

Oklahoma (Langston University, Oklahoma State University Combined) Annual Report - FY2021

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Contributing Organizations

Langston University
Oklahoma State University

Executive Summary

Overview

Oklahoma contains a broad array of natural resources, agricultural production regions, commodities produced, communities, families, businesses, and industries. The state ranks 5th nationally in the number of farms and 8th in farm acreage. Vast forage production areas, the ability to graze winter wheat, and the sub climate of the high plains have made cattle production an enormous industry in Oklahoma, ranking 4th nationally in cattle and calves. Wheat, poultry, hay for sale, cotton, nursery crops, forest products, oilseed crops, nuts and vegetables all play an important role in the broad agricultural economy. The level of value added to raw products in the state is low and needs to improve to continue to help diversify rural economies.

Huge fluctuations in weather from recurring statewide drought to periodic flooding present challenges for both research and extension and will continue to have significant implications on agriculture and natural resources in the state.

Management of natural resources is significantly affected by ecosystem degradation and loss of services, land use changes and habitat fragmentation, water availability, and climate change. These challenges summarize a global phenomenon in which human activities, both directly and indirectly, influence the management of natural resources. Considerable untapped opportunity exists for the improved use of natural resources for recreation and the development of bio-based industries with an emphasis on sustainable energy.

Human health issues are major economic and social concerns as Oklahoma often ranks high in risk factors such as child and adult obesity and diseases such as heart disease and diabetes. Rapidly changing communities ranging in population from rural to urban also exist within the state's boundaries. Programs must be adapted for the broad and rich ethnic, cultural and social diversity within the state. Issues, challenges, and opportunities with respect to agricultural production, the environment and natural resources, communities and markets, scientific discovery, economic downturn, and technology development exist within Oklahoma, the region, and the nation.

Critical Issue: Animal Production Enterprises

Over 2 million beef cattle graze Oklahoma pastures. Ranchers are constantly in need of information and technologies to make ranching easier, more productive, more profitable, and better for the environment. We are conducting research into new ways to use high-tech tools to precisely manage grazing systems, and reduce methane emissions from grazing cattle, making them simultaneously more efficient and have a lower environmental footprint. A 3- year virtual fence experiment was initiated at multiple locations. It has been determined that virtual fencing has potential to be effective for grazing management, which would open a new paradigm for landscape and animal management. We have also identified needed areas of improvement.

Even though productivity of the beef industry has risen greatly in the past several decades, there has been very little emphasis on the efficiency of nutrient utilization. Recent interest has focused on utilizing physiological mechanisms that contribute to feed efficiency to guide future advances in productivity. As feed costs are 55-75% of total production costs, it is in all producers' best interest to improve feed efficiency. An initial project is underway to determine the role of glucose metabolism on appetite regulation and feed efficiency. It appears that variation in glucose metabolism and possibly insulin sensitivity could account for some the large amount of variation in feed intake observed in growing and finishing beef cattle.

We have sequenced transfer RNAs, once thought to be statically expressed, and discovered they are dynamically expressed and subject to variation. This variation impacts how future genome-wide association studies interpret genetic variation not expected to alter protein sequence. We have sequenced genomic DNA from *Bos javanicus*, an endangered bovine species. Comparative genomics of *B. taurus* and *B. javanicus* will allow scientists to interpret the ancestral bovine genome and evolution of bovines.

Our work is improving how animal scientists look at genetic variation. Previously, genetic variation analysis focused mainly on gene coding regions and ignored mutations that did not expect to alter the amino acid sequence. Our work has identified that synonymous mutations (not expected to alter amino acid sequence) may harbor phenotype altering capacity thanks to differences in tRNA expression and availability. Further, our work in comparative genomics of bovines and functional annotation further reveal the importance of non-coding genomic regions on gene expression and traits.

A control method recently introduced into the US is feeding grazing animals the nematode-trapping fungi, *Duddingtonia flagrans*, through supplementation with a product called Livamol® with BioWorma® (LB). The fungi pass through the animal and trap and consume parasite larvae in the feces. This has potential to decrease the number of infective larvae consumed, lessen parasite burden, and may change IP species composition. This study evaluated effects of feeding LB, copper oxide wire particle boluses (COWP), and a combination to naturally infected goats. Treatment affected the number of larvae recovered per gram feces and percent of larvae recovered from the total fecal eggs cultured. A treatment by roundworm species effect was present when assessing the percent of different nematode genus in fecal samples. The mode of action of COWP and LB is different. COWP acts inside the animal to reduce the number of GIN whereas LB acts to reduce the number of infective larvae on pasture that over time will reduce parasite burden. The length of this trial may not have been sufficient to see LB effects over the long term. Hot, dry weather during the trial may have affected fecal egg hatch, larval development, and subsequent infection. The fact that the LBCOWP treatment was comparable to the control treatment in L3 per gram feces and L3 percent suggests that there may be an interaction between *Duddingtonia flagrans* and copper in the animal.

The Internal Parasite workshop and FAMACHA training is an annual producer-education event since 1990. In the early years, the workshop/training focused upon fecal egg counts (FEC) as the instrument for assessing parasite burden; however, in recent years, the workshop has emphasized the use of FAMACHA. Participants are exposed to FEC but not provided experiential learning as in past workshops. One-hundred-forty-five (145) persons registered from around the US and several foreign countries, 56 attended the live Zoom workshop, 34 took and passed the required quiz, and 21 submitted the required video of COVER, PUSH, PULL, POP (30 sec max). Thus, 21 participants received certificates and purchased FAMACHA cards. Videos of the presentations are posted on <https://www.youtube.com/playlist?list=PLK7xUIM5caPL0uU5nQw9dKgyU2e3ZHK0>. From the Internal Parasite workshop and FAMACHA training conducted in partnership with the Rural Agricultural Development Authority of Jamaica, 15 participants took and passed the required quiz, and submitted the required video of COVER, PUSH, PULL, POP (30 sec max). Thus, 15 participants from the Jamaican trainings received certificates and received FAMACHA cards. Small ruminant producers were educated in sustainable internal parasite control, which should reduce the reliance upon anthelmintics.

Langston University led a consortium of fellow universities and goat associations to develop an authenticated, science-based online presence. To date, 945 and 2,349 participants have enrolled in the Meat Goat and Dairy Goat certification course (English), respectively, and 55 and 99 participants have enrolled in the Meat Goat and Dairy Goat certification course (Spanish), respectively. The number of participants completing and receiving certification for the Meat Goat course is 480 and 14 and for the Dairy Goat course is 179 and 28 for the English and Spanish versions, respectively. Certified participants represent 49 US states, Puerto Rico, and 18 countries. Overall pretest scores for required and elective modules averaged approximately 71%; thus, most producers were required to study module content and take the post-test. Post-test scores are roughly 25% higher than pre-test scores, indicating a gain in knowledge by the producer. Some small ruminant producers may not have extensive livestock production experience. These certification courses are a trusted source of science-based goat production information. The online availability of these resources allows producers to access and find needed information, using it to enhance farm productivity and income and to safeguard the health and welfare of their animals.

Many goat producers believe that artificial insemination (AI) will increase the rate of genetic progress in their herds but feel that they lack the knowledge, skills and abilities necessary to use artificial insemination. Seventeen registered participants completed evaluation forms. Eight (47%) respondents rated the workshop as “excellent” and nine (53%) rated it as “good.” Sixteen respondents (94%) rated the subject matter as “very interesting and timely” and one respondent (6%) rated the workshop as “of moderate interest.” All seventeen respondents (100%) rated the presenters as “very qualified. Fifteen respondents (88%) said that the workshop met their expectations and that their objectives for attending the workshop were satisfied. The artificial insemination workshop provided practical knowledge, skills and abilities necessary producers to immediately use artificial insemination in their herds.

Critical Issue: Economic Development and Poverty Alleviation

The USDA loan guarantee program for business and industry was studied in relation to Oklahoma communities. The study found that Oklahoma communities with businesses receiving the loan guarantees had a positive impact on total retail sales per capita between 2005 and 2015, with larger effects during recessionary periods. The positive impact on local sales tax generation is an often overlooked component of effective rural development.

Job productivity was studied in relation to broadband availability and adoption. This study adds to the growing body of evidence that broadband metrics focused on adoption, not simple availability, are more closely related to job productivity in both rural and urban areas. Federal broadband policy traditionally only funded infrastructure but shifted to supporting adoption during COVID 19. This research supports this shift and makes the case for additional programs that address barriers to broadband adoption.

A study of whether internet access by itself or in conjunction with a laptop would improve educational outcomes of high school students that lacked broadband connection at home was conducted. The study showed that a laptop with internet access is critical for improving educational outcomes among students.

The rural library hotspot lending program was expanded to have 24 participating libraries across rural Oklahoma. The targeted demographic of low income, low education participants ranked the program 9.6/10. A rural digital navigator pilot program was launched which helped residents sign up for a new federal broadband subsidy and learn how to effectively use their devices and find reputable information online.

The "County Training Program" required by Oklahoma law has evolved into a certification program for all county government officials and staff. The financial statements and budget required to be filed by each county government was overhauled. Hundreds of data points are now uploaded to populate the form electronically rather than manually. Accountants who contract with county governments have been trained on correct completion of the State Auditor and Inspector form. Important project results are: (1) accurate, correct financial statements, (2) cost savings, (3) better compliance with the law regarding filing deadlines, and (4) earlier tax collections. Earlier tax collections recognize the time value of money resulting in more interest earnings for some and less interest expense for others.

Critical Issue: Environment and Natural Resources

Researchers found that bobwhite response to tree and shrub cover can differ as much as an order of magnitude between sites in western Oklahoma. Specifically, whether bobwhite selected for shrub cover and whether they strongly avoided trees, depended on the study site in focus. Based on these results, we caution managers to not make broad generalizations about bobwhite habitat needs and emphasize the importance of accounting for local differences in the availability, arrangement, and scaling of resources.

A research team found that greater prairie chickens with broods primarily used patches on grasslands up to 1-year postfire that had high abundances and biomasses of invertebrates as food sources compared to other patches that had longer postfire durations, or unburned patches. Greater prairie chickens further modified their habitat selection within these food-rich patches by selecting areas with cooler temperatures during the hottest part of the day. These included clumps of grasses or cover beneath multi-stemmed resprout shrubs. These results add to the growing body of literature highlighting the importance of creating grassland heterogeneity with prescribed fire.

OSU Extension reports that from information about prescribed fires conducted in Oklahoma in 2021, it was found that landowners are conducting more growing season burns. Landowners reported that 20% of all the burns conducted were growing season burns, which increase plant and insect diversity, that in turn create better gamebird habitat.

Researchers demonstrated that a novel camera trapping method could estimate abundance for multiple game species concurrently using a single study design. Though white-tailed deer and wild turkey have different life history strategies and use the landscape in different ways, the camera trapping method was able to detect both species without needing to account for different body sizes, movement speeds, or landscape use.

Researchers at OSU and collaborators Dr. Tim O'Connell and collaborators examined historical data on forest songbirds in Oklahoma under periods of prolonged drought and periods of ample precipitation. They found that distributions of at least 9 species of warblers, vireos, and flycatchers in the southern Great Plains were more strongly influenced by long-term swings in precipitation than they were by increases in temperature. The modeling revealed potential outcomes for these species under various future climate scenarios, affecting tens of thousands of square miles in eastern in central Oklahoma.

Researchers Dr. Scott Loss and PhD student Jared Elmore illustrated how NEXRAD weather radar systems could predict collisions between birds and windows, greatly advancing efforts to mitigate a top threat to populations that potentially claims 1 billion birds in the US every year. Migrating birds show up on radar. They discovered that nightly intensity of spring and fall migration as detected by radar correlates with numbers of observed collisions. Thus, radar can be used to forecast collisions and target actions to reduce them like reducing nighttime lighting.

The NREM Extension team of Drs. Dwayne Elmore, Laura Goodman and John Weir shared eastern redcedar management strategies with more than 820 people at extension events including field days in collaboration with county Extension, Master Cattlemen, Cow-calf Bootcamp, Goat Bootcamp, ODWC, and Quail Forever. On social media they created 61 posts about the effects and management of eastern redcedar with 379,522 impressions/reach (unique users/post), 17,434 engagements (likes, shares, comments), and 1,259 link clicks (to factsheets).

Critical Issue: Family and Child Resilience

Over 17% of Oklahoma's children will experience at least one adverse event such as abuse, neglect, or violence during their lifetime. Family dysfunction increases these numbers to at least 300,000 children per generation. The state ranks second in the nation for number of divorces, but only 18th in number of marriages. Divorce has negative impacts on parents and youth and increases the risk of negative outcomes in youth. Youth whose parents divorce have a 25-30% increased risk of suffering a mental health condition. Improving parenting skills, family breakdown, and youth ability to overcome adversity are critical to Oklahoma's future.

So as to advance the socio-economic development of the state, and have an impact on issues that address the critical areas of child and family resilience, OSU Extension Family and Consumer Sciences educational programs and resources were provided to Oklahoma adults; specifically targeting parents. In response to the challenges posed by the COVID-19 virus, Family and Consumer Sciences state specialists and county educators continued to provide quality researched-based education through various virtual platforms and in-person workshops while following state and local social distancing protocol.

Oklahoma State University's Co-Parenting for Resilience program helps divorcing or separating parents reduce the negative impacts of the couple's divorce on their children and fulfills the state-mandated requirement of education for divorcing parents. In 2021, Co-Parenting for Resilience classes were provided both in-person and online, to 1,560 parents in 53 Oklahoma counties. Evaluation results show that Co-Parenting for Resilience is effective at helping reduce the impact of divorce on children and increasing paternal coping and positive parenting. Comments from parents who completed the program include: –“My parents divorced when I was twelve and before this class I didn't think I was affected by it, but my own dad basically dropped out of my life. I don't want my son to be raised without a father; I'll be involved in his school activities and show up for his ballgames.” and “I really appreciate this class; I often refer back to my notes on how to be more engaged with my children” and “I realized some areas I need help in and how my actions made the situation worse. I made it well know that I didn't like my co-parent and there are things I shouldn't have said in front of my kids. There are many things I wish I had known before, and now that I have had this class there are things I would have done differently for my kids' sake.”

