

AgKnowledge

COMMUNITY RESEARCH SERVICE

2018

KENTUCKY STATE UNIVERSITY
COLLEGE OF AGRICULTURE, FOOD SCIENCE,
AND SUSTAINABLE SYSTEMS



**CERTIFIED
ORGANIC**

**KYSU researchers integrate small
ruminants into organic crop rotation**





Dear Reader,

I am excited to present the 2018 edition of *AgKnowledge* magazine, an annual publication of Kentucky State University's Land Grant Program including the College of Agriculture, Food Science, and Sustainable Systems and the Cooperative Extension Program. This annual report is designed to highlight the research and

Extension activities that our faculty and staff are conducting at Kentucky State University.

Over the past year, the Land Grant Program's faculty, staff and students have concentrated on research and Extension programming to serve the stakeholders of the Commonwealth, with an emphasis on serving minority and limited-resource populations in rural and urban settings. We held local and national workshops to further our efforts to support agriculture in Kentucky communities, we initiated new research endeavors, we built new community partnerships, and we were awarded many hard-earned grants to help us further our mission. In 2017, we established new programs in urban agriculture, livestock nutrition, and forestry, and added new resources to our organic agriculture program and horticulture research initiatives.

In 2018, we will continue to build valuable partnerships with community and government organizations, and we will promote our programs and potential to prospective students and collaborators. Kentucky State University's agriculture programs continue to make great strides.

We are here to serve you, our stakeholders. Please give us your feedback and let us know how we can help you solve your problems. Follow us on social media—@kysuag on Facebook, Twitter and Instagram—and visit us on the web at www.kysu.edu/ag to keep up with our day-to-day activities in communities near you. Subscribe to our newsletters, sign up for our workshops. Join us for a campus visit or invite us to your school or community event. We can't wait to work with you.

Thanks again for reading, and we hope you can use the information provided in this magazine. If you have questions, please call (502) 597-5120 or email kysuag@gmail.com with questions.

Kirk Pomper, Ph.D.
Land Grant Director and Interim Dean of the College of Agriculture,
Food Science, and Sustainable Systems
Kentucky State University

AgKnowledge

2018 Edition, Volume 4

President

DR. M. CHRISTOPHER BROWN II

Land Grant Director and Interim Dean, College of Agriculture, Food Science, and Sustainable Systems

DR. KIRK POMPER

Associate Extension Administrator

DR. JOHNNIE WESTBROOK

Interim Assistant Research Director

DR. BOB DURBOROW

Chair, Division of Aquaculture

DR. JAMES TIDWELL

Chair, Division of Agriculture and Natural Resources

DR. JOHN SEDLACEK

AgKnowledge Project Manager

BLAIR HESS

Graphic Designer

WYVETTE WILLIAMS

Contributing Photographers

JONATHAN PALMER, CHET
WHITE, CHARLES WEIBEL,
ASHLEY BATES, JESSE
OSBOURNE, KIRK POMPER

Contributing Writer

ASHLEY BATES

AgKnowledge magazine publishes annually by Kentucky State University Land Grant Program to promote the research and extension work of the 1890 Land Grant Institution.

Educational programs of Kentucky Cooperative Extension serve all people regardless of economic or social status and will not discriminate on the basis of race, color, ethnic origin, national origin, creed, religion, political belief, sex, sexual orientation, gender identity, gender expression, pregnancy, marital status, genetic information, age, veteran status, or physical or mental disability. Kentucky State University, University of Kentucky, U.S. Department of Agriculture, and Kentucky Counties, Cooperating.



@kysuag

CONTENTS



2 STATE AGRICULTURE FACTS

3 NEWS BRIEFS

7 BOVINES ARE BACK
New professor revamps beef cattle research at KYSU

8 REESTABLISHING HEMP IN KENTUCKY
Research looks at marketability, potential in organic rotations and growing in aquaponics

11 ORGANIC DIVERSIFICATION
Research introduces goats as rotational option for organic producers

12 THE MOBILE FISH DOCTOR
New app and computer games help learners of all ages cure fish diseases

17 BANKING ON SHRIMP
KYSU Aquaculture increases crop consistency to ensure market prices

19 RESTORING THE AMERICAN CHESTNUT
Kentucky State works to restore species and assist farmers with forest management

20 BACKYARD GARDENING
Research in urban agriculture will help growers improve production for their communities

22 THE BIG CATCH
KYSU researcher develops products from Asian carp meat to reduce overpopulation in Kentucky waterways

25 PACKAGING PAWPAW
Researchers and students work to create pawpaw jam as a value-added product

26 THE POTENTIAL FOR AQUACULTURE
Research looks at repurposing wastewater facilities for fish production

29 A NATURAL FERTILIZER
Research finds use for waste to save farmers money and eliminate disposal issues



Kentucky

AGRICULTURE FACTS

Kentucky has long been known for its agriculture offerings. As one of the state's leading and most vital industries, agriculture contributes approximately \$45.6 billion to Kentucky's economy each year. The Commonwealth has just over 77,000 farms covering about 13.04 million acres of land, with the average farm size around 169 acres.

