Agricultural Research Service
Small Farm Research Agri-news

Dale Bumpers Small Farms Research Center
Booneville, Arkansas

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Quarterly

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The mission of the Dale Bumpers Small Farms Research Center is to develop scientific principles and technologies to enhance the profit-ability and sustainability of small-scale farms.

Greetings from the Research Leader, Dr. Phillip Owens

Dr. Phillip Owens

Welcome back to the Dale Bumpers Small Farms Research Center Newsletter. We have been busy publishing scientific papers and preparing for the field season which is rapidly approaching. We are ever mindful of our stakeholders and community and continue to focus on opportunities to incorporate technology into small-scale farm operations. The U.S. is currently faced with issues related to national food security and rural economic prosperity that are inherently tied to the success of farms making up 89% of the U.S. Agricultural sector, small farms. The viability of small farms and rural economic prosperity in the U.S., similar to other commercial sectors, depends on the adaptability of technological advances that reduce costs while maintaining productivity. Much of the research carried out for large production farms is applicable to small, low-capital farms, in theory. However, many of these technologies and practices for large-scale farms have not been translated into tools, guidelines, or systems that small farmers can adopt without significant risk. This persistent risk and lack of adopted technologies remains a significant challenge for small farms success and proliferation. Work carried out by the Dale Bumpers Small Farms Research Center has and will continue to take on this challenge and help increase profitability and sustainability of small farms. However, an expanded and continuing effort is needed to meet the increasing number and novelty of production challenges with translatable agricultural research that helps turn research and theory into user-friendly, practical tools and practices for farmers and producers. As you work your farm and see opportunities for technology integration into your operation, let us know. We have the mission to develop tools to help you be more profitable and sustainable to support the economy of rural America.

Dr. Zamir Libohova's Soil Modeling Research Spotlight

Dr. Zamir Libohova

Heavy metals concentration in soils across the conterminous USA

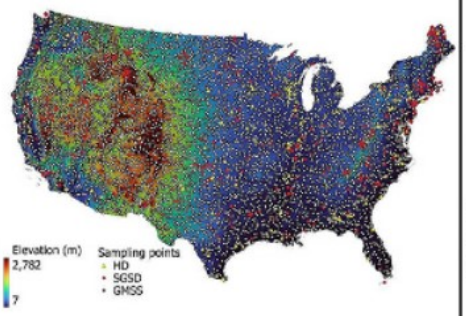
A recent paper was published in **Science of Total Environment journal** for a study conducted in the conterminous states of USA on the heavy metals [Cadmium (Cd), Copper (Cu), Nickel (Ni), Lead (Pb), and Zinc (Zn)]. The paper was coauthored by scientists at the Dale Bumpers Small Farms Research Center, Dr. Phillip Owens, and Dr. Zamir Libohova and research postdoctoral fellows Dr. Edwin Winzeler and Dr. Joshua Blackstock. Assessment and proper management of sites contaminated with heavy metals require precise information on the spatial distribution of these metals. The study observed high lead concentrations near urban areas and peak high concentrations of all studied metals were found in the Lower Mississippi River Valley. Copper, Nickel, and Zinc concentrations were higher on the West Coast and Cadmium concentrations were higher in the central USA.

The updated maps will help support environmental assessments, monitoring, and decision-making with this methodology applicable to other soil databases, worldwide. The maps presented in this study could be useful to identify risk areas and target remedies through proper management decisions at a regional level. Future studies will focus on employing new point observations to update the maps for their suitability to support decisions at a local level. (maps shown on next page)

Full journal article at link below:

Adhikari, K., Mancini, M., Libohova, Z., Blackstock, J., Winzeler, E., Smith, D.R., Owens, P.R., Silva, S.H.G., Curi, N., 2024. Heavy metals concentration in soils across the conterminous USA: Spatial prediction, model uncertainty, and influencing factors, Science of The Total Environment, Volume 919, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2024.170972.

