
2021 AgRESEARCH ANNUAL REPORT

A YEAR IN REVIEW



ANNUAL REPORTS are designed to showcase progress, and as dean of UT AgResearch, a part of the UT Institute of Agriculture, I am pleased to share that our 2021 annual report will not disappoint. Although the year was characterized by lingering challenges brought on by the COVID-19 pandemic, UT AgResearch faculty, staff, and graduate students continued their exemplary and impactful efforts on behalf of the state of Tennessee and society as a whole.

I am particularly pleased that in the midst of the pandemic UT AgResearch advanced the UT One Health Initiative, which is researching various links between the health of humanity and the health of the state and global ecosystems. UT AgResearch also launched a strategic Precision Livestock Farming Initiative to support the state's cattle industry as well as our growing poultry-based interests.

UT AgResearch scientists increased extramural funding by 40 percent compared to 2020, including sources beyond the USDA, like the National Science Foundation, the National Institutes of Health, and NASA. Of course, partnerships with organizations like The Nature Conservancy and the Shackelford Trust continued to provide vital links between our research and the resources and needs of our communities and the state. Finally, we are grateful that the state of Tennessee saw fit to invest in future research through enhanced infrastructure and equipment modernization with a \$50-million grant from the state's federal American Rescue Plan funds.

In 2021 our faculty were recognized with numerous prestigious national and international awards and honors, including memberships on the World Health Organization (WHO) Advisory Group on Critically Important Antimicrobials for Human Medicine, the Food and Agriculture Organization of the United Nations, and professional recognitions for lifetime achievement and for emerging scholars, to name just a few.

As UT AgResearch begins its 141st year of service in 2022, our commitment to providing Real. Life. Solutions. has never been stronger. Our scientists pledge to continue to help society understand and adapt to the world's changing physical climate, economic evolutions, and social needs. We appreciate your interest, support, and partnership in our work, and we hope this report helps illustrate how our research benefits Tennessee and the world.

Hongwei Xin
Dean, UT AgResearch
University of Tennessee Institute of Agriculture
March 2022

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OUR LAND-GRANT MISSION

The University of Tennessee and the Institute of Agriculture are part of the national system of land-grant colleges and universities. Created in 1862 with the passage of the first Morrill Act, also called the Land-Grant College Act, the nation's land-grant institutions provide excellence in teaching, research, and extension to educate the next generation of farmers, ranchers, and citizens seeking post-secondary education. Key to the land-grant system are agricultural experiment stations, which were established in 1887 by the federal Hatch Act. In Tennessee, the UT AgResearch system includes ten stations, now named UT AgResearch and Education Centers.

The UT AgResearch and Education Centers are unique outdoor laboratories located strategically across Tennessee to enable teaching, research, and extension opportunities representative of the state's diverse agricultural enterprises as well as its soils, topographies, and climate. The research conducted at each Center provides invaluable data-driven discoveries for the betterment of agriculture and natural resources management across the state and beyond.

AGRESEARCH AND EDUCATION CENTERS ACROSS TENNESSEE



Key Facts:

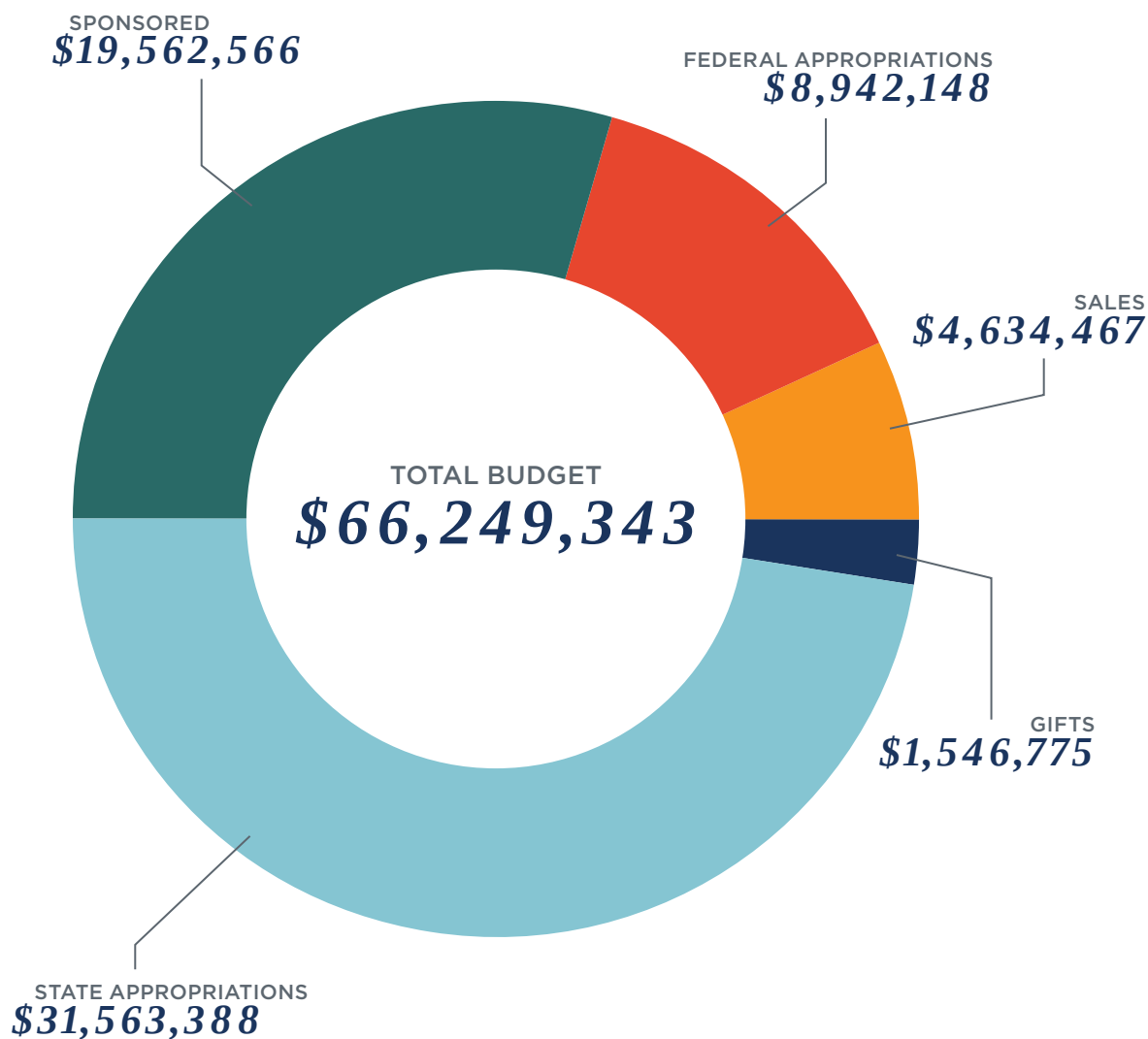
- UT AgResearch includes **139 faculty** and **667 staff** (including about **270 graduate assistants/students**) across eight academic departments and ten AgResearch and Education Centers.
- The diversified and balanced research portfolio supports Tennessee's **\$79.3 billion economy** related to agriculture and forestry industries.
- Strategic research initiatives and partnerships address current and emerging scientific and social challenges.
- Ten AgResearch and Education Centers on **39,000 acres** conduct approximately **1,000 field trials** each year. These Centers enable problem-solving research and demonstrations under real-world conditions as well as timely dissemination of the latest research findings to farmers and allied industries through in-person or virtual field days and technical publications.



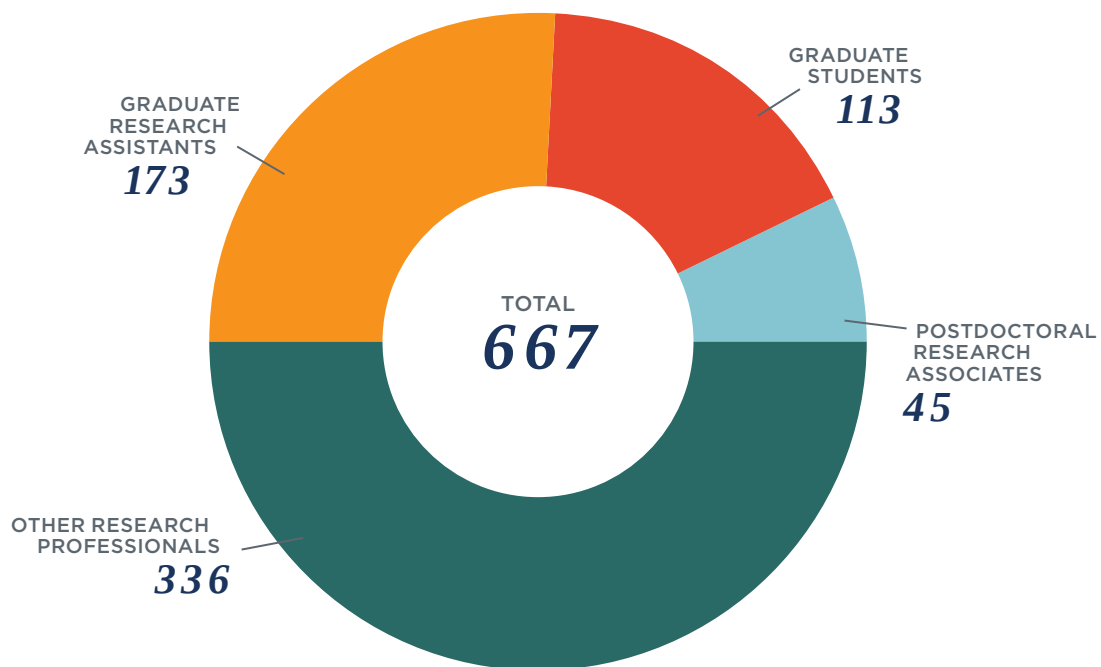
FISCAL SUMMARY

The 2021 UT AgResearch budget totaled more than \$66 million, including federal and state appropriations; publicly and privately funded research grants and sponsorships; as well as gifts, endowments, and sales of commodities produced on the AgResearch and Education Centers.

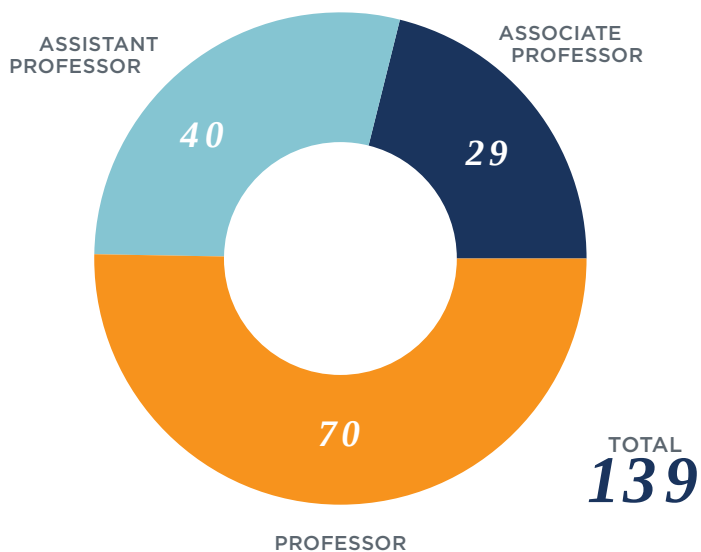
While these figures represent an overall decrease in funds from 2020's figure of \$68,254,872, the difference is mainly attributable to a reduction in sponsored programs, from approximately \$23 million expenditures in 2020 to \$19.5 million in 2021 due to COVID-19. We are pleased to report that state appropriations grew by more than \$300,000, federal funding grew by more than \$1 million, and extramural contract and grant awards grew \$7.6 million (40 percent).