91% of Co-Parenting for Resilience participants became more likely to encourage their child to have a positive relationship with their other parent

88% of Co-Parenting for Resilience participants became more likely to communicate directly with their co-parent instead of communicating through their child

81% of Co-Parenting for Resilience participants became more likely to view their child's other parent as a valued member of the parenting team

Critical Issue: Food Safety and Food Insecurity

All people deserve the right to food security to avoid life threatening illnesses. Food security means access to enough food for an active, healthy life. Hence the USDA refers to those without access to these necessities as food insecure. And with the closure of the last remaining grocery store within the area referred to as the “east side” in Oklahoma City, the area has been termed a “food desert” because the only grocery items are what might be found at convenience stores and discount chains that deal in canned or packaged goods only (Dickerson, 2019). This unfortunate circumstance provides ample opportunity for Langston University to help develop a plan to assist food insecure individuals in the area. As extension educators, we have the ability to share our knowledge and reinforce the idea that anyone can create a productive urban garden with minimal resources and patience. Whether people are creating gardens in their backyard, a small courtyard, a patio or even just a balcony, it is our responsibility to ensure that citizens in our community are knowledgeable in growing their own food. The people that we serve in our community will have a better understanding that growing

fruits and vegetables can be easy and requires very little time once you acquire a few basic skills. Once individuals learn to grow and sustain nutrient dense foods, we as extension educators can introduce new fruits and vegetable for growth and then discuss the benefits of adding them to their daily diet. Langston University's implementation of an urban garden in Northeast OKC has proven that we can create a relevant food source in very limited resource area.

Critical Issue: Human Health and Hunger

In 2021, 895 adults participated in the Fresh Start program and learned valuable skills needed to consume a healthy diet and be physically active on a limited income. One hearing-impaired couple learned how to prepare healthier food and use house chores to move more after work. OSU provided an interpreter to join the paraprofessional and participants to cross communication barriers during lessons. The husband has lost 20 pounds, has more energy, and is motivated to get fit to he can live a long life.

81% of the 3,333 Show Me Nutrition graduates improved their abilities to choose healthy foods.

89% of the 251 Teen Cuisine graduates improved their abilities to choose healthy foods.

88% of the 59 OrganWise Guys graduates improved their abilities to choose healthy foods.

86% of the 513 3rd-5th grade students surveyed following the Virtual Farm to You exhibit identified foods they should eat for good health.

81% of the 511 KIK It Up graduates improved their abilities to choose healthy foods.

97% of the 437 Fresh Start graduates improved in one or more dietary quality areas.

In order to improve the health of Oklahomans with Diabetes, the program Live Well, Eat Well, be Active, with Diabetes (LEAD), a four-lesson series, was presented to 64 Oklahoma adults. Comments from participants include: "After learning the MyPlate method and other tips from the LEAD program, I am no longer taking either my long or short-acting insulin. This is wonderful news!" and "I am eight months into this year-long program. In January I could not walk for more than six minutes at a time, but this week I was able to walk for one hour and swim for 30 minutes in one day! I was discouraged because my weight loss has slowed, but these non-scale victories have given me new motivation."

72% of Live Well, Eat Well, be Active, with Diabetes participants have maintained or lost weight

56% of Live Well, Eat Well, be Active with Diabetes participants are in better control of their blood glucose

To improve food handling, preparation, and preservation skills, programs such as Cooking for 1 or 2, Food Safety for Seniors, and My Plate for My Family were presented to 834 adult participants. The Home Food Preservation program was attended by 772 adults and youth. An FCS County Educator commented, "With our new electric jam and jelly makers and electric hot water bath canners we have created new interest among youth in the art of home food preservation through the use of STEM technology." A county resident reported "I only called for help on a canning equipment problem, but during our conversation I learned the old family recipes and thrift store jars I was using were putting me and my family at risk of food poisoning! The FCS educator invited me to a class where I can get current instructions, safety information, and certified recipes."

23% increase in intent of Cooking for 1 or 2 program participants to use safe food handling and preparation practices

33% increase of adult Home Food Preservation participants who plan to use safe and effective food preservation practices

26% increase of youth Home Food Preservation participants who plan to use safe and effective food preservation practices

In an effort to increase physical activity among Oklahomans, especially seniors and others with mobility issues, the programs Walk with Ease, Arthritis Foundation Exercise Program, and Tai chi: Moving for Better Balance were presented to 1,637 adults. Program participants commented: "When I first joined, my fingers were often locking up and taking a long time to bend again. After working on the exercises at home, they seldom lock up anymore and my ring fingers are straighter than when I started." "Tai chi has benefitted my yoga exercise routine. The slow, gentle movements are easy on a senior citizen's body. The concentration required for coordination between hands and feet is a true gift for the preservation of the cognitive process." "My ankles had been swelling, but through the balance, strengthening exercises, and flexibility classes I have been able to get this condition under control. I am extremely pleased with the results."

89% of participants said the program has helped them increase physical activity

79% of participants report that participation in the program has helped them function better during daily activities

81% of participants report their health has improved as a result of the program

73% of participants report the Arthritis Foundation Exercise program has made a difference in their arthritis symptoms

83% of Tai Chi participants report a decreased fear of falling

The Expanded Foods and Nutrition Education Program (EFNEP) at Langston University was created to help improve the sustainability and quality of life for many Oklahomans. Oklahoma has the eighth-highest adult obesity rate in the United States, where 1 in 3 struggles with this issue. This means approximately 34% of Oklahomans are obese. The program has a target audience that includes all youth and adults in the state of Oklahoma and new data suggests we are making progress by addressing some of these obesity issues in our area. Some of our main goals include fully adapting high-impact strategies that target weight loss, improving or creating wellness among participants, and increasing activity in youth while making healthy life choices. Some of the main challenges for the participants in our program can be attributed to the fact that Oklahoma desperately suffers as a result of issues stemming from food deserts in the urban areas of the state. The lack of nutritional knowledge in the communities and a lack of income to purchase healthy foods are major factors when developing strategies that are designed to combat this epidemic. Obesity remains one of the most significant epidemics our country has faced. Obesity contributes to millions of preventable illnesses and billions of dollars in avoidable health care costs. Improving nutrition and increasing activity in early childhood is important because it helps people make easier and more beneficial health choices throughout their daily lives while targeting the inequities they face. Success within our program is submitted to the Webneers database, where it is reviewed by a board of members at the state and national level. The EFNEP program at Langston University has reached over 5000 youth and adult participants since 2015 and data shows that participants within our program have significantly improved in areas of physical activity, diet quality, and food safety. The Langston University EFNEP program has increased its number of participants, both youth and adults each year since 2015, which suggests our impact is being felt throughout the state of Oklahoma. Despite these modest gains, obesity continues to put millions of Americans at an increased risk for a range of chronic diseases, such as diabetes and heart disease. As we continue to combat obesity and chronic illness, it is vital that we diversify our methods and strategies. One such program relates to our partnership with Urban League of Greater Oklahoma City.

Critical Issue: Personal Finances and Job Readiness

In order to advance the socio-economic development of the state, and have an impact on issues that address employment, personal financial management, and quality of life, Family and Consumer Sciences Extension educational programs and resources were provided to Oklahoma children, youth, and adults; with target groups including youth, adults, community leaders, job seekers, and businesses. In response to the challenges posed by the COVID-19 virus, Family and Consumer Sciences state specialists and county educators continued to provide quality researched-based educating through various virtual platforms and in-person while following state precautions and social distancing protocol.

To teach adults basic money management skills such as budgeting, setting financial goals, and credit management, programs such as Check and Balance and Dollar Decisions, were presented to 196 adults. By using the skills they learned, participants will have greater confidence in their financial future.

23% increase in intent to improve financial planning and responsible money management practices

To assist Oklahoma businesses and communities, customer service workshops were presented to 73 front-line employees in the service industry. Participants learned that their attitude, customer service skills, and the first impression they make, can have a positive or negative impact on not only their employer, but also their community. One participant commented, "How you treat your guest doesn't only leave an impression of your office, it is the entire community that is affected."

11% increase in understanding the role of customer service in building community support for a business

11% increase in understanding the role dissatisfied customers play in business loss

14% increase in understanding the importance of training employees to publicly support their organization

We conducted job readiness programs such as Pathways to Success, which teaches basic living skills to low-income Oklahoma adults, with 144 adults and older youth to help Oklahomans improve both their marketability to potential employers as well as opportunity for success in the workplace.

86% participants improved in the skills necessary for obtaining employment

86% of participants improved in the skills necessary for successful workplace conduct and positive interactions

Critical Issue: Plant Systems

Langston University's Sustainable Gardening School had an impact through increased vegetable production for each of the twelve participants that were enrolled in the school. Many also got to experience marketing their crops in local farmers markets. Several of the participants expressed, that this was the first time they had returned back to their heir properties and finally, because of the sustainable gardening school, were beginning to find ways, in which they could make these properties profitable for them and their families. Not only was the benefit financial but the participants saw improved community connections for mutual support of agriculture production. They also felt they had the encouragement to live in rural communities like Boley, Oklahoma. Many of these participants had lived in large metro areas like Oklahoma City, Tulsa, or Dallas. Now, because of the pandemic they have seen the benefit of returning to rural areas that they grew up in or their grandparents lived in.

From the USDA-NASS wheat variety survey conducted in Oklahoma during the 2021 crop season, OSU wheat varieties accounted for 63% of the total hard winter wheat planted acreage reported by variety name (same as 2018-2020). Hence potentially, almost two-thirds of the 2021 Oklahoma wheat crop was seeded with OSU genetics that accounts for less than one-eighth of the genetics providers in Oklahoma.

From the wheat breeding program, thorough rheological and bake analysis by the Wheat Marketing Center, Portland, OR led to the conclusion that three candidate HRW cultivars (featuring the Bx7oe glutenin) awaiting release consideration "have potential as blending wheats to increase the strength of the average HRW blend intended for use in products requiring more gluten strength, such as pan breads, noodles, and frozen dough". More emphatically, all candidates showed water absorption and mixing stability times consistent with high quality HRS. Their peak development times for dough mixing aligned more closely with Canadian Western Extra Strong wheat. These and other characteristics underscore the fact this kind of genetics carries an unprecedented value proposition.

In 2021, OSU released turf bermudagrass cultivars, 'Latitude 36', 'NorthBridge' and 'Tahoma 31' continued expanding their market penetration, primarily in the US, and substantially in some other nations in the world. These varieties were produced on more than 40 sod farms in the US. Twenty-six US states have used these grasses in various cases (FL, GA, SC, NC, AL, MS, TN, VA, WV, DE, MD, MO, KY, PA, TX, NM, CA, OH, PA, OK, IN, KS, AR, NV, LA, IL), including 150+ golf courses, 25+ professional fields (such as Washington Redskins-FedEx Field, Philadelphia Eagles Field, St. Louis Rams-practice fields, Arrowhead Stadium, Kauffman Stadium, FC Dallas-Toyota Stadium, Texas Rangers baseball field, Tulsa Drillers-ONEOK Field), and 25+ college/university stadiums (University of Oklahoma-football and soccer fields, Texas A&M University-Olsen and Kyle Fields, etc.). Latitude 36 has been selected as one of three clonal standard cultivars in National Turfgrass Evaluation Program bermudagrass national tests since 2013, demonstrating its popularity and superiority in the turfgrass industry. Recently, Tahoma 31 has been planted to highly visible facilities, including the U.S. Capitol West Lawn in Washington, D.C. and Churchill Downs horse racecourse in Kentucky. It was not coincident using our varieties for these projects. It was because our varieties are solidly improved in some highly desirable traits (cold hardiness, drought resistance, high quality).

The OSU Weed Science program screened thousands of Oklahoma weed biotypes for herbicide resistance to aid weed managers in best management practices. From these screenings, we were the first to identify cross-resistant ACCase resistant Italian ryegrass in Oklahoma. With this information herbicide treatments that are not effective can be replaced with new plans that are. Successful ryegrass control can decrease grain discounts and improve Oklahoma wheat yields by at least 20%.

Identification and management tools for rescuegrass (*Bromus catharticus*), a winter annual grass weed that is poorly understood in the state and beyond. Wheat fields infested with rescuegrass provide little grain and often are not worth investing chemical weed management dollars into as the plant is highly competitive and responds poorly to herbicides. A recently awarded USDA-NIFA-AFRI (CARES) proposal, is supporting further research of how to best manage this plant, including Extension efforts to communicate our findings.

A research team demonstrated the use of management technologies for irrigated corn and cotton through the Testing Ag Performance Solutions program. This project along with our subsurface drip irrigation of cotton project, is yielding data needed to develop irrigation recommendations for cotton. The current data suggests that when the soil profile is near field capacity at the onset of the season, cotton yield and quality in the panhandle region can be optimized by applying irrigation at a rate to replace 30% of the estimated ET minus rainfall. We are also demonstrating that corn yields can be optimized with considerably less N fertilizer than what is utilized by participants. Yield response to irrigation rates is very much dependent on rainfall and ET patterns which are inconsistent from year to year. In 2022 this data will be compiled for the corn study in an effort to better understand seasonal variability in hopes of improving recommendations to include the dynamic nature of response to both nitrogen and irrigation.

Critical Issue: Youth Development

All-terrain vehicle (ATV) injury is an increasingly important public health problem that disproportionately affects populations in rural environments. Oklahoma averages between 18 and 24 ATV-related deaths each year and ranks between 15th and 20th in the nation in ATV fatalities. The Oklahoma 4-H Youth ATV Training Center has taught 50 ATV Youth Rider Courses reaching over 300 youth during the past year. Each course includes certification in 11 different riding exercises. A 2-hour Youth Leadership component was added to the ATV Class for groups that wanted to do some team building. Activities teach group communication and respect between team members. We are grateful to the Oklahoma Farm Bureau for support of the educator position and the Oklahoma Farm Bureau/Oklahoma 4-H ATV Training Facility.

Food, Fun, 4-H (FF4H) reached 511 households. Of those registered in the meal preparation educational program, 378 households had at least one family member enrolled as a member of Oklahoma 4-H. In total, 586 Oklahoma 4-H members participated in FF4H this year. The first lesson launched on May 10, and the final lesson will launch on August 10. Each month participants experienced cuisines from different countries around the world. Countries, cuisines, and cultures featured were Italy, Germany, Greece, and Japan. Along with gaining knowledge about different countries' cultures, participants also learned about kitchen safety, gained skills in cooking and communication, and were provided with family physical activities to promote a healthier lifestyle.

This summer STEMist's were able to conduct in-person county visits where they taught a variety of STEM workshops: Power of Wind, Wonder of Water, Spheros, Solar Systems and Beyond, NASA Forward to the Moon. The STEMist visited 17 counties throughout Oklahoma and reached over 250 4-H members. They also hosted two virtual STEM camps, Seed to STEM and Camp Rock. These camps consisted of pre-recorded videos that were published every week in July. Registered campers received a package containing all the supplies they needed to participate in the camps. These camps reached over 600 4-H members. All participating members had a great time learning about plant DNA and how fossils and geodes are made.

