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LOUISIANA Agriculture

Assuring Our Future Through
Scientific Research and Education



Keeping our plants healthy

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LSU AgCenter
Research · Extension · Teaching

LSU AgCenter Scientists Join World Movement to Promote Plant Health

Linda Foster Benedict

On Nov. 4, 2004, Ray Schneider, an LSU AgCenter plant pathologist, now deceased, was taking an Illinois farmer on a tour of the soybean research plots on a field near the LSU campus. He noticed some suspicious-looking leaves at the bottom of some of the plants that looked to him like the dreaded Asian soybean rust disease, which had wreaked havoc on the continents of Asia and Africa and had recently been detected in South America in Brazil.

Schneider had recently been part of a nationwide team of scientists trained to be on the lookout for this disease. This was a matter of national security because the disease was known to spread fast and destroy entire fields —and with it a significant part of the agricultural economy.

The disease was, in fact, found to be Asian soybean rust, and because of the fast action of an AgCenter team, a national crisis was averted.

Although from the past, this is just one example, albeit dramatic, of how AgCenter scientists and other agricultural scientists around the world work behind the scenes to keep plants healthy. To call attention to their work, the Food and Agriculture Organization of the United Nations has designated 2020 as the International Year of Plant Health.



Ray Schneider, former professor in the Department of Plant Pathology and Crop Physiology, who died on Oct. 9, 2019, was featured on the cover of the winter 2005 Louisiana Agriculture, along with an article about his momentous discovery that the dreaded Asian soybean rust disease had spread to North America, giving authorities the necessary alert to avert a disaster. Cover photo by Mark Claesgens

The AgCenter abounds with examples of how its scientists are on the front lines in waging battles to keep plant problems caused by diseases, insect pests, poor soil health and weeds from becoming pandemics.

One is these scientists is Raj Singh, plant pathologist, who has an article in this issue of Louisiana Agriculture on "Specialty Crop Plant Diseases on the Rise in Louisiana." Singh is known as the "plant doctor" because he has a doctor of plant medicine degree from the University of Florida. He is the director of the AgCenter's Plant Diagnostic Center, which serves as a place where people can get plant problems analyzed.

In this article he tells readers to help him locate and document several diseases that are spreading and causing economic loss in Louisiana. One of the more recent problems is boxwood dieback, a disease of the popular boxwood evergreen shrub, which is widely used across the state in landscapes. At this time there is no cure for the disease. Singh is holding training sessions with nursery growers and landscapers to help them identify the disease so it can be controlled and its spread stopped.

To keep plants, crops and trees healthy is far more cost-effective than dealing with full-blown plant health emergencies.

"Anything that impacts the ability of that plant to produce to its maximum yield potential is a plant health issue," said Lawrence Datnoff, head of the Department of Plant Pathology and Crop Physiology.

Plant health not only helps end hunger but also protects the environment and makes agriculture sustainable. Everyone can get involved in the Year of Plant Health:

- Be careful taking plants and plant products with you when traveling.
- Regularly monitor and report pests on your farms and in your landscape.
- Follow AgCenter research-based recommendations in growing plants and controlling diseases, insect pests and weeds.

Linda Foster Benedict is the editor of Louisiana Agriculture magazine.

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Louisiana Agriculture is published quarterly by the Louisiana Agricultural Experiment Station. Subscriptions are free. You may also subscribe to a web version of the magazine, which is available at www.LSUAgCenter.com. Please go to the "Louisiana Agriculture Magazine" site if you would like to receive an email notification when a new issue is online. For more information or to subscribe, please contact:

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LOUISIANA Agriculture
Vol. 63, No. 1, Winter 2020
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ON THE COVER: Raj Singh is an associate professor and director of the Plant Diagnostic Center in the Department of Plant Pathology and Crop Physiology. He encourages readers to help him locate and document diseases that are spreading and causing economic loss in Louisiana. Photo by Olivia McClure

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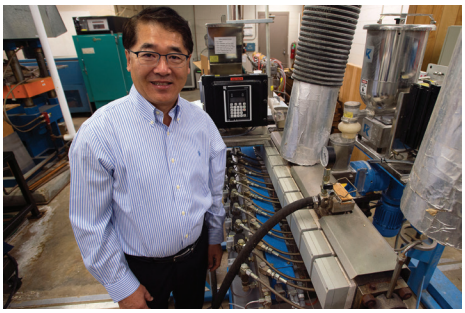
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AgCenter NEWS

Qinglin Wu named Gordon D. Cain chair



Qinglin Wu, a researcher in the School of Renewable Natural Resources, has been named the Gordon D. Cain Endowed Chair of Agriculture. Wu's research focuses on wood and natural fiber polymer composites, and he has received three U.S. patents. Gordon D. Cain was a county agent in northeast Louisiana, beginning in the 1920s. One of his many achievements was helping bring electricity to the farm at a time when rural people were suspicious of "new technology" and "book farmers." The endowment was established in 1988 in memory of Cain's children. Photo by Olivia McClure

CDC study shows Louisiana adult inactivity level reaches 30%

Maps released by the Centers for Disease Control and Prevention show that Louisiana is one of seven states with the highest prevalence of physical inactivity among adults. More than 15% of adults in every state are inactive, but in Louisiana that number jumps to 30%.

The LSU AgCenter is working to address physical inactivity in the state through the Healthy Communities initiative.

"We might, for example, help a community work on making existing park facilities more attractive, help make a downtown more walkable or create physical activity through painted play spaces," said Denise Holston, an AgCenter nutrition specialist and registered dietitian, who is leading the program across the state to address nutrition and physical activity in Louisiana.. "We know that every community is different, so the type of work that we do is decided by local community members."