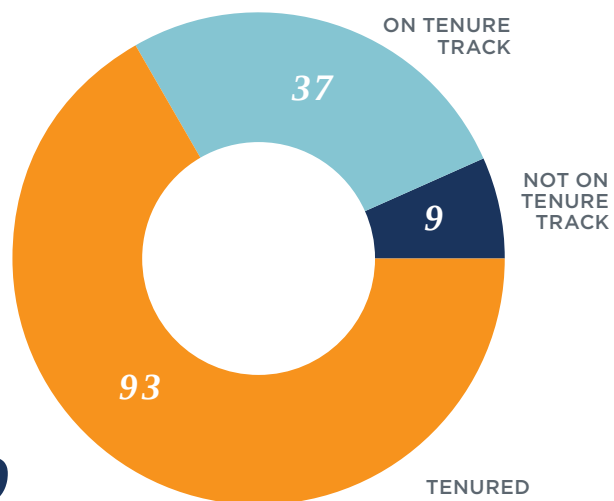
RESEARCH PROFESSIONAL STAFF



AGRESEARCH FACULTY RANK



AGRESEARCH TENURE STATUS



IMPACTFUL RESEARCH

UT AgResearch faculty conduct hundreds of research projects each year. Many of these efforts contribute to one of four major research initiatives and partnerships that specifically target key issues faced by society, producers, consumers, and policymakers across the state, region, nation, and globe. Each effort strives to advance the science and engineering associated with agricultural production and the sustainability of our natural resources. Highlights of our major initiatives and a few projects that advanced in 2021 are listed on the following pages.



ONE HEALTH INITIATIVE

Preserve and promote human, animal, plant, and environmental health to advance economic growth, and conserve biodiversity at local, national, and global scales: that's the mission of the UT One Health Initiative, a UT System-wide approach housed within UT AgResearch. One Health scholars from across the UT System participate in studies that seek to understand the myriad of factors that threaten human and animal health and the health of our environment.

More than \$9 million of funding has been generated since the UT One Health Initiative was established in 2020, and topics of interest include climate change; emerging infectious diseases transmitted by water, food, and insects; and producer stress and mental health. Debra Miller, who maintains a split appointment between the College of Veterinary Medicine and the Department of Forestry, Wildlife and Fisheries, serves as interim director.

A complete description of the initiative can be found online at onehealth.tennessee.edu. In addition to externally funded efforts, in 2020 UT awarded six competitive and one non-competitive seed grants to UT faculty, and in 2021 these studies progressed as planned. Topics include:

- Mussel mortality in the Clinch River in East Tennessee
- Socioeconomic epidemiology of disease risk in wildlife trade networks
- Controlling *Escherichia albertii*, an emerging human pathogen
- Molecular detection of zoonotic pathogens
- Modelling chronic inflammation
- Assessing climate change on cotton production
- Chronic wasting disease prion detection and environmental manipulation

The UT One Health Initiative also hosted a virtual workshop that included faculty from UT and two Israeli institutions (Hebrew University and Tel Aviv University) to explore and foster research collaborations amongst the two countries. Also in 2021, researchers introduced a One Health survey course as well as an academic minor for interested students, a monthly seminar series, a podcast series with comedian Shane Mauss, and more activities to educate scholars and the general public about the importance of One Health and the activities of the UT One Health Initiative.



INNOVATIVE SOLUTIONS TO REDUCE DISEASE RISK IN AMPHIBIAN TRADE

Led by Matthew Gray and Neelam Poudyal in the Department of Forestry, Wildlife and Fisheries and Nina Fefferman in the Department of Ecology and Evolutionary Biology, this study is one of the six UT One Health Initiative seed grants. The regional, national, and international trade of wildlife—a \$300 billion industry involving an estimated 2.5 million animals across 1,000 species—has facilitated the movement, spillover, and global emergence of numerous infectious diseases. Among them are SARS-CoV-2—a zoonotic pathogen that infects humans and animals—and chytrid fungi—a pathogen responsible for the greatest biodiversity loss in modern history. To understand and prevent translocation of harmful pathogens around the globe, these scientists are collecting preliminary data on the prevalence of beneficial and harmful microbes in wildlife trade, using amphibian trade as a model system. The researchers are identifying trade and industry practices that could reduce harmful microbes and promote beneficial microbes. They also are collecting social and economic data that can be used to solicit government support for an industry-led healthy trade program. The goal is to work with the US amphibian care community to ensure its sustainability and protect wildlife health and biodiversity by decreasing opportunities for microbial spillover from captive to wild populations.



DIGITAL AGRICULTURE

PRECISION LIVESTOCK FARMING

UT AgResearch is investing heavily in precision livestock farming to enhance production sustainability so US producers can remain profitable and competitive in the global market. Significant improvements in the production efficiency of all livestock sectors is needed to meet the anticipated growth in demand for animal proteins by a more prosperous worldwide population over the next thirty years.

Precision livestock farming techniques will help farmers achieve this goal and involves improving an individual animal's health and well-being through real-time monitoring of the animal's condition. The monitoring includes analysis of behavioral, biological, physiological, and environmental measurements. The innovative technologies feature automation and artificial intelligence, big-data analytics, machine learning, and real-time monitoring and decision-making.

Precision livestock farming systems allow producers to make better individual animal or herd or flock management decisions based upon quantifiable, objective measures. Timely decisions can result in higher process efficiency along with improved animal health and welfare. Human working conditions will improve, too, as will the environmental impact of individual and regional agricultural operations.

More than two dozen faculty and staff from multiple departments are engaged in the work, with more expected to join. Robert Burns, distinguished professor in the Department of Biosystems Engineering and Soil Science, coordinates the overall project, and Daniel Berckmans, a worldwide leader in the development of precision livestock farming, joined UT in 2021 to assist in the work. Berckmans is serving as an adjunct distinguished professor, also in the Department of Biosystems Engineering and Soil Science.

To facilitate the initiative, AgResearch is realigning the capabilities at two of its ten AgResearch and Education Centers. The Little River Animal and Environment Unit of the East Tennessee AgResearch and Education Center near Knoxville plans to have milking robots in operation by late fall 2022, and the Middle Tennessee AgResearch and Education Center in Spring Hill is refocusing its facilities to support precision beef and poultry production research.



NEW EQUIPMENT TO IMPROVE BEEF CATTLE DEVELOPMENT, REPRODUCTION, HEALTH, AND PERFORMANCE

The Super SmartFeed System is an automated cattle feeder used to provide precise supplement levels for cattle. It can provide specified amounts of supplements to individual animals with limited carryover between animals. To fully utilize the paddock system at the Middle Tennessee AgResearch and Education Center, animal scientist Kyle McLean began overseeing the installation of the Super SmartFeed System and a similar unit called 4 SmartFeed Pro in May 2021. This equipment will give AgResearch scientists the ability to integrate both feeding and continuous weight monitoring technologies into beef research.



AGRICULTURE GENOMICS AND SYNTHETIC BIOLOGY

CENTER FOR AGRICULTURAL SYNTHETIC BIOLOGY

Founded in 2018, the UT Center for Agricultural Synthetic Biology (CASB) is the first and only synthetic biology center focused on agricultural organisms, placing Tennessee at the forefront of the intersection of agriculture and sustainability.

Synthetic biology relies on engineering principles and computational strategies to design DNA for installation into organisms for novel functions. Among many other applications, these functions include improving the physiology of crop plants, farm animals, and food microbes for health and sustainability goals.

Composed of six faculty members from four UTIA departments, CASB exists as a cost center enabling multidisciplinary collaboration with state-of-the-art facilities and more than 4,000 square feet of dedicated space, including the first UT lab designed for secure and sensitive research. Available equipment includes robotics for high throughput screening and a unique fluorescence inducing laser projector (FILP) to image plant florescence.

Current and emerging efforts include:

- Gene/genome editing (CRISPR)
- Synthetic DNA-parts-based gene construction
- Synthetic promoters and transcription factors
- Advanced molecular diagnostics for food-borne pathogens
- Robotic systems for cell and tissue testing
- Crops used as “chassis” organisms for synthetic circuits
- Synthetic genomes and sub-genomes for crops
- High throughput assay development for human and animal parasites

To date, faculty from the Center have published more than thirty journal articles, including articles published in *Science* and *Nature*. Total external funding has exceeded \$27 million in CASB-led projects, and thirty-five students, scientists, and faculty currently receive approximately \$22 million in funding from CASB projects.

UNDERSTANDING DECOMPOSITION

Scientists with CASB are also working on a project to detect changes in plants near dead bodies. Funded by DARPA (Defense Advanced Research Projects Agency), the cutting-edge research is an example of the Center's work that has applications outside of agriculture. In the US, 100,000 people go missing every year. Difficulty in the rapid identification of sites of human decomposition complicates the recovery of bodies, especially in forests. Since cadavers release chemicals, including large amounts of nitrogen, as well as drugs and metals unique to the individual, into the soil as they decompose, the scientists' theory is those chemicals can be picked up by nearby plants' roots and cause changes that can be observed in the foliage. Working with colleagues from the Department of Anthropology, they have been testing this theory, using drones equipped with technology that can see things that can't be observed by the naked eye. These aerial scouts fly over the university's famed Forensic Anthropology Center, otherwise known as the “Body Farm,” to remotely detect subtle changes in the hyper-spectral wavelengths of light being reflected off the plants near decomposing bodies that have been carefully studied by the scientists. The goal is to understand how plants react to human decomposition.



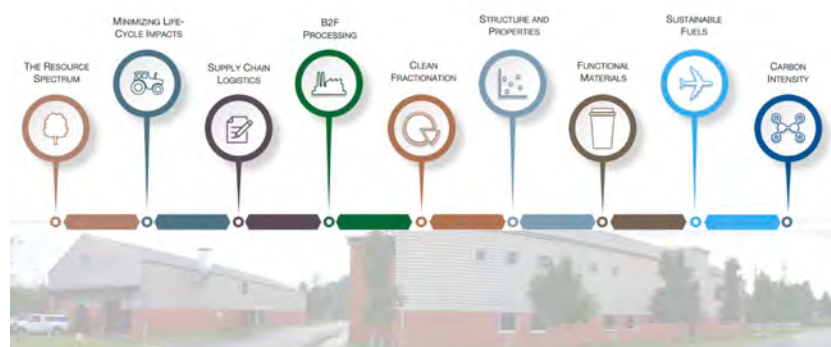


ADVANCING A BIOECONOMY

CENTER FOR RENEWABLE CARBON

Our world is carbon based. The mission of the UT Center for Renewable Carbon (CRC) is to create and disseminate the science and new technologies that enable the sustainable use of carbon from biomass for materials, chemicals, fuels, and energy. Scientists within the Center are internationally recognized leaders in the development of new or improved bioenergy sources, biorefinery processes, bioproducts, and biomaterials.

They help coordinate the science and knowledge transfer needed to develop a bio-based economy. This includes identifying sustainable source feedstock, supply chain logistics, the structure and chemistry of manufacturing inputs, as well as valuable uses for manufacturing products and co-products.



The ten members of the Center's faculty carry appointments across the Department of Forestry, Wildlife and Fisheries and the Department of Biosystems Engineering and Soil Science. They collaborate with colleagues in other departments, including the Department of Agricultural and Resource Economics, and with numerous outside agencies such as the Oak Ridge National Laboratory and the National Renewable Energy Laboratory, as well as industry. The faculty are also training the workforce required for advanced technology industries to develop a sustainable and economically viable bioeconomy. Finally, they advise community stakeholders and industry leaders who are building the new bioeconomy.