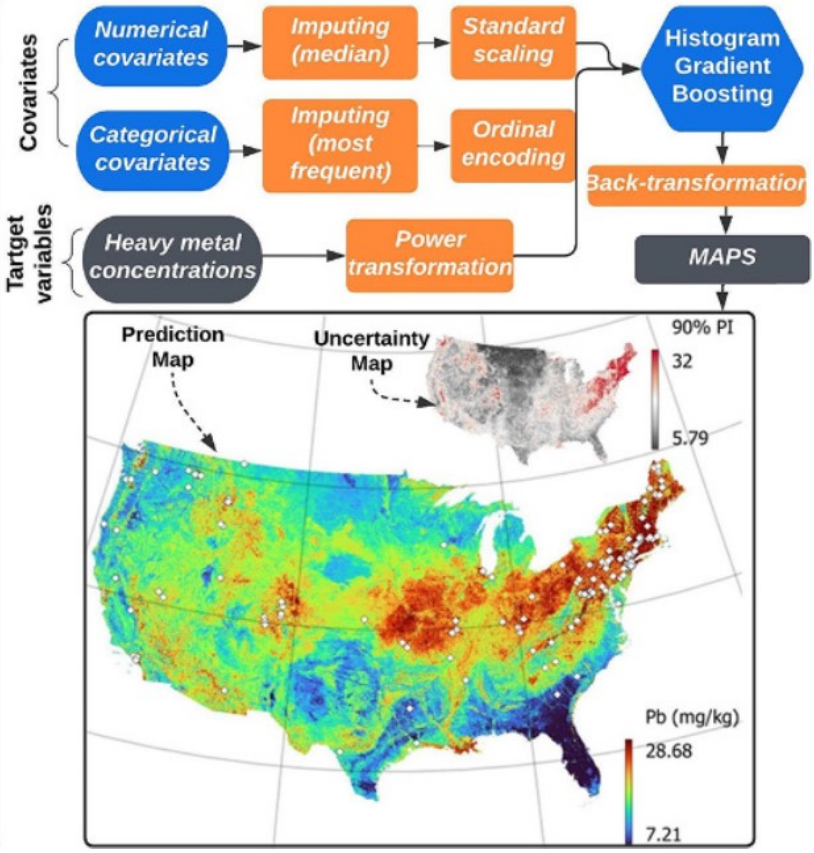
Below: Maps showing the location of the observations, the distribution of Pb in the conterminous US and the methodology used for this study.



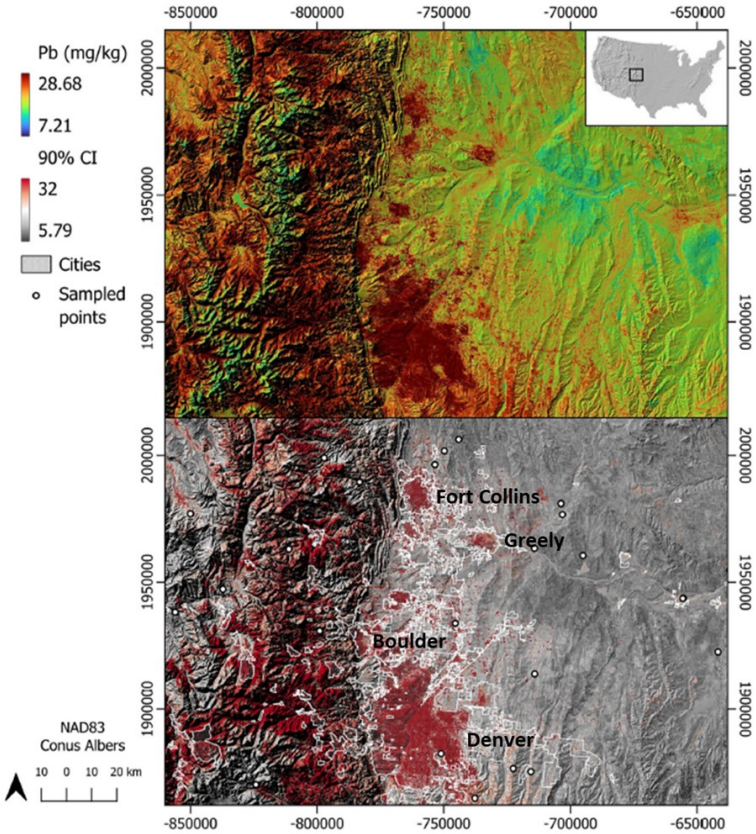
INPUT
- 9,183 point observations
- 14 environmental covariates

