of Lepidoptera and obtaining digital images of North American species of Lepidoptera. Within the Lepidoptera, 2,840 specimens were added to the collection, including 124 species that were new to the collection. In addition, 393 specimens were identified to genus and 3,200 specimens were identified to species. An additional 543 lepidopteran specimens were identified as part of a graduate student's M.S. research project on prairie pollinators.

High-resolution digital images for 1,584 species of Lepidoptera were produced as part of the NSF-funded "Digitization TCN: Lepidoptera of North America Network: Documenting Radiation in the Largest Clade of Herbivores". After additional manipulations in Photoshop, these will be uploaded to the Symbiota Collections of Arthropods Network web site.

Loans of insect specimens for systematics research totaled 586 specimens and label data for additional specimens that were not loaned was provided to three researchers. Three voucher numbers were assigned to graduate students and faculty who submitted specimens.

As part of general outreach activities, a short educational video about the roles of insects in the Kansas River was produced for Friends of the Kaw, a 501(c)3 conservation group that advocates for the Kansas River. Also, a session on entomology was provided as part of the Kansas Master Naturalist training program at the Konza Prairie Biological Station.

Briefly describe how your target audience benefited from your project's activities.

The target audience for this project includes the scientific community interested in plant and insect diversity and population and community dynamics. As a result of activities for this objective, the target audience gains access to the resources of the K-State Museum of Entomological and Prairie Arthropod Research.

Briefly describe how the broader public benefited from your project's activities.

Documenting and understanding the biodiversity present in a region, making that information available to a variety of researchers or other interested parties, and serving as a permanent storehouse and clearinghouse for that information is fundamental to public concerns such as agriculture, conservation and the environment, medical/veterinary health, and education. Having an understanding of the insect fauna, providing specimens to researchers, and identifying specimens all serve the public interest. Contact with the public via different modes of outreach also educates the public regarding the importance of insects in their lives and the natural world.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There are no current changes with respect to this objective. One technician and one undergraduate student worker were involved with the project during the reporting period. The technician was heavily involved in the collection and identification of Lepidoptera. The undergraduate student worker received training on obtaining high quality digital images of moth and butterfly specimens.



3. Advance research on taxonomy of various plant and insect groups, and on polyploidy and plant diversity

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project will advance research on taxonomy of various plant and insect groups, and on polyploidy and plant diversity. There are many gaps in our knowledge of the plant and insect taxonomy and flora/fauna of North America, and much cryptic taxonomic diversity has gone unrecognized. As an example, polyploidy is an important phenomenon in plant evolution, yet there remain many open questions with respect to the implications of polyploidy for plant diversity.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Major activities with respect to Objective 3 include collections-based research, field, and/or laboratory investigation focused on plant and insect/arthropod diversity. Research continued throughout the reporting period, with particular foci on: taxonomy of plant groups (the plant genera *Phlox*, family Polemoniaceae; *Euphorbia*; Euphorbiaceae).

Briefly describe how your target audience benefited from your project's activities.

The target audience for this project includes the scientific community interested in plant and insect diversity and population and community dynamics. As a result of activities for this objective, the target audience gains access to specimen collections and annotations, and will gain information through research publications.

Briefly describe how the broader public benefited from your project's activities.

Increased scientific information on plant and insect diversity, coupled with the foundational specimen resources of the research collections (Objectives 1 and 2, above), benefit society by contributing to an improved understanding of the natural world.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There are no current changes with respect to this objective. One undergraduate student worked on research (relating to changes in plant chemistry over time based on herbarium specimen data) during the reporting period (with funding from other sources).

Presentations:

Ferguson, C. J. Where do we go from here? Envisioning opportunities for plant systematics in a post-pandemic world. Botany 2021 – Virtual! (annual meetings of the American Society of Plant Taxonomists, the Botanical Society of America, and others), online meeting, 18-23 July 2021. (invited talk, ASPT Incoming President address)



4. Increase understanding of population and community dynamics of plants and animals, particularly plants in the Great Plains region

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project will increase understanding of population and community dynamics of plants and animals, particularly of plants in the Great Plains region. Populations are affected by multiple stressors, including abiotic drivers such as climate or fire, as well as biotic stressors such as predators or herbivores. In spite of substantial research effort describing the impacts of both abiotic and biotic drivers on population dynamics of plants and animals, we are limited in our ability to predict the effects of multiple drivers in a changing climate. In particular, it is difficult to predict the sum impact of multiple drivers when both abiotic and biotic conditions are changing with climate change, and when different drivers can interact with one another (e.g., drought renders plants more susceptible to herbivores).

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Major activities with respect to Objective 4 include: field data collection on stressors' impacts in ~15 Great Plains plant species and multiple other non- Great Plains species, as well as modelling work designed to quantify these stressors' impacts on population dynamics. Additional modelling was conducted to quantify the effects of stressors on an additional 50 Great Plains species and multiple other non- Great Plains species, using long-term data from Konza Prairie Long-Term Ecological Research Site.

Briefly describe how your target audience benefited from your project's activities.

The target audience for this project includes the scientific community interested in plant and insect diversity and population and community dynamics. As a result of activities for this objective, the target audience had access to multiple presentations, in multiple forums, as well as both technical reports to agency stakeholders and governmental agencies, as well as publications in scientific journals.

Briefly describe how the broader public benefited from your project's activities.

An increased understanding of population dynamics benefit society by contributing to an improved understanding of the natural world. In addition, multiple studies originating from this objective contributed directly to listing decisions under the Endangered Species Act, thus facilitating preservation of such species for the broader public's enjoyment.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to

communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There are no current changes with respect to this objective. 6 undergraduate, 3 graduate students, and one postdoctoral scholar (funded by other sources) worked on research for this project.

Publications:

Louthan, AM, ML DeMarche, and LG Shoemaker. 2021. Climate sensitivity across latitude: scaling physiology to communities. *Trends in Ecology and Evolution* 36: 931-942. (accepted during reporting period; published in October 2021)

Louthan, AM, J Walters, AJ Terando, V Garcia, and WF Morris. 2021. Shifting correlations among multiple aspects of climate complicate predicting future demography of a threatened species. *Ecosphere* 12: e03740.

Louthan, AM and WF Morris. 2021. Climate change impacts on population growth across a species' range differ due to nonlinear responses of populations to climate and variation in rates of climate change. *PLOS ONE* 16: e0247290.

Doak, D, E Waddle, R Langendorf, A Louthan, N Chardon, R Dibner, D Keinath, E Lombardi, C Steenbock, R Shriver, C Linares, M Begona Garcia, WC Funk, S Fitzpatrick, WF Morris, M DeMarche. 2021. A critical comparison of the strengths and weaknesses of integral projection models and matrix projection models. *Ecological Monographs* 91: e01447.

Presentations:

Louthan, A. Global variation in climate and biotic interaction effects. Invited seminar, Plant Biology Program, Southern Illinois University. January 21, 2022. (oral presentation)

Sutton, A and A Louthan. Interactive effects of grazing, fire, and climate on forb abundance. Konza Long-term Ecological Research Site, annual meeting, Manhattan, KS. September 4, 2021. (oral presentation)

Louthan, AM, AW Baumgardner, J Ehrlén, J Dahlgren, A Loomis, and WF Morris. Sensitivity of population growth rate to climatic and biotic drivers across species' ranges. Botany conference, virtual. July 18-23, 2021. (oral presentation)

Improving Agricultural Efficiency, Sustainability and Profitability Through Innovative Research and Community-based Programming

Project Director

Laurie Chandler

Organization

Kansas State University

Accession Number

7000056



Business Planning Key to Agricultural Sustainability

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Business planning continues to be important for those involved in agriculture. This holds true whether a farm is in financial distress or is in a time of strong income. Commodity price levels have been relatively strong in 2021 and, while input costs began to increase in late 2021, many producers had purchased inputs prior to much of that increase. However, even in this improved financial condition for the farm sector, it is important for each producer and their advisors to know and understand the financial position and financial performance on each operation.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Specific 2021 activities include the following:

- 1,764 KFMA member farms representing 2,195 families in 100 of the 105 counties in Kansas. The KFMA membership represents over \$1.33 billion in value of farm production including more than \$210 million in value of livestock production. The total acreage used in production by these operations is 4.5 million acres. After a substantial drop in net farm income in 2015, net farm income has improved in each of the last five years. The analysis completed for these farms in 2021 represents the 2020 net income figures which show an increase from just under \$203 million in 2019 to over \$296 million in 2020.

- There were at least 6,005 “face-to-face” contacts with the 2,195 farm families during the year. Some of these occurred as on-farm visits or other one-on-one meetings and some occurred via Zoom or other remote technology. Activity during these meetings included review of financial and production records to identify improved record keeping and use of records; income planning and management; marketing decisions; equipment and other capital asset purchase/lease decisions; transition/succession and estate planning; among other topics.

- Fifty-three presentations to groups with approximately 1,415 in attendance.

- 2,260 whole-farm analyses were completed during 2021, allowing for comparative analysis and improved decision-making. The analysis reports include information on the current year and a trend analysis of the operation for the previous five years. Out of the total analyses completed, 953 are represented in the KFMA Summaries and for the information made available to the public through the KFMA website (www.AgManager.info/KFMA) and through other avenues, making this information available to all individuals involved in agriculture.

- 1,133 benchmark reports were processed for KFMA members during 2021.

- 2,911 individual crop and livestock enterprise analyses were completed for presentation to the individual members for comparative analysis and improved decision making. Of these, 1,649 are represented in the enterprise analysis summary reports. The enterprise analysis summary reports are also available to the public as with the whole-farm analysis (www.AgManager.info/KFMA).

- At least six radio interviews, as well as numerous news articles, were completed, delivering the KFMA data and decision-making information to many individuals in addition to the KFMA membership.

- KFMA data was utilized for in-class instruction, graduate and undergraduate student assignments and research projects, case farms and instructional aids. It is estimated these activities reached over 225 students in the College of Agriculture during 2021.

- KFMA data was utilized in numerous research and extension activities completed during 2021.

Briefly describe how your target audience benefited from your project's activities.

The total number of producers engaged in one-on-one consultations (in-person or remote) was 2,195. Each of these KFMA members have increased awareness of the financial performance of their farm operation. Additional producers (non- KFMA members) have also been reached through delivery of radio interviews, news articles, workshops, training sessions and other meetings.

Briefly describe how the broader public benefited from your project's activities.

Producers who are able to sustain long-term profitability will benefit other community members by increasing the viability of rural communities and their access to a safer and less expensive food supply.



Increasing Access to Locally Produced Fruits and Vegetables

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The demand for locally produced fresh produce continues to grow in Kansas, and there are not enough fruit and vegetable farmers to meet that demand. There is a great need for technical expertise and education among aspiring, new, and existing fruit and vegetable producers. Many small-acreage produce growers are first-generation farmers with limited resources. A 2017 Kansas Department of Agriculture survey, showed that 80% of farms that grow specialty crops are under 6 acres in size, and only 11% exceed 20 acres. Data from the ARMS survey analyzed by Jablonski et. al. (2018) shows that profitability increases with scale, and risk decreases with scale. So, given this information, our specialty crop farms are high risk, low profit, and yet there is an unmet demand for local food. The COVID-19 pandemic dramatically increased demand for locally grown fruits and vegetables both from commercial sources and home gardens.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Kansas horticulture extension professionals partnered with outside agencies to provide training for fruit and vegetable producers and gardeners on topics relating to production practices, food safety, and risk management.