Oklahoma 4-H hosted their annual 4-H Innovate Youth Leadership Summit. Innovate is a youth development program designed to teach youth life skills and introduce youth to career opportunities in STEM related fields. This year we had 20 teen members attend the Summit representing eight counties. All Innovators attended a three-day summit that focused on learning how to present a workshop, the principles and steps behind the innovation process, and how to apply it in their own communities. To ensure each Innovator is equipped with the proper tools they need to succeed, each Innovator was required to bring an adult partner. Summit workshops included: Chemistry in the Kitchen, Engineering and Photography Fun. Each Innovator was challenged to return to their communities and teach these workshops to at least 200 contacts each. Over the next few months, Innovators will be reporting on their workshops and participate in monthly Zoom check-in meetings to ensure their success.

OSU specialists developed "From Farm Gate to Your Plate: The Farm Bill Affects Us All." The program is targeted for youth in 7th-12th grades and focuses on education of agricultural policy, the basics of the Farm Bill, fun 4-H facts, along with some engaging activities for each participant. A description of the skills learned are included with each lesson. You don't have to be an Ag Policy expert to lead this project as a [helper guide](#) includes all the information needed. This curriculum can be used individually or in a group/school enrichment setting and can even be accessed on mobile devices. Learn more at <http://4h.okstate.edu/farm-bill>.

For the first time since 2019, Oklahoma 4-H'ers gathered at the State Capitol for a day of learning and sharing at Oklahoma 4-H Day at the Capitol. More than 110 4-H club members from across the state, as well as 4-H'ers from Langston University, had an opportunity to meet with state legislators and share stories about the positive impact 4-H has in communities in all 77 counties during the 23rd 4-H Day at the Capitol. Elizabeth Chambers, state 4-H president, and Makayla Gilbert, a representative of Langston 4-H, had the opportunity to address Oklahoma's senators on the Senate floor. These youth got the chance to talk to their lawmakers and also hear messages from 4-H alumni who serve in elected positions about the impact that 4-H has on their lives. Oklahoma Lt. Governor Matt Pinnell told the youth in attendance "It is important for you to engage in civic activities because your voice can make a difference. The opportunities are there through 4-H for you to continue to build your leadership skills." State Representative Jadine Nollan said of the event, "Today I got a better understanding of how bright, talented, and confident today's youth are. It's reassurance that our state will be in good hands."

4-H is the Cooperative Extension Service dynamic, non-formal educational program for today's youth. The program combines the cooperative efforts of youth, volunteers, state-land grant universities, state and local government and the Cooperative State Research and Extension Service of the US Department of Agriculture. 4-H offers youth the chance to develop the skills, acquire knowledge, and form attitudes that will enable them to become self-directive, productive, and contributing members of society. Through hands on educational experiences, members develop practices designed to prepare them for the real world. Participants were able accomplished their goals. Testimonials were positive and stated these positive experiences helped them to make better decisions and they learn so much.

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

Langston University surveyed youth, parents, and interested clientele regarding the types of programs, projects, topics, and activities they would like to participate in, learn about, and see. These ideas were utilized for program development and implementation. Also, educators, professionals, staff, and staff were recruited to assist with program delivery. Based on participation input, more programs are conducted on S.T.E.A.M. Topics include: Terrariums, Fish, Animal Science, Fishing, Goats, Horse, Nutrition and Wellness, Etiquette, Local, State, Regional activities that included National 4-H Conference National 4-H Agri-Science Conference, and other educational meetings at the local, state, regional, and national levels.

Highlighted Results by Project or Program

Critical Issue

Animal Production Enterprises

[Precision management strategies to improve productivity and sustainability of Oklahoma grazing systems.](#)

Project Director

Richard Reuter

Organization

Oklahoma State University

Accession Number

1023096



Progress report 2021

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

We seek to use precision management technology to improve sustainability of grazing systems. We are currently focused on use of virtual fencing and precision supplementation in beef cattle.

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 have implemented a virtual fencing system at 4 research locations. One of these is a privately-owned cooperator. Some of these installations have been supported by external funding from the EPA. We implemented a study with beef cows and determined that virtual fencing is not more stressful to cows than electric fencing. We are currently monitoring forage

ecosystems and run-off water quality from pastures in which the riparian areas will be protected with virtual fencing in the future.

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

Researchers in precision grazing technology have additional information and resources to understand how to implement and use virtual fencing successfully. Graziers also have information to know that virtual fencing is not going to increase stress on their animals. When we finalize run-off water measurements in 3 years, grazing managers and the public will benefit from improved run-off water quality from grazing lands that are managed with virtual fencing.

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

If virtual fencing is successful, it will result in better run-off water quality from grazing lands, and the water supply that people use for drinking water and recreation will have lower sediment, nutrient and bacterial loads.

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.

1. Jeffus, J., R. Reuter, K. Wagner, L. Goodman, and T. Parker. 2021. Effects of virtual fencing on cortisol concentrations and behavior of beef cattle. *J. Anim. Sci. (Abstr)*. 99 (Suppl3):1-2. <https://doi.org/10.1093/jas/skab235.001>.

Enteric Diseases of Food Animals: Enhanced Prevention, Control and Food Safety

Project Director

Guolong Zhang

Organization

Oklahoma State University

Accession Number

1018350



Butyrate and Forskolin Augment Host Defense, Barrier Function, and Disease Resistance without Eliciting Inflammation

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

Host-directed therapy has emerged as a promising antibiotic-free strategy for disease control and prevention. Host defense peptides (HDPs), also known as antimicrobial peptides, are small molecules of the innate immune system featuring antimicrobial and immunomodulatory properties. Inducing HDP synthesis is a host-directed antimicrobial therapy that is being actively explored.

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 investigated the ability of butyrate and forskolin to induce the expressions of chicken HDP genes and further evaluated their efficacy in protecting chickens from *Clostridium perfringens*-induced necrotic enteritis. Our results demonstrated:

- 1) A strong synergy between butyrate and forskolin in inducing the expressions of several, but not all, HDP genes;
- 2) Dietary supplementation of butyrate and a forskolin-containing plant extract resulted in significant alleviation of intestinal lesions and the *C. perfringens* colonization in a synergistic manner in a chicken model of necrotic enteritis;
- 3) A combination of butyrate and forskolin further improved feed efficiency and reduced carcass fat content without affecting the growth performance of broilers.

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

Our results highlight a potential for developing butyrate and forskolin, two natural products, as novel antibiotic alternatives to enhance intestinal health and disease resistance in poultry and other animals.

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

A novel class of antibiotic alternatives may be developed to ensure safety and sustainability of animal products with relying on antibiotics thus minimizing the development of antimicrobial resistant pathogens.

MANAGEMENT PRACTICES FOR PRODUCTION OF GOATS IN THE SOUTH-CENTRAL U.S.

Project Director

Arthur Goetsch

Organization

Langston University

Accession Number

1012650



Goat Management Project Annual Report (October 1, 2020 to September 30, 2021)

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

Goat production is a rapidly growing livestock industry in the USA, but much less research has been conducted with goats than other livestock species. There are many factors limiting levels and efficiencies of production by goats that restrict economic returns. Research is needed to increase profitability from goat production and lower costs to consumers of goat 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.

A broad array of experiments has been conducted to address many aspects of goat production and management. For example, emission of the greenhouse gas methane by ruminant livestock contributes to climate change and is a loss of potential energy for the animal. Studies with stationary and portable respiration calorimetry systems have shown that consumption by goats and sheep of the forage *Sericea lespedeza*, high in condensed tannins and found throughout most of the USA, has resulted in appreciable and consistent decreases in methane production. Also, an increased reliance of ruminant livestock on drinking water relatively high in salinity is expected as a result of climate change. Tolerance to very high levels of salinity and water with varying types of minerals appears similar among different breeds of meat goats and hair sheep and greater than that of beef cattle. Another factor very important to production of goats in the south and south-central USA is internal parasitism, in particular because of resistance of parasites to commercially available anthelmintics. A multiple-year study with different breeds of goats, on-station and in collaboration with private farms, displayed how significant progress can be achieved in increasing animal resistance to internal parasitism through a disciplined selection program. For dairy animals, results of a recent study indicate that for highest levels of production by lactating dairy goats such as of the Alpine breed, time of access to feed should not be markedly limited. Although, restricted dietary access would not appear to adversely impact efficiency of production. Likewise, lactational performance of Alpine goats in early to mid-lactation will be constrained with diets high in forage of moderate quality and large particle size. High levels and efficiencies of production by lactating Alpine goats may only be realized with high-quality forage, which is deserved of future research attention.

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

The primary target audiences for findings of this project are livestock producers and extension/outreach personnel, animal science researchers and teachers, and livestock allied industries. It should be evident from examples of activities conducted briefly overviewed above that higher levels and(or) efficiencies of production can be achieved for greater economic returns by employing technologies and practices evaluated. This applies directly to livestock producers as well as extension/outreach personnel, other researchers, teachers, etc.

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

The broader public would derive benefit from project activities such as studies of simple and practical means of decreasing emission of the greenhouse gas methane. Similarly, research to achieve efficient use by ruminant livestock of the abundant sources of saline/brackish water throughout much of the USA would be of value in increasing availability of fresh/tap water for human usage. Moreover, activities to decrease the cost of food for human consumption have considerable value.

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.

Changes/Problems: There have been delays in activities because of COVID-19 conditions, which has resulted in a request for an extension to the project.

Training/Professional Development. There have been numerous participants in the project. Primary ones are faculty and staff of the American Institute for Goat Research. In addition, as noted from authors listed on publications, this project has entailed a great deal of collaboration with researchers at other institutions. There have been many individuals from abroad contributing to this research. Visiting researchers from Ethiopia, Brazil, Japan, Morocco, Algeria, and Bolivia have participated in experimentation of this project. Undergraduate students have also taken part in the project.

Plans. Laboratory and statistical analyses at the Institute will continue, along with development of articles to be submitted to peer-review journals. In addition, because of the backlog of samples and impact of COVID-19 conditions and personnel limitations on laboratory analyses in 2019-2021, some samples from these and other experiments are being analyzed for standard components at a commercial laboratory. Because of COVID-19 restrictions including limited personnel access to campus for an extended period of time, periodic mandatory teleworking periods, and an approximate 6-month university prohibition of conduct of new research involving livestock, some research activities were postponed and(or) delayed. A study will be conducted to determine effects of consumption of different natural sources of saline/brackish water in Oklahoma on feed intake, digestion, metabolism, and performance of two meat goat breeds. A pilot trial will be conducted to evaluate the accuracy and usefulness of floor-collected vs rectal-collected feces of meat goats consuming a forage-based diet in confinement. A study is planned to determine effects of the level and quality of dietary forage and level of ruminally degradable fiber during different periods of lactation on feed intake, digestion, metabolism, behavior, and milk yield and composition of Alpine goats. The Institute has had a monitoring and prevention program for Johne's disease in place for the last few years. In collaboration with Oklahoma State University, activities will continue to learn more about most effective management strategies for this disease in goats and sheep. A trial evaluating persistence of the mycobacterium causing Johne's disease under environmental conditions will be completed in December, 2021, with results to be published in the coming year. A trial evaluating in utero transmission of Johne's disease in pregnant goats is being planned. A study will be conducted to evaluate the accuracy of low-cost-off-the-shelf-components GPS collars with commercially available GPS collars.

Dissemination. Principal outputs of the project have been in information dissemination via abstracts and associated poster and oral presentations at meetings of professional scientific societies and publication of findings in peer-reviewed scientific journals. Moreover, information gained has been disseminated through the website of the American Institute for Goat Research and extension activities such as the Annual Goat Field Day, various workshops held throughout the year, the quarterly Goat Newsletter, etc. Some of the publications in this last reporting period, not listed in earlier reports, are listed below.

RIBEIRO, L. P. S., PUCHALA, R. AND GOETSCH, A. L. 2021. Effects of *Sericealespedeza*, an ionophore, and sources of medium- and long-chain fatty acids on body weight, feed intake, digestion, ruminal methane emission, and levels of blood and ruminal fluid constituents of Katahdin and St. Croix hair sheep. *Small Rum. Res.* 205. 106566. doi.org/10.101b/j.smallrumres.202/106566. 15 pages.

MOEHLENPAH, A. N., RIBEIRO, L. P. S., PUCHALA, R., GOETSCH, A. L., BECK, P., PEZESHKI, A., GROSS, M. A., HOLDER, A. L. AND LALMAN, D. L. 2021. Water and forage intake, diet digestibility, and blood parameters of beef cows and heifers consuming water with varying concentrations of total dissolved solids. *J. Anim. Sci.* 99(10). skab282. doi:10.1093/jas/skab282.

RIBEIRO, L. P. S., PUCHALA, R., LALMAN, D. L. AND GOETSCH, A. L. 2021. Short communication: The composition of various sources of water in Oklahoma available for consumption by ruminant livestock. *Appl. Anim. Sci.* 37:595-601. doi.org/10.15232.aas.2021-02192.

TADESSE, D., PUCHALA, R. AND GOETSCH, A. L. 2021. Effects of restricted feed intake on blood constituent concentrations in Dorper, Katahdin, and St. Croix sheep from different regions of the USA. *Vet. Anim. Sci.* 14. 100211. doi.org/10.1016.j.vas.2021.100211.

TSUKAHARA, Y., GIPSON, T. A., HART, S. P., DAWSON, L. J., WANG, Z., SAHLU, T. AND GOETSCH, A. L. 2021. Genetic selection for resistance to gastrointestinal parasitism in meat goats and hair sheep through a performance test with artificial infection with *Haemonchus contortus*. *Animals* 11. 1902. doi.org/10.3390/ani11071902.

TSUKAHARA, Y., GIPSON, T. A., PUCHALA, R. AND GOETSCH, A. L. 2021. Selection methods for models to predict feedstuff associative effects in goats. *J. Anim. Sci.* 99(Suppl. 2):39-40. doi.org/10.1093/jas/skab096.072).

RIBEIRO, L. P. S., PUCHALA, R. AND GOETSCH, A. L. 2021. Effects of *Sericea lespedeza* on feed intake, digestion, and ruminal methane emission in hair sheep. *J. Anim. Sci.* 99(Suppl. 2):41. doi.org/10.1093/jas/skab096.075).

WANG, W., PUCHALA, R., RIBEIRO, L., PORTUGAL, I., GIPSON, T. A. AND GOETSCH, A. L. 2021. Effects of dietary inclusion of *Sericea lespedeza* hay on behavior, heat energy, and ruminal methane emission by growing Alpine doelings and Katahdin ewe lambs. *J. Anim. Sci.* 99(Suppl. 2):38. doi.org/10.1093/jas/skab096.070.

BELKASMI, F., LOURENCON, R. V., PUCHALA, R., DAWSON, L. J., GIPSON, T. A., RIBEIRO, L. P. S., ENCINAS, F., CALLE, R. M. AND GOETSCH, A. L. 2021. Effects of the nutritional plane before and after breeding on performance of different hair sheep breeds. *J. Anim. Sci.* 99(Suppl. 3):489-490. doi.org/10.1093/jas/skab235.862.