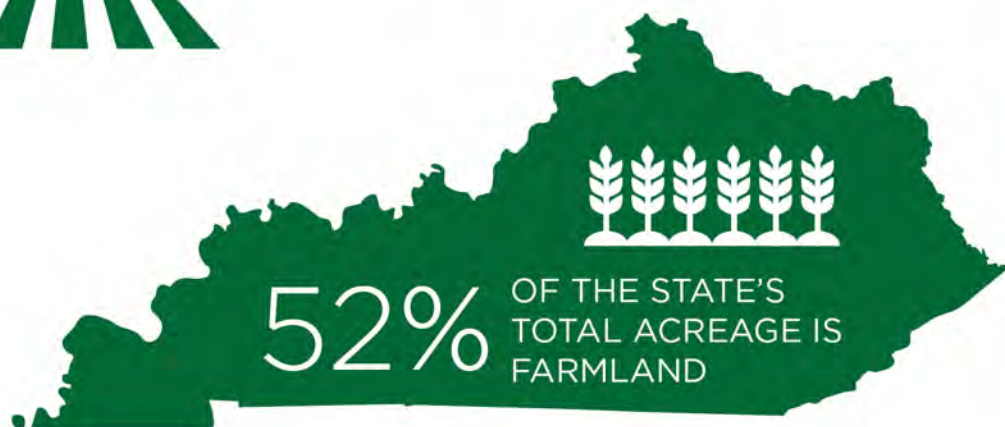


77,065 farms in Kentucky



135

farmers markets



52% OF THE STATE'S TOTAL ACREAGE IS FARMLAND

\$5 billion

annual economic impact of ag on Kentucky



73,570 "small farms" with gross sales less than \$250,000/year



12 million acres of forestland cover **49%** of Kentucky

91,000 miles of streams in Kentucky



225,000 acres of ponds, lakes and reservoirs



#1 IN THE COUNTRY FOR THOROUGHBRED HORSES



POULTRY, INCLUDING BROILERS, IS KENTUCKY'S LEADING COMMODITY

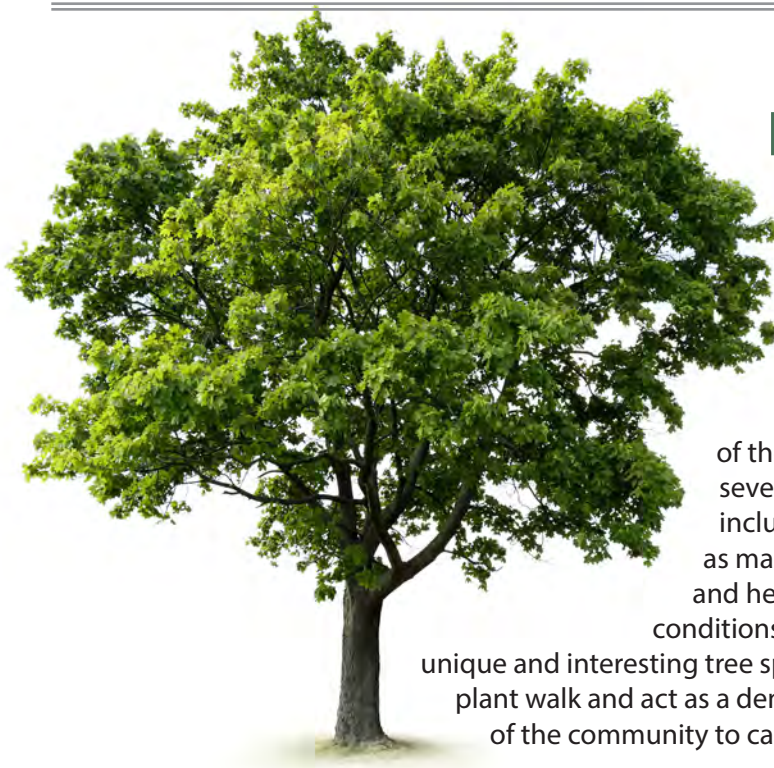


KENTUCKY IS THE LEADING CATTLE PRODUCING STATE EAST OF THE MISSISSIPPI RIVER

NEWS BRIEFS

Native Plant Center Established at KYSU Greenhouse

In 2018, Kentucky State University's Land Grant Program established a Native Plant Center housed at the greenhouses on the Harold R. Benson Research and Demonstration Farm in Frankfort. Managed by Research Assistant Megan Gearhart, this center will propagate native plant species in order to restore local ecosystems. The Native Plant Center will also contribute to a new arboretum and plant walk on Kentucky State University's campus in Frankfort. Student organizations, including the Green Society and Minorities in Agriculture and Natural Resources and Related Sciences (MANRRS), will grow plants in the center that could be used for fundraisers.