Briefly describe how your target audience benefited from your project's activities.

- Johnson County Extension collected over 300 pre- and post-program evaluation forms, in which more than 75% of attendees reported a significant increase in knowledge in the areas of sustainable farm and garden practices.
- In Sedgwick County, through the virtual Design & Grow Gardening Workshop that was held in 2021, 113 people learned about soil health and no-till vegetable gardening, 117 people learned skills for indoor seed starting, 114 people learned skills for gardening with wildlife, and 220 people learned about edible landscaping.
- Johnson County completed a 2-year grant project with Kansas Department of Agriculture to deliver education and research for tree fruit producers in northeast Kansas, focused on developing high density apple production in Kansas. Extension also provided support to the Kansas Specialty Crop Growers Association(KSCGA) including managing a \$61,000 grant and helped secure an additional \$9,000 dollars in funding for their farmer members.

Success Story: Horticulture extension professionals worked to support commercial producers through their collaboration with the Kansas Specialty Crop Growers Association (KSCGA). Taking on leadership roles within this partner organization, one agent's participation on the KSCGA's Board of Directors contributed to over \$60k of grant funding to support KSCGAs resources for KS farmers, 85% increase in the association's membership, and a 29% increase in scholarships granted to local food crop producers for the 2021 calendar year.

Surveys conducted at farmer workshops and field days indicate that on average the participants were likely to increase acreage of their operation and were especially likely to increase planted acreage of high value specialty crops following their participation in Extension programing.

Briefly describe how the broader public benefited from your project's activities.

Increased access to locally grown, nutritious fruits and vegetables through a variety of means increases food security and health for Kansas citizens, reduces environmental impacts, and increases community vitality.



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

With a surge in new gardeners and subsequent food security concerns related to the global pandemic, Extension horticulture professionals sought to leverage digital communication resources with our in-house horticultural expertise to reach stakeholders needing to navigate their new world of food gardening. An additional need was the ability to engage with existing stakeholders lacking adequate outlets for gardening interests and activities.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The webinar series “The K-State Garden Hour” was developed in 2020 by extension horticulture agents and specialists to reach traditional and new audiences with research-based information related to food gardening. The webinar series was such a success, it was decided to continue the webinar into 2021. This effort engaged agents and specialists in a variety of roles including planner, graphic designer, Zoom and Facebook event manager, host, presenter, moderator, email manager, Facebook spam combatant, social media manager, and evaluation expert. K-State Research and Extension Communications Team hosted Facebook Events for each webinar from a state level. Local units co-hosted the events, expanding the audience statewide. The project became a unique way for people to learn about different aspects of gardening, while also hearing from a wide variety of experts in Kansas.

From February to December 2021, we recorded over 16,326 total participants. Our live attendance reached over 7,701 people, and 8,625 people watched the recorded presentations. This exceeded participation from last year by doubling our participation in just 15 webinar sessions. Our highest attended webinar was on Container Gardening, with 1,034 live participants. We had Kansan’s log on from 104 of the 105 counties. Participants from 39 US states, 4 continents, and 5 international countries also registered.

Briefly describe how your target audience benefited from your project's activities.

Based on evaluation data from our impact survey, the webinar series had an impact on each of the five grand challenges established by K-State Research and Extension that every Kansan faces: global food systems, water and natural resources, health, community vitality and developing tomorrow’s leaders.

- **Global Food Systems:** 7 out of 10 participants reported improved human nutrition by having increased availability and access to fresh produce as a result of the webinar series. This includes 82% of total participants that reported harvesting fresh fruits, vegetables, and herbs from their gardens and 80% that reported consuming or preserving freshly harvested produce they grew with the help of the K-State Garden Hour webinars.

- **Water and Natural Resources:** 73% of the participants reported making five efforts to improve water quality and 56% reported implementing five water conservation practices as a result of the webinar series.

- **Health:** 56% of the participants reported improved individual physical & emotional health and 57% of the participants also reported improved quality of life within their community as a result of the webinar series.

- **Community Vitality:** 77% of the participants reported implementing five pollinator supporting practices in order to increase pollinator habitat as a result of the webinar series. 55% of all participants also reported reducing waste sent to landfills as a result of the webinar series.

- **Developing Tomorrow’s Leaders:** 8 out of 10 participants reported implementing five science literacy practices as a result of the webinar series. These practices included finding unbiased research-based information, reading and understanding fertilizer/pesticide labels, identifying plant problems, and selecting proper plants for their local environments. In addition, 76% of total participants felt confident in their ability to use the information from these webinars to teach others how to garden more successfully.

Success Story: Comments received from program participants provided further evidence of the impacts of our program:
“Armed with information from your webinars, I’ve been able to convince family members to eliminate insecticide use in our gardens/landscape to benefit the pollinators. We are expanding our pollinator friendly plantings.”

Briefly describe how the broader public benefited from your project's activities.

Program participants are more food secure as a result of learning and implementing garden best practices presented in the webinar series and are more confident in their gardening activities as a result of learning best practices.



Local Food Systems

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Kansas is one of the top 12 most overweight states in the U.S, and yet some of Kansas’ most economically disadvantaged counties have child food insecurity rates above 25%. One potential solution to Kansans’ lack of access to healthy food is to produce more healthy food locally and build consumer demand for locally grown products. However, more than 90% of the state’s dollars spent on food are spent on food from outside of Kansas, causing many small and mid-sized Kansas farms struggle to sell their products locally and make a profit. The COVID pandemic greatly exacerbated these problems and made the challenges of our local food system in Kansas even more apparent.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

K-State Research and Extension (KSRE) has been working to address both the immediate needs of Kansans related to food systems, many related to the COVID-19 pandemic, while also focusing on strategic planning and networking to further support a sustainable food system model moving forward. In particular, KSRE is focusing on 1) Economic Opportunity; 2) Community Engagement; and 3) Internal Capacity Building. One example of the team’s work is that KSRE and the Kansas Department of Agriculture (KDA) have been working together annually to organize farmers market vendor/ direct to consumer food marketing workshops across the state.

Briefly describe how your target audience benefited from your project's activities.

Approximately six months after the workshops, we administered a survey of all participants at the workshops. In 2021, most (72%) of respondents indicated that they gained new knowledge, skills and change in attitudes regarding to food safety after participating in the virtual workshop. Many (43%) of respondents indicated that they made other changes to their farmers market/ direct to consumer sales after the webinar.

Success Story: At one of these workshops, we included a “Farm to School” panel with speakers including the Nutrition Services Director of a local Kansas school district with over 6,000 students. One of the farmer workshop participants connected with the school food service director after their presentation and that farmer has now sold about \$100,000 of produce to that school district and is now also starting to sell to other school districts.

Briefly describe how the broader public benefited from your project's activities.

The impacts of local food production include:

- On the farm, a system of locally-grown and locally sold vegetables creates 13 full-time operator jobs for every \$1 million earned in revenue. In contrast, farms that do not grow and sell vegetables locally create only 3 full-time operator jobs.
- Eating local foods is associated with better nutrition, obesity prevention, and reduced risk of diet-related chronic disease. Studies show that farmers selling their produce directly to the consumer helps lower obesity, diabetes, and the overall death rate.



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Volatile grain prices make it difficult for farmers to successfully market their grain. For several years, low grain prices took place, caused by relatively high world production and lower demand. More recently, grain and oilseed prices have surged, due to higher export demand from China, and production issues in South America. Higher prices are good, but require management and marketing skills by producers. Integrated risk management helps producers utilize crop insurance, grain marketing tools such as forward pricing and hedging, and government programs to attain levels of sustainable profitability. Hands-on education and opportunities to try using these tools in a simulated setting helps the adoption of these tools and practices in the real world, in situations of both higher and lower prices.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

This project was funded, in part, by a grant received from the North-Central Extension Risk Management Center. In-person, hands-on workshops were conducted at six locations throughout the state, for 84 participants. Participation was limited due to COVID. Two other in-person sessions were conducted as part of the annual Risk and Profit Conference in Manhattan, with a total of 72 persons participating. In addition to the in-person meetings, five online sessions were conducted in January, March, and May, without the marketing simulation, to help producers understand marketing tools and begin to plan and utilize them. These were attended by 373 persons. Workshop materials were also posted on the AgManager.info website, with 907 views on the site during the program year. Additionally, there were 307 views of the recordings on YouTube.

Briefly describe how your target audience benefited from your project's activities.

Producers learned how to integrate crop insurance decisions into whole-farm risk management using pre-harvest grain marketing strategies and developed a grain marketing plan for a simulated farm that allowed them to utilize various marketing strategies that they may not have tried previously. Crop producers dealing with limited irrigation also came to understand and utilize provisions in insurance options available to them for limit-irrigated corn and other crop enterprises. They also considered cotton and other non-traditional crops such as canola for their operations, because of understanding the risk management strategies available to them. Finally, producers implemented grain marketing risk management strategies learned at the workshops on their own operations for both established and emerging crops.

Programs were evaluated for impact. The in-person intensive workshops were ranked on a five-point scale with 1 being “Not Valuable at All” and 5 equal to “Very Valuable”, with the average score being 4.33 out of 5.0. The online meetings averaged 4.36 on the same scale.

Comments received across the state and from online participants included:

- *I learned to get a plan in place, for both price and dates to sell, not just the price target.*
- *I need to be more proactive with forward planning/pricing. Establish a plan; set pricing minimum; know my production costs; sell when profitable.*
- *I have never had a grain marketing plan before. I will create one for the 2021 crops. This workshop showed me the need to have a plan and how to go about creating one.*
- *I learned to sell increments of production during the year, but not forward contract for multiple years. And I need to know what my costs of production are, so I know if I'm making a profit or losing money.*
- *I hope to use options, in addition to the forward contracting that I do now.*

Briefly describe how the broader public benefited from your project's activities.

Producers will also be equipped to make appropriate selection of relevant government programs for their farm(s). This will lead to more competitive producers who are able to sustain long-term profitability, which will benefit other community members by increasing the viability of rural communities and their access to a safer and less expensive food supply.



“Finances and the Farm” online course teaches critical farm management skills

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Producers in Kansas have faced several challenges in recent years, threatening the profitability and long-term viability of their operations. Lingering effects of the downturn in the farm economy, lower commodity prices during the trade war with China, supply chain disruptions due to the COVID-19 pandemic, and escalating input prices have all challenged agricultural operations to more closely manage their finances.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The *Finances and the Farm* online asynchronous class was launched in 2021, which offers 6 modules of videos and hands-on activities covering topics of farm recordkeeping, balance sheet, income statement, cash flow, managing family living expenses, and goal setting. Bonus content includes calculating cost of production, grain marketing, family communication, and managing farm stress. Participants have 6 months to complete the course from the time of registration and completing the course allows participants to receive Farm Service Agency Borrower's Training financial credits, allowing them to take advantage of lower interest rate FSA loans.

Briefly describe how your target audience benefited from your project's activities.

From January-December 2021, 133 participants took the *Finances and the Farm* online course. Numerous comments were received on the course evaluation of how convenient it was to take the course on their own time, at their own pace.

Knowledge change was evident on all the main course topics:

- 73% of participants reported their knowledge of keeping quality farm records was moderate to advanced before the session. After the session, 100% reported their knowledge was moderate to advanced.
- 45.5% of participants reported their knowledge of putting together a balance sheet and assessing it was moderate to advanced. After the session, 91% reported their knowledge was moderate to advanced.
- 36% of participants reported their knowledge of putting together an income statement and assessing it was moderate to advanced. After the session, 91% reported their knowledge was moderate to advanced.
- 27% of participants reported their knowledge of putting together a cash flow statement and assessing it was moderate to advanced. After the session 91% reported their knowledge was moderate to advanced.