TADESSE, D., PUCHALA, R., GIPSON, T. A. AND GOETSCH, A. L. 2021. Effects of feed restriction on blood constituent concentrations in hair sheep. *J. Anim. Sci.* 99(Suppl. 3):487. doi.org/10.1093/jas/skab235.858.

LOURENCON, R. V., RIBEIRO, L. P. S., PUCHALA, R., WANG, W., GIPSON, T. A. AND GOETSCH, A. L. 2021. Effects of level and source of dietary forage on performance of lactating Alpine goats. *J. Anim. Sci.* 99(Suppl. 3):489. doi.org/10.1093/jas/skab235.861.

RIBEIRO, L. P. S., PUCHALA, R., MOEHLENPAH, A., MERERA, C. AND GOETSCH, A. L. 2021. Effects of levels of brackish water and NaCl on water and feed intake by different breeds of goat and hair sheep yearlings. *J. Anim. Sci.* 99(Suppl. 3):490-491. doi.org/10.1093/jas/skab235.863.

PUCHALA, R., RIBEIRO, L. P. S., LOURENCON, R. V. AND GOETSCH, A. L. 2021. Effects of *Sericea lespedeza* on methane emission and health status in grazing Boer goat wethers. *J. Anim. Sci.* 99(Suppl. 3):492. doi.org/10.1093/jas/skab235.866.

TSUKAHARA, Y., GIPSON, T. A., HART, S. P., DAWSON, L. J., WANG, Z., PUCHALA, R. AND GOETSCH, A. L. 2021. Genetic and phenotypic correlations for growth and resistance to gastrointestinal parasitism in meat goats and hair sheep. *J. Anim. Sci.* 99(Suppl. 3):491-492. doi.org/10.1093/jas/skab235.865.

TSUKAHARA, Y., GIPSON, T. A., HART, S. P., DAWSON, L. J., WANG, Z., PUCHALA, R., SAHLU, T. AND GOETSCH, A. L. 2021. Genetic improvement for resistance to gastrointestinal parasitism in growing meat goats and hair sheep through a centralized performance test in the southcentral USA. *J. Anim. Sci.* 99(Suppl. 3):493. doi.org/10.1093/jas/skab235.868.

TSUKAHARA, Y., GIPSON, T. A., HART, S. P., DAWSON, L. J., WANG, Z., PUCHALA, R., SAHLU, T. AND GOETSCH, A. L. 2021. Heritability for growth and resistance to gastrointestinal parasitism in meat goats and hair sheep. *J. Anim. Sci.* 99(Suppl. 3):492-493. doi.org/10.1093/jas/skab235.867.

Critical Issue

Economic Development and Poverty Alleviation

[Evaluating Costs, Benefits, and Risks of Insect Control Strategies in Post-Harvest Food Storage and Processing](#)

Project Director

jeffrey vitale

Organization

Oklahoma State University

Accession Number

1019643



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

Food processors must balance consumer preferences for safe, healthy foods with long shelf life while reducing the use of traditional pesticides and herbicides that have been targeted for reduction/elimination by phytosanitary and environmental regulations. This project is researching strategies and technologies to improve the ability of the grain marketing system to respond in this more stringent regulatory environment. Economic evaluations and assessments, including risk aspects, are conducted with the ultimate goal of providing comparisons of alternative insect control methods to enable food processors to select optimal strategies.

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.

Dr. Vitale is the new PI of this Hatch project and took over for Dr. Brian Adam following Brian's departure from OSU in 2020. Dr. Adam's accomplishments have been well documented in prior Hatch reports. Dr. Vitale's work in 2020 fiscal year was successful in obtaining a new research grant that will allow three years of new research on post-harvesting pest management of cured ham products. Award was received at the end of fiscal year 2021 so no new research activities were conducted for this year. Dr. Vitale will be working with team scientists at Kansas State and Mississippi State on developing alternative post-harvest pest control measures such as the use of pre-treated coated nets that provide protection to meat products during the curing process without the use of fumigation (e.g. methyl bromide).

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

Nothing to report for this fiscal year. This project is expected, however, to provide substantial impacts to cured ham producers through the adoption of improved pest control measures that increase control efficiency through the use of regulatory compliant methods.

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

Nothing to report for this fiscal year. This project is expected to provide substantial impacts in the future to consumers of cured ham products by the use of improved pest control measures that will lower the cost of cured ham products on store shelves while reducing health issues associated with previous methods based on methyl bromide.

Development of value-added products from food industry waste

Project Director

Danielle Bellmer

Organization

Oklahoma State University

Accession Number

1016171



Development of value-added products from food industry waste

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

Food processing industries generate a significant amount of waste, which often ends up in landfills. The beer brewing industry generates a large volume of solid waste in the form of brewers spent grain that is mostly unutilized. Spent grain contains potential nutritional value in the form of fiber, protein, and minerals, and could be used for creation of value-added products rather than being disposed of as waste. The goal of the project is to develop new value-added food products for human consumption from brewers spent grain.

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.

Brewer's spent grain (BSG) contains valuable nutritional components, including protein, fiber, and antioxidants. Due to its brittle texture, strong nutty flavors, and dark color profiles, BSG has seen limited use in food products for human consumption. In order to take advantage of the BSG traits, an artisan chip product has been developed that contains high levels of BSG. Iron Monk Brewery in Stillwater has provided BSG samples for use in product development. Several different chip formulations were developed with appealing texture and flavor characteristics. The favored formulation contains sweet potato and up to 42% BSG. Results from sensory testing were very positive, and indicated that chips with higher levels of BSG were as appealing to consumers as the lower levels of BSG inclusion.

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

The most significant target audience would be breweries. This new value-added product could be economically beneficial for breweries nationwide, providing them an opportunity to turn a processing waste into an asset.

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

Waste generation and buildup is a significant problem worldwide, and any efforts to minimize the amount of waste being sent to a landfill are beneficial for everyone. In addition, the creation of value-added products from waste streams helps to form a closed loop of resources. The generation of all food ingredients requires land, water, and energy resources, and when material is sent to a landfill, all of the natural resources used to create it are wasted as well. Utilization of waste helps to conserve all of our natural resources.

Critical Issue

Environment and Natural Resources

Management and Policy Challenges in a Water-Scarce World

Project Director

Lixia Lambert

Organization

Oklahoma State University

Accession Number

1025338



Management and Policy Challenges in a Water-Scarce World

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

A sufficient supply of clean water is essential to public health, ecosystem function, and economic growth. Oklahoma's water resources confront complex challenges, including climate change, drought events, pollution, and increasing demand due to expansion of irrigation agriculture, population growth, and economic diversification. Many agricultural producers, industries, communities, and leaders are concerned about water scarcity and quality. It is essential to understand the interconnections between water accounts and financial externalities in the event of unforeseen disruptions. This project is affiliated with the Multistate project to quantify water quality and quantity issues and their economic impact.

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.

I published two peer reviewed articles on climate change impacts on irrigation water demand and productivity in Southeastern U.S. Findings are useful to local field crop producers in aiding decisions on irrigation technologies and land use at the farm and watershed level. I also applied research on rainfed wheat-based double crop options for the southern great plains region including Oklahoma and Kansas; collaborated with colleagues from agricultural economics and plant and soil science disciplines to estimate the economic value of soil moisture information and insurance options in assisting farmer decision making for summer crops choices following winter wheat. In addition, a national study on water quality violations was conducted to assess if social media was useful for examining local water quality perceptions. The research quantified the

relationship between consumer social media perceptions and reported drinking water quality to generate insight for state water managers and policymakers. Results demonstrate that, in many cases, water violations in one urban area emerge as national news, which had the effect of eclipsing local water issues circulating on social media.

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

To understand the drought severity and impact in the south-central semiarid prairies, we have conducted a multidimensional case study of recent droughts in the region. Preliminary findings were presented to the European Geosciences Union (EGU) General Assembly 2021. We engaged managers from the state department of wildlife to document and estimate the loss in outdoor recreation and ecosystem service due to drought events. Ongoing research on rainfed wheat based double crop will inform local winter wheat producers on selecting cover and summer crops to improve soil moisture use efficiency and land productivity. A factsheet on water quality in Oklahoma was published through Oklahoma Cooperative Extension Service. This factsheet was mentioned by the Tahlequah daily press, raising awareness of local well water quality.

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

Research findings inform the general public about Oklahoma's water quantity and quality challenges and strategies that can be used to cope with these challenges.

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.

NA

[Developing Conservation Strategies for Biodiversity in Grasslands](#)

Project Director

CRAIG DAVIS

Organization

Oklahoma State University

Accession Number

1023128



Progress Report

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

Development of conservation strategies for grasslands in the Southern Great Plains requires not only an understanding of the historic drivers that shaped and maintained these ecosystems, but an understanding of the contemporary drivers that are currently shaping them. This is particularly relevant in Oklahoma where large-scale alterations to the landscape have occurred through eastern red cedar encroachment, energy development, and conversion of grasslands to cropland, resulting in highly fragmented landscapes.

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.

Through our research on woody plant encroachment, we have found that not all woody plant species are perceived similarly by imperiled grassland bird species. For example, height and density of the same woody plant species results in different responses from the same bird species. Furthermore, we found that bobwhite response to tree and shrub cover can differ as much as an order of magnitude between sites in western Oklahoma. Specifically, whether bobwhite selected for shrub cover and whether they strongly avoided trees, depended on the study site in focus. Based on these results, we caution managers to not make broad generalizations about bobwhite habitat needs and emphasize the importance of accounting for local differences in the availability, arrangement, and scaling of resources.

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

The activities from my project will have on-the ground impact for conservation of imperiled grassland species as well as biodiversity of these grassland systems. Managers of state WMAs and federal refuges along with properties managed by NGOs such as The Nature Conservancy will have a better understanding of how woody encroachment both positively and negatively impacts the fauna of grassland systems in Oklahoma and the Southern Great Plains. Development of targeted management practices will be critical to long-term conservation strategies for biodiversity in grasslands of the Southern Great Plains and activities from this project provide guidance for developing such strategies.

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

Activities from this project more broadly benefit the public by guiding conservation strategies and management practices that will allow sustainable populations of grassland birds to be maintained as well as enhancing biodiversity in the Southern Great Plains which will provide important ecosystem services (e.g., pollinators, wildlife viewing, hunting opportunities) that will greatly benefit local economies.

Management and Policy Challenges in a Water-Scarce World

Project Director

Ali Mirchi

Organization

Oklahoma State University

Accession Number

1021419



Management and Policy Challenges in a Water-Scarce World

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

This project applies a stakeholder-driven modeling framework to increase awareness about plausible future water resources management outlook based on a robust understanding of water availability and potential solutions to improve management. The project will generate critical information about water sustainability for different stakeholders to inform the water management dialogues based on an understanding of the tradeoffs associated with different adaptation strategies. The research contributes to characterizing water resource and human system response to climatic and anthropogenic perturbations (i.e. Objective 1 of the multistate Hatch project entitled "Management and Policy Challenges in a Water-Scarce World."

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 included modeling and analysis of weather data. We ran the Soil and Water Assessment Tool (SWAT) watershed hydrology simulation model to assess hydrologic tradeoffs of sustaining riparian habitats. Our work has shown that the Middle Rio Grande region is facing increasing water-scarcity due to declining riverwater and potential fresh groundwater depletion within the 21st century. However, the hydrologic impacts of providing environmental flows on the agricultural sector are not prohibitive. Climate water stress, in the form of highly variable inflows, poses a challenge for providing environmental flows, magnified by the conjunctive nature of the system. Further, we analyzed weather data from the Oklahoma Mesonet to characterize station aridity and likely impacts on reference evapotranspiration data provided by the Oklahoma Mesonet. Improved estimates of reference evapotranspiration will be useful for irrigation planning and management. These activities have helped generate critical information about the sustainability of water supply for different stakeholders and contributed to better use of weather data to inform irrigation management.

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

Our work has demonstrated to water management decision makers and stakeholders that status quo irrigated agriculture in the Middle Rio Grande faces likely fresh groundwater depletion within the 21st Century as river water reliability declines in a projected warm-dry future. We presented our preliminary analysis of the tradeoffs associated with providing environmental flows in the Middle Rio Grande to key stakeholders. We also informed the Oklahoma Mesonet about our characterization of station aridity and how that results in over-estimation of reference evapotranspiration.

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

We have shared our results with fellow scientists through conference presentations and peer-reviewed scientific journals. An open-editorial in the Conversation platform attracted attention from the public and stirred a dialogue around potential water bankruptcy in the American Southwest and potential adaptation strategies.

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.

COVID-19 continues to limit the ability to convene stakeholder meetings. Virtual meeting is a fall back option to make progress, nonetheless. The project activities have created opportunities to train two postdoctoral researchers and a PhD student. The results have been disseminated to communities of interest through meeting with stakeholders, conference presentations, peer-reviewed journal publications, and an open-editorial article.

Stakeholder meetings

Assessing future climate impacts on endangered and threatened groundwater-dependent species in the Edwards Aquifer Region using a novel hybrid artificial intelligence framework, virtual event, South Central Climate Adaptation Science Center Stakeholder Advisory Committee Meeting, November 2021

Journal articles

Wineland, S. M., Ba?ao?lu, H., Fleming, J., Friedman, J., Garza-Diaz, L., Kellogg, W., Koch, J., Lane, B. A., Mirchi, A., Nava, L. F., Neeson, T. M., Ortiz-Partida, J. P., Paladino, S., Plassin, S., Gomez-Quiroga, G., Saiz-Rodriguez, R., Sandoval-Solis, S., Wagner, K., Weber, N., Winterle, J., Wootten, A. M. (2021). The environmental flows implementation challenge: Insights and recommendations across semi-arid, water-limited systems in North America. *WIREs Water*. doi:10.1002/wat2.1565

Chakraborty, D., Ba?ao?lu, H., Gutierrez, L., Mirchi, A. (2021). Explainable AI reveals new hydroclimatic insights for ecosystem-centric groundwater management. *Environmental Research Letters*, 16(11). doi.org/10.1088/1748-9326/ac2fde

AghaKouchak, A., Mirchi, A., Madani, K., Di Baldassarre, G., Nazemi, N., Alborzi, A., Anjileli, H., Azarderakhsh, M., Chiang, F., Hassanzadeh, E., Huning, L. S., Mallakpour, I., Martinez, A., Mazdiyasi, O., Moftakhari, H., Norouzi, H., Sadegh, M., Sadeqi, D., Van Loon, A. F., Wanders, N. (2021). Anthropogenic drought: Definition, challenges and opportunities. *Reviews of Geophysics*. doi.org/10.1029/2019RG000683

Capt, T., Mirchi, A., Kumar, S., Walker, W. S. (2021). Urban Water Demand: Statistical Optimization Approach to Modeling Daily Demand. *Journal of Water Resources Planning and Management*, 147(2): 04020105. doi.org/10.1061/(ASCE)WR.1943-5452.0001315

Samimi, M., Mirchi, A., Townsend, N.T., Gutzler, D.S., Daggubati, S., Ahn, S., Sheng, Z., Moriasi, D., Granados-Olivas, A., Alian, S., Mayer, A., and Hargrove, W.L. (In Press). Climate change impacts on agricultural water availability in the Middle Rio Grande Basin. *JAWRA Journal of the American Water Resources Association*. 2022. doi:10.1111/1752-1688.12988

Sandoval-Solis, S., Paladino, S., Garza-Diaz, L., Nava, L., Friedman, J., Ortiz-Partida, J.P., Plassin, S., Gomez-Quiroga, G., Koch, J., Fleming, J., Lane, B., Wineland, S., Mirchi, A., Saiz-Rodriguez, R., Neeson, T. (Accepted). Environmental Flows in the Rio Grande - Rio Bravo Basin. *Ecology and Society*, Forthcoming, 2022.