MODEL
- Histogram-based Gradient Boosting

OUTPUT
- Prediction and Uncertainty maps of Cd, Cu, Ni, Pb, and Zn across the CONUS



Right: Higher concentrations of Lead (Pb) in the Fron Range at the foothills of the Rocky Mountains are observed in the major cities resulting mostly from the past use of leaded fuel, and in the Rocky Mountains mostly from the soils overlying granitic and metamorphic geologic formations.



Dr. Joan Burke's Small Ruminant Research Spotlight

Dr. Joan Burke

There are a lot of exciting areas of research for sheep and goats occurring at the DBSFRC. One area is a nematode-trapping fungus called *Duddingtonia flagrans*, marketed as Bio-Worma® or Livamol with BioWorma® became available in recent years (currently sold by Premier 1). It is the ONLY method of parasite control that focuses on the worms on the pasture. Farmers have always wanted to know whether there was a method of parasite control that could be applied on pasture. The method starts when spores of the fungus are fed to sheep or goats, passing through the animal digestion system intact – it has NO effect on the animal. The spores are deposited in the fecal pellets along with the parasite eggs. As the eggs hatch to develop into infective stage larvae, the spores develop and begin trapping the parasite larvae, killing and consuming them. Thus, it breaks the worm's life cycle.

There are two aspects of research yet to be conducted. The first research objective is to help the many grass-fed producers who ask how they can use the product to be included in a feed supplement. We are in the process of determining whether the fungal spores (as BioWorma®) can be added to a trace mineral and maintain efficacy. The results of controlled studies are very promising showing that parasite larvae are reduced as well or better compared with including the fungus in the feed. Results of a field study conducted by our collaborators at Louisiana State University are pending.

The second research objective is to reduce the economic burden without hindering efficacy of the fungus product. The commercial product can be spendy and should be used at a time when animals are at highest risk of parasite infection including around the time of weaning for young animals, and around the time of lambing and early lactation for ewes and does (continue on page 6).

A collaborator at Fort Valley State University will determine if the product can be given every other day rather than daily and maintain the ability to reduce parasite larvae. Another area of research is determining prevalence of Cache Valley Virus in ewes. The Cache Valley Virus has undocumented economic outcomes (from high rates of lost pregnancies that most farmers are unaware of) and animal welfare concerns. Cache Valley virus is a mosquito transmitted disease. If the virus infects ewes during the first ~45 days of pregnancy there can be negative outcomes including abortion, stillbirth, dystocia and mild to severe deformities in lambs which can be born dead or alive.

Ewes infected early in that period are likely to abort, whereas ewes that are infected later in that period are likely to produce lambs with deformities. Incidence in the ARS flock appears to be occurring more frequently and affecting more ewes and their offspring. In fact, antibody titers have indicated as many as two-thirds of the August bred ewes became infected in 2022 and 2023. Use of an insecticide ear tag attached to collars on the sheep around the time of breeding did not reduce negative outcomes. Collaborators on this research include the Arkansas Department of Health, the Centers for Disease Control, the University of Arkansas, and fellow ARS researchers from Manhattan, KS and include entomologists, environmentalists, and economists are hoping to collect mosquitos to determine the strain of the virus and develop methods to control viral outbreaks in sheep and goats. The USDA's National Animal Health Monitoring System (NAHMS) Sheep Study will occur in 2024 (USDA ,APHIS, NAHMS Sheep 2024 Study Information) and may possibly determine prevalence of Cache Valley Virus in sheep participating in the study across the U.S. In addition, collaborators will capture the prevalence of Bluetongue Virus, another vector born disease carried by biting midges (no-see-ums). Bluetongue Virus affects the fall lambing flock as well as young animals and rams.