TWO CRC PROPOSALS FUNDED BY SOUTHEAST REGIONAL SUN GRANT CENTER

Through an innovative partnership with the USDA's National Institute of Food and Agriculture, the nation's Sun Grant Centers will invest almost \$2 million to support new science and engineering projects vital to creating sustainable market alternatives to value-added products from finite resources. In March 2021, the Southeast Regional Sun Grant Center at UT announced six recipients of the 2020 regional competitive grants, and two are Center for Renewable Carbon (CRC) projects:

- Lignin-based quantum dot composites for biomedical applications, David Harper, professor of forestry, wildlife and fisheries, principal investigator
- Lignin-based polyester vitrimers, Arthur Ragauskas, Governor's Chair, Biorefining, and professor of chemical and biomolecular engineering with a complementary appointment in UTIA's Department of Forestry, Wildlife and Fisheries and Mi Li, assistant professor of forestry, wildlife and fisheries are co-principal investigators. Ragauskas also serves in the US Energy and Environmental Sciences Directorate at the Biosciences Division at Oak Ridge National Laboratory.

A panel of scientists from around the country selected these projects from among seventy-three preproposals. The projects will provide new insights to advance the sustainable bioeconomy of the southeastern United States. These projects promise to have a lasting impact by introducing sustainably derived, uniquely functional materials to several unconventional markets. At the same time, research will provide guidance into future products to expand the region's bioeconomy and provide a roadmap for continued economic growth.



HIGHLIGHTS FROM THE ACADEMIC DEPARTMENTS

Faculty within the academic departments that serve the UT Institute of Agriculture often have joint appointments that span across two or more of the Institute's major units: the Herbert College of Agriculture, the College of Veterinary Medicine, UT AgResearch, and UT Extension. Listed in the following section are descriptions of the eight academic departments with AgResearch faculty as well as a few notable efforts of our many outstanding scientists.

Agricultural and Resource Economics

Researchers within the Department of Agricultural and Resource Economics serve a diverse array of information needs across the state, nation, and globe. In Tennessee alone agriculture in 2021 generated \$79.3 billion in output and accounted for nearly 339,400 jobs. Analyses of the economic impacts of resources can include the size and value of forestry industries; tourism, including subsets like hunting, fishing, or recreational boating; access to broadband or technical infrastructure; and many other types of inputs that impact state, regional, national, and even global economies.

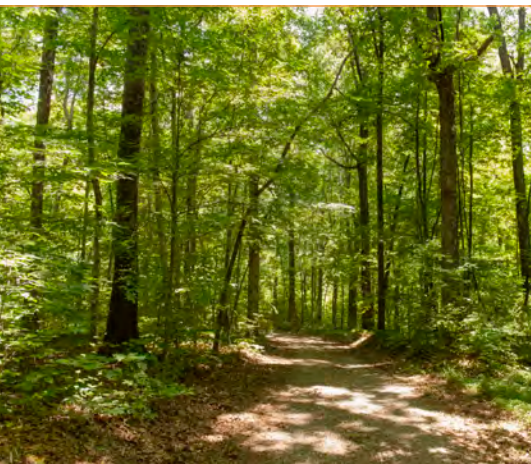
From providing information and guidance for producers making production and management decisions to providing policymakers with science-based research to guide policy design and implementation, faculty work to support our food, fiber, and energy systems while protecting the environment and enhancing our health and welfare.

RESEARCH HIGHLIGHTS

A Brilliant Past and Bright Future

Two members of the Department of Agricultural and Resource Economics received prominent recognition from the Southern Agricultural Economics Association (SAEA). Burton C. English, an internationally recognized pioneer in the field of bioenergy economics, received the 2021 Lifetime Achievement Award for his significant and enduring contributions to the agricultural economics profession. Karen DeLong, associate professor, received the association's Emerging Scholar Award. Her research focuses on livestock economics, agricultural policy, international trade, and experimental economics. She is participating in a multi-institutional project examining consumer preferences for US beef and estimating beef import demand in select countries within Asia, Europe, and Latin America. Project results will provide insights regarding economic implications of changes in trade policies and provide information on how the US beef export market can be strengthened.

Sreedhar Upendram, assistant professor, received the 2021 Bonnie Teater Community Development Early Career Achievement Award from the Southern Rural Development Center. Upendram developed an ability-to-pay index that enabled unprecedented sharing of data and resources across federal and state agencies. The US Environmental Protection Agency recognized the index as a novel model for identifying and assessing disadvantaged communities, a priority under the Biden Administration. His work focuses on identifying and strategically assisting the state's most distressed rural communities with their most urgent needs, including rural water infrastructure, broadband access, and digital literacy. Since 2017 Upendram and his collaborators have received more than \$8.6 million in grant funding to support these efforts.



EMERGING MARKET FOR TENNESSEE HARDWOODS COULD TAKE ROOT

UTIA is teaming up with the Tennessee Department of Agriculture on a grant designed to increase the state's hardwood exports to Vietnam. Andrew Muhammad, professor and Blasingame Chair of Excellence in Agricultural Policy, will conduct a detailed market assessment and provide trade insights and guidance as it pertains to this emerging market. Tennessee is one of the top three hardwood lumber-producing states in the US. Exports have accounted for roughly 60 percent of the state's hardwood production, mostly to one market—China. However, a trade war has resulted in a decrease of more than \$100 million in global sales for Tennessee suppliers. As Vietnam is emerging as a major exporter of finished wood products such as furniture and flooring and is already an important market for Tennessee forest products, this effort should build upon and strengthen this market and provide an opportunity for the state to capture increased market share in Vietnam. Funded by USDA's Foreign Agricultural Service, the grant will also enable on-site trade missions to provide opportunities to better understand the needs, logistics, and requirements necessary to anchor the supply chain.



RESEARCH TARGETS FOOD LOSS AND WASTE REDUCTION

Forty percent of food produced in the US is estimated to be lost or wasted, while approximately one in eight households experiences food insecurity. The COVID-19 pandemic has exacerbated the situation, creating uncertainty at the retail level of the food supply chain, potentially altering food shopping and inventory management practices. In 2021, economists with the Department of Agricultural and Resource Economics received a \$423,316 USDA National Institute of Food and Agriculture grant to study food loss and waste reduction at the consumer-grocery retailer interface. Study results regarding consumer and retailer attitudes toward food loss and waste reduction programs could aid in future programming design. "This study will provide a results-driven set of recommendations for future voluntary food loss and waste reduction programs," said lead researcher Kimberly Jensen. "Findings will provide estimates of how food loss and waste information shape consumers' choices in products, stores, and at-home practices."

The Tennessee Grocers and Convenience Store Association has agreed to participate in a key survey that gauges current practices of the food industry to mitigate food loss. Researchers will also use this information to identify opportunities to help Tennessee's food industry reach food loss reduction goals. Food loss and waste also create significant environmental impacts and comprise the single largest component of landfill waste.

In addition to Jensen, the multidisciplinary research team includes Karen DeLong, T. Edward Yu, and Jackie Yenerall from the Department of Agricultural and Resource Economics and C. Rita Chen and Curtis Luckett from the Department of Food Science.



IMPROVING CROP INSURANCE PROVISIONS

Producers strategically time planting their crops within certain dates, sometimes referred to as the "planting window." This can be a stressful time, as research has shown that planting too early or too late can result in diminished yields and reduced profitability. Unfortunately, unfavorable weather sometimes prevents planting during this optimal window. Further, producers typically have large expenses prior to planting, such as fertilizer costs. The prevented planting provision with federal crop insurance reimburses producers for their financial losses due to inability to plant the intended crop.

A new \$498,000 effort led by associate professor Chris Boyer, who is teaming with UT Extension specialist Aaron Smith and researchers with Mississippi State University, is exploring potential improvements to the prevented planting provision. Results from the study will offer policymakers information that can improve the actuarial performance of the provision while still providing producers with a powerful risk management tool. "The long-term goal of this project is to look at potential changes to prevented planting that might result in better utilization of US land resources and to ensure producers can still have protection against losses due to prevented planting," says Boyer. A large component of this grant includes using the knowledge gained to improve risk management educational programs for southeastern producers.

Agricultural Leadership, Education and Communications

The Department of Agricultural Leadership, Education and Communications (ALEC) serves the state, nation, and global community through research, extension, and teaching efforts. Its work helps leaders and communities and develops educators and communicators to meet the grand challenges society faces in the fields of food, agriculture, natural resources, and human sciences. The faculty work to establish strategic partnerships with educational systems, communities, and industries to develop innovative outreach and Extension programs that deliver Real. Life. Solutions.

RESEARCH HIGHLIGHTS

The department is home to the state's education program for future teachers of postsecondary school agricultural education programs as well as several curriculum development efforts associated with Tennessee 4-H and National 4-H Youth Development programs.



ALEC WINS NATIONAL ASSOCIATION OF AGRICULTURAL EDUCATORS AWARD FOR OUTSTANDING POSTSECONDARY EDUCATION

The Department of Agricultural Leadership, Education and Communications (ALEC) received the 2021 National Association of Agricultural Educators Outstanding Postsecondary Agriculture Program during the 2021 NAAE Convention. The award is presented to postsecondary programs that emphasize lasting teaching methods, enhance student motivation, and exemplify great experiential learning.

ALEC partners with the UT Knoxville College of Education, Health and Human Sciences, and through ALEC students may earn a Bachelor of Science with a concentration in agriculture education. The UT Knoxville teacher preparation program provides career-focused learning experiences in secondary classrooms, and ALEC emphasizes experiences that prepare candidates to

teach the nation's youth about one of the pillars of the national economy—agriculture. Leadership development is infused into every facet of the experience and is a key component of the ALEC academic program. Teacher candidates' successes include organization and club officers in groups such as Collegiate 4-H and FFA (Future Farmers of America), Sigma Alpha, Young Farmers and Ranchers, Student Government, National 4-H, and National FFA.

Smith International Center

The UTIA Smith Center for International Sustainable Agriculture provides leadership, vision, and opportunities for globalizing the Institute's research and outreach. The goal is to help UTIA faculty integrate cutting-edge scientific research and technology and expertise in community outreach as well as student engagement to solve the food needs of the world's growing population through sustainable methods. The Smith International Center was established through a generous endowed gift from the Donald and Terry Smith Foundation, and faculty work across the institute's four units (Herbert College of Agriculture, College of Veterinary Medicine, UT AgResearch, and UT Extension) to establish partnerships around the world.



A BETTER WAY TO RAISE CHICKENS FOR LOW-INTENSITY, SMALL STAKEHOLDERS

How can rural producers in Rwanda better produce chicken for both household consumption and profit? Researchers with the UTIA Smith Center for International Sustainable Agriculture suggested a hybrid model for the Rwandan broiler industry, among other improvements, in an article in World's Poultry Science Journal. Through a four-year pilot project, researchers partnered with a Rwandan feedmill, Zamura Feeds Ltd., to test a poultry production model with smallholders. Through this project, the US and Rwandan teams examined the broiler supply chain and identified ways to improve the broiler industry in Rwanda.

"Smallholders in Rwanda make up over 80 percent of farmers and cultivate less than 2.2 acres of land on average. Many farmers already raise chickens in traditional backyard settings, primarily for home consumption," said Hans Goertz, the project administrator and co-author of the article. "In a densely populated, mountainous country such as Rwanda, intensifying poultry production presents an avenue for households to diversify and improve their income and nutrition."

Animal Science

The Department of Animal Science engages in four key areas of research: animal health and well-being, genetics and genomics, nutrition physiology, and reproductive physiology. It serves Tennessee and regional producers and the internationally competitive animal agriculture industry by developing and transferring new knowledge regarding the production of animal commodities. The department's efforts make significant contributions to the economy of Tennessee and the world. Research also has implications for the health and well-being of the global human population and its increasing demand for readily available and affordable animal-based protein.

RESEARCH HIGHLIGHTS

Animal Health and Well-being

Animal health and well-being are crucial building blocks for successful farm operations and a safe, high-quality, and abundant food supply. Research within the department focuses on beef and dairy cattle, sheep and goats, horses, and poultry. Disease prevention is a main focus, including strategies that analyze animal behavior or farm management impacts. Other research focuses on virulence factors of disease-causing pathogens, treatment, and intervention; and work can involve understanding immune function and biological responses to disease as well as developing vaccines.