Kentucky State University Plans an Arboretum

In an effort to help beautify campus by replacing trees that have been lost and to enhance its utility and educational outdoor space, Kentucky State University's Land Grant Program will develop the landscaped grounds of the university by planting native shade trees and several varieties of fruit and nut trees. Researchers, including Derek Law, and students will work to plant as many trees as possible and to ensure their survival and health in the challenging soil and environmental conditions that are found on the campus. Adding these unique and interesting tree specimens to the grounds will enhance the campus plant walk and act as a demonstration of a food forest to help bring members of the community to campus.



Students Plant and Maintain Monarch Butterfly Habitats

The monarch butterfly is probably the most widely recognized of all American butterflies with its distinct orange, black and white wings. One of the most notable characteristics of this butterfly is the amazing 3,000-mile journey some will make in the fall to their overwintering sites in the Sierra Nevada Mountains of Mexico or to southern California. Monarch waystations are habitats that provide resources necessary for monarch butterflies to produce successive generations and sustain their migration. Without milkweeds throughout their spring and summer breeding areas in North America, monarchs would not be able to produce the successive generations that culminate in the migration each fall. To help foster the remaining depleting population of monarch butterflies, Kentucky State University's Green Society, the student environmental group, planted native milkweeds and other Kentucky perennials as part of a monarch waystation located at the Harold R. Benson Research and Demonstration Farm in Frankfort. The students also planted a waystation at the university's 307-acre Environmental Education and Research Center in Henry County and will work to maintain the plants over the next year.

College of Agriculture Graduate Students Successfully Defend Theses

Nine graduate students in the College of Agriculture, Food Science, and Sustainable Systems successfully defended their theses in 2017.

- Bijesh Mishra, Masters in Environmental Studies, "Adoption of Sustainable Agricultural Practices Among Kentucky Farmers and Their Perceptions about Farm Sustainability."
- Anitha Kisanga, Masters in Environmental Studies, "Evaluation of Potential Pathogenic Bacteria in Spices from Local Stores in Kentucky."
- Kristy Allen, Masters in Aquaculture/Aquatic Studies, "Potential of Dietary Supplementation of Omega-3 Rich Algal Meal (*Schizochytrium sp.*) for Pacific White Shrimp (*Litopenaeus vannamei*) Feed."
- Thomas Tierney, Masters in Aquaculture/Aquatic Studies, "A Comparison of Biofloc, Clear-water, and Hybrid-water Culture Systems for Super-intensive Shrimp (*Litopenaeus vannamei*) Nursery Production."
- Brian Edgar, Masters in Environmental Studies, "The Potential of Biochar Production for Agricultural Purposes from Kentucky Woody Plant Species."
- Srijana Thapa Magar, Masters in Environmental Studies, "Self-Compatibility in Pawpaw: Parentage Confirmation and Evaluation of Fruit and Seed Set in Two Pawpaw Varieties 'Sunflower' and 'Susquehanna' in Kentucky."
- E. Kyle Slusher, Masters in Environmental Studies, "Identification and Quantification of Parasitoids in Blackberries Sprayed with Three Biologically Based Insecticides and Bordered by Native Perennial and Pasture in Franklin County, KY."
- Dakota Raab, Masters in Aquaculture/Aquatic Studies, "Small Scale Production, Marketing, and Economic Feasibility of Boneless Bighead and Silver Carp Meat."
- Jeffrey L. Warner, Masters in Aquaculture/Aquatic Studies, "Reproductive Ability of Second Generation Koi x Goldfish Hybrids."

Research Begins on Hemp as a Textile



Prior to its prohibition in 1937, hemp was an important part of the agricultural and industrial base of Kentucky. With the crop now legal to grow with a permit, this proud heritage of hemp production is reemerging. The number of potential industrial applications for hemp is expanding, so interest and investment in production and products made from hemp is increasing

nationwide. As a textile fiber for home furnishings and apparel products, hemp has a number of properties that make it useful in fabrics and textiles, yarns, raw or processed spun fibers, paper, and carpeting. Hemp is ideal for home furnishing applications because it is resistant to mold and ultraviolet light. Because hemp fibers readily absorb dye and become softer and more comfortable with long-term use, hemp is a good choice for apparel and home furnishings. Dr. Allison Young, associate Extension professor in Family and Consumer Sciences, has started research that will address the factors that can positively influence the use of hemp for consumers, small producers and retailers. The results of this research will be used to develop Extension programming to help hemp growers and textile developers.