When asked after the course if the participants planned on implementing principles they learned, of those that responded to the course evaluation 100% planned on developing and analyzing a balance sheet and income statement every year, 91% planned on developing and analyzing a cash flow statement every year, and 55% planned on making a family living budget.

Comments received from the class were very positive:

- *I didn't know there were so many ways to track a business. Now I do.*

- *Although I had taken an Ag Economics class in college over 20 years ago, the class provided updated information that hopefully will allow us to make a go at a small cow/calf operation.*
- *I never fully comprehended how much I could utilize the reports we produce on an annual basis for tax purposes. I appreciate having the excel documents - especially the monthly cash flow document.*
- *The course did a good job of covering the broad points of farm financials. It helped me to learn more financial terms. The class was able to offer up a fairly wide variety of options for most operations on how to manage finances. I felt that all the information was communicated accurately and clearly.*
- *I definitely enjoyed the course and learn a great amount. While in college I took finance courses, but none specifically related to agriculture. It was nice to learn more of it from that side. I thought the course flowed well and with examples of everyday situations made it easy to follow.*
- *I actually learned a lot and feel a lot more confident in my finances.*
- *Should have taken the class when I started to farm.*

Briefly describe how the broader public benefited from your project's activities.

Producers who are able to sustain long-term profitability will benefit other community members by increasing the viability of rural communities and their access to a safer and less expensive food supply.

Critical Issue

Health

Closing Out (end date 09/07/2023)

[Fly Management in Animal Agriculture Systems and Impacts on Animal Health and Food Safety](#)

Project Director

Cassandra Olds

Organization

Kansas State University

Accession Number

1026339



House fly movement in CAFOs

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

House flies (*Musca domestica*) are able to acquire and transmit bacteria from the surfaces they come into contact with. These bacteria, many of which are resistant to anti-microbials pose a threat to both animal and human health. This project aims to address how far flies move within the environment or the drivers for them to disperse.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

This research determined that house flies in cattle feedlots are strongly attracted to concentrate based food, high in protein and sugar. Using color marked flies observed over 24 hours we determined that while flies could move across the lot they tended to stay within the local area of the feed bunks. It was also determined in laboratory studies that house flies had the ability to distinguish between low and high concentrations of sugar and if given the choice would chose the higher concentration of sugar. This work has important implications for feed and waste management in confined cattle feeding operations.

Briefly describe how your target audience benefited from your project's activities.

Livestock producers can now be more aware how flies move and how to limit fly movement reducing pathogen transmission risk. This project is important for developing better fly management strategies to reduce fly numbers but also pathogen transmission.

Briefly describe how the broader public benefited from your project's activities.

This information is important not only for livestock producers but the general public too. House flies are found exclusively around human settlements, as such hospitals, restaurants and food producers are all concerned about pathogenic bacteria, anti microbial resistance and bacterial carriage by house flies. Knowing what causes flies to move can be used to mitigate the impact of flies as vectors.

Sustainable Practices, Economic Contributions, Consumer Behavior, and Labor Management in the U.S. Environmental Horticulture Industry

Project Director

Cheryl Boyer

Organization

Kansas State University

Accession Number

1026234



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project addresses issues in the production and marketing of specialty crops, primarily nursery and greenhouse crops. Production issues are related to screening landscape plants for use in challenging and changing climates and greenhouse studies with Dahlia growth and development. Marketing projects are associated with the social media marketing of farm products.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The project related to evaluating landscape plants for use in Kansas climates advanced the process of identifying and introducing new ornamental plants for landscape professionals and consumers. The study compared plant performance in greenhouse-induced stress environments (heat and drought) to real-world survival at seven sites across the state. Greenhouse studies supported field-grown results, demonstrating that greenhouse stress studies can be used to screen out plants poorly suited to Kansas landscapes and identify potential additions to landscape plant selections.

Dahlias are a popular plant for the landscape, and many landscape dahlias are produced first in the greenhouse. One recent problem with growing dahlias is that a dahlia crop may die shortly before market, rendering them unsalable. There is little information known about "dahlia decline." Our goal was to investigate this phenomenon further. Karen Schneck, a recent MS graduate student, investigated different parameters centered around dahlia decline. She conducted several experiments intending to induce the phenomenon. The initial hypothesis as to the cause of dahlia decline is elevated root-zone temperatures that lead to root decline and death. The pandemic hampered her experimentation and project, but she was still able to complete her work. She treated the dahlia root zones with excess temperatures, ultimately showing that some dahlias can tolerate elevated root zone temperatures. Some cultivars showed root damage but were able to recover over a period of time. We were not able to reliably demonstrate dahlia decline through all the experiments.

Social media marketing has become increasingly important in cultivating consumer interest in specialty crops, whether at agritourism stops, grocery stores, or curiosity about production practices. We studied the visual appeal of graphic elements on consumer engagement and willingness to purchase three products: sweet bell pepper, apple, and petunia. Photo quality matters, as does price, message, the presence and age of people in images, and storytelling. Responses varied for each component tested; however, consumers were more willing to engage and purchase depending on their personal shopping preferences.

Briefly describe how your target audience benefited from your project's activities.

Industry stakeholders include owners and employees of nurseries, greenhouses, garden centers, landscaping companies, u-pick farms, wineries, etc. Participants in these businesses learned about the results of these studies at industry-focused Extension outreach events, often featuring pesticide applicator credits. Audiences benefitted as our work provided more insight into the dahlia decline phenomenon. We did not entirely rule out elevated root-zone temperatures as a cause. Still, we did show that dahlia decline is likely a combination of factors causing the problem and could include high root-zone temperatures. Marketers learned to improve their skills to reach target consumer audiences more effectively.

Briefly describe how the broader public benefited from your project's activities.

Improved landscape plant choices make every managed environment more sustainable and attractive, with fewer inputs (water, fertilizer, maintenance, etc.). Identifying and addressing production challenges reduces plant loss and productivity losses, delaying price increases for specialty crop products. Effective marketing of specialty crop products enhances the public's understanding and appreciation of local agriculture products and reduces supply chain disruptions by encouraging local sales. The broader public will continue to have the opportunity to purchase and plant dahlias for the landscape. Our work provides valuable insight for landscape and ornamental plant producers, so they have the tools to produce some of the best possible plants for the consumer.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The COVID-19 pandemic provided ample challenges for completing and advancing plant production studies. Due to campus facility shutdowns, greenhouse studies were delayed. In one case, a greenhouse study failed due to a malfunction in the cooling system resulting in too high temperatures just before data collection.

A study was initiated in the spring of 2021, evaluating *Crococsmia*. This bulb crop looks similar to freesia and gladiolus and flower in bright colors (reds, oranges, yellows) for the landscape in the summer. One production issue is the erratic sprouting and foliage growth and development. The bulbs are also generally not considered cold-hardy. This study aimed to address two objectives; test pre-plant treatments of the bulbs to look at resulting growth. And then, successful plants would be planted into the landscape to evaluate for hardiness in Kansas. Unfortunately, we encountered two limiting factors: 1) student labor to assist in carrying out the final part of the project (COVID-related limitation) and 2) greenhouse failure just as the greenhouse experiments were about to produce data. The heating/cooling system did not provide close to optimal growing conditions, thus potentially rendering confounding data. The experiment was terminated.

Results were delivered to stakeholders in online learning opportunities: pesticide applicator training, Kansas Turf and Landscape Conference, and the Center for Rural Enterprise Engagement New-Media Marketing Insight Summit. Additionally, results from this project were presented at scientific conferences as outlined in the publication list below.

Schneck, K.K., **C.R. Boyer**, and C.T. Miller. 2021. Supraoptimal root-zone temperatures influences *Dahlia* (*Dahlia xhybrida* Hort.) growth and development. *HortTechnology* 31(6): 667-678; <https://doi.org/10.21273/HORTTECH04896-21>; KAES #: 21-146-J.

Zagonel, A.M., J.A. Shellhouse, L.M. Baker, H.H. Peterson, and **C.R. Boyer**. 2021. The (right) picture is worth a thousand words: Comparing the engagement rate between stock and natural photos. National Agricultural Communication Symposium. (Poster; 2021 Outstanding Research Poster Award)

Baker, L.M., A.M. Zagonel, O.K. Doyle, A.R. Poulin, **C.R. Boyer**, and H.H. Peterson. 2021. Visual appeal: The role of visual elements of Facebook posts on consumer engagement and willingness to purchase. National Agricultural Communication Symposium. (Oral; Accepted)

Boyer, C.R., J.R. Pool, and J.J. Griffin. 2021. Development of a screening procedure for identifying new woody landscape shrubs for Kansas. Proc. Northeastern Plant, Pest, and Soils Conf. 6:42. (Abstr.)

Baker, L.M., **C.R. Boyer**, H.H. Peterson, and A.M. Zagonel. 2020. The Center for Rural Enterprise Engagement: Helping agricultural businesses navigate new media marketing. Extension Professionals of Florida Conference. (Poster)

Miller, F., B. Garcia, and **C. Boyer**. 2020. Dealing IPM education: One card at a time. National Association County Agricultural Agents Kansas Conference (*State of Kansas poster winner, accepted to national AM/PIC Conference)
https://www.nacaa.com/posters/poster_list.php?poster_id=1974

Gilmore, J., C. Shoemaker, C. Rivard, **C. Boyer**. 2020. The partnered apprenticeship model: Implications for beginning farmer learning and program development. Proc. of the Urban Food Systems Symposium. (Oral)

Boyer, C.R., F.L. Miller, and B.M. Garcia. 2020. Dealing a winning strategy: An integrated pest management card deck for Extension learning. HortScience 55(9): S393. Abstr. [Oral]

Boyer, C.R., H.H. Peterson, and L.M. Baker. 2020. Transdisciplinary work in horticulture: The Center for Rural Enterprise Engagement. HortScience 55(9): S399. Abstr. [Oral]

Schneck, K.* and C.T. Miller. 2020. Effects of elevated root-zone temperatures on dahlia (*Dahlia xhybrida*) rooting. HortScience. 55(9):S216. Abstr.

Baker, L.M., A.M. Zagonel, **C.R. Boyer**, and H.H. Peterson. 2020. Marketing matters: Interpreting survey-based heatmaps to understand consumer preferences for elements of Facebook posts designed to market petunias online. HortScience 55(9): S398. Abstr. [Oral]

Baker, L.M., **C.R. Boyer**, and H.H. Peterson. 2020. Insight into insights: A workshop developed for adult learners focused on new-media marketing. Proc. Assoc. for Intl. Ag. and Extension Ed.
https://www.aiaee.org/attachments/category/192/AIAEE_2020_programproceedings_finalspreads.pdf

Parental practices supporting positive eating behaviors during independent eating occasions among early adolescent children

Project Director

Glade Topham

Organization

Kansas State University

Accession Number

1021425



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Childhood obesity continues to be a large health challenge worldwide with highest prevalence for racial minorities and families in poverty. Poor dietary habits and sedentary behavior have been implicated in the development of obesity. Furthermore, teens have been found to have poorer eating habits during independent eating occasions when caregivers are not around to supervisor or guide choices. Prior to our research, little research had been done examining patterns of behavior during independent eating occasions for teens and on examining efforts of parents to try to have a positive influence on their teens' eating choices when they are not around to directly influence them. Knowledge relative to these patterns could help parents and teens and helping professionals work to improve teen healthy eating.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

During the reporting period, we interviewed 12 parent-teen dyads (individual interviews) regarding how parents and teens uniquely approach and experience independent eating during the COVID pandemic. Interviews included questions regarding how parents and teens relate to each other around food and eating patterns before and during the pandemic. Staff completed coding of parent and child interviews and utilized what was learned from interviews to make adjustments to our

Qualtrics survey to allow us to learn more broadly from a large number of participants about family experiences of independent eating occasions during the pandemic (survey was broadly disseminated during fall 2021 during the following reporting period).