Oral presentations

Chakraborty, D., Ba?ao?lu, H., Gutierrez, L., Mirchi, A. 2021. Using Artificial Intelligence for trustworthy projections of hydrological droughts in a karstic aquifer. American Geophysical Union Fall Meeting 2021, New Orleans, Louisiana.

Singh, A., Taghvaeian, S., Mirchi, A. Examining weather station aridity in the Oklahoma Mesonet. 2021 Annual International Meeting of the American Society of Agricultural and Biological Engineers (ASABE).

Samimi, M., Mirchi, A., Taghvaeian, S., Moriasi, D., Sheng, Z., Gutzler, D., Alian, S., Hargrove, W. Evaluating Irrigation Interventions for Agricultural Resiliency under Future Water Scarcity in a Desert River Basin. 2021 Annual International Meeting of the American Society of Agricultural and Biological Engineers (ASABE).

Hydrologic carrying capacity in human-environment systems, Voices Lecture Series in conjunction with The State We're in Water exhibition, virtual event, OSU Library, April 2021.

Agricultural water sustainability in the Middle Rio Grande under future climate projections, Water Science and Management Seminar Series, New Mexico State University, March 2021.

Water sustainability for functional socio-ecological systems, Panel Discussion on Valuing Water, World Water Day Virtual Event Series, Michigan Technological University, March 2021.

Poster presentations

Samimi, M., Mirchi, A., Yildirim, T., Moriasi, D., Alian, S. 2021. Environmental flows to support riparian forest galleries in the middle Rio Grande/Bravo Basin. American Geophysical Union Fall Meeting 2021, New Orleans, Louisiana.

Yildirim, T., Moriasi, D., Mirchi, A., Starks, P. (2021) Short-range winter wheat yield prediction in Oklahoma using artificial neural network. ASA-CSSA-SSSA 2021 International Annual Meeting - American Society Of Agronomy, Crop Science Society Of America, Soil Science Society Of America.

Singh, A., Mirchi, A., Taghvaeian, S. Spatiotemporal analysis of weather station aridity in the Oklahoma Mesonet. Water Smart Innovations Conference and Exposition 2021, Las Vegas, USA.

Open Editorial

Sadegh, M., Mirchi, A., AghaKouchak, A., Madani, K. Avoiding water bankruptcy in the drought-troubled Southwest: What the US and Iran can learn from each other. The Conversation, September 29, 2021.

Plan for next reporting period

We will continue the modeling activities (e.g., SWAT and APEX) focusing on climate impact assessment to derive insights for adaptive water resources management. Results will be disseminated through professional meetings and research publications.

Critical Issue

Family and Child Resilience

Easing the Impact of Divorce on Oklahoma Children and Youth

Project Director

Randy Taylor

Organization

Oklahoma State University

Accession Number

7001509



Co-Parenting for Resilience

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

Oklahoma ranks among the top five states in the nation for highest number of divorces. Separation or divorce, while often a necessary solution to marital discord, is a period of adjustment for all families. Without effective communication skills and an organized approach, parents can unintentionally add to the challenges their children experience.

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.

Oklahoma State University's Co-Parenting for Resilience program helps divorcing or separating parents reduce possible negative impacts on their children and fulfills the state-mandated requirement of education for divorcing parents. In 2021, Co-Parenting for Resilience classes were provided both in-person and online, to 1,560 parents in 53 Oklahoma counties. Participants discovered effective ways to help their child have a healthy adjustment to their parents' separation. The parents learned how to talk to their children about the separation or divorce, how children are affected by separation from their parents, how the parent-child relationship changes following separation or divorce, and how to manage conflict with a co-parent.

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

Co-Parenting for Resilience is effective at helping reduce the impact of divorce on children and increasing paternal coping and positive parenting. 91% of Co-Parenting for Resilience participants became more likely to encourage their child to have a positive relationship with their other parent. 88% of Co-Parenting for Resilience participants became more likely to communicate directly with their co-parent instead of communicating through their child. 81% of Co-Parenting for Resilience participants became more likely to view their child's other parent as a valued member of the parenting team. Participant comments showed a commitment to staying engaged in their child's life and a realization of how the words they use to talk about their co-parent can affect their children.

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

The Co-Parenting for Resilience program strives to counter the negative emotional and behavioral health impacts of divorce on children. Improved parent-child relationships contribute to increased adult productivity at work and improved behavior control in children, which creates better learning environments in schools and improved peer relationships.

Critical Issue

Food Safety and Food Insecurity

Cereal Grains Products and Ingredients – Opportunities for Future Food and Feed Additives

Project Director

Patricia Rayas-Duarte

Organization

Oklahoma State University

Accession Number

1016155



Cereal Grains Products and Ingredients – Opportunities for Future Food and Feed Additives

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

Cereal grains and their ingredients are a source of mostly energy for a large portion of the world population. New technologies and more complete understanding of the properties of cereal grains and their components will drive innovation in the processing and development of new products to fulfill the needs of present and future consumers.

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 of this project helped to better describe and understand the properties of cereal grains alone and in combination with other ingredients. The interest of gluten free ingredients in baked products continues to grow and the concepts developed in this project assist to better understand the effect of other non-cereal grains and their ingredients have in baked products through out steps during their processing.

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

Target audiences include processors, food industry and academia researchers benefited in the expansion of understanding from the interrogation of the properties during and after processing. The general public benefited from our outreach activities and presentations in informal teaching in trade associations and clubs where results were presented as what this is important.

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

The broader public benefited from different interactions of outreach audiences of all ages including Grand Parent University, Summer Academies, Community College partnerships and presentations in social clubs.

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 to the industry personnel and researchers in academy via peer reviewed publications.

1. Rosas-Sánchez, G. A., Hernández-Estrada, Z. J., Suárez-Quiroz, M. L., González-Ríos, O., **Rayas-Duarte, P.** 2021. Coffee Cherry Pulp by-Product as a Potential Fiber Source for Bread Production: A Fundamental and Empirical Rheological Approach. *Foods*, 10, 742, <https://doi.org/10.3390/foods10040742>
2. Garrett, R., Bellmer, D., McGlynn, W., **Rayas-Duarte, P.** 2021. Development of New Chip Products from Brewer's Spent Grain. *Journal of Food Quality*. Vol 2021, Article ID 5521746, <https://doi.org/10.1155/2021/5521746>
3. Marburger D.A., de Oliveira Silva, A., Hunger, R.M., Edwards, J.T., Van der Laan, L., Blakey, A.M., Kan, C-C., Yan, L., Garland-Campbell, K.A., Bowden, R.L., Chen, M.-S, Tilley, M., Chen, Y.R., Bai, G., Seabourn, B.W., Jin, Y., Kolmer, J.A., Davila-El Rassi, G., **Rayas-Duarte, P.**, and Carver, B.F. 2021. 'Gallagher' and 'Iba' hard red winter wheat: Half-sibs inseparable by yield grain, separable by producer preference. *Journal of Plant Registrations*. Accepted October 2020. Issue online 11 Feb 2021. Article DOI: 10.1002/plr2.20116 <http://dx.doi.org/10.1002/plr2.20116>

Critical Issue

Human Health and Hunger

Expanding Health and Nutrition Education of Adults and Youth

Project Director

Randy Taylor

Organization

Oklahoma State University

Accession Number

7001511



Nutrition Education

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

Poor diet and physical inactivity increase the risk of obesity, which in turn increases the risk of chronic conditions such as diabetes and heart disease. Seventeen percent of Oklahoma adolescents and 36% of adults are considered obese.

Oklahoma's above average poverty rate has led to high levels of hunger and food insecurity, which is associated with chronic disease.

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.

Community Nutrition Education Programs (CNEP), uses Expanded Food and Nutrition Education Program (EFNEP) and Supplemental Nutrition Assistance Program Education (SNAP-Ed) funding to improve the health and nutrition status of low-income Oklahomans. Youth programs are taught both in- and outside school settings, and adult education is delivered to individuals or groups. In 2021, 10,574 youth and 895 adults participated in nutrition education programs and learned valuable skills needed to consume a healthy diet and be physically active on a limited income.

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

Eighty-five percent of youth program participants improved their ability to choose healthy foods. Instructors have commented that the students have been reading food labels and paying attention to their sugar intake. A student who started the program not liking vegetables or understanding their role in maintaining health, now likes eating vegetables and salads. Ninety-seven percent of adult program participants improved in one or more dietary quality areas while learning how to prepare healthier foods and use household chores to increase physical activity.

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

Classroom teachers reported they also benefited from the nutrition lessons their students received. Several teachers have become more aware of the sources of sugar and fat in their diet and have begun to exercise more.

In the greater community, reducing food insecurity and improving healthy eating practices has been shown to contribute to improved educational achievement, lowered health care costs, and fewer sick days.

Metabolism of Glycerides in Insects

Project Director

Jose Soulages

Organization

Oklahoma State University

Accession Number

1023370



Metabolism of Glycerides in Insects

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

Triglycerides (TGs) are the predominant chemical form in which FA are stored in the insect fat body. Synthesis, storage, and utilization of FA are key processes for insect survival and reproduction. To achieve a successful reproductive cycle, female mosquitoes must be able to accomplish in ~72h a massive synthesis of FA and TG using the amino acids provided in the protein rich blood meal. They should also mobilize the FA to the ovaries, which involves export of FA from fat body, transport through the hemolymph and import of FA by the ovaries. These processes involve the products of numerous genes. Our project intends to uncover the biological relevance or essentiality of a few predicted key genes that are involved in fat metabolism and transport in female *Aedes aegypti*.

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 purpose of the studies carried out in this period was to evaluate the importance of two FA transporters apoLp and LTP in the ability of mosquitoes to export fat from the fat body to the ovaries and allow a proper oogenesis. To this end, we reduced the expression (synthesis) of apoLp and LTP genes using RNA interference. The results clearly showed that low expression of apoLp or LTP prevents proper lipid transport to the ovaries and, thus, prevents the formation of eggs and/or the production of fertile eggs. This information may be of importance from a general biological perspective because it shows the significance of the two genes studied in the reproduction of this mosquito (*Aedes aegypti*).

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

Two graduate students worked and completed their graduate studies in Dec 2021. Karen Belloso Rojas, master's degree in Biochemistry and Molecular Biology, and Claudio Galvez Sagastume, Ph.D. degree in biochemistry and molecular biology. The students presented the results of their studies to different OSU audiences, some from our department and some more diverse audiences, such as those attending the annual BMBGSA Symposium. Moreover, the M.Sc. and Ph.D. thesis have been submitted to the graduate college and the OSU library.

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

The audience of our studies is constituted by biochemists, biologists, and entomologists that are interested in the metabolism of fat in vertebrates and in arthropods. The audience of our studies is distributed around the world in research institutions. To demonstrate the impact of our research, we can mention that our studies were cited in approximately 400 scientific articles reported during the 2020-2021 period (Information obtained from Google Scholar). Graduate and undergraduate students in our department also constitute an important audience for our studies. However, the studies performed this year have not been reported in international journals, yet.

Biology, Ecology & Management of Emerging Disease Vectors NE1943

Project Director

Bruce Noden

Organization

Oklahoma State University

Accession Number

7000250



Biology, Ecology & Management of Emerging Disease Vectors

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

This project continues to focus on the biology, ecology and management of emerging disease systems that are important in the United States. Through the activities undertaken, my project is addressing the surveillance and monitoring of disease vectors and the pathogens they transmit in the southern Great Plains region. We are also engaged in determining the ecology and distribution of invasive and native disease vectors that are continuing to spread throughout the United States.

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 last reporting period, I have initiated activities which are continuing to achieve significant progress towards the goals of the project. Regarding the first objective, research activities have focused on sending tick samples to a national study focus on the rabbit tick. Given the recent invasion of the US by the longhorned tick, studies are now developing genetic comparisons to better differentiate between tick species which were not thought to be important but can now be confused with this new species of tick. For the second objective, research activities have focused on regional understanding of climate changes on mosquitoes ability to overwinter across the US and the pooling of data to create a distribution map to measure the spread of *Aedes japonicus*, an invasive mosquito species in the southern US.

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

The target audience for these projects are the residents of Oklahoma who experience tick and mosquito-borne pathogens as well as members of the extension network who are vital links in their communities. We are working directly with local health departments (Oklahoma City) to strengthen their community involvement in the dissemination of appropriate tick and mosquito messaging. We are also continuing to provide updates to our extension personnel regarding new pathogens detected and appropriate methods to control blood-sucking arthropods.

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

As this project is just at the beginning stage, there hasn't been a lot of spillover into the broader public domain. However, I have used information from this project in interviews provided for local newspapers and TV interviews in the last year.

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.

Critical Issue

Personal Finances and Job Readiness

Preparing Youth for the Real World

Project Director

Randy Taylor

Organization

Oklahoma State University

Accession Number

7001510



Reality Check

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

Twenty-one percent of Oklahoma children live below the federal poverty line and are at greater risk for remaining there through adulthood. Nearly 9% of the state's household have no checking or savings account, and 26% of Oklahomans work in lower wage jobs that pay more than minimum wage, but not enough to prosper.

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.

Family and Consumer Sciences Educators partnered with local schools across the state to present Reality Check, an interactive financial simulation, to 470 youth in grades 8-12. The simulation provided students with an opportunity to learn basic life skills such as budgeting and managing a bank account. Students were assigned a role with certain circumstances such as marital status, number of children, income, and monthly expenses. Then they participated in day-to-day activities including: bill payment, food and clothing purchases, medical and child care responsibilities. Their objective was to "live" for one month without overspending.