Graduate Student Works with Farmers on Food Security



The availability of an adequate, nutritious food supply worldwide is essential to sustaining future generations and to sustainable agriculture. As the world faces the possibility of not producing enough food to feed its growing population, little attention has been focused on farmland as an essential part of the solution to solve hunger. Kentucky State University's Land Grant Program is working with Kentucky farmers to understand the complex relationships among farming practices, policy, environment, diet and human health. Cynthia Rice, a student in the College of Agriculture, Food Science, and Sustainable Systems Master in Environmental Studies program, is working with farmers across the state to help contribute solutions for the future of food security. Rice is collecting data on the perception that farmers have in regards to food security as it impacts farm practices and procedures. By discussing topics such as perennial and annual crops, animal and value-added practices, labor practices, and storage and transportation procedures, this research may help identify issues and information gaps and help Kentucky farmers adapt their operations to increase food security.

KYSU Research Farm Establishes New Pawpaw Breeding Orchard

Kentucky State University established a new pawpaw breeding orchard on the Harold R. Benson Research and Demonstration Farm in Frankfort. By spring 2018, more than 1,000 pawpaw seedlings from the KYSU breeding program will be planted. Kentucky State has the largest pawpaw breeding program in the world and is home to the U.S. Department of Agriculture's National Clonal Germplasm Repository for pawpaw, which stores seeds from all known pawpaw breeds across the globe. KYSU's research farm is also home to another mature pawpaw orchard with several different trees, including KSU-Atwood and KSU-Benson, two varieties bred and released by Kentucky State University.





Bovines *are* Back

New professor revamps beef cattle research at KYSU

A new assistant research professor of livestock nutrition is working to revitalize the beef cattle research program at Kentucky State University. Dr. Ibukun Ogunade joined the staff of the College of Agriculture, Food Science, and Sustainable Systems in 2017 and

this year will focus on applied beef cattle nutrition with an emphasis on improving forage quality and utilization, the use of alternative feed ingredients, the use of feed additives, and the development of laboratory and on-farm techniques to improve forage and feed analysis. Dr. Ogunade is working

to apply metatranscriptomics and metabolomics approaches—or analyzing the genes of the cattle herd—to enhance our knowledge of the gastrointestinal microbial population, health and nutrition of beef cattle.

Dr. Ogunade will also work to evaluate the use of alternative feeds, such as by-products, that may provide nutrients needed by beef cattle at a lower cost to farmers than the conventional feeds that are available. He is looking to evaluate hemp seed processing waste as a potential feed ingredient for beef cattle. With an increased interest in hemp production, the concept of utilizing the waste products of hemp processing is an intriguing possibility for sustainable agriculture.

Ultimately, Dr. Ogunade's research aims to increase the profitability of Kentucky beef producers by improving the sustainability, productivity and efficiency of beef cattle production in Kentucky.



Opposite: Farm Technician Michael Rankin



Reestablishing Hemp in Kentucky

Research looks at marketability, potential in organic rotations and growing in aquaponics

In 2017, Kentucky State University's Organic Research Program continued its participation in the Kentucky Industrial Hemp Research Pilot Program, in which KYSU has participated since its inception in 2014. Kentucky was the top producer of hemp in the United States in the 19th and 20th centuries with thousands of acres of hemp in production. Yields reached their peak around 1917 with more than 18,000 acres of the crop growing primarily in central Kentucky. Hemp production declined in the late 20th century and hemp was classified as illegal to grow by the federal government under the Controlled Substances Act of 1970.

Hemp was once again legalized as a controlled substance crop under the passing of the 2014 Farm Bill (KRS 260.850-260.869, and 7 U.S.C.§ 5940) and

the Kentucky Department of Agriculture began taking applications to grow or process hemp. In 2017, hemp grown at Kentucky State University's Harold R. Benson Research and Demonstration Farm was part of 3,200 acres of the crop planted by licensed growers across the state.

Most recently, hemp research at Kentucky State University included a study in collaboration with Alltech Crop Science that assessed the impact of Alltech biofertilization products Soil Set® and Grain Set® on grain yield. This was the final year of this study that began in 2015. The results of this research indicated that a combination of Soil Set® and Grain Set® produced greater plant biomass but not necessarily higher grain yields. These results somewhat agree with results from



2016 in which increases in both grain and biomass were observed with the combination treatment. The increases may be linked to enhanced soil enzyme activity, which has been observed with use of these products.

Kentucky State University's Organic Research Program also conducted the final year of a three-year study partially funded by Fibershed, a non-profit organization that promotes development of regenerative fiber production systems. This research looks at the effects of field retting of hemp on soil quality. Retting is the process in which hemp stalks are placed on the soil surface and allowed to partially decompose in order to facilitate fiber extraction and naturally soften the fibers for textile use. Data analysis from 2017 is ongoing but results from 2015 and 2016 indicate that this retting process may help maintain soil quality by reducing soil organic matter losses associated with completely removing hemp stalks from the field for fiber extraction.

In 2018, researchers will look at how hemp fits in diversified organic crop rotations. Other projects will include an organic hemp variety trial of strains that have been previously untested in Kentucky and a research trial investigating aquaponic production of hemp for non-intoxicating cannabinoid compounds that may have use as health supplements. Hemp research at Kentucky State University aims to find best production practices and best uses for the crop to help establish a viable market for farmers in the future.