Briefly describe how your target audience benefited from your project's activities.

Parents and teens who participated in our interviews were provided opportunities to become more reflective and thoughtful about how they approach independent eating occasions and what things parents do that are helpful to teens to make healthy food decisions during independent eating occasions.

Briefly describe how the broader public benefited from your project's activities.

During the reporting period we had one paper published and one nearly completed for publication and presented our research at two national conferences regarding the experience of parents and teens during independent eating occasions with implications for how parents might influence their teens to support their teens in making good food choices. Professionals who provide front line services to families participating in these conferences and review the publication outlets. In this way helping professionals have expanded awareness of how to help families in this topic area.

Closing Out (end date 09/07/2023)

[Behavioral economics and the intersection of healthcare and financial decision making across the lifespan](#)

Project Director

Diane Kiss

Organization

Kansas State University

Accession Number

1017241



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Financial information is complicated and the majority of consumers feel that they lack the adequate knowledge and skills for obtaining and processing the information. An important aspect that is not well understood is the link between health care choices (preventive care behavior as well as coverage for various procedures and treatments), and the financial implications on both consumers and the public. The impact of financial capability and health care decisions is bi-directional. This project will assess barriers and motivators that influence the decision-making process on the micro level (consumers) through a health and healthcare lens.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

During the reporting period we fielded two surveys. We are currently in the process of analyzing the data and are beginning to develop manuscripts that will report our findings.

Briefly describe how your target audience benefited from your project's activities.

While the work is on-going, we expect our outcomes to open the pathway to better patient-doctor conversations about money. That family members will know how, when and what types of questions to ask, and to whom, in an attempt to help avoid costly financial errors and improve patient outcomes through understanding, comprehending and acting on that information.

Briefly describe how the broader public benefited from your project's activities.

While the project is on-going, we expect it to result in a greater understanding of how families make financial decisions especially how they consume and ultimately manage large amounts of complex information in stressful situations (specifically the loss of health). The results should provide a foundation for developing, implementing, and evaluating

educational initiatives to increase health literacy, health insurance literacy and improve financial decision making in the face of physical, financial, emotional and psychological change.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

A Ph.D. student with an interest in learning more about collecting, cleaning, and analysing primary data is participating on the project team as an independent study course. One anticipated outcome is a conference paper with the goal of pursuing publication in a peer-reviewed journal in our field.

2021 Health

Project Director

Laurie Chandler

Organization

Kansas State University

Accession Number

7001728



Diabetes Education Goes Online

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Kansas Department of Health and Environment reports that 10% of Kansans are affected by diabetes, an underlying and contributing cause of death in the state. The majority of those managing this chronic disease are low-income residents but the disease is not limited to any socio-economic level. Diabetes costs an average of \$16,752 a year per person, about \$9,601 of which is directly attributed to the disease. Having access to affordable and researched-based education is vital for all Kansans to improve their health behaviors and help manage their diabetes.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Dining with Diabetes (DWD), a national extension program, has traditionally been offered in-person only, and consists of a series of four classes, including sessions on nutrition education, healthy cooking demonstrations, simple physical activity routines, and tasting healthy foods. The classes are designed for people with diabetes and their family members, caregivers, and support persons. The program's focus is to help individuals learn strategies to lessen the health risks of diabetes.

Based on an identified need to improving access to the DWD course and to respond to the pandemic., K-State Research & Extension created *Dining with Diabetes Online*. This course is presented through the Canvas learning platform. It includes educational videos, meal planning and healthy snack ideas, healthy recipes, cooking demonstration videos, and optional interactive discussion sessions. The course may be offered in a hybrid format with in-person components of food tastings, group interaction and connections to local resources and experts.

In the past year, 93 individuals registered for *Dining with Diabetes Online*, with a 62% completion rate. 41% completed the pre survey and 18% completed the post survey.

Briefly describe how your target audience benefited from your project's activities.

Participants completing the post survey reported:

- 85% reported cooking more at home since the program
- 94.5% reported eating smaller portions

- 60% reported using recipes provided by the program

- 37.8% indicated they fit exercise into their daily routine more since the program

Nearly 45% of the program participants were aged 60 or younger. 21% were aged 40 or younger. This data regarding participant age suggests that *Dining with Diabetes Online* appears to be reaching a younger audience when compared to in-person delivery.

Success Story:

- “I think taking my meds everyday like I’m supposed to and eating healthy and exercising more has helped get my numbers down. I know I’ve learned a lot from this class. It’s helped a lot.” - *DWD Online Participant July 2021- (This participant also reported to the instructor that A1C levels were reduced from 11.6 to 6.6 after 5 months.)*
- “*Living with diabetes is a full time job...it takes a lot of work and planning. I am using the plate method to plate food and am increasing the amount of vegetables that are on the plate.*” - *Frontier District Participant*

Briefly describe how the broader public benefited from your project's activities.

- Improved health through positive lifestyle changes
- Reduction in the development of prediabetes and Type 2 diabetes
- Reduction in Type 2 diabetes-related complications



Education for Safe Food Handling

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The US CDC estimates that each year 48 million people in the US get sick from a foodborne illness, 128,000 are hospitalized, and 3,000 die. K-State Research and Extension has been a provider of various home and commercial food safety education programs including ServSafe®, a nationally recognized training program targeted for food service managers, entry-level food handlers and community organizations.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

K-State Research and Extension (KSRE) extension professionals provided in-person ServSafe® food safety training for high school students preparing for the food service industry and for community members working as essential workers in food service. Per ServSafe® protocol, online courses were only available through the National Restaurant Association.

Additional food safety trainings were offered throughout Kansas to meet specific needs of childcare providers, nursing home, food stand/concession workers and community members.

Briefly describe how your target audience benefited from your project's activities.

ServSafe®

In 2021, KSRE organized 13 ServSafe® Food Handler classes with 156 participants completing the class. Most (123) participants responded to a post-session survey and indicated that they had increased knowledge and skills in best food safety practices. Participants strongly agreed/agreed to the following:

- 75% plan to practice new skills

- 78% learned the appropriate length of time to wash hands and 74% plan to wash hands more often
- Food thermometers: 69% are more aware of the benefits, 62% learned how to use and 61% intend to check food temperatures with a food thermometer
- 78% learned how to avoid cross- contaminating foods

Food Safety Outreach

Virtual and in- person food safety trainings were offered throughout Kansas. For example, in Leavenworth County, over 200 individuals signed on and participated in a virtual food safety training.

Food safety education is also incorporated in community outreach efforts. For example, Cowley County used COVID-19 CARES Act funds to bulk purchase items for later distribution as “Quarantine Boxes.” 5,584 boxes were distributed in 2021. Food safety information - including essential food safety steps and food temperatures were featured on a handout with a QR link to the K-State Research and Extension publication "At- Home Safe Food Handling It's in your hands." (MF2465)

Briefly describe how the broader public benefited from your project's activities.

By supporting K-State Research and Extension nutrition, food safety, and health programs, people adopt safer food handling practices, incidences of foodborne illness decrease, a safer food supply is available, medical costs decrease, quality of life improves, employees are more productive and miss fewer days of work due to illness. Other community members benefit as well by reducing the public cost of health care and health insurance, food businesses contribute to the community through jobs and offering safely prepared food, and the number of productive and contributing citizens are increased.



Healthful Relationships for Healthy Families and Children

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

During early childhood, children’s brains are developing at a rate unequaled through the rest of their lives. Children’s ongoing interactions, primarily with adult caregivers, form the basis for how their neurological pathways are constructed and how their brains process emotional, cognitive, and sensory information. In addition, when children live in nurturing environments they increase their success in school, ability to build relationships, and build a path for future life success.

By focusing on what adults can do to advance positive brain development in children, we can provide opportunities for caregivers to build better brains and provide positive nurturing environments that allow children to work collaboratively, get along with other people, and control one’s emotions. These are the skills most valued in the future job market, in family relationships, and in personal health and well-being.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Extension professionals spearheaded efforts to provide evidence-based programming across Kansas to help families, caregivers, and early childhood professionals become proficient in supporting positive neurological development in young children. Program include:

- *Better Brains for Babies*, a collaboration with the University of Georgia, which focuses on a strengths-based approach to parenting and childcare (e.g., “let us make smarter kids!”) instead of a deficit-based approach to parenting and childcare (e.g., “you need training”).
- *Strengthening Families Program 7-17*, a program that emphasizes the parenting skills of bonding, setting boundaries, and monitoring, is designed for parents who desire to improve family relationships and to keep their kids safe from alcohol and drug use. K-State Research and Extension currently has 18 individuals trained to implement the program.

Other programs offered include *Together We Can*, *Relationships Smarts*, *Suddenly In Charge*, *Bonding Thru Board Games*, *StoryWalk*®, mental health initiatives, and efforts to increase access to child care across the state of Kansas.

Briefly describe how your target audience benefited from your project's activities.

Participants in these trainings increased their own understanding of neurological development, the importance of positive and intentional adult-child interaction, and how to mitigate the effects of stress and trauma on young children. Further, these trainers are now providing their own audiences with these skill-building resources, and effecting change in their own communities:

- The mental health presentation that took place at Clifton-Clyde High School reached over 300 individuals. Of those that completed surveys, 92% reported an increase in knowledge on depression and 88% felt the presentation helped them recognize it is okay to ask for help or how to help someone in their life if needed.
- After completing the *Strengthening Families Program 7-17*, a family member was able to find housing and a job in addition to improving relationships with the children.

Success Story: The Grooming Project is a program of Empowering the Parent to Empower the Child (EPEC), a 501c3 nonprofit in Kansas City, MO devoted to helping impoverished families become self-reliant through job training in the high-demand, high-pay trade of pet grooming. The Grooming Project’s education-based approach not only financially empowers single parents in poverty through equipping them with credentials in a competitive market, but it also ensures that they focus on improving their family’s future as a whole through parenting and budgeting classes, mental health support, life skills courses, and other needed medical services coordinated with many local organizations.

The Program created life skills component to work with the parents in the program and they are all required to complete the *Strengthening Families Program 7-17*. This has been an on-going partnership and many parents have successfully completed the program.

One participant described how the program challenged the parenting style she had experienced in her youth: “Up until I came into this program, the cycle was just repeating itself over and over and over. I was a yeller ... I was very inconsistent in my discipline. Or very inconsistent in any kind of positive reinforcement, too. So, I do believe that we still have some stuff that we will always need to work on, but I think that the cycle has changed.”

Briefly describe how the broader public benefited from your project's activities.

K-State Research and Extension’s Family and Child Development programming contributes to environments where safe, stable and positive relationships flourish.