Genetics and Genomics

The UTIA Genomics Center for the Advancement of Agriculture is committed to the advancement of agriculture by developing new strategies for improvement of productivity and sustainability of food production systems, particularly beef production. The Center is taking a holistic approach including strategies to improve genetics, animal health, reproduction, structural soundness, disease and pest resistance, heat tolerance, nutrition, and understanding consumer sciences among others.

Understanding the complex interrelationships between genes, gene functions, and how an organism's genome is capable of responding to the environment is the essence of the work, which is inherently data dense. New computational equipment to support high throughput, intensive data analysis is

SOLUTIONS FOR IMPROVED CATTLE PRODUCTION

Scientists in the Rumen Microbes Lab managed by associate professor Phillip Myer are endeavoring to understand how the gut biome in beef cattle, including ruminal protozoal populations, affects feed efficiency and the associated implications for animal nutrition as well as health and well-being. Ruminants possess a unique rumen microbiome that contributes to the successful conversion of low quality feedstuffs to high-quality protein, and it has also been linked to feed efficiency, methane production, and other critical production traits. What's more, the genetics of the individual animal can influence its future growth and reproductive success. A recent study published in Animals by Myer and collaborators in his lab and industry showed that the ciliated protozoal community diversity differed between low- and high-feed efficient steers. Greater abundances of unidentified protozoa genera were detected in the low-feed efficient steers. These data suggest that unidentified protozoa and ciliated protozoal community diversity influence feed efficiency in beef steers.

Heat stress is detrimental to food-producing animals. It impairs their physiology at the cellular level, and despite producers' best efforts to maintain animals at optimal temperatures, productivity remains suboptimal, especially during warmer months. An increase of frequency and intensity of heatwaves caused by global climate change would exacerbate the problem.

*Associate professor Augustin Rius and his research team have determined the cattle experiencing heat-induced systemic inflammation may be helped in part by nutritional as well as therapeutic interventions by reducing the accumulation of oxidants in the animals' intestine (Antibiotics 2021). In a separate study published in Scientific Reports, Rius and colleagues found evidence that supplementing the feed of lactating dairy cows with a postbiotic from the fungus *Aspergillus oryzae* (which is used in fermentation) enhanced the animals' thermal tolerance likely through a mechanism that entails reduced inflammation.*



EQUINE MANAGEMENT AND CARE

Department of Animal Science faculty collaborated with colleagues in the Department of Large Animal Clinical Sciences in the College of Veterinary Medicine to study clinical factors associated with the survival of starved horses. Each year in the United States, unwanted horses may become neglected, starved, or abandoned. Many die despite our best efforts. Recovery therapies include refeeding and veterinary care, and they often require substantial time and financial investments. To better understand the likelihood for starved horses to survive the first 100 days after initial evaluation, a retrospective case series was performed using hospital records of starved horses brought to the College of Veterinary Medicine for treatment and rehabilitation. Published in the Journal of Equine Veterinary Science, Liesel Schneider, Ashley Cox Self, Melissa T. Hines, and Jennie Lin-Zambito Ivey learned that a body condition score is a better indicator of survival than body weight. Also, white blood cell count is lower in horses that survived more than 100 days of refeeding.

now available to all UTIA students, staff, and faculty through the Genomics Center, which is directed by professor Jon Beever. Two new Linux servers with data storage are online and ready for use, and a new Windows server with a CLC Genomics license is available through the UTIA Genomics Hub. This equipment is suitable for multi-terabyte genomics, proteomics, metabolomics, and phenomics projects, including tasks such as genome assembly, read/spectra mapping, variant calling, association analysis, image processing, machine learning/deep learning, and more.

Nutrition Physiology

Research in nutritional physiology focuses on nutritional strategies that benefit animal production. Genomics, biochemistry, and molecular biology are integrated with whole animal physiology and on-farm studies to address a range of questions using modern, interdisciplinary approaches. Challenges currently addressed by this research group include:

- Optimizing diet to enhance growth and efficiency
- Enhancing animal health and well-being
- Integrating grazing management and nutrient supplementation with forage availability and quality
- Reducing the environmental impacts of animal production systems
- Elucidating molecular pathways that control cellular growth and development

Reproductive Physiology

Sustainability of farm animal production is directly dependent on animals producing live offspring in an efficient manner. Infertility and reproductive inefficiency carry significant economic consequences to all domestic livestock industries. Therefore gaining an understanding of factors contributing to infertility is of critical importance to maximize reproductive efficiency of domestic livestock species.

Faculty within this group research ways to improve estrous synchronization and timed insemination outcomes, determine transmission and occurrence of reproductive diseases, unravel some of the mysteries related to fetal-maternal communication, identify the mechanisms of and alleviating environmental and endogenous factors that negatively impact embryonic survival, and improve methods for in vitro embryo production and animal cloning. A multifaceted approach at the whole animal, cellular, and molecular level is engaged.

Biosystems Engineering and Soil Science

The Department of Biosystems Engineering and Soil Science (BESS) brings broad engineering and scientific expertise to issues of critical importance to society through the study of sustainable agriculture, sustainable development, and resource stewardship. Specific topics being addressed by faculty include new tools and techniques to improve the productivity of livestock production systems through precision farming with machines and farming systems for optimized performance; soil and water resource management; impacts of climate change; construction science; and fuels and value-added products from renewable resources.

RESEARCH HIGHLIGHTS

Research projects are divided into these main areas of study:

- Soil conservation and health
- Hydrology and water management
- Waste management
- Bioprocessing and biomass conversion
- Design of microemulsions
- Instrumentation, sensors, and control systems



BESS PRECISION LIVESTOCK FARMING TEAM MEMBERS RECOGNIZED INTERNATIONALLY

UT AgResearch is investing heavily in Precision Livestock Farming (PLF) to enhance production sustainability so Tennessee and US producers in general can remain profitable and competitive in the global market. The Initiative is being coordinated by Department of Biosystems Engineering and Soil Science (BESS) faculty member and distinguished professor Robert Burns, and he, along with other members of the BESS faculty, received some top professional honors in 2021. Burns was recognized with the top honor from the Structures and Environment Division of the American Society for Agricultural and Biosystems Engineers, and the renowned air quality expert was also invited to serve on two important committees that advise the USDA and United Nations on issues related to agricultural production and air quality: the USDA Agricultural Air Quality Task Force and the United Nations Food and Agriculture Organization (FAO) Technical Advisory Group on Methane.

In 2021, assistant professor Hao Gan was awarded the 2020 Giuseppe Pellizzi Prize for his PhD work in the areas of specialty fruit crops and yield mapping. The biennial international prize recognizes the best PhD dissertation on agricultural mechanization. Gan also advised the department's undergraduate team that placed third in a national design competition with a project titled "Solid-State Microwave Control and Data Collection System." And, finally, BESS added Daniel Berckmans, a worldwide leader in the development of precision livestock farming, as an adjunct distinguished professor. He is expected to help chart the direction and growth of the precision livestock farming programs at the UT Institute of Agriculture as well as serve as an active investigator on competitive research proposals and grants.

While these recognitions are notable for each individual researcher, taken in aggregate, it's evident that UT AgResearch is dedicated to improving and serving the state's valuable livestock and poultry industries.





BESS PAPERS AMONG EDITORS' TOP SUBMISSIONS FOR 2021

Two papers submitted by separate Department of Biosystems Engineering and Soil Science (BESS) research groups garnered the attention of the terrestrial microbiology section editors for the journal *Frontiers in Microbiology*. The editors highlight them as among the published works that demonstrate the broad diversity of research terrestrial microbiology research being performed. "All research presented displays strong advances in theory, experiment, and methodology with applications to compelling problems," they write.

The first paper, "Soil microbial communities associated with biodegradable plastic mulch films," by Sreejata Bandopadhyay, José E. Lique y González, Kelsey B. Henderson, Marife B. Anunciado, Douglas G. Hayes, and Jennifer M. DeBruyn, helps lay the groundwork for understanding biodegradation dynamics of biodegradable plastics in the environment. Biodegradable plastic mulch films (BDMs) have emerged as a sustainable alternative to widely used nonbiodegradable polyethylene (PE) films. BDMs are tilled into the soil after use and are expected to biodegrade under field conditions. However, little is known about the microbes involved in biodegradation and the relationships between microbes and plastics in soils. The research studied agriculturally weathered plastics from two locations alongside laboratory enrichment experiments to assess differences in the microbial communities associated with BDMs and PE films.

The second paper, "Quorum Sensing Signals Alter *in vitro* Soil Virus Abundance and Bacterial Community Composition," by Xiaolong Liang, Regan E. Wagner, Bingxue Li, Ning Zhang, and Mark Radosevich, explores the specific action of eight different individual quorum sensing (QS) signals on prophage induction in soil microbial communities. In biology QS is the ability to detect and respond to cell population density by gene regulation. That is, QS enables bacteria to restrict the expression of specific genes to areas of high density, thus enabling the expression of specific phenotypes where they would be most beneficial to the community. This explains many coordinated behaviors among bacteria. Prophages are pieces of virus genomes in a host cell's DNA. In their paper, the authors report QS autoinducers triggered virus replication in soil bacteria. The response was significant enough to alter the soil bacterial community's composition *in vitro*. The findings have implications for the role of phage-host interactions in ecologically significant processes including photosynthesis or the development of antibiotic resistance.

Entomology and Plant Pathology

The Department of Entomology and Plant Pathology provides leadership in the generation and dissemination of knowledge on insects, related arthropods, and plant and animal diseases that affect the quality of life of all Tennesseans. The department is the only academic unit in Tennessee with the mission and responsibility to provide basic and applied information on questions of plant diseases and insect related problems affecting plants, animals, and humans. Departmental programs focus primarily on solving problems within Tennessee, yet draw on information generated worldwide and, in turn, provide information that is useful throughout the world.

RESEARCH HIGHLIGHTS

Faculty within the Department of Entomology and Plant Pathology concentrate the majority of their efforts in these three areas:

Bioinformatics, Genomics, and Molecular Interactions

Bioinformatics, genomics, and molecular interactions encompass the study of the fundamental molecular components that build life and the relevance of their interactions to physiological and pathogenic processes in plants, insects, nematodes, and microbes. This area includes diverse, state-of-the-art research techniques to examine how inherited information and basic molecular building blocks yield organismal phenotypes, behaviors, adaptations, and evolution.

Organismal Biology, Ecology, and Systematics

Organismal biology, ecology, and systematics encompasses the study of the plant and animal life histories, including interactions within communities and with the environment. Topics include biology and ecology of plant associated insects, nematodes, and microbes; plant, human, and animal disease vectors; arthropods associated with humans and their structures; host-pathogen, host-parasite, and host-parasitoid interactions; plant, insect, and nematode microbial symbioses; pollinator biology and ecology; and forensic entomology.

\$1 MILLION SEED FUNDING SECURED TO ADVANCE ENHANCED BIOLOGICAL INSECT CONTROL ISSUES

A UT Institute of Agriculture laboratory has helped develop biological insect control technology attracting \$1 million in seed funding. A team from the Department of Entomology and Plant Pathology led by professor Juan Luis Jurat-Fuentes and including Heba Abdelgaffar and Jason Burris worked collaboratively with Impetus Ag, a research and development firm based in St. Louis, Missouri, to advance the initial concept to practice.

Sustainable Disease and Integrated Pest Management Systems

Sustainable disease and integrated pest management (SDIPM) systems provide economic means to reduce pest and disease losses while minimizing negative impacts on the environment. SDIPM systems provide the solutions to positively impact food production and meet the increased global demand. They also improve plant and animal health in forests, parks, landscapes, and other natural systems. These systems incorporate many disciplines, including entomology, nematology, plant pathology, weed science, animal science, veterinary medicine, public health, and food science and technology.