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

Reality Check is effective at helping youth understand the financial responsibilities associated with living independently. After participating in the program, there was a 15% increase in intent of youth to be careful with their money and a 5% decrease in intent to spend money as soon as it is obtained. In regards to saving money, there was an 11% increase in knowledge of the importance of saving money in a bank and a 9% increase in students who believe the best time to start saving money is now.

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

Students who participate in the Reality Check program have a better understanding of the realities of adulthood. Observing and assisting in the simulation reminds educators of the importance of providing hands-on financial literacy education. One teacher commented, "Reality Check shows our students that they need to understand how to budget and start planning for what education or skill they would like to receive. We want to begin providing this program to our high school students as well."

Critical Issue

Plant Systems

Beneficial Use of Residuals to Improve Soil Health and Protect Public, and Ecosystem Health W4170

Project Director

Hailin Zhang



Using animal wastes and biosolids as a beneficial soil amendment to supply nutrients and organic matter

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

Manure is produced from poultry and livestock operations in large quantity and biosolids are also readily available from municipal wastewater treatment plants. Those materials contain valuable plant nutrients and organic matter and are good amendments in improving soil health if used appropriately.

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 goal is to use those materials in an agronomically sound and environmentally friendly manner. We had a biosolids field experiment and currently have animal manure testing services. My applied research projects and services have contributed to sustainable practices that farmers and municipalities to beneficially utilize those resources.

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

I participated in trainings and public meetings with concerned citizens to discuss policies, procedures, and impacts of using residuals; conducted on-site visitations of demonstration sites of field plots to observe the outcomes of using residuals; had electronic communications with the public to disseminate any findings from the research; and attend and present at professional conferences. The targeted audience was well informed about the current science and policies on using residuals, which can minimize the impact on the environment.

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

Citizens are concerned about issues related to municipal and agricultural by-product reuse in food or feed production or related to environmental quality. My effort in directly interact with the clientele directly involved will minimize public nascence and cost of disposing those residuals by properly land applying to improve crop yields and soil health.

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.

Research findings and beneficial information have been disseminated via meetings and extension fact sheets. No changes are anticipated in the future.

Closing Out (end date 09/07/2023)

[Improving Soybean Arthropod Pest Management in the U.S. S1080](#)

Project Director
Tom Royer
Organization
Oklahoma State University
Accession Number
7000516



Improving Soybean Arthropod Pest Management Annual Report, 2021

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

Document changing soybean pest and beneficial arthropod assemblages. Characterize soybean insect biology and ecology. Educate farmers, industry, colleagues, general public, and agricultural professionals using traditional tools and innovative methods.

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 established two insecticide efficacy trials targeting stinkbug and defoliating caterpillars. Stinkbug populations did not materialize as expected, and foliar caterpillar populations were not at economic levels. Therefore, the trials were not completed.

Provided statewide information on soybean insect losses for Oklahoma, that were included in a regional publication with primary author F.A. Musser.

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

Upgraded Current report CR-7167 "Management of Insect and Mite Pests in Soybean". Oklahoma Cooperative Extension Service to provide current information on

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

Nothing to report.

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.

Did not have the insect pressure needed to conduct activities for soybean insect management. Information will be provided to stakeholder when insect pressure dictates need.

Closing Out (end date 09/07/2023)

[Pilot Program For Daylily \(Hemerocallis sp\) Research And Outreach At Langston University](#)

Project Director

Kanyand Matand

Organization

Langston University

Accession Number

1012702



PILOT PROGRAM FOR DAYLILY (HEMEROCALLIS SP) RESEARCH AND OUTREACH AT LANGSTON UNIVERSITY

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

Daylily is a commercial, medicinal, and research crop that is limitedly produced using modern technologies, such as in vitro tissue culture. Therefore, it takes a longer period to develop sufficient new plants to meet the new cultivar's market demand. Further, the limited availability of effective tissue culture protocols have limited the application of modern improvement technologies such as gene transfer and CRISPR/Cas9 on this crop.

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.

Non-Technical Summary

Daylily is an ornamental crop which is widely grown primarily because of its flowers; natural beauty. It is also grown because of its other many uses, such as, medicinal, landscape, research, fire retardant, and erosion prevention, etc. The normal daylily multiplication rate is very low. This has inspired efforts to improve it by improving its popular multiplication method (division). However, its plant production rate still is also lower compared to modern methods, such as tissue culture. Currently the tissue culture method is not widely used for daylily multiplication, primarily because of the inconsistency in its responses, even when promising protocols are applied across genotypes. The challenge to the broad application of tissue culture in daylily is exacerbated by the distrust of some breeders and growers, who still believe in the inconsistency of the technique in reproducing the parental identity in the progeny clones. Such short coming can affect not only the clone name, but also its value. Goal: this program was designed to develop a universal method of producing daylily plants, at a higher rate across a wide range of daylily cultivars. It also aims at conclusively demonstrating to skeptics the reliability of tissue culture technique in reproducing the parental identity in progeny clones. Method: collect plant tissues from 250 different cultivars, sterilize, cut, and culture them on Murashige and Skoog media containing sugar and single or combined growth regulators. Observe morphogenesis, organogenesis, and somaclonal variations. Root new plants; then move them to the greenhouse before transferring them to the field. Reach out to local and state daylily breeders, growers and consumers through outreach activities. Outcome: this program will develop a more efficient, universal daylily protocol that will produce more plants across a spectrum of daylily genotypes, than division. It will provide the most updated assessment of somaclonal variations in daylilies. The program will develop the first Langston University daylily nursery and genetic stock, with broad selections of flowers for landscaping the university's three campuses as well as faculty and staff's private lands, when desired. The program will provide the most extensive and diverse genetic plant stock for both field and lab research education in the School and Department of Agriculture. It will improve agricultural students' research skills and experiential learning and expand research opportunities and diversify Honors Program's student thesis research topics.

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

The target audiences included farmers from underserved communities, Historically Black colleges and Universities, Oklahoma colleges and universities, general plant biology and agricultural scientists, daylilies growers and enthusiasts, and other biological scientists and students.

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

Langston University (LU) has become the lead institution for daylily biotech research in Oklahoma and developed a significant genetic stock of at least 250 cultivars. The project has developed the most efficient and reproducible organ-based micropropagation protocols than any existing ones. All those protocols are applicable at room environmental conditions and do not require costly growth chamber-controlled conditions. It also resulted in developing broad cultivar-based biological profiles indicating different adaptation responses.

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.

Changes/Problems

There were no changes required.

What opportunities for training and professional development has the project provided?

Direct research skills and experiential learning opportunities were offered to three students that were supported by the project. They included Zoe McGowan, Naomi Daniels, and Troy Buchanan III. The project also included hands-on lab and field activities of students who participated in Genetics, Crop Production and Plant Breeding courses. More than 30 students, who were not directly funded by the project but took those courses, benefited from class presentations and lab experiential learning through the project's activities. Because of restrictive COVID 19 conditions, students participated only in onsite lab research skills and experiences.

How have the results been disseminated to communities of interest?

In compliance with COVID-19 health requirement, the primarily targeted audience was the Langston University (LU) community and other minority communities of farmers and high school students in the vicinity of the university through field demonstrations and high school and 4-H student hands-on activities. The results were also disseminated through open

access peer-reviewed journals. The project results were also broadly disseminated through the School of Agriculture and Applied Sciences' magazine (Agrovision) that is disseminated through online release and hard copies distributed to visitors and people without access to internet.

What do you plan to do during the next reporting period to accomplish the goals?

The next reporting period will focus on wrapping up with more project's lab and field research activities and student experiential learning. It will also pool all discoveries to develop a general guide for a universal in vitro plant regeneration protocol. Preliminary data on daylily transcriptomic activities could also be reported. The final project report will be finalized.

Water Management and Adaptation to Climate

Project Director

Randy Taylor

Organization

Oklahoma State University

Accession Number

7001545



Master Irrigator Program

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

Irrigated agriculture is the largest consumptive use of water in the state of Oklahoma. This water is used to the benefit of the economy as illustrated by the fact that the Oklahoma Panhandle thrives as a result of extensive irrigation and provides approximately 25% of the agricultural revenue for the State. Despite gains in water productivity resulting from adoption of technologies such as the center pivot irrigation, there is evidence that continued advancements in productivity and efficiency can be realized.

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 Master Irrigator Program from OSU Extension provides advanced training on irrigation water management, irrigation system and equipment maintenance, energy conservation, water conservation and quality, and economics of irrigated agriculture.

The program includes classroom training, peer-to-peer exchange of information between producers, field demonstrations, and free-of-charge services such as energy audits through mobile irrigation laboratories. Instructors include extension specialists, irrigation specialists, and economists from OSU and adjoining states, producers, crop consultants and NRCS personnel.

Participants are required to complete four days of training to be eligible for the following benefits:

- Four days of basic and advanced training on irrigation, crop choices and irrigation systems.

- Participants will be eligible for reimbursements of \$2000 on purchase of soil moisture sensors. through funding provided by Oklahoma Conservation Commission and Oklahoma Water Resource Board.

- Free of charge energy and irrigation system efficiency audits will be provided to the participants through mobile irrigation laboratory.

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

The Oklahoma Master Irrigator Program produced 37 graduates from the Oklahoma Panhandle and Southwest Oklahoma. These participants represent total of 83,505 irrigated acres, nearly 80% of which came from Oklahoma Panhandle. Post program survey results indicated that 40% participants improved their knowledge on irrigation 'a great deal', 54% 'moderately', and 6% said their knowledge improved 'a little'. From our first program, eight participants purchased soil moisture sensors and used reimbursement offered by partner agencies on the purchase. An additional six participants used services offered by Mobile Irrigation laboratory. We conducted 16 well efficiency audits and 4 irrigation uniformity tests as a part of this program.

Personal communications with two participants revealed that they changed pivot tires to improve the functioning of their pivots. Additionally, one participant purchased moisture sensors but did not seek reimbursement through partner agencies.

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

Prior research in the High Plains region found that using precision irrigation scheduling increased water productivity by 25% compared to conventional irrigation application. This was achieved with a 10% reduction in water use and a 13% yield increase. This suggests that adoption of precision irrigation management could reduce water demand by 76,000 acre-feet/year statewide while potentially increasing productivity.



Urban Water Conservation Education

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

The population of Oklahoma City is growing while our water capacity is not; therefore, we need to reduce our water usage to extend not only our water availability to customers but also the life of our water infrastructure facilities.

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.

Our goal was to educate Oklahoma City Water Utilities customers and area youth on multiple, low cost, high-impact, water conservation practices that they could replicate within their own landscapes and gardens in a conscious effort to conserve water. To achieve this goal, we taught water conservation practices in public workshops, televised implementation demonstrations, been interviewed on public radio, and added knowledgeable staff with several Oklahoma County Master Gardeners at farmer's markets, nurseries, garden centers, libraries, and area schools to provide water conservation information to the public.

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

Our messaging has consistently included teaching inexpensive ways that consumers can reduce their water usage while creating an awareness that water is a limited resource. Since September of 2019 through August of 2021, we conducted 77 water conservation events for adults, reaching a total of 91,819 adults and conducted 71 water conservation youth events, reaching a total of 1,156 students. Based on the evaluations of the 5,000 participants from workshop or events, residents have adopted these water conservation practices:

- 100% will use mulch in the gardens & flowerbeds

- 61 % will use hardscape materials in their landscape design for water efficiency

- 81% will incorporate organic matter, including compost, within the landscape

- 84% will install drip irrigation systems in the gardens & landscape

- 84 % will put soaker hoses in the garden/landscape to reduce respiration & evaporation

- o 89 % will use rain barrels &/or household items for water recycling

- o 84.5% plan on planting drought tolerant & native plants in the landscape in the future

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

As more people adopting water conservation strategies the overall demand on the Oklahoma City water system will be reduced.

Type

Projects / Programs

Projects / Programs without a Critical Issue

11

Closing Out (end date 09/07/2023)

Biology, Ecology, and Pest Management of Wood-Destroying Subterranean Termites

Project Director

B Kard

Organization

Oklahoma State University

Accession Number

1016566



Biology, Ecology, and Pest Management of Wood-Destroying Subterranean Termites

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

Subterranean termites are a severe wood-destroying pest, annually causing billions of dollars in damage to wooden structures in the United States and world-wide. Gaining knowledge about their biology and habits, as well as efficacy of termiticides, termite baits, and management strategies and tactics is essential to their control. This project studies termite biology and the role of termites in the natural environment. In addition, this project conducts scientific tests on variety of termite management products, to include liquid insecticides, baiting systems, wood-preservedatives and termite physical barriers.

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.

Increased scientific knowledge of the impact of termites on greenhouse gas emissions and contributions of termites to metabolic gas production into the environment.

Increased Pest Management Professional's knowledge of termite biology and behavior.

Improved pesticide applicator's skills and pesticide safety proficiency.

Added to our knowledge of termite impacts within the soil environment.

Increased the number of well-trained, certified pesticide applicators, thus improving efficiency while reducing the amount of pesticides entering the environment.

Published several scientific texts concerning termite biology and impacts in the natural environment, including a proposed revision of Florida state regulations concerning efficacy of pest management products for termite control. This proposed revision will have nationwide impact.

Provided hands-on training to pest management professionals, extension educators, scientists, students, and pesticide applicators during conferences, workshops and pesticide applicator certification training.

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

Provided advice and consultation to Private and Commercial pesticide applicators, and many citizens of Oklahoma.

Provided several teaching sessions to pest management professionals, students, and the general public.

Several research studies were published, increasing knowledge of urban and structure damaging pests and improving our control techniques. The scientific information was provided to pest management professionals, industry representatives and scientists, and the general citizenry thereby increasing their proficiency in urban and structural pest control.

Pest management information was published and distributed to extension educators, pest management professionals, students, colleagues and US citizens.

Fact sheets and Pest e-Alerts were provided as additional information distribution tools.

Target audience increased their knowledge of household and wood-destroying pests and their control.

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

Increased public and pest control professional knowledge of urban- and structural-damaging pests and improved training on control techniques.

Provided pest management training and educational materials to numerous private and commercial pesticide applicators in Oklahoma, as well as pesticide users nationwide.

Increased our knowledge and use of termite-resistant building materials.

Provided several fact sheets and termite information to pest management professionals and the general public. On-going television segments continue to receive visits and address termite management and household pest management. These segments are available on the OSU TV site as well as multi-state SunUp and Oklahoma Gardening programs.

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. Provided many teaching sessions to pest management professionals, students, and the general public.

Mentored undergraduate students involved in biological and pest management sciences.

Provided hands-on training to pest management professionals, extension educators, scientists, students, and pesticide applicators during conferences, workshops, in-service training sessions, symposia, and pesticide applicator certification training.

b. Dozens of classroom and field training events and presentations at professional conferences were conducted. These events will continue throughout the succeeding year. Several scientific papers were published and distributed to extension educators, pest management professionals, students, colleagues and US citizens.

c. The project will continue to provide hands-on training and teaching events to include pesticide applicator certification programs and professional conference presentations.