Powerful Tools for Caregivers

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Today, more than one in five Americans (21.3 percent) are caregivers, having provided care to an adult or child with special needs at some time in the past 12 months. This totals an estimated 53 million adults in the United States up from the estimated 43.5 million caregivers in 2015. Informal caregiving is considered a chronic stressor, as caregivers consistently report greater stress than non-caregivers.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

“Powerful Tools for Caregivers (PTC)” is a statewide program that empowers caregivers to adopt self-care practices that help manage stress, increase communication, and tackle tough situations, leading to less caregiver burnout and more successful informal caregiving relationships. The course is comprised of six sessions, taught once weekly by trained extension

professionals. PTC is available in three formats: 90 minute or 2 ½ hour class for caregivers of adults with chronic conditions, and the two-hour class for caregivers of children with special health or behavioral needs. It is offered both in person and online.

Briefly describe how your target audience benefited from your project's activities.

More than 100 participants completed ten classes, both in person and virtually in program year 2021. Participants reported lessened stress, greater self-care practices and more effective self-care in post evaluations. One hundred percent of participants planned to take action because of the course - specifically in the areas of communication, stress reduction and self-care. This course reduces caregiving burden on Kansans and greater utilization of community resources, leading to increased health and overall wellness of caregiving population in Kansas.

Success Story: Thank you! I have been struggling with a mower issue for the past month. This does not sound like a big deal but when you have 5 acres to mow, it really is. My riding lawn mower has been broken for about 4 weeks. Today, as I am reading the first chapter of the book, I thought about it and called a location that will come get the mower, fix it, and bring it back. This is a huge step for me to surrender to someone else who can actually do something! Thank you! I cannot tell you and the team you are working with thank you enough! This is my first step in truly taking care of myself and I am thrilled to say the least. And I am not trying to push mow 5 acres.

Briefly describe how the broader public benefited from your project's activities.

Empowering caregivers to adopt self care practices that help manage stress, increase communication and tackle tough situations leads to less caregiver burnout and more successful informal caregiving relationships statewide. This ultimately results in a healthier and more successful Kansas population.



Walking to Reduce Effects of Chronic Disease

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Physical inactivity and poor dietary habits have been linked to many chronic diseases and adverse health conditions --as well as to psychosocial problems. In 2013, nearly 80% of adults did not meet minimum physical activity recommendations. Less than 10% of Kansans eat enough fruits/vegetables (CDC, 2015) and chronic disease is responsible for more than 70% of health care costs. Studies show that eating and living the Mediterranean Way can reduce risk of developing certain diseases, including Alzheimer's disease, cardiovascular disease, diabetes, and some types of cancer. Other benefits include lower blood pressure and weight loss, and improved eye health by protecting against macular degeneration.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Walk Kansas is an 8-week, team-based, health initiative founded on the Physical Activity Guidelines for Americans established by the US Department of Health and Human Services (revised in 2018.) It is offered statewide in the spring by K-State Research and Extension. Participants log physical activity and fruit/vegetable consumption. Teams select a challenge and report regularly through an interactive online learning system. (This online system was also utilized for community walking programs offered outside of Walk Kansas.) Weekly newsletters provide educational content for participants.

In 2021, newsletters focused on preventing and managing 8 chronic disease conditions including mental health, heart disease, osteoporosis, Alzheimer's disease and brain health, obesity, arthritis, diabetes and cancer.

Kansas Extension agents continued to support walking efforts throughout the year with the Walk with Ease program made available through a partnership with Kansas Department of Health and Environment. Walk with Ease is a program from the Arthritis Foundation that helps participants increase their confidence, mobility and flexibility. Multiple agents provided these trainings throughout the state in 2021. The partnership continues in 2022 and will also target low-income audiences through the Kansas SNAP-Ed program.

Briefly describe how your target audience benefited from your project's activities.

In 2021, Walk Kansas participant numbers were lower due to the ongoing COVID-19 Pandemic. A total of 985 teams with 5,467 people participated. Over the eight weeks, 755,234 total miles were recorded. 54% of teams were workplace teams.

The following outcomes were achieved as reported by participants that completed evaluation surveys:

- 84% reached the minimum goal of at least 30 minutes of physical activity 5 or more days per week all or most of the time
- 82% were confident they would continue this amount of physical activity over the next 6 months
- 47% did strengthening exercises at least twice per week, some or most of the time
- 48% increased fruit and vegetable consumption and 81% were confident/very confident to continue consuming more fruits and vegetables
- 65% responded that they are somewhat or much more aware of controllable risk factors for chronic disease. Over 250 participants responded that they have made or plan to make changes to prevent or delay chronic disease in these areas: getting regular physical activity, do strengthening exercises at least twice per week, lose weight and/or maintain a healthy weight, get adequate and good quality sleep, and protect skin from sun exposure.

Success Stories:

- *One of the participants had extreme success with the Walk with Ease program. When she first started she could only walk 10 minutes and her gait was unstable. At the mid-session assessment her time was 13:00 minutes. At the end of the program she was walking 20 minutes or more with a strong stable gait. In the post assessment her time had greatly improved. She took 3 minutes off of her time. She indicated that by participating in the program her diabetes was under better control. – West Plains District*
- *I've watched my best friend slowly increase his activity over the last 2+ years. He's gone from zero to easily being able to walk 5 miles and still enjoy it.e.. He looks at his numbers after every walk and watches where he is in the rankings. – Sedgwick County participant*
- *Individuals enjoy the team component of this program. Several people commented in participant surveys that being a part of a team held them accountable to exercise and eat healthier. They did not want to disappoint teammates and exercised often.- Central Kansas District*

Briefly describe how the broader public benefited from your project's activities.

By adopting healthful lifestyle habits, such as those promoted through Walk Kansas, people will experience less chronic and acute illnesses, have lower medical costs, and notice improved quality of life. Also, employees will be more productive and miss fewer days of work due to illness. Other community members would benefit as well by reducing the public cost of health care and health insurance, and increasing the number of productive and contributing citizens.

Critical Issue

Water

[Advanced Understanding and Prediction of Pollutants in Critical Landscapes in Watersheds](#)

Project Director



Test advanced/new monitoring technologies to detect water quality issues

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The project deals with development and/or testing of advanced precision measurement technologies for better understanding of harmful algal blooms in the lakes and farmponds and innovative cotton growth technologies. We plan to implement high-frequency sensors and UAVs to collect climatic, hydrologic and water quality data at varied time and spatial scales.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

In 2021, we began testing a multi sensor stationary buoy in Marion Reservoir in Kansas for detecting valuable blue-green algae growth characteristics. The buoy was instrumented with in-situ sensors for near continuous measurements of water temperature, specific conductance, dissolved oxygen, pH, dissolved organic matter, turbidity, light penetration and chlorophyll and phycocyanin fluorescence. Partial data had been collected while the complete set is planned to be fully deployed in 2022.

We take an active part in exploring the benefits (production and environmental) of cotton production in western Kansas. To evaluate crop applicability and growth characteristics, we are instrumenting and erecting low-cost energy budget towers in two fields in western Kansas.

Briefly describe how your target audience benefited from your project's activities.

The target audience is agricultural community, land users, home owners, watershed planners, municipal stormwater managers and other stakeholders who are impacted by watershed management programs related to development and implementation of water-quality BMPs. The immediate and direct beneficiaries of the project are state and federal agency personnel as well as environmental consultants. We published three research papers in specialty-appropriate journals and made a presentation at the ASABE meeting.

Briefly describe how the broader public benefited from your project's activities.

All stakeholders will benefit from potential water quality improvements; landowners and taxpayers will benefit from the development of efficient BMP implementation plans that are economically feasible. Better management of HABs, prediction of their timing and toxicity are crucial for local community and livestock.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

From September 2 to 3, 2021, Sheshukov (project PI) and participants from the other participating states meet in person in Gainesville, FL (University of Florida) or virtually. From the 2-day meeting, we identified tasks to be implemented in the next reporting period, with which the participants could better understand research gaps and needs regarding BMPs and environmental needs. During the meeting we envisioned and scoped the development of a proposal for a special journal collection on the topic of "Advances and gaps in agricultural and urban BMPs across critical scales" that will be submitted to a top-tier journal in the specialty. To develop this proposal we participated in an interactive series of breakout

sessions supported by an electronic Jamboard to draft and discuss new ideas and content of the collection. This provided a unique opportunity to meet the project participants better and forge collaborations for the special collection and ensuing proposals.

Two graduate students (Piu and Koudahe) were involved in data collection and preliminary analysis of data on cotton fields. Both of them (Umme Fatema Piu and Komlan Koudahe) are expected to defend their MS theses in 2022.

Publications:

- Koudahe, K., Sheshukov, A.Y., Aguilar, J., Djaman, K. (2021) Irrigation-Water Management and Productivity of Cotton: A Review. *Sustainability*. 13(1): 70. <https://doi.org/10.3390/su131810070>
- Oker, T.E., A.Y. Sheshukov, J. Aguilar, D.H. Rogers, I. Kisekka. (2021) Evaluating Soil Water Redistribution under Mobile Drip Irrigation, Low-Elevation-Spray-Application, and Low-Energy-Precision-Application using HYDRUS. *Irrigation and Drainage Science Engineering*. 147(6), 04021016. [https://doi.org/10.1061/\(ASCE\)IR.1943-4774.0001553](https://doi.org/10.1061/(ASCE)IR.1943-4774.0001553)
- A.Y. Sheshukov, Gao, J., K.R. Douglas-Mankin, H. Yen. (2021) Observed Data Source used for Bias Correction Introduces Variability and Uncertainty to Downscaled Climate Projections for Hydrologic Modeling. *Transactions of the ASABE*. 64(2): 203-220. <https://doi.org/10.13031/trans.14061>

Management and Policy Challenges in a Water-Scarce World

Project Director

Nathan Hendricks

Organization

Kansas State University

Accession Number

1021045



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Our project quantifies the demand for water and the value of water in competing uses. Our project also compares alternative water management strategies and institutions.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We published a study of the irrigation demand response to local ethanol market expansion in Kansas from 2003-2017. Ethanol plants incentivize feedstock production (i.e., corn) in localized areas because proximity to the plant increases price received net of transport costs. Moreover, much of the corn produced in western Kansas is irrigated due to limited rainfall. We estimate that ethanol expansion in Kansas has increased irrigation water use. Specifically, a 10 million gallon/year increase in refining capacity within 50 km leads to a 1.03 acre-ft increase in water use per field. Moreover, we detect increased irrigated corn acreage and decreased irrigated soy and alfalfa acreage when an ethanol plant is constructed or expands its refining capacity. Finally, we predict that approximately 4% of current statewide irrigation water use is attributable to ethanol markets.

We also examined agricultural land value capitalization of ethanol market expansion in Kansas using transaction-level land value data for 1995-2017. We hypothesized that corn prices and thus land values in the vicinity of an ethanol plant are higher relative to parcels located farther from a plant. We further hypothesized that irrigated parcels capitalize on ethanol expansion to a greater extent than non-irrigated parcels due to differences in corn water demand and precipitation in Kansas. We estimate that an irrigated (non-irrigated) parcel having one or more ethanol plants situated within 50 km fetches an 8.8%

(6.3%) price premium relative to more distant irrigated (non-irrigated) parcels, on average. We estimate the average marginal effect of a 10 million gallon per year increase in ethanol capacity within 50 km is a 4.8% (1.8%) increase in irrigated (non-irrigated) land value.