Small Ruminant Update

The 2024 winter lambing season at DBS-FRC has wrapped up with close to 80 new lambs. Winter lambing has its challenges, but nothing too tough for the sheep crew. This season brought close to a week of well below freezing weather with snow that just wouldn't melt. Once it did melt, it was quickly followed by a lot of rain which means a LOT of mud. Though the crew was short-handed through most of the lambing season, each member stepped up to ensure the lambs stayed warm and dry, putting down extra shavings for bedding in the cold, as well as in their common use areas after the rains. Thanks to the extra effort by the staff the lambs are thriving and now enjoying the warmer days.

The 2023 fall born lambs were recently weaned and are growing nicely. Some of these lambs will be available in the DBSFRC spring online sale. The sale is expected to take place in April. When a specific date is set, we will announce it on our website.

Dr. Christine Nieman Cattle Research Spotlight

Dr. Christine Nieman

Developing best management practices for warm season native grass establishment-Kolten Wright

In 2022, the Nieman lab, along with collaborators from the University of Tennessee and Middle Tennessee University, received an Organic Agriculture Research and Extension Initiative (OREI) grant to study organic establishment methods for native warm season grasses (NWSG). enerally, NWSGs are difficult to establish due, in part, to sensitivity to weed competition. Conventional establishment practices greatly depend on herbicides for reducing weed competition, which is not an allowable strategy in organic agriculture. Currently, there are no existing recommendations for organic establishment of these species.

The study compares four total species, three NWSGs, switchgrass, eastern gamagrass, and a three-way mix of big bluestem, little bluestem, and indiangrass, and one introduced species as a control, bermudagrass (Figure 1, Study Map). Each species will be established using the four management treatments: Dormant, smother crop + haying, smother crop + roller crimping, and fallow, all strategies were developed with weed control as the priority.

In 2023, the fallow treatment was tilled based on weed presence (approximately every 5-7 weeks) to prevent the development of weed seed heads. Tillage will continue as needed until planting in June of 2024. Creating a seedbed is generally the recommended strategy for conventional establishment, (continued on page 9)

Figure 1. A drone image of the study plots with the cereal rye cover crop from spring 2024. The study includes four warm season grass treatments, four establishment treatments, with four replicates per combination for a total of 64 plots.

(from page 8) though it is generally followed up with herbicide application, not possible under organic standards. In 2023, the other management treatments, a pearl millet smother crop was planted in spring (Figure 2), the pearl millet was harvested in late summer, followed by a second smother crop, cereal rye, planted in fall. The purpose of a smother crop is to prevent the development of new weed seeds or root development of perennial weed species. The difference in the remaining three management treatments is how the cereal rye smother crop will be harvested and the date of warm season grass planting. The smother crop + hay treatment will terminate the cereal rye by cutting and baling it for hay or baleage in April, followed immediately by planting the grasses. The smother crop + roller crimper will use a roller crimper to terminate the cereal rye in April, followed immediately with planting grasses into the crimped cereal rye. In the dormant treatment, grasses are planted into living cereal rye in March, with cereal rye termination occurring via haying in April.