Opposite: Rose Johnson helps harvest hemp at the Harold R. Benson Research and Demonstration Farm. **Top:** Dr. Shawn Lucas works with Ellyn Anthony in the organic hemp plot at the KYSU farm.



Kentucky State University Organic Research Group from left: Kimberly Barmore, Ellyn Anthony, Derek Law, Dr. Shawn Lucas, Joshua Maddox, Rose Johnson. **Opposite:** Andrew McKay

Organic Diversification

Research introduces goats as rotational option
for organic producers

Kentucky State University's Organic Research Group started a study on integrated crop-livestock rotations that will help farmers across the state better manage their soil and water resources. This five-year project will examine the impacts of integrating small ruminants—in this case, goats—onto land used for crop production.

In this study, two years of organic grain production will be followed by three years of goats on pasture. Dr. Shawn Lucas, assistant professor of organic agriculture, and his research team will measure impacts of animal integration and crop production on soil quality, groundwater quality, crop yields and weed pressure in an organically managed rotation sequence. The research

team under Kentucky State University's College of Agriculture, Food Science, and Sustainable Systems established experiment blocks on the organic land of the Harold R. Benson Research and Demonstration Farm in Frankfort and buried soil moisture samplers under each plot. A soil solution will be pulled from each plot for analysis throughout the experiment and continuous soil samples will be taken.

This research is funded through the U.S. Department of Agriculture National Institute of Food and Agriculture (USDA-NIFA) Evans-Allen Research Program. This work will provide farmers useful information on how to increase crop diversification and manage their soil and water resources.



The Mobile Fish Doctor

New app and computer games help learners of all ages cure fish diseases

Kentucky State University's Land Grant Program is working with Oregon State University to develop two data software products, a pathogen identification software application and a fish disease case study database. These technologies will make learning easier for students, research professionals and practicing veterinarians and help them diagnose fish diseases.

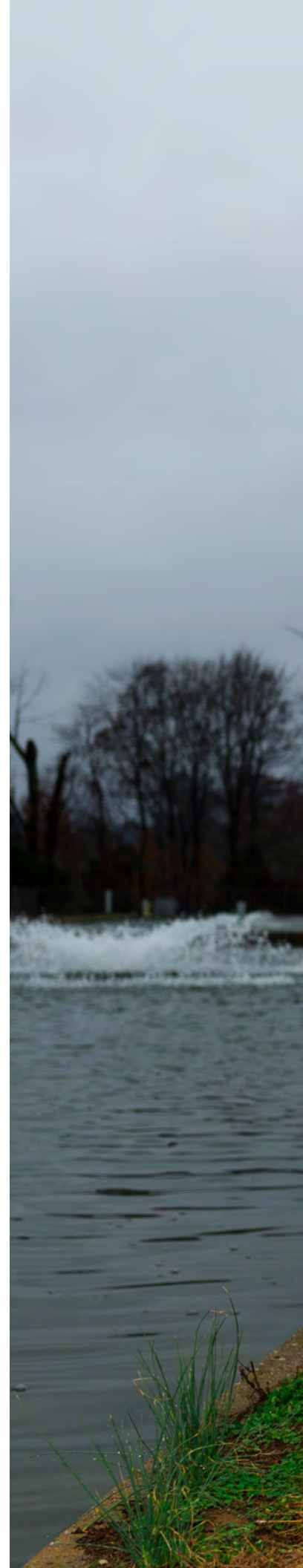
Dr. Robert Durborow, state Extension specialist for aquaculture and interim associate research director of the university's Land Grant Program, received a Capacity Building Grant from the U.S. Department of Agriculture to develop these technologies.

The fish disease case study database will be accompanied by two computer teaching games, FishDetective and SimFish, that will create role playing scenarios to help students solve fish kill mysteries. The app, which will be free

and compatible on Apple and Android mobile devices, is the first of its kind and will be available in fall 2018. It will facilitate identification of fish pathogens and advise users of treatment options. This will result in improved accuracy of identifying fish diseases and selecting the most appropriate treatments. The app uses Google platform and will be the beginning of a large fish disease diagnostic clinical database that eventually will allow users access to a vast number of laboratories across the U.S.

Kentucky State University will use the app and the database in undergraduate and graduate classroom laboratory exercises enabling students to perform epidemiology work, data mining of clinical disease case observations, and risk assessments.

For more information, contact Dr. Durborow at robert.durborow@kysu.edu or (502) 597-6581.