A study was published on the relationship between farm size and groundwater depletion using historical data on water use in Kansas. We show that doubling a farm's irrigated cropland decreases groundwater extractions by 2%–5% holding constant the crop type and irrigation system. However, a corresponding shift by larger farms to different irrigation technologies offsets this reduction in groundwater use, leading to a slight increase in overall groundwater use. So, while larger farms appear to be more efficient with their water use, they also tend to have slightly larger overall water use.

We also published a study of irrigator water quality testing behavior and perceptions of the impact of low water quality on crop outcomes. In total, we evaluated survey data for 637 producers operating over the Kansas portion of the High Plains Aquifer. We find that producers exhibit greater concern for groundwater quantity than the quality of groundwater. For instance, one-third of respondents indicated “moderate” or “major” concern over the agricultural impacts of low water quality. By comparison, one-half of respondents indicated “moderate” or “major” concern over the agricultural impacts of low water quantity (as measured by well yield). Finally, we estimate producer willingness to pay for a marginal improvement in water quality (as measured by salinity levels) using contingent valuation. We estimate willingness to pay ranging from \$26/well to \$39/well for an incremental increase in the salt content of irrigation water.

We published a paper that synthesizes lessons that can be learned from the recent experience of local efforts to manage groundwater in Kansas. We utilized several different sources of data to determine some measure of support or resistance to local groundwater management by individual users and examined if certain resource characteristics were correlated with their support. We also provided a qualitative analysis of different management plans and examine what factors may have led to their degree of success. We find that the local management plans developed in Kansas generally follow the best-practice design principles laid out in the pioneering work by Elinor Ostrom. However, we find that most of the plans have not led to substantial reductions in water use, except for a policy implemented in a small portion of Sheridan County. A plan that relied on voluntary participation did not generate sufficient participation.

In another effort, we collaborated with a Groundwater Management District (GMD) board of directors and conducted a survey of irrigators to ask if they support different types of water management plans. Results from the survey were presented at the GMD annual meeting and will also be analyzed further for future academic publications.

Briefly describe how your target audience benefited from your project's activities.

The research on ethanol and water use helps stakeholders understand the effect of ethanol on water use and land values. This gives policymakers important information when weighing alternative policy options and gives water managers important information for targeting management strategies. One concern raised by this study is greater financial leverage of irrigated farms, potentially leading to increased future vulnerability to declining income, slackening of bioenergy mandates, or declining irrigation water availability due to climate change or aquifer drawdown.

Our work on farm size helps groundwater managers better assess how irrigation water demand is likely to change in the future as farm consolidation continues.

The research on water quality gives policymakers and groundwater managers information on the willingness of farmers to pay for improved water quality. This can be used to weight the costs and benefits of different policy actions that could improve water quality.

The work on water management efforts gives insights to water managers and water users about what types of management strategies have been most effective. Our overall conclusion is that collective management efforts that are small-scale and mandatory show the greatest promise for success. This result helps stakeholders know how to focus their efforts that will be most effective.

Our survey of irrigators in Groundwater Management District (GMD) #1 in western Kansas finds broad support among farmers for mandatory reductions in water use. We find that at least 75% of irrigators support at least a 10% mandatory reduction in water use. However, there are differing opinions about how to assign the allocations. Any plan that specifies the method of assigning allocations receives much less support and there is no single most-preferred method. The survey results highlight a major challenge in groundwater management—many farmers want to see reductions in water use, but they disagree on the best method to achieve the reduction.

The survey of irrigators about different management plans helped the board of directors better understand the preferences of irrigators so that they could implement a plan that would receive support.

Briefly describe how the broader public benefited from your project's activities.

Most of our activities provide important information that can improve policymaking and inform the management strategies used by farmers. This benefits the broader public by helping to ensure that water is effectively managed for greater societal benefits.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Publications

Gardner, G., G.S. Sampson, and D. Presley (2021). "Irrigator perceptions and the value of groundwater quality in the High Plains Aquifer." *Journal of Soil and Water Conservation* 00118, <https://doi.org/10.2489/jswc.2021.00118>.

Sampson, G.S., A. Al-Sudani, J. Bergtold (2021). "Local irrigation response to ethanol expansion in the High Plains Aquifer." *Resource and Energy Economics* 66, 101249, <https://doi.org/10.1016/j.reseneeco.2021.101249>.

Gardner, G. and G.S. Sampson (forthcoming). "Land value impacts of ethanol market expansion by irrigation status." *Journal of Agricultural and Resource Economics* doi:10.22004/ag.econ.313314.

Ao, Y.Z., N.P. Hendricks, and L.T. Marston. 2021. "Growing farms and groundwater depletion in the Kansas High Plains" *Environmental Research Letters* 16: 084065.

Perez-Quesada, G. and N.P. Hendricks. 2021. "Lessons from Local Governance and Collective Action Efforts to Manage Irrigation Withdrawals in Kansas" *Agricultural Water Management* 247: 106736.

Parker, Emily. 2021. "Anaerobic Membrane Bioreactor (AnMBR) economic viability on swine operations" MS Thesis, Kansas State University.

Microirrigation: A Sustainable Technology for Crop Intensification and Improved Crop Productivity

Project Director

Freddie Lamm

Organization

Kansas State University

Accession Number

1021229



Annual Progress Report 2020-2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project addresses irrigated crop water management issues in Kansas with particular emphasis on subsurface drip irrigation (SDI), which is a type of microirrigation. The project also addresses hydrological issues, as well as soil physics issues, associated with irrigated water management. The project has 4 principal investigators with 2 sited in semi-arid western Kansas and 2 situated in semi-humid eastern Kansas.

Kansas has efforts in all 4 objectives of the multistate project W-4128.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Progress for Obj 1:

Studies were conducted in western Kansas to compare subsurface drip irrigation (SDI) and mobile drip irrigation (MDI) as a means to increase irrigation efficiency and to increase water productivity (more crop per drop). These studies are finding that both SDI and MDI are acceptable means of improving irrigation management.

A study evaluating the potential for intensification of corn production with SDI is showing that the selection of appropriate corn hybrids and seeding rate (plant density) are important factors in intensification. Precise irrigation management in this study at a level to only replace 85% of the normal irrigation amount has been sufficient.

Research and analyses were initiated to improve our understanding of water quality related to clogging of SDI systems in Kansas. An initial draft of a new extension paper is under review and revision.

Progress for Obj 2.

Field research to identify the number and optimal location of soil water sensors was continued. An on-farm experiment at the Flickner Innovation Farm in Central Kansas consisted of intensively sampling near-surface soil water conditions to generate detailed spatial maps of soil water that were repeated through the non-growing season. A new study shows that rootzone soil water can be accurately predicted solely from a sensor located near the soil surface. Field sampling and analysis of the soil physical properties of 40 stations of the Kansas Mesonet was concluded. This new dataset of soil physical properties can be used to inform mechanistic models or to develop pedo-transfer functions for irrigation applications.

Progress for Obj 3.

Two web tools hosted in the Soil Water Processes Github repository were developed. A tool for batch analysis of green canopy cover called Foliage is available at <https://soilwater.github.io/foliage/>. Another tool for forecasting soil water content using the FAO-56 model and historical weather is at <https://soilwater.github.io/fdk/>

Kansas (K-State) partnered with a company, Ceres Imaging who provided remotely sensed thermal and multispectral images of four fields in the Garden City, KS area throughout the 2020 corn growing season to evaluate irrigation scheduling. Weekly maps of NDVI and SAVI from manned aerial imagery were combined with empirical equations to estimate both basal and combined crop coefficients at 1-meter resolution. These crop coefficient maps demonstrate potential to help irrigators make more informed irrigation management decisions during the growing season.

Progress for Obj 4.

A combination of road (visual) surveys and Division of Water Resource's databases (e.g., WIMAS) are being used to assess the current status (scope and geographical distribution) of SDI and other irrigation systems in southwest Kansas. For this reporting period, the road survey is still ongoing with a couple more counties left. This information will be used to inform and develop further research and extension efforts to transfer SDI technology to a diverse clientele.

Additions were made to the extensive Kansas website concerning subsurface drip irrigation, SDI in the Great Plains, <https://www.ksre.k-state.edu/sdi/>

Briefly describe how your target audience benefited from your project's activities.

Continued evidence that intensification of corn production can be achieved without increasing irrigation water needs implies this is a sustainable irrigation strategy.

Both SDI and MDI are still emerging technologies in the Central Great Plains and irrigators visit our field sites and also our websites to gain new information,

A major review of subsurface drip irrigation research during the past decade within the USA can help guide and set future research priorities.

The web application for determining crop evapotranspiration from digital images and weather data is another tool producers can use to help manage irrigation on their own farms.

The Soil Water Processes research group generated new knowledge that can be used to improve irrigation management and maximize the return-on-investment of soil water sensors. During webinars and while doing on-farm work we were able to interact and share our research findings with local producers and crop consultants.

Briefly describe how the broader public benefited from your project's activities.

General public: Irrigation is a major water user in Kansas with up to 95% of the total water use in western Kansas. When irrigated crop water management is improved through research and extension society benefits by lessening withdrawals from groundwater resources. Improved crop water productivity (more crop per drop) helps maintain rural economies, while lessening water resource usage.

Students: Field and laboratory data collected during this period was used for teaching soil physical properties and processes in a dual-level course in environmental soil physics. Data was also used in several examples of a graduate level course in scientific programming and reproducible research. Students use data collected for previous research studies to learn basic agronomic concepts through coding. A clear example is the use of weather data to compute crop evapotranspiration and the use of soil moisture data to learn how to create publication quality figures.

One graduate student was trained in flying unmanned aerial vehicles (UAVs), installation and use of soil moisture sensors, and in use of Python. The results of this study were disseminated within K-State research community (graduate research forum and 3MT (3-minute thesis) competition), Kansas public, stakeholders and legislators (Kansas Governor's Water Conference), and to International scientific community (American Society of Agricultural and Biological Engineers Annual International Meeting).

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There have been no major changes to the project goals or directions during this period.

Both undergraduate and graduate students have been trained in this project.

Publications:

Dyer, W*, Bremer, D., Rossini, P*, Stone, M**, and Patrignani, A. 2021. Laboratory Calibration of the Spectrum Field Scout TDR 300. Kansas Agricultural Experiment Station Research Reports: Vol. 7: Iss. 4. <https://doi.org/10.4148/2378-5977.8070>

Flory, J**; Grane, J*, and Patrignani, A. 2021. Using a Sprayable Biodegradable Polymer to Reduce Soil Evaporation in Greenhouse Conditions. Kansas Agricultural Experiment Station Research Reports: Vol. 7: Iss. 5. <https://doi.org/10.4148/2378-5977.8079>

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Lamm, F. R., P. D. Colaizzi, R. B. Sorensen, J. P. Bordovsky, M. Dougherty, K. Balkcom, D. Zaccaria, K. M. Bali, D. R. Rudnick and R. T. Peters. 2021. A 2020 vision of subsurface drip irrigation in the U.S. *Trans. ASABE*, 64(4):1319-1343. <https://doi.org/10.13031/trans.14555>

Nahitiya, D*, Bisheh, M. N*, Lollato, R. P., and Patrignani, A. 2021. Preliminary Classification of Soil, Plant, and Residue Cover Using Convolutional Neural Networks. Kansas Agricultural Experiment Station Research Reports: Vol. 7: Iss. 5. <https://doi.org/10.4148/2378-5977.8081>

Oker, T.E., Sheshukov, A.Y., Aguilar, J., Rogers, D.H. and Kisekka, I., 2021. Evaluating Soil Water Redistribution under Mobile Drip Irrigation, Low-Elevation Spray Application, and Low-Energy Precision Application Using HYDRUS. *Journal of Irrigation and Drainage Engineering*, 147(6), p.04021016.