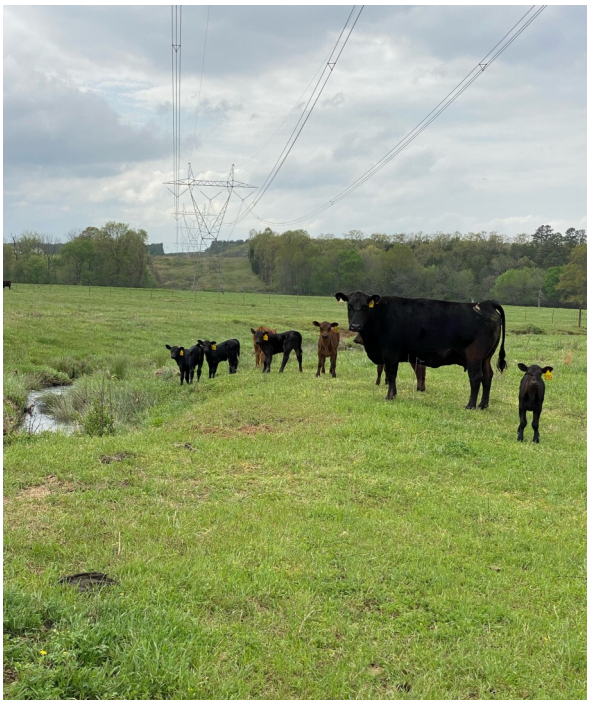
In 2024, the main variables measured will be soil temperature and moisture and weed competition. We hypothesize that the establishment strategies will influence the soil temperature and moisture around germination, which may affect the timing of germination and early support of the seedling. Soil moisture and temperature will be continuously monitored with data loggers and sensors within 16 plots. Weed competition will be measured by counting the density of NWSG tillers at germination and 6-8 weeks after germination and measuring the amount of photosynthetically active radiation (PAR) reaching NWSG under the weed canopy. PAR sensing measures the amount of sunlight within 400-700nm, the range of wavelengths needed by the plant for photosynthesis. Weeds may out compete the NWSGs by growing faster and capture sunlight needed by the slower growing NWSG. Measurements of the amount of light available to NSWG or the amount of light blocked by weeds, is useful for assessing competition between NWSG and weeds.

This study will end in 2025 with final plant density and yield values to conclude which management strategy resulted in the most successful establishment and yield. Finally, we will develop best management practices for producers interested in organic NWSG establishment.

Figure 2. The pearl millet smother crop on July 5, 2023, 3-weeks after planting

Cattle update

Winter is the time for Spring preparations for the Cattle Crew at Dale Bumpers Small Farm Research Center. The crew is geared up and ready for the calving season that just began. The pastures and fences are brush-hogged and ready for the calves to hit the ground. Stricter pasture rotations have minimized the hay usage this winter and the cows are in their calving pastures. The crew has also began preparing the equipment for the spring and summer activities such as brush-hogging, spraying and fertilizing.



USDA ARS Southeast Area Award

Dr. Phillip Owens and team won the USDA ARS Southeast Area (SEA) Team Administrative and Program Management Award

The USDA ARS Artificial Intelligence Climate-Smart Intern Program was selected as the winners of the SEA Administrative and Program Management – Category 1 for Leadership & Management. The team was Dr. Prasanna Gowda (Associate Area Director, Stoneville, MS), Dr. Brian Scheffler (Research Leader, Stoneville, MS), Dr. Allen Torbert (Research Leader, Auburn AL) and Dr. Phillip Owens (Research Leader, Booneville AR) for initiating the University of Texas at Arlington Internship Program.

The program has been active for 2 years and focuses on developing the artificial intelligence climate-smart intern program targeting underrepresented STEM students. This program focuses on technical solutions through machine learning, neural networks and ultimately artificial intelligence that are changing society and agricultural applications. As a priority, ARS is forging ahead with directives to impart this technology to achieve the mission to develop and deliver state-of-the-art, science-based methods that improve the post-harvest processing, preservation, quality, marketing and consumption of safe and nutritious foods.