Provide presentations, scientific posters and proceedings publications from scientific conferences.

Publish additional scientific journal and technical papers on a continuing basis.

Continue experiments investigating the efficacy of new termiticide application technologies and protocols to protect wooden buildings against termite damage.

Continue experiments concerning termite-resistant building materials to determine the materials that have an extended construction life in termite-infested soils.

Characterizing and Enhancing the Activities of Beneficial Insects in Range Ecosystems

Project Director
William Hoback
Organization
Oklahoma State University
Accession Number
1019561



Investigation of burying beetle secretions

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

Most burying beetles get their common name by burying a small dead vertebrate and using the carcass to rear their offspring. After burial, the beetles coat the carcass in oral and anal secretions that prevent the carcass from rotting. We investigated the effects of these secretions on preserving the meat of the carcass at room temperature.

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.

Working in collaboration with the Department of Biochemistry and Molecular Biology, we collected secretions from an unusual species of burying beetle that does not use carcasses for reproduction. We tested the effects of feeding on gene expression. This is the first step in discovering how the secretions prevent microbial growth and may lead to new ways to preserve meat at room temperature and new types of antibiotic.

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

Antibiotic resistance is a major challenge to food security and animal and human health. Finding new natural agents is a priority to identify novel mechanisms and burying beetles because of their unique biology need to be investigated further. By identifying the mechanisms of antimicrobial properties in these beetles, we are one step closer to developing products that can benefit humans.

The research led to one peer-reviewed publication in the Journal PLOS ONE.

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

Human health and agriculture benefit from these investigations.

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.

We collaborated to train two graduate students and three technicians in acquiring secretions and determining their properties in gene expression.

Detection, characterization, and inhibition of foodborne pathogens, toxins, and spoilage microorganisms

Project Director
Peter Muriana
Organization
Oklahoma State University
Accession Number
1016158



Detection, characterization, and inhibition of foodborne pathogens, toxins, and spoilage microorganisms

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

The proposed project is specifically involved with various facets of food safety whereby my research focus has involved the characterization and application of inhibitors (natural nitrite/sodium nitrite, antimicrobials, liquid smoke extracts, ozone, hypochlorous acid), antimicrobial interventions including physical equipment (post-process lethality measures for safety or RTE meats such as pre- and post-package pasteurization), pasteurization (liquid egg), chemical interventions (liquid smoke extracts for inhibiting *Listeria monocytogenes* in RTE meats), biological interventions (bacteriocins, fermented 'natural nitrite' to inhibit *L. monocytogenes* on RTE meats) and general and molecular approaches to characterizing foodborne pathogens (microplate adherence assay of biofilms, *in vitro* and *in vivo* invasiveness of *Listeria monocytogenes*). I have also examined ways to produce robust biofilms in the lab by *L. monocytogenes*, STEC *E. coli*, *Salmonella* serovars, *Staphylococcus aureus*, and *Pseudomonas* spp. and demonstrating different efficiencies of sanitizing antimicrobials against them. My lab is recognized for work on surface pasteurization on RTE meats by USDA-FSIS in regard to validation studies performed for industry and my published work in this area appears in the USDA-FSIS 'guidance for the industry'. Most recently my lab is addressing USDA-FSIS 'knowledge gaps' in the area of food safety of air-dried beef (biltong) that is not subject to heat lethality treatment as US companies must demonstrate that processes they use to manufacture this product is inhibitory to foodborne pathogens associated with raw meats before they can manufacture and sell such 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.

Major goals and specific objectives of this project:

1. To examine the use of biological interventions (bacteriocins of lactic acid bacteria; bacteriophage) to inhibit pathogens and spoilage organisms in foods. Bacteriocins are antimicrobial proteins produced by many bacteria, but the bacteria that we are focusing on are those that are safe to eat which are often used in manufacture of many foods, the lactic acid bacteria (LAB); these are used to make yogurt, cheese, buttermilk, acidophilus milk, summer sausage and are often present in high numbers in these products. My lab has previously identified various modes of actions of bacteriocins produced by LAB to inhibit the foodborne pathogen, *Listeria monocytogenes*. By combining different bacteriocins that have different modes of action (i.e., different ways in which they can attack *Listeria*), a combination of them is more effective than simply a lot of bacteriocin with a single mode of action. We are now examining bacteriocins that are inhibitory to multiple foodborne pathogens so that a particular bacteriocin could be applied in different product applications to inhibit a different pathogen when needed. We are also identifying bacteriocins that inhibit *Clostridium spp.*, to complement (or replace?) nitrite in processed meats and determine if they inhibit spore germination or simply kill the vegetative cells after spores germinate.

2. 'Natural Nitrite'. To use 'natural nitrite' (i.e., vegetable-source nitrate → microbial fermentation conversion to nitrite) for control of Clostridia spp. in vacuum-packaged products. We have identified bacteria that can ferment vegetable-derived nitrate into nitrite (i.e., 'natural nitrite' because it is produced by bacterial fermentation) and developed an agar assay to discern conversion of nitrate into nitrite by bacterial colonies on agar media and demonstrated that new isolates make as much nitrite as currently used cultures. We further demonstrated that 'natural nitrite' (i.e., celery nitrite) was equivalent to suppressing *Clostridium* spore germination in hotdogs as was sodium nitrite.

3. Foodborne pathogens and spoilage organisms: Biltong (dried beef) processing; Characterization of the safety of new food processes in the US that are not currently validated for confirmation of producing food safely. My lab has taken on the task to identify various aspects related to biltong processing and identify conditions for the safe manufacture of biltong in order for small processors to readily obtain validation data that allows them to manufacture and sell biltong in the US..

- Inoculated beef pieces were inoculated with a mixture of 5 *Salmonella* serovars processes in vacuum-tumbled in marinade (2.2% salt, 4% v/w vinegar, spices) for 30 min and hung to dry (75°F / 55% RH) for 8 days. The resulting process resulted in >5-log reduction of *Salmonella*, with internal water activity of < 0.85, and moisture loss of ~60%.
- Additional trials were performed with additional pathogens because food safety managers for various retail supermarkets want assurances that the process is also inhibitory to other pathogens that are often found on raw beef (*STEC E. coli*, *Listeria monocytogenes*, and *Staphylococcus aureus*) and we also achieve >5-log reduction of these organisms during the processing of biltong.

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

This project covers a variety of audiences that are reached through various efforts. Efforts in the teaching of formal classes (Food Microbiology FDSC3154/MICR 3154; Food Microbiology and Safety FDSC 5120; Advanced Food Microbiology FDSC4153; Research and Thesis FDSC5000/FDSC6000) provides an audience of students and future technical professionals. Efforts made in presenting seminars, workshops (HACCP workshops), symposia, lay emagazine articles (www.fapc.biz: FAPC Connect; FAPC Food Safety blog, FAPC youtube channel, podcasts), and youtube videos cover a wide range of audiences that includes consumers, students, industry workers, professionals, managers, academicians, state legislators, and the general public. Scientific presentations and journal articles target scientific/academic professionals, administrators, legislators, food industry management, and the general public (Google Scholar shows that my peer reviewed research papers have been 'cited' >3,086 times). My laboratory's facebook website <http://www.facebook.com/FAPCFoodMicroLab> has >2,848 facebook 'likes') and my page in Research Gate https://www.researchgate.net/profile/Peter_Muriana has >30,959 'reads' of posted research papers) covering an audience of interested subscribers from around the world as well as technical and scientific-minded individuals. Extension/outreach activities that are often done with small companies provide an audience of food-related businessmen and industry professionals and sometimes leads into new research areas (i.e., microbial validation of biltong dried beef processing).

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

The broader/general public benefited from our project by virtue of the food safety manifestations that my research covers to help ensure safe food manufacturing and safe food products. My lab examined ways in which antimicrobial interventions could be applied by food manufacturers and processors who in turn may implement them and produce safer food supply for the general public. This is something that the public may not 'see' but implementation of antimicrobial interventions by processors helps reduce the risk of foodborne disease outbreaks.

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 encountered in our approach to this research.

The results of our research work are disseminated by different mechanisms: by peer-reviewed research publications, departmental/university magazines, the R.M. Kerr Food & Ag Product Center (FAPC) web site. Also, information is disseminated through professional seminars or presentations (i.e., at the Nevada Food Safety Task Force/2015, the FDA Western Regional Conference/2016, Annual Meeting of the International Association for Food Protection/Tampa, FL, 2017; Salt Lake City, UT, 2018; Louisville, KY, 2019; virtual-online, 2020 & 2021) or workshops where industry-applicable research is presented and discussed. We have an inhouse communication specialist who does well to help us put out short bulletins/articles (FAPZ.biz website, FAPC Connect, Food Safety blog articles, and FAPC podcasts) and other extension related publications. Some of our industry project reports are used by companies to provide as documentation for USDA process validation. I also chair the FAPC Food Science Research Symposium that has been taken place annually since 2001 that is open to the university and stake-holder community to witness the research being performed and accomplishments obtained..

Enhancing Rural Economic Opportunities, Community Resilience, and Entrepreneurship

Project Director

Brian Whitacre

Organization

Oklahoma State University

Accession Number

1018233



FY 2021 Report

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

Our project is focused on factors affecting the overall quality of life in rural areas. This year, we published research on several pertinent topics: (1) hydraulic fracturing's impact on housing prices; (2) Whether a specific USDA program led to increased tax revenue in recipients, and (3) whether an opioid policy response actually encouraged illicit opioid abuse.

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.

Our major activities this year were concluding / publishing research studies on the 3 topics above. We have ongoing projects in other quality-of-life areas. These studies are:

Kangil Lee and Brian Whitacre. 2021. "A Study on the Impact of Unconventional (and Conventional) Drilling on Housing Prices in Central Oklahoma." *Sustainability*. 13(24): 13880. [Link](#)

Ty Rope Smith and Brian Whitacre. 2021. "The Impact of USDA's Business and Industry Loan Guarantee Program on Tax Revenue in Oklahoma Communities." *Community Development* 52(2):205-224. [Link](#)

Devon Meadowcroft and Brian Whitacre. 2021. "Do Prescription Drug Monitoring Programs Encourage Prescription – or Illicit – Opioid Abuse?" *Substance Abuse* 42(1): 65-75. [Link](#)

Outreach Oriented Reports:

Brian Whitacre and Katy Rippetoe. "Mask Mandates and Retail Consumer Spending: A Comparison of Oklahoma Communities during COVID-19." Oklahoma Cooperative Extension Service Fact Sheet AGEK-1998. June 2021. 6 pp. [Link](#)

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

The target audience (OK residents) directly benefitted from the first two studies. Based on Oklahoma data, they document that hydraulic fracturing did NOT impact housing prices in central Oklahoma, and that there is a positive relationship between the USDA's Business and Industry Loan Guarantee program and tax revenue generation in Oklahoma communities that received those loans. The final product (an extension report) documents the limited relationship between mask mandates and retail consumer spending in Oklahoma. This is of interest to community leaders in many small towns.

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

The broader public (in this case rural residents in general) can benefit from the first 2 studies since they provide an evidence base to build from. Other studies have found that hydraulic fracturing can impact housing prices in some locations; our result demonstrates that this does not hold unilaterally. There was only a very limited body of evidence on the USDA program's impact, despite it being one of the largest components. The final study shows that there may be unintended consequences associated with one specific opioid policy response. Programs that monitor prescription drug data may end up encouraging illicit opioid use instead. These are all important considerations for rural policymakers.

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. Research is underway on several other quality-of-life factors (obesity and economic development; demographics associated with rural hospital closure).

Closing Out (end date 09/07/2023)

[Fostering the sustainability of Oklahoma aquaculture: Products, production and methodology](#)

Project Director

malcolm mccallum

Organization

Langston University

Accession Number

1012649



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

However, Oklahoma's industry is at a competitive disadvantage to those in bordering states like Arkansas due to the reduced availability of water. Additionally, many products that have been successful in other regions (e.g. freshwater prawn, crawfish), or are uniquely suited to production in Oklahoma (crawfish, turtles, and frogs) have received little attention from the research community. Focusing attention on this group of aquaculture species will provide new opportunities and information vital to the health of the Oklahoma aquaculture industry.

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.

Aquaculture is a rapidly growing industry in the U.S. However, Oklahoma's industry is at a competitive disadvantage to those in bordering states like Arkansas due to the reduced availability of water. Modern technologies to improve water quality and conserve water usage are largely unused. Additionally, many products that have been successful in other regions (e.g. freshwater prawn, crawfish), or are uniquely suited to production in Oklahoma (crawfish, turtles, and frogs) have received little attention from the research community. The turtle industry is rapidly declining, the frog and crawfish industry have been ignored, and the prawn industry is absent despite suitability and lack of competition in the region. Focusing attention on this group of aquaculture species will provide new opportunities and information vital to the health of the Oklahoma aquaculture industry. Purpose: Investigation of water quality, nutrition and stress responses across multiple aquaculture species will provide information that can be widely applied to production in Oklahoma, the region and beyond.

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

General objectives of the project are to study aquaculture practices to establish sustainable production options with simultaneous increased profitability and or efficiency. Specific objectives are to: 1) Compare the performance of various aquaculture species on alternative foodstuffs and supplements; 2) identify physical, physiological and genomic responses of aquaculture species to stressors in an aquaculture system; 3) determine the time required for turtles to adjust and begin reproduction after stocking; 4) develop protocols for feeding frogs artificial foods; 5) determine if dejelling amphibian eggs improves survivorship; 6) establish if artificial pond liners improve water quality and conserve water consumption; 7) evaluate the suitability of brackish water from multiple sources for aquaculture organisms. Selection of species is based on products currently raised in Oklahoma and selected products with potential for marketability in the state. Species used across experiments and currently produced in Oklahoma include Channel Catfish, American Bullfrog, Redear Turtles, Common Snapping Turtles, and Spiny Softshell Turtles. Species used across experiments that constitute new products in the state include Freshwater Prawn, Australian Red Claw Crawfish, and an assortment of tropical fish.

The accomplishments are addressed below in regard to the seven project objectives/areas. We compared the performance of various aquaculture species on alternative foodstuffs with prawns, tadpoles and turtles, and further studies are ongoing. This resulted in one manuscript on prawns in review, one manuscript with tadpoles in review and one published, and one turtle manuscript nearing submission with a second undergoing data analysis. We are currently identifying physical, physiological and genomic responses of aquaculture species to stressors in an aquaculture system. In this line we have collected data for production of the draft genome for the freshwater prawn and are examining genomic responses to different levels of nutritional stress. We expect at least two manuscripts will be submitted in the next term. We have extracted DNA and developed libraries for sequencing of a frog that is ready for sequencing (this was delayed by COVID-19). We began data collection for development of protocols for feeding frogs artificial foods. Preliminary data is in analysis and nearing submission. (Continuation was delayed due to COVID-19) We will begin work on dejelling amphibian eggs during 2020-2021. (This project was delayed by COVID-19). The evaluation of brackish/fracking water for use in aquaculture is in planning phase.