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Parker, N* and Patrignani, A. 2021. Evaluating Traditional and Modern Laboratory Techniques for Determining Permanent Wilting Point. Kansas Agricultural Experiment Station Research Reports: Vol. 7: Iss. 5. <https://doi.org/10.4148/2378-5977.8080>

Rossini, P. and Patrignani, A. 2021. Predicting rootzone soil moisture from surface observations in cropland using an exponential filter. *Soil Science Society of America Journal*. doi.org/10.1002/saj2.20319.

Rossini, P* and Patrignani, A. 2021. On-Farm Assessment of AquaSpy Soil Moisture Sensors for Irrigation Scheduling. Kansas Agricultural Experiment Station Research Reports: Vol. 7: Iss. 5. <https://doi.org/10.4148/2378-5977.8082>

Rossini, P., Ciampitti, I, Hefley, T., and Patrignani, A. 2021. Soil moisture-based framework for guiding the number and location of soil moisture sensors in agricultural fields. *Vadose Zone Journal*. <https://doi.org/10.1002/vzj2.20159>.

Solé-Torres, C., F. R. Lamm, M. Duran-Ros, G. Arbat, F. Ramírez de Cartagena, and J. Puig-Bargués. 2021. Assessment of microirrigation field distribution uniformity procedures for pressure-compensating emitters under potential clogging conditions. *Trans. ASABE* 64(3):1063-1071. <https://doi.org/10.13031/trans.14486>.

Presentations:

Bisheh, M.N., Nahitiya, D., and Patrignani, A. 2020. Quantifying Soil, Plant, and Residue Cover from Images of Agricultural Fields Using Convolution Neural Networks. *Virtual ASA-CSSA-SSSA International Meetings*.

Diggins, D.C., Brown, W.G., Ochsner, T.E., Patrignani, A., and Oruganti, P. 2020. Cropland Observatory Nodes (CRONOS): Early Prototypes and Initial Results in Oklahoma. *Virtual ASA-CSSA-SSSA International Meetings*.

Fink, K., Gerhardt, A., Rocateli, A.C., Patrignani, A., and Lollato, R. 2020. Identifying Yield Limiting Factors for Alfalfa Using on-Farm Surveys. *Virtual ASA-CSSA-SSSA International Meetings*.

Frieden, L., Lollato, R., Ochsner, T.E., and Patrignani, A. 2021. In-season Forecasting of Grain Yield and Soil Moisture in Winter Wheat. Manhattan, KS. Research Experience for Undergraduate Fellows (Summer 2021) as part of the Rainfed Agricultural Innovation Network (RAIN) initiative.

Koudahe, K., J. Aguilar, M.B. Kirkham, K. Djaman, and A.Y. Sheshukov, 2021. Integrating field measurements, novel modeling, and remote sensing datasets for crop coefficient and evapotranspiration calculations in thermo-limited region of the High Plains. Poster Presentation. In 2021 Governor's Virtual Conference on the Future of Water in Kansas. Nov. 17, 2021.

Parker, N. and Patrignani, A. 2020. Revisiting the Methods for Measuring Soil Water Retention Curves. *Virtual ASA-CSSA-SSSA International Meetings*.

Patrignani, A. 2021. Monitoring the components of the soil water balance using state-of-the-art Technologies. June 2021. VI Jornadas de Ciencia y Tecnología (Translation: VI *Conference of Science and Technology*). Universidad Nacional de Rosario, Argentina.

Patrignani, A. 2021. Konza Prairie Environmental Monitoring Network. Konza Long Term Ecological Research Network Annual Meeting. Sep. 4, Manhattan, KS.

Patrignani, A. and Ochsner, T.E. 2021. Practical applications of in-situ green canopy cover. *Soil and Water Conservation Society*. Virtual meeting, July 26-28, 2021.

Patrignani, A., Jakas, M., Bisheh, M.N., Nahitiya, D., and Forbes, S. Exploring the Spatial Variability of Soil Respiration in Production Fields. *Virtual ASA-CSSA-SSSA International Meetings*.

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Wiederstein, T., Sharda, V., Aguilar, J., Sharda, A., Hefley, T., and Ciampitti, I "Evaluating spatial and temporal variations in subfield level crop water demands". Poster presented at Kansas Governor's Water Conference (Virtual), Nov. 17-18, 2021.

Weiderstein, T., Sharda, V., Aguilar, J., Sharda, A., Hefley, T. "Evaluating spatial and temporal variations in subfield level crop water demands". Presented at 2021 ASABE Annual International Conference, July 12-16, 2021 (Held virtually).

Irrigated Water Management for Western Kansas

Project Director

Freddie Lamm

Organization

Kansas State University

Accession Number

**In 2-3 sentences, briefly describe the issue or problem that your project addresses.**

The goal of this project is to develop/adapt irrigation methods and irrigation management strategies suitable for profitable and environmentally friendly agricultural production in semi-arid western Kansas. The project also addresses crop water management and associated crop cultural management issues, irrigation system design issues, general irrigation water management, and irrigation scheduling procedures. The project has 4 principal investigators with two sited in semi-arid western Kansas and two situated in semi-humid eastern Kansas. There are three agricultural engineers and one agricultural meteorologist on the project.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.**Progress for Obj 1.**

Research plots were established at KSU-SWREC (Garden City, Kansas) to evaluate different application devices for center pivot irrigation systems. Two crops, corn and cotton, were planted on the center pivot with four different application devices, LEPA, MESA and MDI with two different emitter rates (3.9 and 7.8 L/h) plots with high and low plant density at a deficit irrigation capacity. Data from this continuing study are being analyzed at this point in time.

Progress for Obj 2.

A multiple year study was conducted at KSU-NWREC (Colby, Kansas) Kansas to compare subsurface drip irrigation (SDI) and mobile drip irrigation (MDI) as a means to increase irrigation efficiency and to increase water productivity (more crop per drop) in corn production. This study found that that both SDI and MDI are acceptable means of improving irrigation management.

Research and analyses were initiated to improve our understanding of water quality related to clogging of SDI systems in Kansas. An initial draft of a new extension paper is under review and revision.

Progress for Obj 3.

A study was initiated to quantify water usage of cotton production in southwest Kansas. Since cotton is a relatively new crop for southwest Kansas, evaluating evapotranspiration rates, crop production function, water stress and water usage of cotton under thermally limited conditions is needed. In-situ data collection of meteorological variables was established for the irrigated KSU-SWREC crop site. Two monitoring stations with above and below ground instrumentation were established inside the center pivot, and another station was added in 2021 outside in a dryland field. Continuous subhourly readings of precipitation, air, skin surface, canopy, and soil temperatures, solar and net radiation fluxes, windspeed, air relative humidity, and soil water content were collected at all monitoring sites. During the growing season agronomic characteristics of cotton and corn were frequently measured. Cotton bulk and lint yields were collected and are being analyzed this winter.

Progress for Obj 4.

A study was continued at KSU-NWREC evaluating grain sorghum performance under deficit sprinkler irrigation where the goal is primarily to save irrigation water but yet be able to assure a crop yield. The grain sorghum was grown on a site with ample soil water in the profile at planting each year (2018-2021). No seasonal irrigation is applied until the boot stage of grain sorghum and then irrigation is applied as needed (100% ET-rain) until total irrigation reaches, 75 mm, 150 mm or full irrigation requirement. These three irrigation levels are compared against a nonirrigated control treatment. The study was completed in 2021 and the data is now being analyzed. Analysis is indicating there is little or no benefit from increasing irrigation above 75 mm for grain sorghum in this region when there is ample soil water in the profile at planting.

Field setup and observations at KSU-SWREC will target data collection necessary to inform the theoretical approach, generating daily ET rates, calculating crop coefficient, and estimating crop water usage. FAO and ASCE methods for estimating reference and crop ET rates based on standard Penman-Monteith approach will be compared with the recently formulated maximum entropy production (MEP) model. The foundation of the MEP model is built on advancements in the non-equilibrium thermodynamics and the principle of maximum entropy, and allows the partition of surface radiative fluxes into (turbulent and/or conductive) heat fluxes as functions of surface net radiation, air and soil temperature, and air relative humidity.

Progress for Obj 5.

Studies were continued at KSU-NWREC (Colby, Kansas) to examine intensification of corn production for both sprinkler-irrigated and subsurface drip-irrigated corn by selection of corn hybrid, increased plant density, irrigation level and advanced fertilization. Preliminary data analysis is indicating that crop intensification does not benefit from increasing irrigation above normal amounts, that hybrid selection plays a key role in crop intensification, and that increasing plant density generally results in greater grain yield.

Briefly describe how your target audience benefited from your project's activities.

The results produced from the project activities will improve design, operation, and management of advanced irrigation systems, such as SDI and MESA, LESA, LEPA and MDI.

Recommendations for irrigation scheduling on corn, cotton, and grain sorghum fields will improve yields and improve water management of individual crop producers.

Intensification of crop production has the potential to increase crop yield and profitability and water productivity without negatively affecting water resource use.

Briefly describe how the broader public benefited from your project's activities.

General public:

Kansas is a major irrigated state and the rural economy of western Kansas is heavily supported and sustained through irrigation. Improvement in irrigation practices protects this valuable rural industry.

Students:

A student intern working at KSU-SWREC at Garden City, Kansas has solidified her plans to pursue a water-related degree.

Two graduate students from Biological & Agricultural Engineering (BAE) department were able to work on quantification of the ET rates of cotton and corn as part of their Masters degree program in BAE.

Two international scholars were able to help and trained on limited-irrigation cotton and corn production as part of their visiting program.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There have been no major changes to the project goals or directions during this period.

Both undergraduate and graduate students have been trained in this project.

Publications:

1. Aguilar, J., Currie, R.S., Tomsicek, D., Haag, L. and Duncan, S., 2021. Testing Irrigated Cotton Production. Kansas Agricultural Experiment Station Research Reports, 7(7), p.6.