JULIAN COSNER SELECTED AS SEC EMERGING SCHOLAR

Julian Cosner, a PhD student in the Department of Entomology and Plant Pathology, was selected as a 2021 SEC Emerging Scholars Program participant for his research on hemp production.

The program, established in 2021, provides professional development and networking opportunities to current doctoral and postdoctoral students, selecting ten students throughout the entire Southeastern Conference.

Cosner's research focuses on the emerging hemp industry in Tennessee. Since hemp was legalized in 2018, little research has been done on the production. Through Integrated Pest Management, the goal of Cosner's research is to not only provide technical assistance to growers but also to increase the economic viability of the crop, especially in Tennessee.

"It can be difficult for farmers to make a living. There is enormous pressure to generate enough production to be profitable," Cosner explained. "Farmers are also facing the added challenge of losing about 35 percent of their crops, and potential revenue, to pests and diseases. If my research can reduce that loss for hemp growers, it can have a huge financial impact."

Cosner hopes his research will help position the University of Tennessee as the authority for the emerging agricultural market.

"It's important for growers to know that UT is doing this research and that we are poised to be the hub of information for a growing hemp industry," said Cosner. "Hemp could be a significant source of revenue in Tennessee in the future, and UT can play an important role in helping growers become profitable."

Food Science

As Tennessee's only academic program devoted to research and teaching related to foods, the Department of Food Science offers a strong mix of theoretical knowledge and hands-on experiences to students and facilities that allow faculty to further our understanding of a basic necessity shared by all of society. Working closely with industry stakeholders, faculty transfer knowledge and science-based best practices to students, the food and beverage industry, government agencies, and entrepreneurs to help provide safe, nutritious, and high-quality foods to the state and to a global society.

RESEARCH HIGHLIGHTS

Faculty within the Department of Food Science concentrate the majority of their efforts in these four areas:

Food Chemistry, Quality, and Wellness

Some of the current research topics include bioactive compounds from soybean and sorghum, flavor and biological active products from foods and other natural resources, lipid innovation, smart coating, carbohydrates with novel functionalities, structures, and functions of food ingredients.

Food Safety, Security, and Biotechnology

Several faculty members focus their efforts on understanding and preventing bacterial, viral, and parasitic food-borne pathogens.

Food Processing and Engineering

Departmental research in food engineering centers on hygienic design of processing equipment and novel food processes.

Food Sensory and Consumer Science

Understanding the dynamic interaction between a person's senses and how this relates to the perception of foods is critical to the consumer experience. Department researchers seek to identify molecular components of foods that give each its characteristic flavor. This work can also involve analyzing the language people use to describe foods.



TRAINING TOMORROW'S FOOD SCIENTISTS AND ENGINEERS

Faculty within the Department of Food Science participate in the USDA-funded Research and Extension Experience for Undergraduates (REEU) summer program. The goal of the program is to advance experiential learning of food science for engineering or chemistry students to meet processing innovation demands in the food industry. The program is designed to increase students' knowledge of the food science discipline; develop their interest in pursuing graduate education or future careers in food processing and engineering; help them understand the land-grant university mission; enhance their skills necessary for future success in the food industry; and provide post-program advising and networking to sustain our mentoring relationship. The eight-week program admits a maximum of eight students per year. It includes a stipend and housing, emphasizes research, but also includes Extension training opportunities. Co-directed by Jiajia Chen, assistant professor of food engineering, and Vermont Dia, associate professor of food chemistry, the program exposes students to projects and mentors involving chemical, agriculture, and food engineering as well as bioactives, lipids, biopolymers, flavor, and more.



NSF STUDY SEEKS TO UNDERSTAND AND PREVENT ICE RECRYSTALLIZATION

Ice recrystallization affects the quality and functional properties of anything stored in a freezer for an extended period. In 2021 scientists with the Department of Food Science were awarded \$550,000 from the National Science Foundation to understand ice recrystallization and to study how to restrict the growth of ice crystals caused by fluctuations in freezing temperatures. Professor Tong (Toni) Wang and associate professor Vermont Dia say successful methods of ice recrystallization inhibition (IRI) should improve the quality of frozen foods. Wang says, "IRI also has the potential to increase the resistance of crops and other plants to freezing temperatures, improve the cold storage of cells and tissues and other items needed to advance biomedical research, and even improve the properties and functionality of materials like de-icers for aircrafts or roads." The researchers' work represents new avenues of funding being pursued by UT AgResearch scientists, beyond traditional grants provided through the USDA.

Forestry, Wildlife and Fisheries

As Tennessee's flagship natural resource program, researchers address the environmental needs of the state, region, and beyond. The Department of Forestry, Wildlife and Fisheries' mission is to advance the science and sustainable management of natural resources and to promote their health, utilization, and appreciation through programs in teaching, research, and Extension. Faculty and researchers are tackling diverse issues, such as evaluating zoonotic disease crossovers, restoring endangered species populations, creating cost assessments for biomass, and more.

RESEARCH HIGHLIGHTS

Faculty within the Department of Forestry, Wildlife and Fisheries concentrate the majority of their efforts in these five areas:

Fisheries

Studying aquatic life in Tennessee's waterways and beyond, researchers are making strides in finding solutions to pollution, fish populations, and degrading ecosystems. Some of the studies include "Antimicrobial Advantages of Paternal Care in Madtom Catfishes" and "Introduction and Monitoring of Native Fish and Mussel Species to the Pigeon River."

Forestry

Researching forestry across the state and Kentucky, current studies focus on visitor impact on forests in the Tennessee Valley Authority reservoirs and how mining has affected forests in the Appalachian Valley, among others. There are also several studies ongoing on family-owned forests, their economic impact, the social impact, and the way they evolve through generations.

Urban Forestry

Focusing on Tennessee's Champion Tree Summer Internship, the collaborative project with the Tennessee Division of Forestry and the Department of Forestry, Wildlife and Fisheries, inventories champion trees across the state and updates them in the database.



Researchers from the Department of Forestry, Wildlife and Fisheries started a five-year study with nine universities to study amphibian resilience to infectious disease. The \$12.5 million study is funded by the National Science Foundation.

The study, called Resilience Institute Bridging Biological Training and Research (RBBiTR), is focused on understanding resilience to a key global threat that has the potential to affect all life: emerging infectious diseases.

Mark Wilber, assistant professor in the Department of Forestry, Wildlife and Fisheries, will lead a research team that will act as one of the mathematical modeling hubs for the project—nearly a \$300,000 effort. The UT Institute of Agriculture team will work closely with the other institutions to integrate field work and lab experiments from across North, Central, and South America into empirically informed models of amphibian disease dynamics at the individual-, population-, and community-levels.

Wildlife

With more than twenty ongoing projects, researchers are studying a wide range of topics, including the genetic structure of elk after translocation, native grass establishment, the Cumberland habitat conservation, and much more. Many of the studies center around the Great Smoky Mountains National Park and other nearby conservation areas.

Wood Science

While scientists research entire forests, they also study the individual trees that make them. Currently, researchers are investigating fumigants for log exports, treated wood and lumber, and even the interactions with wildlife like skunks and bats.



Researchers with the Department of Forestry, Wildlife and Fisheries were awarded \$500,000 from the USDA National Institute of Food and Agriculture to improve productivity, resiliency, and overall health of eastern grasslands. Led by Pat Keyser, professor and director of the Center for Native Grasslands, researchers will study multiple types of grasses commonly used for grazing cattle to determine the best food source. In particular, the researchers will evaluate productivity, profitability, sustainability, animal health, and ecosystem health.

Over the three-year grant period, the researchers hypothesize that the novel grazing systems will improve beef production, soil and water quality, and overall process sustainability.

In 2021, Keyser authored *Native Grass Forages for the Eastern U.S.* In the book, Keyser shares decades of experience combined with the latest, science-based information on native grasses, geared toward farmers, technical advisors, scientists, and conservationists. He includes more than 350 references and more than 200 graphs, charts, and tables. His extensive research and experience in this area have made him the leading expert on their use in the eastern United States.

Plant Sciences

The Department of Plant Sciences is dedicated to research, teaching, and outreach. Research by scientists in the department ranges from row crop production and sustainability to ornamental horticulture and turf grass. Over the course of 2021, plant sciences released 438 publications and enrolled 188 students.

RESEARCH HIGHLIGHTS

Faculty within the Department of Plant Sciences concentrate the majority of their efforts in these three areas:

Crop Production and Sustainability

As well as teaching through the Herbert College of Agriculture, researchers across ten AgResearch and Education Centers conduct hundreds of experiments every year to help producers across the country grow their product. Research presented by these scientists is known in the industry as unbiased and credible findings.

Public Horticulture and Production—Ornamentals and Turfgrass

Ornamental and turfgrass research performed by scientists here helps to determine which consumer-ready plants are grown and sold in Tennessee and across the Southeast. Trials are carried out across the state at UT Gardens locations in Knoxville, Crossville, and Jackson.

Plant Genetics and Biotechnology—Breeding and Biotech, Epigenetics

The experts in plant sciences focus on current initiatives while looking to the future. Through their research, better plants are made to protect against diseases and insects and grow a higher quality product.



SLOW AND STEADY WILTING MAKES FOR BETTER BEANS . . . SOYBEANS THAT IS

In 2021, researchers concluded a four-year study on drought-tolerant soybeans. The soybean varieties were tested under irrigated, rainfed, and simulated drought conditions. The team collected soybean water loss, wilting scores, leaf maintenance, and yield data through six different controlled and field experiments. One of their key findings showed a correlation to water needs in young plants versus mature plants: if a soybean used lots of water during vegetative growth, less water would be available in the soil to support reproductive growth and pod filling when the drought stress occurs. The next step in this research is expanding to include a wider range of soybean maturity groups, as well as those that produce oils that are higher in monosaturated fats, known in the industry as high oleic soybean varieties. Soybean genotypes that show slow-wilting traits are being incorporated into breeding efforts to develop and improve drought-tolerant soybean varieties.

Beef and Forage Center



The University of Tennessee Beef and Forage Center facilitates research and educational activities while serving as a focal point and catalyst for research, Extension, and teaching efforts related to issues facing beef and forage systems in Tennessee and beyond. The Center is a collaboration between the Department of Plant Sciences and Department of Animal Science, often including other departments for collaborations. Gary Bates, professor and interim head of the Department of Plant Sciences, oversees the Center.

In 2021, researchers released nine publications and reports on their research in beef cattle. Headlining the research topics was invasive ticks, accounting for three of these studies. This includes the Asian long-horned tick that was first discovered in Tennessee in 2019. Researchers are now collaborating with producers and industry leaders to keep cattle herds safe from the dangerous species.



Other research publications focused on cow reproduction. Researchers are working to increase fertilization, shorten the calving season, and limit diseases during pregnancy.

Also in 2021, researchers published three publications and reports on beef forages. In one of the studies, researchers compared alfalfa mixed with tall fescue or bermudagrass. The team determined alfalfa grown alone had more weeds than when it was mixed with other grasses.

A different study looked at using browntop millet to aid native grass establishment. Researchers grew browntop millet with big bluestem and switchgrass to aid forage production during the seedling year. The research team found browntop millet is a suitable companion crop that helps offset production losses during the establishment of native grasses.

A third study worked to find barriers to forage innovation. By surveying beef cattle producers and agricultural professionals, researchers learned both populations had limited knowledge regarding native warm-season grasses. Researchers concluded more Extension education is needed to tell producers and other professionals about the grasses.

A photograph of two men walking away from the camera down a dirt path in a forest. The man on the left is wearing an orange short-sleeved shirt and blue jeans. The man on the right is wearing a grey short-sleeved shirt, dark pants, and a brown cowboy hat, and is pointing his right index finger towards the trees. The forest is dense with green foliage and tall trees.