Dr. Robert Durborow, interim assistant research director, professor and state Extension specialist in aquaculture





**College of Agriculture, Food Science,
and Sustainable Systems**
and Land Grant Program

www.kysu.edu/ag | [@kysuag](https://twitter.com/kysuag)



Dr. Andrew Ray, assistant professor in aquaculture

Banking on **Shrimp**

KYSU aquaculture research increases crop consistency to ensure market prices

Shrimp are the most popular seafood item in the United States, however most shrimp are imported and some of those imports are of questionable quality. There is a demand for fresh, never-frozen whole shrimp, especially from food-conscious consumers, chefs and supermarkets. However, fresh U.S. shrimp are very difficult to acquire during the off season, even in southeastern coastal areas. Production systems in Kentucky, such as high tunnels in which shrimp can be grown for about half of the year or indoor aquaculture systems where shrimp can be grown year-round, are attractive for farmers. These systems are especially suited to small-scale farms, which can fulfill niche markets around densely populated regions. In addition, shrimp are typically sold on whole ice, which means no processing is involved.

Dr. Andrew Ray and his research team are investigating ways of increasing the predictability and consistency with which shrimp are

produced. They also look at system management tactics that improve the sustainability and efficiency of shrimp production.

In 2017, Kentucky State University produced 1,200 pounds of marine shrimp at its high tunnels. Dr. Ray harvested this crop of fresh, head-on shrimp in late September. Kentucky State University has been successful selling this shrimp for \$12 to \$17 per pound at farmers markets in Kentucky. Additional research is needed to ensure those prices can be upheld for regularly harvested shrimp produced in large quantities, but there is strong potential for profit with prices in that range. Although start-up costs can be high, indoor cost of production is roughly \$6 per pound; high tunnel production is even less expensive.

Shrimp have a relatively short growth cycle. Dr. Ray's team gets shrimp from a hatchery in Florida and rear them in a 35-day nursery phase before the grow out phase. If the systems are indoors, the grow out phase is 100 days, for a total of 135

production days. In high tunnels, the grow out phase is somewhat longer due to fluctuations in the weather.

In addition to their extension research in marine shrimp production, Dr. Ray and his team constructed two high tunnels at central Kentucky schools. These greenhouses are at Versailles Montessori School in Versailles and at Providence Montessori Middle School in Lexington—both of these areas are considered food deserts by the U.S. Department of Agriculture, meaning the surrounding areas do not have adequate access to food resources. Each high tunnel contains two recirculating aquaculture systems with a 500-gallon tank, a solids filter and a biological filter. Koi, tilapia and largemouth bass grow in these systems, and students are involved in constructing the tunnels, collecting water quality data, deciding what to feed the fish, measuring the fish, stocking and harvesting the fish, and many other science-based activities. These teaching high tunnels will also be used to grow plants.



Restoring the American Chestnut

Kentucky State works to restore species
and assist farmers with forest management

Before the chestnut blight (*Cryphonectria parasitica*) that was first detected in America in the early 1900s, the American chestnut tree (*Castanea dentata*) was a staple of the economy of many rural communities in Kentucky. The tree provided income with its annual harvest of chestnuts and lumber, and it provided food for a large variety of wildlife. However, the blight virtually eliminated the tree's population from state forests.

Today, Kentucky State University researchers are working with the American Chestnut Foundation to repopulate the once prominent tree of Kentucky's forests. Dr. Richard Cristan, who joined the Land Grant Program in 2017 as an assistant research professor, and his research team will plant American chestnut trees at the university's Environmental Education and Research Center in Henry County, Ky., and will carefully monitor their progress. In addition to repopulating a native tree, this research could lead to establishing another option for small farmers looking to increase the profitability of their land through harvesting nuts and lumber.

Dr. Cristan's research team will also evaluate the effectiveness of planting native grasses, wildflowers

and pollinator tree species to increase the presence of pollinators. By looking at different densities and species, Dr. Cristan hopes to determine the best combination for attracting these pollinators. Additionally, the team will evaluate the impact of the emerald ash borer on Kentucky. This study will take place at the EERC and at Bernheim Arboretum and Research Forest in Clermont, Ky. To assess Emerald Ash Bore impact, the team will utilize drones and Geographic Information Systems (GIS) technologies to locate affected areas and then evaluate the species growing in areas that will potentially replace these ash trees. The concern is that invasive plant species may move into these areas.

This research will result in better management practices for Kentucky land owners who are hoping to increase the presence of pollinators on their land and who are implementing proper forest management practices.

Dr. Cristan has expertise in agroforestry, silviculture, habitat restoration, forest operations, invasive plant species and water quality.

Dr. Richard Cristan, assistant research professor in forestry

Backyard Gardening

Research in urban agriculture will help growers improve production for their communities

Many believe that because Kentucky's acreage is mostly rural, urban agriculture does not apply to this state. However, urban agriculture is not limited to large cities. Kentucky State University's Dr. Leigh Whittinghill is currently working to redefine what the average person pictures when they hear "urban agriculture."

Urban agriculture does not have to be gardens on the rooftops of 20-story buildings. It can mean raised beds or a small garden in a backyard.