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

The broader public benefited from our project's activities in that we have broken new ground in aquaculture production that promises to impact the socioeconomic welfare of the citizens of Oklahoma. We have also served as a resource for the general public that it accessed for unbiased information.

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 FaceBook page and group was established for communication with over 400 producers in the state and surrounding region. We posted/post pdfs of posters and manuscripts to the page and group as they are developed. We further regularly disseminated hundreds of news items during this period that kept producers abreast of new developments and issues related to Oklahoma aquaculture.

Numerous consultations over the phone and online have continued. One undergraduate research student participated fully in multiple studies this period. She coauthored one published manuscript and will be a coauthor on a second. Additional students occasionally assisted in research. Further, components of this research have contributed to the laboratory and lectures of two different courses this period.

The plans are discussed in regard to the seven project objectives/areas. We will continue feeding experiments with additional species and repeat a prawn diet experiment to examine and verify temperature influences on performance. We will sequence the second species and continue stress response studies. The frog feeding experiment is underway and moving forward. The dejelling experiments were delayed to 2020-2021. The work with saline waste water is planned to start in 2020-2021.

We have continued with the program changes implemented last year. This has gone smoothly. COVID-19 has disrupted supply chains and slowed research progress and appears to have slowed the peer review process. Further, travel restrictions and scholarly meeting cancellations due to the pandemic made attendance and presentation at scholarly meetings largely impossible unless they were moved to a virtual environment. We have made adjustments to the management of projects to help reduce the possible impact of COVID-19 in 2020-2021.

This period produced six journal articles and three additional data sets in need of analysis.

Improving Beef Cow/Calf Enterprise Water and Nutrient Utilization

Project Director

David Lalman

Organization

Oklahoma State University

Accession Number

1016156



Water Use and Forage Utilization Efficiency in Beef Cows

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

With a high concentration of beef cows in Oklahoma and the Southern Great Plains region, water availability and water quality are critical elements in maintaining healthy, productive livestock. In this project, we will determine water requirements and water quality standards for beef cows. The latest data available for estimating water requirements for beef cows were published in 1956 (Winchester and Morris, 1956). Little is known about the usefulness of brackish water in maintaining healthy livestock. A second objective in this work is to investigate and characterize genetic traits that influence cow forage utilization in the Southern Great Plains. In this context, cow efficiency is defined as grams of calf weaning weight produced per mega calorie of metabolizable energy consumed by the cow.

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.

A study was completed to determine the effects of water quality and age (yearling heifers or mature cows) on relative water consumption, forage intake, and forage digestibility. Under the conditions of this experiment, beef heifers and cows consumed substantially more water than the Nutrient Requirements of Beef Cattle (NASEM, 2016) guidelines indicate. Secondly, brackish water used in this experiment did not reduce water intake, forage intake, nor forage digestibility.

Preliminary results from this project also contributed to our knowledge of factors affecting forage intake, maintenance requirements, and forage utilization efficiency in beef cows. Body condition score was negatively related to forage consumption. This has been suggested in the past (NASEM 2016) although little data was available to quantify the effect of body composition on forage intake. Secondly, cows with lower maintenance energy requirements lost less weight during lactation and produced more milk energy at the same time. These results contradict previous studies conducted across different breeds, suggesting that increased milk yield was associated with increased maintenance.

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

Study results have been reported at American Society of Animal Science section and national meetings and published in peer reviewed journals and abstracts. Furthermore, research updates have been provided in our Departmental Research Report.

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

Project activities and results have been discussed in SUNUP TV segments, and published in Extension newsletters, press releases, and in our Animal and Food Science Research Report.

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.

Graduate and undergraduate students have been directly involved in conducting these research activities, analyzing data, and writing reports and publications. Two Master's degrees and one PhD degree have been awarded to students directly involved in this project. Project results will continue to be disseminated as study results are finalized. Results will be disseminated through Extension fact sheets, SUNUP TV segments, field days, and various newsletters.

Closing Out (end date 09/07/2023)

[Integrated Systems Research and Development in Automation and Sensors for Sustainability of Specialty Crops](#)

Project Director

Ning Wang

Organization

Oklahoma State University

Accession Number

1021004



Integrated Systems Research and Development in Automation and Sensors for Sustainability of Specialty Crops

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

Rapid food quality evaluation has always been in a great demand for food processing and for crop breeding. Non-contact sensing techniques, especially image processing, have been widely. However, it is challenging to evaluate the quality for the items with hard shell, such as peanuts and pecans, with regular imaging system (RGB or NIR).

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.

Symptoms of peanut smut are present only on pods and kernels, so disease ratings can only be done after harvest. Symptoms can vary from normal-looking pods with a few clusters of small brown bumps on kernels, to hypertrophied, tumorous pods with kernels completely replaced by dark-brown teliospores. While deformed pods are common in susceptible genotypes, pods without visible exterior symptoms may also contain kernels that are completely or partially replaced with teliospores. The current method used by researchers is hand-opening and rating individual pods, which is slow, laborious, and unsafe for evaluators. Hence, Dr. Ning Wang's team has been developing other solutions to replace the human inspection. After

evaluating various sensing methods, x-ray imaging shows a great potential to detect the damaged peanuts without cracking the shell and identify the levels of damages. Hence, Dr. Wang's team is developing an X-ray imaging solution to identify the damaged peanuts with smut disease.

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

- Peanuts scientists and breeders will be beneficial from the project by using the developed x-ray imaging system to speed up the quality rating process.
- Undergraduate and graduate students will learn the knowledge of digital imaging, sensing, automated controls and skills to develop a solution for practical challenges.
- Producers and processors will be provided a tool to monitor the quality of the produce. The methods developed can be used for other produces with shell.

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

The possibility of *T. frezzii* movement outside of Argentina into other major production countries is a significant concern. To prepare for such an event, the peanut research community needs to develop commercially acceptable smut-resistant cultivars. At present, a significant roadblock to screening for resistance to peanut smut is the time required to phenotype germplasm. Pods are individually opened by hand and examined for incidence (presence/absence) and/or severity of disease. Hence, developing new tools to improve the breeding process is in a great demand to provide public the best quality of the 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.

Due to the Covid pandemic, the development work was slowed down due to the shortage of technical personnel and components needed for the proposed work in BAE Lab. The progress of the project was stopped several times.

In 2021, with the difficulty, we still trained two undergraduate students to work on the projects and learn how to design, develop, and test a practical solution to the targeted problem. The undergraduate students participated OSU Research Week, 3-min Technical Presentation Competition, and Undergraduate Research Symposium to present their work on the X-ray imaging system.

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

Project Director

SALEH TAGHVAEIAN

Organization

Oklahoma State University

Accession Number

1020915



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

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

Recent reductions in agricultural water availability exacerbated by frequent droughts and more competition from other sectors have posed many challenges to sustainable and economic production of food, feed, fuel, and fiber. My project is focused on adopting new irrigation technologies and improving on-farm irrigation management to increase farm profitability and environmental sustainability.

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.

Our major activities included field testing of a new approach to cotton irrigation management that relies on monitoring soil moisture, canopy temperature, and crop health using a combination of sensors installed in field and onboard satellites. In addition, we evaluated the effectiveness of smart irrigation scheduling methods under variable soil, crop, and climatic conditions and when exposed to different levels of accuracy in input data. These applied research activities were accompanied with meetings, webinars, fact sheets and video clips to inform stakeholders of the project outcome.

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

The target audience for these activities were farmers in western Oklahoma, where irrigation is required to meet water demand of most crops. Our findings showed that smart technologies can be used effectively to reduce the amount of applied water in southwest Oklahoma, especially in years with wet springs, and to increase the amount of applied water in west central Oklahoma to avoid water stress and yield reduction. In case of soil moisture sensors, their performance was negatively impacted in soils with higher clay content and salinity, a point that should be considered by farmers under these circumstances.

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

Increasing water productivity in irrigated agriculture and producing more crop per drop benefits public in two ways, first by helping achieve and foster food security (reducing hunger) and second by making more water available for other uses or by slowing the rate of increase in agricultural water demand. Improving irrigation scheduling also helps downstream ecosystems that rely on shared water resources and are sensitive to water quality, which has additional 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.

Taghvaeian S, Porter D, Aguilar J. 2021. Soil moisture-sensing systems for improving irrigation scheduling. Oklahoma Cooperative Extension Service publication BAE-1543. Available online at: <https://extension.okstate.edu/fact-sheets/soil-moisture-sensing-systems-for-improving-irrigation-scheduling.html>

Closing Out (end date 09/07/2023)

[Relationships Between the Microbiome and Internal Parasitism in Goats](#)

Project Director

Yonathan Tilahun

Organization

Langston University

Accession Number

1017311



[Relationships Between the Microbiome and Internal Parasitism in Goats](#)

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

Goats are relatively more susceptible to internal parasites than sheep and cattle, and the leading cause of goat morbidity and mortality in the southeast and south-central U.S. is internal parasitism. Sustainable and practical management practices to address internal parasitism in small ruminants are lacking. Resistance to commercial anthelmintics limits the ability to control internal parasites by this method alone, which previously has been relied upon. Selection of small ruminants for internal parasite resistance has not received adequate attention and offers a sustainable method of production.

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.

General objectives are to 1) characterize relationships among the microbiome at different sites of goats; 2) determine how relationships among the microbiome at different sites of goats are affected by internal parasitism, primarily infection with *Haemonchus contortus*, level and type of parasitism, anthelmintic treatment, and reinfection; and 3) elucidate how the

microbiome of goats in production settings varies with resistance to internal parasites and other environmental conditions. Specific objectives of the experiments are to 1) determine relationships among the microbiome at different sites of goats as influenced by *Haemonchus contortus* infection; 2) identify relationships among the microbiome at different sites of goats as influenced by level of *Haemonchus contortus* infection; 3) characterize effects on the microbiome at different sites of goats of the nature or type of infection with internal parasites and impact of anthelmintic treatment; 4) elucidate effects on the microbiome at different sites of goats of the nature or type of infection with internal parasites, impact of treatment with anthelmintics, and reinfection with internal parasites; and 5) quantify differences in the microbiome of animals varying in resistance to internal parasitism and characterize influences of other conditions under normal production settings

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

A post-doctoral visiting scientist has been collaborating on the project on all steps of the studies at hand. Three undergraduate research students participated fully in multiple studies this period. Students were involved in leadership activities of the laboratory in terms of management of the laboratory. Students were highly active in laboratory wet bench work. Students were or were encouraged to become more involved with computational biology aspects, being heavily involved in assisting in the orchestration of different analytical methods for the raw DNA sequences that were obtained from third party sequence facilities. All students will be included as coauthors on published manuscripts.

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

The broader implications of this project are that natural resistance will begin to be used more often than anthelmintics involving antibiotic that build parasitic resistance following long durations of treatments. Thus, natural resistance will provide more robust methods of resistance than antibiotics.

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.

Current efforts include one publication in "Scientific reports," and additional efforts towards publication are being made for the work conducted. Also, the research being conducted is being publicized via the School of Agriculture and Applied Sciences method of communication through newsletters, high school recruitment, and other venues.

COVID-19 has disrupted supply changes implemented last year, such as the purchasing of 200 microliter tips and other supplies required to carry out laboratory analyses. Furthermore, travel to scientific meetings is still restricted often being conducted virtually.

[Structure-function studies on viral-host interactions key to animal immunity](#)

Project Director

Junpeng Deng

Organization

Oklahoma State University

Accession Number

1012888



[Structure-function studies on viral-host interactions key to animal immunity](#)

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

The main goal of this research is to provide detailed molecular basis by which a number of important viral and host proteins function, and to provide important clues on how to design novel anti-viral reagents key to the immunity of livestock animals. The outcome will be helpful for development of treatments and preventions against a number of infectious diseases that target livestock animals and are economically devastating.

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 use structural biology to study how certain viral proteins interact with host immune systems, as well as how molecular chaperone Hsp90 functions. We aim to provide atomic details about the protein-protein, protein-ligand interactions that will be useful for design specific inhibitors to combat viral infection and cancer.

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

The outcome will be beneficial for not only the health of Oklahoma residents, but also agricultural stock animals.

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

The results will fill the knowledge gap in not only virology, but also cell biology, biochemistry and molecular biology because the outcome will reveal unique membrane biogenesis, lipid transportation and provide novel structure based inhibitor design to combat cancer.

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.

n/a

[Using Big Data and the Internet of Things to Manage Tomorrow's Agricultural Production Systems](#)

Project Director

Paul Weckler

Organization

Oklahoma State University

Accession Number

1014140



Using Big Data and the Internet of Things to Manage Tomorrow's Agricultural Production Systems

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

The goal of this project is to develop intelligent control systems and sensors to help monitor, optimize, and manage agricultural machinery systems. The big data sets produced by the sensors are processed in a computer-based learning environment to enact real-time machine operational decisions.

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 has already completed the testing and analysis of the field performance of commercially available soil sensing systems to determine their suitability for use on automated agricultural machinery. In the past year the project has developed methods for processing image data from UAVs to aid in cotton and peanut production, and tested a 3D camera-based autonomous navigation system for row crop production.

- o Pickering, A., Aranda, G., Wang, N., Long, J., Weckler, P. 2021. *3D Camera-Based Autonomous Navigation System for Row Crop Production*. presented at the 2021 ASABE Annual International (Virtual) Meeting. July 12 – July 14, 2021. Paper number 2100985
- o Young, W., Long, J., Bennett, R., Wang, N., Weckler, P. 2021. *Development of Image-based Data Processing Methods for UAVs in Peanut and Cotton Production*. presented at the 2021 ASABE Annual International (Virtual) Meeting. July 12 – July 14, 2021. Paper number 2101023

Due to the COVID-19 pandemic, progress on this project has not been as efficient as planned or desired.

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

This project performed head-to-head comparison of commercially available soil sensing systems to determine their suitability for use on automated agricultural machinery. Multiple sensors were collecting data of the same fields at the same time. This ensured that the data collection conditions were consistent.

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

Several of the research sensors and commercial prototype sensors tested and evaluated by this project have undergone further development and improvement. Two of the sensors are now available to the general public as commercial off-the-shelf products. Was invited to present this project at the Research Symposium, College of Mechanical and Electronic Engineering, Northwest A&F University, Yangling, China.

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.

Due to the COVID-19 pandemic, progress on this project has not been as efficient as planned or desired. Two research papers were presented at the 2021 ASABE Annual International (Virtual) Meeting. July 12 – July 14, 2021.