HIGHLIGHTS FROM THE A_GRESEARCH AND EDUCATION CENTERS

UT AgResearch operates a statewide system of ten AgResearch and Education Centers for the benefit of the residents of Tennessee and beyond. Each Center serves as a working farm allowing scientists to test their theories regarding agricultural and forest production and natural resources management. The Centers even contribute to broader studies that might include monitoring the state of our environment, climate studies, and issues involving the global One Health initiative.



Ames

The Ames AgResearch and Education Center is located on 18,400 acres in Fayette and Hardeman Counties in Southwest Tennessee. The land is privately owned by the Successor Trustees of the Hobart Ames Foundation and operates for the benefit of the University of Tennessee. Other universities currently conducting research at Ames include Rhodes College and the University of Memphis.

Ames is known for agronomy, beef cattle, forestry, wildlife, entomology, history, and archaeology. Each spring the Center hosts the National Championship for Field Training Bird Dogs, inviting hundreds, even thousands, of people to its campus.

A research project studying the breeding techniques of cattle is entering its second year. Justin Rhinehart, professor and Extension specialist, and Courtne Carter Bridges, graduate student, are looking into the timeline for breeding cows through AI and how the possibility of having bulls return thirty days later may impact fertility rates. The end results of their work will primarily help commercial purebred breeders to increase conception rates of high dollar cows to maximize utilization of herd cows.

Research of chronic wasting disease (CWD) is continuing at Ames. Allan Houston, a faculty research professor, is participating in a pilot study for a potential National Science Foundation grant to study the disease. Houston is also working on other collaborations including collecting CWD samples with Mississippi State University and training dogs to detect CWD with Colorado State University. West Tennessee continues to be affected by CWD, as Fayette and Hardeman Counties have the highest positivity rates in the state, at 13.7 percent and 9.2 percent respectively.

The Center continued its socially distant field trials and the National Championship for Field Trials bird dogs in January and February of 2021, and again in December. All social events were cancelled.

In July 2021, Ames hired Jodi Letham as assistant center director. Letham is the first woman to join the system of statewide AgResearch and Education Centers as a member of its leadership team. She previously served as an Extension specialist for the Northwest New York Dairy Livestock and Field Crops Team at Cornell University.





East Tennessee

Established on land purchased in 1869, the East Tennessee AgResearch and Education Center includes 1,968 acres in Knox and Blount Counties. The Center is known for supporting research in the areas of turfgrass management; corn, soybean, and wheat genetics; organic vegetable production; fruit and vegetable crop management in high tunnels; community (VOLunteer)-supported agriculture; plant diseases; weed science and management; genetics, nutrition, and reproductive management in beef and dairy cattle; row crop and forage variety testing; amphibian diseases; native warm-season grasses; bacterial pathogenesis and antimicrobial resistance in poultry; pollinator habitat and behavior; agro-forestry; and much more.

The Center also provides convenient access for students in the Herbert College of Agriculture and the College of Veterinary Medicine who need resources (land, crops, livestock, etc.) and framework for field studies and exercises.

MAJOR EFFORTS

- Cutting-edge studies of new chemistries and technologies to maintain control of major agronomic weeds like Palmer amaranth and horseweed.
- Vital efforts to identify effective standards and practices for monitoring and reducing pathogens in global wildlife trade, with specific implications for the US amphibian pet trade industry. The geographic risk assessment of *Batrachochytrium salamandrivorans* (Bsal) will be used to identify surveillance sites and response strategies.
- Annual soybean F1 hybrid crosses help scientists identify valuable combinations of agronomic, seed quality, and disease-resistance traits. As of this year, more than 200,000 acres have been planted with UT-bred soybeans, bringing in over \$151 million in revenue.
- A new three-year, multi-state study on forage systems compares two forage systems on the productivity of spring-calving beef cattle. While research has demonstrated that native warm-season perennial grasses can profitably produce high rates of gain on growing classes (steers, heifers) of beef and dairy cattle, little data is available on how such grasses affect productivity of cow-calf operations or how they impact an overall forage system at the farm scale.
- Field research is advancing the understanding of how temperature affects behavior of free-living adult tree swallows and is expanding what is known about the life history of a tree swallow breeding population in the South.



LIVE AND LEARN INTERNSHIP PROGRAM

The Live and Learn Internship Program celebrated ten years in 2021. Since 2011, more than fifty University of Tennessee students have completed the two-year program, exchanging 12 hours of work a week at the East Tennessee AgResearch and Education Center for on-site housing. The program provides interns with experiential-learning opportunities to gain a deeper understanding of livestock and crop management/production practices, in addition to providing a close-up look at the many intricacies of agricultural research.

Forest Resources

Headquartered in Oak Ridge, Tennessee, the Forest Resources AgResearch and Education Center is composed of three forest units located in East and Middle Tennessee—Oak Ridge Forest, Cumberland Forest, and Highland Rim Forest. The Center is a field research laboratory located on more than 11,400 acres. It is a regionally recognized leader in developing new technologies applicable to modern forestry and wildlife resources management and environmental stewardship.

ACCOMPLISHMENTS

- The Forest Resources AgResearch and Education Center is continuing the Tennessee Nature Conservancy UT AgResearch Working Woodlands/Carbon Project. This project supports the UT One Health Initiative and UT Sustainability efforts. Teaching and outreach opportunities are also part of the project moving forward. This work is expected to help launch future projects that will support long-term climate change initiatives as well as provide incentives to private forest landowners as they consider the requirements and cost of long-term carbon projects for their own land (i.e., continuous forest inventory, forest management planning, certification, etc.).



- Since the start of 2021, hundreds of black walnut seedlings and northern red oak seedlings were planted at the Oak Ridge Forest and Cumberland Forest. This is part of a research project in partnership with the Department of Entomology and Plant Pathology, Purdue University, and the US Forest Service. The long-term goal is to evaluate the efficacy of entomopathogenic fungi and to protect the trees from thousand cankers disease. Black walnut trees are an economically important deciduous hardwood tree to the forest products industry in Tennessee and throughout the Appalachian region. It is expected that the project will be a launching pad for other statewide and regional climate change initiatives.
- A new switchgrass study will support previous research efforts at the Forest Resources Center and new agronomic planting/species methods moving forward. Unmanned aircraft systems provided by a Virginia Tech partner will also be used in the research for aerial reconnaissance, LIDAR deployment, and mapping.
- Researchers are creating a natural grassland/meadow demonstration project next to the UT Arboretum Auditorium/pollinator research project plot location area. This project will showcase native plants that thrive in natural East Tennessee meadows. The 1-plus acre project planting area was treated in May 2021 with a plastic covering to kill invasive plants and competing fescue. A controlled, prescribed burn will be administered in March 2022 with planting efforts to follow. Students and other volunteer organizations will assist with annual maintenance moving forward. The project is funded by a private donor, who is supplying hundreds of native plants from a local nursery and has agreed to furnish additional plants on an as-needed basis.
- Face-to-face field days have allowed the Center to once again engage with clientele, inviting them to return for interaction and networking. Community outreach efforts allow the researchers to highlight how we provide natural resource management solutions for the people of Tennessee.
- Tennessee Healthy Hardwoods Field Day—April 2021 (fifty-six attendees)
- Woods and Wildlife Field Day—October 2021 (forty-eight attendees)



Highland Rim

The Highland Rim AgResearch and Education Center, established in 1943, includes 615 acres. The Center conducts cow-calf research emphasizing forage utilization and breeding and fire and air-cured dark and burley tobacco breeding, management, and curing.

KENTUCKY/TENNESSEE TOBACCO IMPROVEMENT (KTTI)

This world-renowned program is developing new and improved tobacco varieties with higher disease resistance, better yield and leaf quality, and reduced harm in the final tobacco product. The program has produced several new tobacco varieties in all three types grown in the state of Tennessee. Increased resistance to diseases (i.e., black shank and blue mold) has allowed producers to grow more pounds of higher quality leaf than in the past. In some cases, disease pressure is so high, producers are only able to continue their work due to the varieties released by this program.

It is estimated that 70 percent of the burley grown worldwide is one of these varieties or contains the genetic material of these varieties.

A major goal of the program is to reduce the levels of harmful components found in the cured leaf to have a safer final product. Much work has been done in recent years to achieve this goal. It will be critical as the industry moves forward under stricter regulations that the levels of harmful components continue to decrease.



NEW GARDEN FOR PUBLIC AND EDUCATION USE

Plans are progressing to establish a garden through a partnership with the Tennessee Extension Master Gardeners in Robertson County. One acre of Center property is being set aside to establish the space, which will serve as a working educational garden and a place for the public to visit and enjoy. The garden will consist of sections dedicated to vegetable production, annual and perennial flowers, and plants. Two older grain bins have been donated and will be erected side by side as open-air gondola structures to serve as a focal point and provide a covered area for classes and meetings.

ROW CROP PRODUCTION RESEARCH EFFORTS

- More than 4,200 individual research plots in corn, corn silage, soybeans, wheat, hemp, sesame, and canola
- State variety trials in soybeans and corn (irrigated and non-irrigated)
- Over 950 individual soybean plots in support of professor Vince Pantalone's soybean breeding program
- Wheat and corn breeding trials supporting professor Dennis West
- Partnership with Tennessee State University researchers in canola production trials



Middle Tennessee at Lewisburg

The Middle Tennessee AgResearch and Education Center at Lewisburg was founded in 1929 as a dairy research facility. It is now home to the Tennessee Beef Heifer Development Program and other efforts to improve cattle production.

MAJOR EFFORTS

As of fall 2021, more than 1,030 Tennessee producers have completed the Tennessee Beef Heifer Development Program. This includes the Beef Heifer Development School held every fall. The goal is to learn the best ways to develop replacement heifers, often the most costly component of beef cattle production.

In the program, producers learn to do the following:

- Increase the opportunity for custom replacement heifer development.
- Demonstrate proper replacement heifer development to beef cattle producers in Tennessee.
- Increase the implementation of heifer development practices that will result in optimum reproductive efficiency as mature cows.
- Demonstrate management techniques necessary for replacement heifers to reach target weights and breed successfully.
- Demonstrate methods of evaluating heifers for disposition, performance, and reproductive traits.

Implementation of this program, through the experts at UTIA, will allow for the rapid expansion of Tennessee's beef herd by improving the longevity of the females, decreasing turnover, and providing exponential improvement in genetics.

Middle Tennessee at Spring Hill

The Middle Tennessee AgResearch and Education Center conducts both research and demonstration trials that provide solutions and education to our community, state, and nation's agricultural producers and the many non-agricultural producing members of the public who rely on our industry for a safe and economical food supply, fiber, and more.

The Center maintains a diversity of resources and opportunities for UTIA researchers and educators within a number of departments.

MAJOR EFFORTS

- The Middle Tennessee AgResearch and Education Center is home of the newly established Hickman Precision Agricultural Technology Unit, which provides a new level of research opportunities for both beef and broiler production and welfare. In addition, the Center hosts the Bull Evaluation and Development Program, a long-term UT Extension initiative benefiting our states' beef cattle producers.
- The Center hosts the annual Fruits of the Backyard Field Day, bringing in hundreds of people who learn to grow fruits and vegetables in their own backyard.
- The Center established a new field day, called Beef Cattle and Forage Crops Field Day. It focuses on beef cattle and forages in addition to precision livestock technologies.



The Middle Tennessee AgResearch and Education Center introduced the Hickman Precision Agriculture Technology Unit in July 2021. This program will focus on the following:

- Precision beef cattle production/management programs
- Enhancing feed and forage techniques
- Agronomic variety trials
- Herd sire genetic and performance evaluation
- Fruit management



Milan

The UT AgResearch and Education Center at Milan is located at the heart of row crop production in Tennessee. It continues its research into no-till technologies with more than twenty-five principal investigators conducting research every year.