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1. Aguilar, J.P., D. Devlin, and B. Golden 2021. Using Farmer-Based Water Technology Farms to Implement New Irrigation Technologies to Sustain the Rural Economy. CIG Showcase: Soil and Water Conservation International Annual Virtual Meeting. July 27, 2021.
2. Aguilar, J.P. 2021. Invited Panel Speaker. Linking Water Use Efficiency with the Carbon Cycle and On-Farm Sustainability. 2021 Sustainable Agronomy Virtual Conference. Aug. 10, 2021.
3. Aguilar, J.P. 2021. Invited Lecturer. Smart Farm Irrigation: North American Flavor to Southeast Asian Condition. International Virtual Course on Integrated Green Technology Towards a Sustainable Planet. Aug. 5, 2021.
4. Aguilar, J.P. 2021. Smart Farm Irrigation: North American Flavor to Philippine Conditions. International Short Course on Propelling Global Competitiveness in Agricultural and Biosystems Engineering Technology. Oct. 13, 2021.
5. Aguilar, J.P. 2021. Understanding Water in Food Production: Drought, Irrigation, and Virtual Water. AG Symposium. Yager Group. KCI Expo Center, Kansas City, MO. Dec. 3, 2021.
6. Aguilar, J.P. 2021. NRT Southwest Experience: Irrigated Agriculture at Scandia. 15 attendees. Aug. 3, 2021.
7. Aguilar, J. P., M. Sanderson, and B. Golden. Understanding Irrigation Systems and New Technologies: Irrigation Trends and Management Tools. Water Resource Management and Irrigation in Kansas Virtual Training Series. Kansas Center for Agricultural Resource and the Environment. Mar. 25, 2021
8. Aguilar, J.P. Irrigation Technology and Management. Kansas State University/KARA Summer Field School (2 Sessions). July 7 & 8, 2021.
9. Aguilar, J.P. Irrigation Technology. Kansas NRCS Precision Ag Short Course. (Recorded for future trainings.) Manhattan, KS. July 13, 2021.
10. Koudahe, K., J. Aguilar, M.B. Kirkham, K. Djaman, and A.Y. Sheshukov, 2021. Integrating field measurements, novel modeling, and remote sensing datasets for crop coefficient and evapotranspiration calculations in thermo-limited region of the High Plains. Poster Presentation. In 2021 Governor's Virtual Conference on the Future of Water in Kansas. Nov. 17, 2021.
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Media Interviews:

1. Interview by Dave Bergmeier of High Plains Journal regarding irrigation's role in Kansas agriculture titled "Irrigation's role in agriculture cannot be overstated" published on HPJ Oct. 9, 2021.
2. Article by Pat Melgares of KSRE News team titled "K-State researchers seeking best ways to grow cotton in Kansas" was picked-up by regional and national news outlets. Salina Post published it on Nov. 28, 2021.
3. KIULe- regular schedule every 4th Thursday of the month (some topics discussed: water conservation, evapotranspiration, Crop Water Allocator, Weather Data Library, Irrigation Innovation Project Field Day, soil moisture sensors, KWO Governor's Conference); Thursday's schedule focus on water-related topic and is shared with Hydro Resources, Kansas Division of Water Resources, and GMD 3.
4. KBUF – rotational schedule with other SWREC programs (some topics discussed: water conservation, moisture sensors, Crop Water Allocator, evapotranspiration, irrigation system maintenance)
5. KWCH News – interviewed by Brityne Rucker for "Eye on Agriculture" segment regarding cotton research

2021 Water and Natural Resources

Project Director

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Organization

Kansas State University

Accession Number

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Extension Addresses Blue-Green Algae Blooms in Kansas Lakes, Reservoirs and Stock Ponds

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Blue-Green Algae (BGA) blooms are being reported each summer at an increasing rate for bodies of water throughout Kansas, ranging from the largest reservoir in the state (Milford Lake) to numerous small stock ponds in pastures. Blue-Green Algae are actually not closely related to other species of algae but are a type of cyanobacteria. Some cyanobacteria produce toxins. Most harmful freshwater blooms are comprised of these species, which can produce an array of toxins that effect nerves, the liver or kidneys, and may act as skin or respiratory irritants in livestock, wildlife, pets, and humans.

Blue-Green Algae blooms are favored by nutrient-rich, warm, still, clear water, and can develop quickly under favorable conditions. BGA is buoyant and can be moved by wind and waves. Reducing nutrient loading in surface water to reduce BGA is a complex, long term endeavor.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Due to the pandemic preventing in-person meetings, a virtual workshop addressing BGA was conducted in 2020. Two treatments appropriate for small ponds were demonstrated, which were the deployment of barley bales and slow sand filters (SSF). Slow sand filters were built, based on a study done by Ohio State University that stated the slow sand filters were quite effective at reducing both intracellular and extracellular toxins from water. The goal was to produce a slow sand filter that was made from readily accessible materials and simplified so that it could be replicated by farmers and ranchers. Two SSFs were made using food grade chemical totes, gravel, sand, and PVC plumbing. The filters were large enough to produce 700 gallons of filtered water a day.

The filters were set up on a pond, so that the biological (smutzdecke) layer could form. The first filter was taken to a farm south of Holton, the pond had suspicious looking algae. The pond was used for watering some meat goats. Tests on the pond were conducted as well as a test on water coming from the filter. Water was pumped with solar pumps from a floating bucket, close to the shore. The second filter was taken to a neighboring pond that also had Barley straw installed. That pond was not being used for livestock but had two confirmed blue-green algae blooms.

After several weeks, the first filter got plugged and very little water was being filtered. At this point the pond tested safe and so the filter was removed. When cleaning it out, we discovered a lot of the sand had infiltrated into the gravel. When we rebuilt it, we added a layer of light weight landscape fabric on top of the gravel to keep the sand from infiltrating. We also discovered that a larger 1-inch polypipe for the outflow, was less likely to get plugged and we enlarged the size of holes on the dispersal tote, as they were getting plugged with slime. The SSF was also used at the Tailgate Talk in Meadowlark Extension District, attended by 20 producers. We are working on a fact sheet of how to construct the slow sand filter as well as a video.

A barley straw bale mitigation pilot project in cooperation with KDHE was also conducted. Ponds in northeast Kansas that had previously developed BGA were treated. Bales were installed at the rate of 7 bales per acre of water, staked down at the shoreline at least 20' apart and at least half submerged.

Briefly describe how your target audience benefited from your project's activities.

An alternative water supply was provided for one additional farm, which impacted 30 head of cattle that were exposed to a BGA bloom. An improved design for the slow sand filters will be field tested next summer. After learning of the BGA threat at the Tailgate Talk, two producers will be installing safer, alternative water supplies for their livestock.

Briefly describe how the broader public benefited from your project's activities.

Awareness and understanding the risks associated with cyanobacteria in public and private water bodies, toxins caused by blue-green algae and harmful algae blooms (HABs) are important for the health and safety of Kansas residents and guests. Nutrient management best practices can reduce the frequency of blue-green algae issues and concern.



Extension Horticulture Rapid Response Services are Improving Quality of Life for Kansans

Final Result

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Kansas residents and businesses are faced daily with questions and decisions to make regarding lawns, landscapes, gardens, and more. The decisions Kansans make directly affect the state's valuable resources such as water, soil, and the overall health of people and the environment.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Throughout 2021, K-State Research and Extension Horticulture Agents and Extension Master Gardener volunteers have been innovative in helping Kansans solve problems with reliable and on-demand access to research based horticulture expertise in multiple formats including: rapid response garden hotlines, sick plant clinics, walk-in office visits, calls, texting, email, the K-State Garden Hour, online webinars and conferences, media releases, and a variety of content posted to YouTube, Facebook, Twitter, Instagram, blogs, and more.

Briefly describe how your target audience benefited from your project's activities.

Kansans who utilize the on-demand horticulture rapid response services provided by Master Gardener volunteers and Horticulture Extension Agents are saving money and time, reducing pesticide and fertilizer applications and contributing to cleaner water, healthy soil, and improved quality of life for all in our state.

Success Story: Each year around 5,000 residents contact the Johnson County Extension Garden Hotline which is staffed by Extension Master Gardener volunteers and supported by the Extension staff. A survey of these residents indicated that 86% of users followed the recommendations provided and that 12% saved time, 8% saved physical energy or had less work, 10% stopped applying unnecessary chemicals and 64% saved up to \$100 as a result of gaining new knowledge.

Briefly describe how the broader public benefited from your project's activities.

Tools and educational opportunities made available by the Kansas Healthy Yards and Communities program will enable Kansans to have increased capacity to manage the effects of challenging environmental conditions, limited water and increased environmental concerns.



Watershed Research and Implementation Partnership Program

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The K-State Watershed Specialist program began in 2000, as a partnership with the Kansas Department of Health and Environment and other agricultural groups. To restore water quality in Kansas requires a fundamental change in behavior and practices toward the land and water.

The goal of the K-State Watershed Specialist program is to reduce non-point source pollution from cropland and livestock sources with the priorities of restoration of impaired water resources; abatement of fecal coliform bacteria, atrazine and pesticides; reduced nutrients and sediment loads, protection of water resources; and implementation of farm/producer best management practices (BMPs).

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Watershed Specialist team provided a broad array of educational services in 2021 including:

- facilitated and/or participated in over 382 educational events, reaching more than 4800 Kansans,

- presented 68 educational presentations,

- held over 583 radio and TV interviews,

- published 8 news articles,

- held 445 one-on-one farm consultations,

- held nearly 13 livestock referrals and

- introduced cover crops into more than 118 on-farm consultations and presentations.

The team provided technical assistance in the implementation of over 190 BMPs, involving nearly 78 different producers across the state of Kansas this year.

- 158 of the 190 BMPs implemented were on cropland, positively impacting nearly 18,244 acres.

- 34 of the 190 BMPs implemented positively affected 1,927 animal units of livestock on over 914 acres.

Briefly describe how your target audience benefited from your project's activities.

The BMPs listed above are what is used to figure pollutant load reductions. Since 2005, when the Watershed Specialist Program began, significant reductions have been made in phosphorus (510,030 pounds), and nitrogen (997,433 pounds) loads in our Kansas rivers. Over 10,000 tons/year of sediment has been saved in the past 5 years alone from the Specialist's efforts.

Success Story: Collaboration with the City of Wichita: The Central Kansas Watershed Specialist has worked closely with the City of Wichita for years. Two programs have been developed to improve water quality in the Little Arkansas River Watershed and directly benefits the City of Wichita.

1. The Atrazine Program began in 2006. The project goal is to offer producers a financial incentive to voluntarily implement atrazine herbicide BMPs to meet surface water quality standards of 3 micrograms per liter, with no seasonal spikes. Funding for the atrazine portion of the WRAPs project was sponsored fully by the City of Wichita. Over the past 10 years, atrazine BMPs have been installed on 172,620 acres of cropland and resulted in an average load reduction of roughly 60% and 8,476 pounds a.i.

The City of Wichita was so pleased with the work in reducing the use and pollutant loading of atrazine that they have more than doubled the amount of funding they are providing to the group since the program began. In 2020, the City also began providing additional funding for education, such as watershed newsletters and field days.

2. Offsite BMP Program began in 2016. The Offsite program is designed to remove at least twice the amount of sediment as would be achieved by onsite BMPs, which benefits water quality in the Arkansas River. Urban developers realize significant economic benefits by choosing to participate in the Offsite BMP program as they have the option to pay an annual fee of \$19/acre in lieu of their usual and quite pricey hydrodynamic separators (HDS) installation. To date, the City of Wichita reported a total of 246 developments, comprising 1,010 acres participating in the Offsite BMP program. To offset these development acres, 497 acres of upstream farmland was converted to no-till. As of January 2022, offsite sediment load was reduced by an estimated 1,589 tons. As a result of this program, developers in Wichita have been able to avoid installing HDS units, for a savings of approximately \$5 million.

The Offsite BMP program in Wichita will continue to grow and evolve, and its continued success will help to establish a model for a regional approach to water quality management.

Briefly describe how the broader public benefited from your project's activities.

The term "WRAPS" was coined by the Kansas Department of Health and Environment (KDHE) in response to the 1998 Clean Water Action Plan issued by the Clinton Administration. The Clean Water Action Plan directed the state environmental agency and the State Conservationist of each state to complete a "unified watershed assessment". Once the assessment was completed, states were then directed to develop "watershed restoration action strategies" (WRAS). Kansas' has long contended that restoration of damages is only part of the need and that action to protect water is also necessary, hence the term WRAPS. As used by KDHE, WRAPS referred to the development of action plans to address nonpoint source pollution sources on a watershed basis.

Type	Projects / Programs
Projects / Programs without a Critical Issue	0
Not Provided	