Urban food production has been around for thousands of years, but it wasn't until recently that the term "urban agriculture," emerged. In fact, the Victory Gardens during World War II—which citizens planted at the request of the government when it was rationing meat and dairy products to encourage growing their own food—and the Relief and Welfare Gardens during the country's Great Depression are examples of widely popular urban agriculture. Production statistics suggest that the Victory Gardens were able to produce as much as commercial production during their time. Throughout history and across national borders and cultures, backyard gardening has been a supplemental source of food and/or income for families in urban areas, especially in times of social or political unrest or economic hardship. The fabled Hanging Gardens of Babylon and the terraces of Machu Picchu are very early examples of human engineering that resulted in the ability to grow plants and food in new settings.

Dr. Whittinghill is working with students and other faculty and staff of the Land Grant Program

to incorporate a demonstration garden into the forthcoming campus arboretum, which will be developed in 2018. The current design allows for 672 square feet of raised beds that will incorporate inter-cropping techniques that aim to produce enough vegetables to provide for a family of four. Dr. Whittinghill hopes that the garden will serve as a tool for students and other members of the community to learn from and build their own urban garden.

In addition to this demonstration garden, Dr. Whittinghill is surveying urban agriculturalists across Kentucky to gain an understanding of what current producers are doing and what their needs are. The goal is to mirror in research what people are actually doing so that findings can be directly applied to Kentucky growers.

Dr. Whittinghill works with Christian County Cooperative Extension in Hopkinsville, Ky., and the city's Challenge House on its community garden. There are plans for two more community gardens in Hopkinsville.





Dr. Leigh Whittinghill, assistant Extension professor in urban agriculture works with Berea Urban Gardens (top) and with students at the Fayette County District Science Fair.



The Big Catch

Dr. Changzheng Wang, associate professor. **Opposite:** Dr. Wang and Dr. Michael Huang work with Agriculture, Food, and Environment major James Brown.



KYSU researcher develops products from Asian carp meat to reduce overpopulation in Kentucky waterways



Big head and silver carp, commonly known as Asian carp, are invasive species that have taken over many waterways across Kentucky. The female fish can produce over one million eggs each year, which makes it very difficult to control the population. Not only are these invasive species a threat to the state's native species, the carp also tend to jump out of the water when they are startled making the fish a danger for boaters.

Dr. Changzheng Wang, associate professor in Kentucky State University's College of Agriculture, Food Science, and Sustainable Systems, works with Two Rivers Fishery, a processor and exporter of all carp varieties located in Wickliffe, Ky., to encourage the removal of Asian carp from the state's waterways. Dr. Wang aims to

reduce populations of these fish by developing value-added products that can be made from Asian carp mince or ground meat.

The market demand for Asian carp in the U.S. is very low because the fish are bony and American consumers are not widely aware of the palatability of Asian carp meat. Dr. Wang hopes these value-added products that are being developed from mechanically deboned Asian carp meat will increase the value and expand the market for the fish in the U.S. and in foreign markets. This would increase the demand for harvesting Asian carp.

Previously, Dr. Wang researched the possibility of making surimi products from Asian carp mince. However, the production of surimi requires the mince to be washed repeatedly, which generates a lot of wastewater. This water is a very

costly issue for inland processors. Because of this, Dr. Wang is working to develop value-added products that will require little to no washing, which would be more economical to produce. Dr. Wang is also investigating the effects of salt concentration and the addition of purple sweet potato powder on the color and gelling properties of the fish meat.

This research will have substantial environmental and economic impacts on Kentucky. The development of environmentally friendly, cost effective, value-added Asian carp products could lead to the creation of an international market. This would help decrease the population of Asian carp in Kentucky waterways and make conditions safer for the state's native species and its fishermen.



Packaging Pawpaw

Researchers and students work to create pawpaw jam as a value-added product

Kentucky State University's Land Grant Program is the home of world-renowned pawpaw research and Extension programs and the site of the U.S. Department of Agriculture National Clonal Germplasm Repository for pawpaw. In its years of work with this unique fruit, which has a mango, banana, pineapple flavor and a very short shelf life, KYSU has release two of its own varieties and helped hundreds of growers around the world establish and improve their orchards. Because of the fruit's thin and delicate skin, it is difficult for farmers to sell the fresh fruit. As a result, KYSU has been researching different means of marketing pawpaw, particularly as a value-added product.

In 2018, the Land Grant Program will begin to sell Pawpaw Gold Jam, a preserve made from pawpaw pulp. Bob Lynch of Corbin, Ky., developed the recipe for this jam. He made over 10 different recipes with varying amounts of sugar, pectin and citric acid. He also experimented with adding lemon juice, honey and other spices. Finally, through a series of test tastings on campus, the favorite recipe was chosen as the official Pawpaw Gold Jam recipe.

Land Grant Program faculty and staff work with students to harvest pawpaws grown at the Harold R. Benson Research and Demonstration Farm and process the fruit. Then they cook and can the jam using the university's Fruit and Vegetable Mobile Processing Unit (FVMPU). Students are involved throughout the entire process, from seedlings to jam on the shelf. This allows them to gain hands-on experiential learning in value-

added agriculture production.