MAJOR EFFORTS

- For more than ten years, researchers have been studying the effects of broiler litter on no-tillage land and cover crops. With this research, Tennessee farmers will be able to evaluate how carbon sequestered in the soil affects their production.
- Progress is being made on reducing the transpiration rate in soybeans. By inserting a trait into soybeans, producers could save water during drought, maximizing yield in water-limited areas.
- Work is being done to look at various urease inhibitors and placement of nitrogen fertilizers in corn. By evaluating certain urease inhibitors, as well as placement of the fertilizer in the soil, researchers can determine the best method and product to use, saving the producer time and money by eliminating the need for additional fertilizer to compensate for the loss.
- Variable rate irrigation is being utilized to study irrigation timing in relation to physiological stages of corn and soybeans. By evaluating different irrigation timings in regard to growth stage throughout the season, researchers can determine the best time to irrigate to avoid crop stress and over-watering, thereby improving grain quality and yield.
- New soybean varieties developed by UT soybean breeders are being evaluated as part of an agreement with the USDA to process biodiesel and crankcase engine oil from Ellis and TN18-4110 soybean varieties and the effect of high oleic/low linolenic oil, which these two breeding lines possess.
- The Center has developed “the best frog eye leaf spot nursery in the world” and plant pathologists evaluate more than fifty soybean varieties and numerous fungicide treatments for varietal resistance or fungicidal efficacy to frogeye leaf spot and other soybean diseases. These studies provide crucial data for farmers across Tennessee and beyond who are faced with soybean disease issues.

Plateau

The Plateau AgResearch and Education Center, founded in 1943, includes 2,100 acres in three locations and is the site of research in beef, fruits, vegetables, field crops, and swine.

The Center is most noted for studies in beef, squash, muskmelons, watermelons, pumpkins, greens, cabbage, green beans, apples, blueberries, and tomatoes.



BEEF RESEARCH

The study of pre-ovulatory follicle status on oocyte metabolism by Sarah Moorey, an assistant professor in the Department of Animal Science, is entering year two. She and ten students, both graduate and undergraduate, are studying the influence of pre-ovulatory follicle size on the follicular fluid metabolome in lactating beef cows. The research abstract has been chosen as a USDA National Institute of Food and Agriculture Merit Award and will be presented at the Society for the Study of Reproduction 2021 Annual Conference.

Researchers are also studying the impact of beef cow body condition on follicular fluid and serum metabolome. Its research abstract was accepted for presentation in the Society for the Study of Reproduction 2021 Annual Conference.

Records from a ten-year study at the Plateau AgResearch and Education Center were used as a part of an undergraduate Chancellor's Honors Thesis. The data was taken from 2010 to 2020 to study postpartum reproductive phenotypes in beef cows. The research abstract was presented at the University of Tennessee Exhibition of Undergraduate Research and Creative Activity.

As part of a USDA NIFA grant, researchers collected 261 white blood cell and plasma samples from Plateau AgResearch and Education Center replacement heifers at weaning and yearling ages. The



Plateau (*continued*)

proposal is called "Identification of gene expression profiles in peripheral white blood cells predictive of heifer pregnancy success." This work provided research experience to three graduate students and five undergraduate students.

ROSE ROSETTE RESEARCH

Scientists continue research into studying rose rosette virus, which costs Tennessee consumers \$2 million annually. As of 2021, researchers have identified the genetic markers and their location for resistance to rose rosette. Funding was also received to conduct a plant screening trial.

OTHER ACCOMPLISHMENTS

- Received a grant from the Southeast Regional National Reference Garden to expand the conifer collection and repair a storm damaged area.
- Completed construction of new garden restrooms/storage facility.
- UT Gardens received the Gamma Sigma Delta Team Award for 2021.



Northeast Tennessee

Established in 1932, the Northeast Tennessee AgResearch and Education Center is the only UTIA AgResearch Center east of UT's flagship campus. Conveniently located in beautiful Greeneville, Tennessee, the Center offers experienced staff with expertise in plant, animal, and veterinary sciences. The 522-acre station is known for conducting world-class research in tobacco production but has added several other important commodities such as row crops for regional variety testing purposes.

HIGHLIGHTS

In 2021, the Northeast Tennessee AgResearch and Education Center successfully established, maintained, and harvested not only tobacco, but also corn, hemp, and soybean trials for yield, fertility, disease, insect, and plant breeding purposes. This work included a new collaboration with the UT Soybean Breeding Program, which will be testing new soybean genotypes in upper East Tennessee.

The UT College of Veterinary Medicine is jointly developing a new outdoor laboratory at the Center to study infectious diseases in beef cattle. The College of Veterinary Medicine is also researching to determine oral bioavailability of leucine in horses.

The Northeast Tennessee AgResearch and Education Center held two successful field days in 2021: the Northeast Tennessee Beef Expo and the Healthy Hardwood Field Day.

Other studies in 2021 included forestry studies in pine nuttall oak and black cherry; food science work in hemp, loblolly pine trees, mint and rosemary; and consumer horticulture studies in apple tree development, blueberries, caneberries, and strawberries.

PILOT PROGRAM WITH NORTHEAST TENNESSEE AGRESEARCH AND EDUCATION CENTER BRINGS FARM-TO-TABLE BEEF TO UT CAMPUS

High-quality, locally sourced UT Beef is now being served on the University of Tennessee, Knoxville, campus, thanks to the Northeast Tennessee AgResearch and Education Center.

Produced at UT's Northeast Tennessee AgResearch and Education Center in Greeneville and being prepared and served through an agreement with UT Dining Services managed by Aramark, the farm-to-table effort supports sustainable agricultural production by utilizing locally grown beef as a reliable food source while maximizing supply chain resiliency.

The beef cattle in this program are raised primarily on a pasture-based system utilizing forage consisting of cool-season perennials—tall fescue and orchardgrass—interseeded with red and white clover. The sustainable, intense grazing system can support a variety of livestock operations across the state while minimizing environmental impact.

Northeast Tennessee AgResearch and Education Center director Justin McKinney hopes this pilot program will be a model across the state and for other institutions to adopt and provide alternatives for locally sourced, high-quality, humanely produced protein products.



West Tennessee

Known for its research on agronomic crops as well as ornamentals, turfgrasses, and horticultural crops, the West Tennessee AgResearch and Education Center is the oldest AgResearch Center in the UTIA System. Scientists from several departments, USDA Agricultural Research Service researchers, and our capable support staff conduct more than one hundred investigations annually to evaluate new cultivars and develop technologies for more efficient crop production in a safer and aesthetically pleasing environment.

MAJOR EFFORTS

AgResearch faculty at the West Tennessee AgResearch and Education Center, in collaboration with industry partners such as Bayer CropScience and BASF, are evaluating emerging technologies for pest control in row crops. These are genetically modified technologies that can withstand herbicides used to control weeds or better tolerate pest infestations. This research targets the most troublesome pests our farmers face, such as herbicide resistant weeds, soybean cyst nematode, or key insect pests of cotton, and determining the efficacy and value to producers.

Researchers are continuing to conduct variety trials on corn, cotton, soybean, and wheat grown at the West Tennessee AgResearch and Education Center. UTIA experimental varieties and hundreds of experimental, pre-commercial, and commercial varieties from other universities and seed companies are rigorously evaluated to better understand their yield potential and other characteristics such as seed or fiber quality, growth habits, and resistance to plant diseases. The micro-gin, also located on campus, is used to collect data on the fiber quality of cotton. The unbiased reporting from researchers affects producers' bottom line by sometimes thousands of dollars, and the data delivered helps them make decisions.

The ongoing effort to empower the future agriculture workforce, fueled by a multi-year USDA National Institute of Food and Agriculture grant awarded to Heather Kelly and her co-investigators exposes undergraduates to the world of agriculture, research and extension, and the potential careers



The Bicentennial Heritage Festival held in October was a one-time event held at the Center honoring 200 years of rural and agricultural heritage in Madison County and the rest of West Tennessee. Approximately 900 people attended, including program providers, and gave both our rural and urban clientele a better understanding of the UTIA mission and the impacts of agricultural advancements in the last two centuries.

that await them. The goal is to attract a diverse and enterprising group of students for a future in agriculture, either in the private or public sector. This is a critical need as Tennessee and the nation face a shortage of people working in the ever-increasing high-tech world of agriculture.

The UT Gardens, Jackson, team collected data evaluating the characteristics of many vegetable and ornamental plants in cooperation with other UT researchers and private partners (i.e., Proven Winners, All-America Selections, Pan American Seed, Suntory, and others). Results are delivered to a diverse clientele at field days and through social media and webpages. The annual Summer Celebration (held virtually) reached more than 7,300 stakeholders, and “Tuesday Mornings with Jason and Celeste,” on Facebook Live, had well over 50,000 viewing contacts in 2021.



The clearing and reforestation of the Center's pine timber was the culmination of more than thirty years of efforts that included being recognized as a Certified Tree Farm. Not only did this provide the opportunity for research dedicated to forestry, and now reforestation, but it was also used for continuing education of forestry professionals and students, and to inform the public about the value and sustainability of this industry to Tennessee's economy.

Noteworthy Achievements

UT TOBACCO BREEDER ROBERT MILLER CONCLUDES A 40-YEAR CAREER OF GLOBAL IMPACTS

Renowned University of Tennessee tobacco breeder and geneticist Robert Miller retired June 30, 2021. His forty-year career with UT AgResearch was marked by breakthrough achievements and global impacts.

Miller is internationally recognized for his development of disease-resistant burley and dark fire-cured tobacco varieties. The varieties he developed benefitted Tennessee producers and producers well beyond the state's borders. In fact, the varieties are grown throughout the world. Miller's TN 86 was the first tobacco variety of any type to have resistance to tobacco poty-viruses, which caused millions of dollars in losses to tobacco producers each year. Virtually all subsequent virus-resistant varieties of all tobacco types grown throughout the world today derive their resistance from TN 86. Reflective of that variety's impact upon worldwide burley tobacco production, TN 86 is one of only two varieties celebrated in the Chinese Tobacco Hall of Fame. TN 90, the second variety Miller developed, was the first burley variety to have resistance to seven diseases. At one time TN 90 was generally regarded within the tobacco industry as the most widely grown burley variety in the world.

In 1999, UT and the University of Kentucky merged their tobacco breeding programs, with Miller named as principal investigator. The joint program has released eleven burley and nine dark disease-resistant tobacco varieties that are widely grown throughout Kentucky and Tennessee. Based on seed sales, approximately 75 to 85 percent of burley and 25 to 30 percent of dark tobacco crops in the United States utilize varieties that Miller developed. These highly disease resistant varieties have greatly reduced yield losses from black shank and Fusarium wilt, two soil-borne diseases that often caused the loss of entire crops. Many of the varieties developed by Miller also have modified chemistry that significantly decreases harmful compounds in tobacco products.



In recognition of his contributions to tobacco growers and the tobacco industry, Miller has received distinguished honors throughout his career. These include the Philip Morris USA Award for Distinguished Achievement in Tobacco Science; the Burley Tobacco Co-op Leadership Award; the J.W. Massengill Award for Distinguished Service to Agriculture; the UTIA Research Impact Award; the UTIA Epsilon Sigma Phi State Team Award; and the Murray State University Distinguished Service to Agriculture Award.



This year upon Miller's retirement, the Robert and Karen Miller Outstanding Graduate Student Award was established within UT AgResearch. The annual awards will recognize one master's student and one PhD student in the Herbert College of Agriculture and UT AgResearch who have demonstrated valuable contributions to science and engineering, such as a new discovery, publication, or presentation. The awards are intended to assist graduate students in preparing for careers with impacts such as those Miller himself achieved.

DOUG HAYES

A researcher and Institute Professor with the University of Tennessee Institute of Agriculture has been honored by a national professional society and recognized for his contributions. Doug Hayes of the Department of Biosystems Engineering and Soil Science has been named a Fellow by the American Oil Chemists' Society (AOCS).