Employee Engagement, Diversity, Inclusion and Outreach

Featured Employee at University

Tiffany Herman, an Animal Caretaker at DBSFRC and college student, was featured in the University of Arkansas at Fayetteville, Entomology Department's "Super Seven" outreach projects for the fall semester 2023. Students created inventive projects to highlight entomology and submitted them. Tiffany was very creative with her submission. She encased a brown recluse in a resin dome. Resin is something Tiffany has worked with on and off for several years. She always wanted to attempt to cast a live specimen, and this was a perfect opportunity to create something unique. She chose the brown recluse or *Loxosceles reclusa*, because it is one of the most common spiders in our area. The resin preserves the specimen and allows viewers to see a real 3D representation. Many spider species aren't common knowledge, especially the brown recluse because it is brown and very similar to common nonvenomous spiders. So being able to see one up close is useful information. The glass-like resin gives you a clear view of the fiddle shape on the recluse's back. The fiddle is the recluse's defining feature and easily sets it apart from most other similar species. Congratulations to Tiffany for being in the "Super Seven" project acknowledgement.

To view archived newsletters or to find more publications, please visit our website at :

https://www.ars.usda.gov/southeast-area/booneville-ar/dale-bumpers-small-farms-research-center/

USDA, Natural Resources Conservation Service

Booneville, Arkansas Plant Materials Center

Research Spotlight 1: Native Pollinator Mix Establishment Study

Photo 1: PMC staff planting pollinator seed mix containing 33 plant

The continuous decline in the population of pollinators everywhere is a huge concern due to their significant role in food production. It is critical to identify the appropriate site-specific plant species and agronomic practices to successfully create the pollinator-friendly habitats with adequate floral abundance and diversity.

Booneville PMC has started a five year research project (Duration: 2024-2028) containing 33 plant species in collaboration with Quail Forever and USDA-ARS (Dale Bumpers Small Farms Research Center). The objective of this project is to evaluate a variety of establishment methods to create pollinator habitats using a native grass and forb seed mix (33 plant species) and determine the impact on soil organic carbon. This field study was started on 29 February 2024 by planting the seed mix with nine agronomic treatments (biochar – 5 tons/acre, disk vs no-disk, no-till drill vs broadcast, chemical vs disk-tillage, burn vs no-burn) (Photos). Floral abundance and diversity will be measured in every crop season.

Overall goal of this project is to provide technical information to NRCS field offices that is relevant to Arkansas agro-climatic conditions when providing the best establishment and management recommendations to create pollinator friendly habitats through cost-share programs.

Photos: 2) base-line soil samples were collected from experimental site to measure soil health parameters; **3**) Biochar was incorporated into soil for some of the experimental plots

The Plant Materials Center has published their Annual Progress Report of Activities. To read the full report please visit their website below. PMC Information is available online at: https://www.nrcs.usda.gov/plant-materials/arpmc

USDA, Natural Resources Conservation Service
Booneville, Arkansas Plant Materials Center

Research Spotlight 2: Effects of Seeding Rate, Date and Termination Timing on Biomass and other Attributes of Cool Season Legume and Grass Cover Crops

Photos:

1) Experimental lay-out for cereal rye cover crop study **2**). Benjamin Holleman (Farm Manager) using Plant Map 3D technology to measure canopy cover

The determination of geographically-specific planting dates, seed rate, and termination time is critical for successful establishment of cover crops in agricultural cropping systems.

The Natural Resources Conservation Service's (NRCS) Plant Materials Program, in cooperation with the Agricultural Research Service (ARS) has initiated multi-location field studies across the nation to refine the regional establishment and management recommendations for cool season cover crops.

Booneville PMC is participating in this nation-wide research effort to determine the appropriate planting date, seeding rate and termination time for cool season cover crops such as cereal rye and hairy vetch in mid-south. At Booneville PMC, the field study was established last year with cereal rye by implementing three planting dates (September-November) and five seeding rates (15 -120 pure live seed lbs/acre) (Photo 1). Canopy cover and biomass will be measured for cereal rye at multiple growth stages in experimental plots using photo imagery and Plant Map 3D technology (Photo 2).

The Plant Materials Center has published their Annual Progress Report of Activities. To read the full report please visit their website below.

PMC Information is available online at: https://www.nrcs.usda.gov/plant-materials/arpmc