KYSU Pawpaw Gold Jam is expected to be on the shelves of the newly opened Thorobred Shop in the Capital Plaza Hotel in Frankfort by this summer. All proceeds from the sales will go to provide student scholarships for the College of Agriculture, Food Science, and Sustainable Systems.

Researchers continue to work to establish the marketability of Pawpaw Gold Jam to determine if this value-added product could be an option for pawpaw producers. Each jar's label will include a link to a consumer survey that will collect feedback on taste, cost and various other aspects of the product.

The jam recipe and other recipes for pawpaw value-added products are approved by the Food Systems Innovation Center and are available for use in the university's FVMPU. If you are interested in processing pawpaw or other fruit or vegetables, contact processing unit manager Dakarai Carrington at dakarai.carrington@kysu.edu or (502) 597-6245.



The Potential for Aquaculture

Research looks at repurposing wastewater facilities for fish production

Kentucky State University's Division of Aquaculture partnered with the London Utility Commission in London, Ky., to explore the potential for breeding and growing up fish at decommissioned water treatment facilities.

With today's developments in technology and stricter guidelines for processing wastewater, many communities are constructing new, larger treatment plants and leaving the old facilities. Many of the decommissioned properties include sedimentation ponds and tanks that could be converted to aquaculture production. Dr. Ken Semmens, assistant professor of aquaculture in the College of Agriculture, Food Science, and Sustainable Systems, is overseeing this project to identify potential secondary uses of these

facilities as aquaculture production locations as part of a Capacity Building Grant he received from the U.S. Department of Agriculture's National Institute of Food and Agriculture (USDA-NIFA).

In 2017, Dr. Semmens and his team made several improvements to the wastewater facility in London to make it more hospitable for fish production. One improvement was to install walkways around the outside of the digesters to improve safety and to make harvesting the fish easier. Paddlefish, catfish, hybrid striped bass, largemouth bass, hybrid bluegill and Koi carp have been grown at the facility. Rainbow trout were successfully grown in three net pens during the winter. While water quality, growth and survival of the rainbow trout were good, some questions about the flavor of

the trout meat arose. Dr. Semmens has additional research planned to determine if flavor concerns are warranted and to investigate possible solutions.

In addition to this research, Dr. Semmens works with classes at North Laurel and South Laurel high schools in London to provide students with hands-on, experiential learning opportunities to stock, sample and harvest rainbow trout from the net pens at the London facility. Kentucky State University's work in Laurel County on this project has encouraged community engagement through tours and educational events. This research will not only help producers potentially earn more money, but it also serves to educate the community about aquaculture and fish production.

Dr. Ken Semmens, assistant professor of aquaculture





Dr. George Antonious, professor

A Natural Fertilizer

Research finds use for waste to save farmers money and eliminate disposal issues

The conventional fertilizer industry is a multibillion-dollar industry in the United States. The most recent data available from the U.S. Environmental Protection Agency (USEPA) says commercial fertilizer consumption in the country totals more than 20 million tons. Dr. George Antonious, professor in Kentucky State University's College of Agriculture, Food Science, and Sustainable Systems, and his research team are working to find more cost-effective and environmentally friendly alternatives to conventional fertilizers.

The team is evaluating sewage sludge as one possible alternative. There are more than 300 waste water treatment plants in Kentucky that process hundreds of tons of waste daily. This makes sewage sludge, which is semiliquid waste obtained from the processing of municipal sewage, readily available. Dr. Antonious sees this research into sewage sludge as a possible replacement for conventional fertilizers as a benefit from multiple angles. Not only does this research identify ways to use waste that faces complications with disposal sites, but it also potentially saves farmers money.

Sewage sludge has a high concentration of organic matter, macronutrients and micronutrients that can enhance the soil's physical, chemical and microbial conditions. These characteristics help to improve soil bulk density, drainage and root penetration as well as providing pesticide bioremediation in contaminated soil. Bioremediation is the use of biological agents to remove or neutralize the contamination or pollution in soil and water. Dr. Antonious's research—which is funded

by a grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture (USDA-NIFA)—focuses on monitoring crop yield and quality as affected by soil amendments, including sewage sludge, as well as chicken and horse manure.

Dr. Antonious and his team also have a long-standing partnership with Alltech Crop Science, and are currently investigating the impact of Soil-Set®, Grain-Set®, and Liqui-Plex® on hot pepper (*Capsicum annuum*) yields and fruit quality characteristics. Hot peppers are used in this study because the consumption of hot peppers has increased during the last decade due to greater interest in ethnic foods in the U.S. The market demand for organically produced food has also increased. Therefore, organically produced hot peppers could serve as a niche crop and a valuable option for small-scale producers. The expected outcomes of this project are to understand the effects of these products better and to stimulate the use of these organic products in agricultural production systems throughout the country.





LAND GRANT PROGRAM