In addition to his role at UTIA, Hayes also serves as a joint faculty member at Oak Ridge National Laboratory and has served as a guest professor at Wuhan Polytechnic University and Jinan University, both in China. His main areas of study include biocatalysis, biodegradable agricultural plastics, bioseparations, and colloids. Specifically, his research program is centered on developing molecular understanding of chemical and biochemical processes at interfaces, including those involving bioplastics and surfactant-water-oil systems. In 2015 he was named as co-leader of a multi-institution study to determine an effective strategy for disposing of plastic mulches commonly used to grow crops, particularly small fruits and vegetables.

Hayes earned a doctoral degree in chemical engineering from the University of Michigan. He has been a member of the faculty at UTIA since 2004. He has coauthored more than ninety journal articles, twenty-three book chapters and three books. Hayes is also currently the editor-in-chief of the AOCS peer-reviewed *Journal of Surfactants and Detergents*.

Hayes currently serves as a member of the governing board of AOCS and recently presented at the annual meeting and expo on biobased surfactants. He has been a member of AOCS since 1991 and has held various leadership and service roles within the organization. "I am deeply honored to have received this award. I owe a debt of gratitude to AOCS for providing me many opportunities to serve as a leader and several colleagues and current and former students for their impact on my career," said Hayes.



DELANEY FOSTER ELECTED PRESIDENT OF NATIONAL ORGANIZATION

Delaney Foster, a Department of Plant Sciences doctoral student, was elected to the office of president in the Weed Science Society of America Graduate Student Organization in 2021.

Foster is researching herbicide resistance at the West Tennessee AgResearch and Education Center under the direction of professor Larry Steckel. Prior to enrolling in the Herbert College of Agriculture, Foster completed a Bachelor of Science in crop and soil science at Abraham Baldwin Agricultural College in Tifton, Georgia, and a Master of Science in weed science at Texas Tech University in Lubbock, Texas.

The WSSA provides science-based information to the public and policymakers and fosters awareness of weeds and their tremendous impacts on managed and natural ecosystems. The graduate student arm of the organization is concerned with advancing the careers of future weed science professionals.

Foster said it is an honor to serve in this peer-elected position, emphasizing the importance of her research in Tennessee. "Herbicides are especially important in Tennessee, because no-till production is prolific in our state. In this system, the ground is never tilled under, which improves soil health and prevents erosion. Along with cover crops, herbicides serve a vital function controlling weeds."

Internal Faculty and Staff Awards

The University of Tennessee Institute of Agriculture recognized some of its top faculty, staff, researchers, and Extension experts at UTIA's annual awards and promotions luncheon on the UTIA campus in Knoxville, July 30, 2021. The event was conducted in person, a welcome return to normalcy after having an online ceremony because of the pandemic in 2020. The awards honor the extraordinary performance of UTIA employees during a difficult year of online education and changes to procedures because of the pandemic. Many of the awards are gifts made possible by faculty, alumni, and friends of the Institute.

UTIA Senior Vice President and Senior Vice Chancellor Tim Cross hosted the award winners and praised them for their work. "After a challenging and stressful year, it's a pleasure to recognize excellence as exemplified by these award-winning members of the UTIA faculty and staff," Cross said. "Their continuing dedication to our land-grant mission of serving Tennessee ensures that we develop and deliver Real. Life. Solutions. to improve health, grow the economy, and enhance our environment."

Douglas Hayes, professor in the Department of Biosystems Engineering and Soil Science, is the winner of the **Charles E. Wharton Institute Professor Award**. The award is UTIA's highest honor.

The other 2021 winners are:

J.E. Moss Achievement Awards

Blake Brown, UT AgResearch, AgResearch and Education Center at Milan

E.J. Chapman Award

Kristy Keel-Blackmon, Department of Forestry, Wildlife and Fisheries

AgResearch Impact Award

Feng Chen, Department of Plant Sciences

T.J. Whatley Distinguished Young Scientist Award

Phillip Myer, Department of Animal Science

AgResearch Mid-Career Faculty Research Excellence Award

Neelam Poudyal, Department of Forestry, Wildlife and Fisheries

AgResearch Dean's Award for Outstanding Support Staff

Bill Lively, UT AgResearch, East Tennessee AgResearch and Education Center

AgResearch Dean's Award for Outstanding Professional Staff

Susan Schexnayder, Department of Forestry, Wildlife and Fisheries

Robert Trigiano, Institute Professor, Department of Entomology and Plant Pathology, named UT Knoxville Chancellor's Professor (the first in UTIA)

Many faculty and staff also received promotions, tenure, or both. A list of all the 2021 UTIA promotions is available online at tiny.utk.edu/agresearchawards21.

National and International Awards and Honors

Department of Agricultural Leadership, Education and Communications

Chris Stripling/Department, National Association of Agricultural Educators, Outstanding Postsecondary Agriculture Program

Department of Animal Science

Jun Lin, named as a Fellow to the Conference of Research Workers in Animal Diseases

Casey Read, a PhD student, was selected to receive a USDA NIFA AFRI Merit Award and was honored as a National Finalist for Trainee Merit Awards at the recent Society for the Study of Reproduction (SSR) Annual Meeting

Huiwen Wang, a PhD student, received first place in the Conference of Research Workers in Animal Diseases oral presentations of dissertations, the Lynn Joens Memorial Award, for “Enterobactin-based immune interventions against Gram-negative bacterial infections in Chickens”

Department of Agricultural and Resource Economics

Andrew Muhammed was elected to the board of directors for the Agricultural and Applied Economics Association (AAEA)

Burt English received the 2021 Lifetime Achievement Award from the Southern Agricultural Economics Association (SAEA)

Karen DeLong presented the Emerging Scholar Award by the Southern Agricultural Economics Association (SAEA)

Department of Biosystems Engineering and Soil Science

Hao Gan, first place for the 2020 (awarded in 2021) Giuseppe Pellizzi Prize

Julie Carrier, serving on the American Society of Agricultural and Biological Engineers (ASABE) Board of Trustees

Robert Burns, technical advisor to the Food and Agriculture Organization of the United Nations

Robert Burns, American Society of Agricultural and Biological Engineers (ASABE) Henry Giese Structures and Environment Award

Jaehoon Lee, excellence in Multistate Research Award on the project “W4188: Soil, Water, and Environmental Physics to Sustain Agriculture and Natural Resources”

Doug Hayes, Fellow, the American Oil Chemists’ Society

Center for Renewable Carbon/ Department of Forestry, Wildlife and Fisheries

Art Ragauskas, Clarivate Highly Cited Researcher

Department of Forestry, Wildlife and Fisheries

Don Hodges, Fellow, Society of American Foresters

Department of Plant Sciences

Delaney Foster, PhD student, elected as President of the Weed Science Society of America Graduate Student Organization

Scott Senseman, Fellow, the Weed Science Society of America

Office of Sponsored Programs

Hollie Schreiber, elected to NCURA Executive Committee

AgResearch

Cyndie Nichols, selected to serve as the Southern Representative for the NIFA Financial Reporting Module Working Group

David White, member of the World Health Organization (WHO) Advisory Group on Critically important Antimicrobials for Human Medicine

Hongwei Xin, Foundation for Food and Agriculture Research (FFAR) Advanced Animal Systems Advisory Council

Hongwei Xin, Fellow, Association of Overseas Chinese Agricultural, Biological and Food Engineers



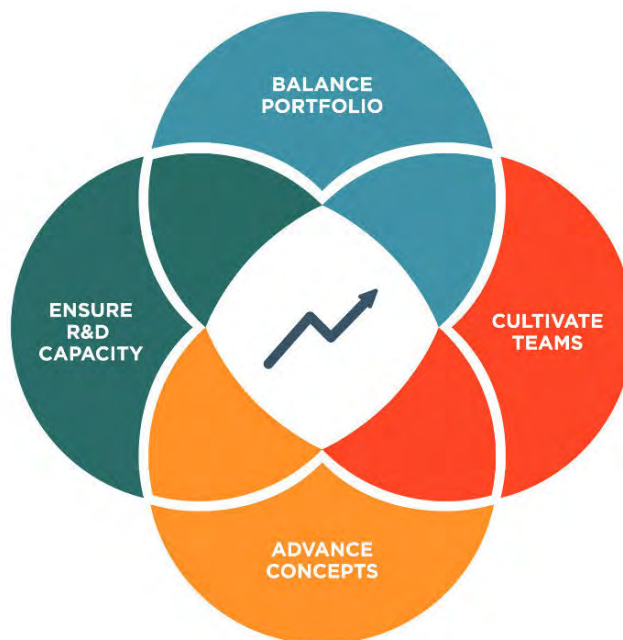
Investing in People and Enhancing Research Capacity

AgResearch was awarded \$50 million in one-time funds from Tennessee's federal American Rescue Plan. The grant will be used to enhance infrastructure and for equipment modernization at the ten AgResearch and Education Centers across the state.

Eight **AgResearch Instrumentation Grants** were awarded at \$342,000 (with equal or greater matching funds by the faculty team or departments). In 2020, twelve grants valued at \$482,000 were awarded, which brings the total investment on the part of AgResearch administration to \$824,000. These instruments will increase the abilities of our research workforce to perform cutting-edge discovery and innovation. The improved research equipment and tools are also expected to better position our faculty in competing for federal grants.

Construction began on the new **Energy and Environmental Science Research Building** on the UT Institute of Agriculture campus in Knoxville. This new building, which replaces the former Ellington Plant Science Building, will include 157,000 square feet over four stories. This facility will house teaching laboratories, research and public service labs, offices, and new classrooms for faculty in multiple departments, including the Departments of Entomology and Plant Pathology; Forestry, Wildlife and Fisheries; and Plant Sciences. The Smith Center for International Sustainable Agriculture will also find its new home in this welcoming facility.

Efforts to implement the three-year **AgResearch Strategic Action Plan** began in January 2021. The plan includes a commitment to support new faculty initiatives, with a targeted investment of approximately \$1 million in research capacity, progressing through several stages of development. The goal is to have four new faculty-driven team initiatives in place by 2024 through an ASAP SPRINT program. A total of eighteen proposals were submitted in 2021, from which six were selected for a detailed review by external experts. The final awards will be announced in early 2022.



2021 New Faculty and Leadership Hires



DANIEL BERCKMANS

- Adjunct Distinguished Professor
- Department of Biosystems Engineering and Soil Science
- 100 percent research
- Precision livestock farming



SEBE BROWN

- Assistant Professor
- Department of Entomology and Plant Pathology
- 75 percent extension/25 percent research
- Row crop integrated pest management (IPM)



SHAOQUING CUI

- Assistant Professor
- Department of Forestry, Wildlife and Fisheries;
Center for Renewable Carbon
- 100 percent research
- Bioderived products science



ALLYSON GRAVES

- Assistant Director of Contracts
- UTIA Office of Sponsored Programs



JODI LETHAM

- Assistant Center Director
- Ames AgResearch and Education Center
- 100 percent administration



CRAIG PICKETT

- Director of Diversity, Equity and Inclusion
- Herbert College of Agriculture/
UT AgResearch/UT Extension



MITCHELL RICHMOND

- Assistant Professor
- Department of Plant Sciences
- 75 percent extension/25 percent research
- Tobacco, hemp, and specialty crop
production and agronomy



TROY ROWAN

- Assistant Professor
- Department of Animal Science
- 70 percent research (35 percent with AgResearch and
35 percent with College of Veterinary Medicine)/30
percent extension
- Beef cattle genomics



HOLLIE SCHREIBER

- Director
- UTIA Office of Sponsored Programs
- 100 percent administration



CHRISTOPHER STRIPLING

- Department Head
- Department of Agricultural Leadership, Education and Communications
- 100 percent administration



MARK WILBER

- Assistant Professor
- Department of Forestry, Wildlife and Fisheries
- 80 percent research/20 percent teaching
- Disease ecology, mathematical modeling, and statistical modeling



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