Small adjustments such as adding crosswalks on streets or better lighting on walking paths help to improve access to physical activity opportunities.

Read the full story at https://bit.ly/2u5Wzkk. **Tobie Blanchard**

Dan Fromme named cotton specialist of the year



Cotton specialists from across the country have named Dan Fromme the Cotton Extension Specialist of the Year, an award sponsored by BASF. Fromme, who holds the Tom and Martha Burch and Delta and Pine Land Co. Endowed Professorship in Cotton Production or Genetics in the LSU AgCenter, was recognized at the Beltwide Cotton Conference on Jan. 9, 2020, in Austin, Texas. Fromme serves as a cotton, corn and grain sorghum specialist at the Dean Lee Research and Extension Center in Alexandria. Photo by Olivia McClure

Three new specialists serve Louisiana farmers, ranchers

Three new specialists have joined the LSU AgCenter. Ashley Keith Edwards is an extension agent and coordinator for regional animal science programs with offices in the Central, Northwest and Northeast regions. David O. Mosely is the state soybean specialist based at the Dean Lee Research and Extension Center in Alexandria. Rasel Parvej has joined the Northeast Region faculty in Winnsboro as a soil fertility and agronomy specialist with statewide responsibilities in row crop soil fertility.

A graduate of Texas A&M University, Edwards supports programming across a broad spectrum of animal science-related areas, including commercial operations, small herds and 4-H livestock activities. Before joining the AgCenter, Edwards served as assistant professor of animal sciences at Louisiana Tech University.

Moseley's major projects will involve working with other AgCenter researchers and agents to facilitate on-station research and on-farm variety performance trials and collaborating with experts in disease, pest and weed management.

A graduate of Texas A&M University and the University of Arkansas, Moseley is a former production research scientist with Monsanto/Bayer in Nebraska and a University of Arkansas extension agent with agriculture and 4-H youth development responsibilities.

A native of Bangladesh, Parvej has a bachelor's and a master's degree from Bangladesh Agricultural University. He earned a doctorate in soil fertility and nutrient management from the University of Arkansas in 2015 and has done post-doctoral work at Virginia Tech and Iowa State University. **Karol Osborne**



Ashley Keith Edwards



David O. Moseley



Rasel Parvej

THE LSU AGCENTER

provides services to help farmers, home gardeners and others identify pests, soil pH and nutrient imbalances, and other problems that affect plant health.

THE PLANT DIAGNOSTIC CENTER

something of a doctor's office for sick plants

During 2019, the center analyzed 822 physical samples and 217 images of plant problems that were submitted digitally.

THE SOIL TESTING AND PLANT ANALYSIS LAB

tested during 2019:

19,975 soil samples

8,645 plant samples

161 water samples

People can submit samples using mail-in kits available at AgCenter offices, hardware stores and garden centers throughout Louisiana.



THE NEMATODE ADVISORY SERVICE

processed during 2019:

1,206 soil samples

This laboratory can confirm the presence and type of nematodes, or roundworms, in soil. This information is critical to implementing the correct control measures and preventing further damage to crops.

International Year OF PLANT HEALTH



Plant Pathology

Many different diseases attack plants, and it can sometimes be difficult to pinpoint which one is the culprit. AgCenter plant doctor Raj Singh oversees the Plant Diagnostic Center, where he helps farmers and home gardeners alike identify pest problems and solutions.



Entomology

Pollinators play a major role in keeping plants healthy. AgCenter entomologist Kristen Healy and forage researchers Wink Alison, Buddy Pitman and Kun-Jun Han are studying ways that farmers and ranchers can help with efforts to improve habitats for bees and other pollinators.



Plant Breeding

One of the best ways to combat pest infestations is through genetic resistance. AgCenter scientists who breed new varieties of rice, sugarcane and sweet potatoes look for traits that make these crops resistant to insect pests and diseases.



Soil Science

Healthy soil helps make healthy plants. AgCenter soil scientists Lisa Fultz and Brenda Tubaña are working on a project funded by the Patrick F. Taylor Foundation that examines how to optimize fertilizer use to reduce runoff and costs while still giving crops the nutrients they need to thrive.



Weed Science

Weeds compete with crops for nutrients, water and space. AgCenter weed scientists help farmers find strategies for controlling these undesirable plants, from using herbicides to implementing cultural practices that discourage weed growth.



Technology

Gadgets and the data they collect are an increasingly important part of modern agriculture. AgCenter experts are studying how to harness the power of technology and "big data" to grow healthier crops.

TEAR OUT

TEAR OUT

TEAR OUT

From Our SOCIAL MEDIA

Join the LSU AgCenter on social media. AgCenter researchers and extension agents reach out via the web with videos, articles and helpful hints on Facebook, YouTube, Twitter and Instagram.
Join the conversation by following the LSU AgCenter.

TWITTER | Follow the AgCenter at twitter.com/LSUAgCenter



FEB 4 | Don Labonte, LSU AgCenter's sweet potato breeder and professor, has bred and developed the first edible ornamental sweet potatoes on the market, Treasure Island Sweet Potatoes! http://bit.ly/DonLabonte #SWEETPOTATOES #LSUAGCENTER #RESEARCH

YOUTUBE | View these videos and our extensive archive at youtube.com/user/LSUAgCenter

FEB 14 | Louisiana Healthcare Connections and the LSU AgCenter have teamed up to produce the video series "Build a Healthy Meal." We'll show you how to make easy, tasty and healthy recipes for the whole family using low-cost ingredients that can be found in your local dollar store or grocery store.



FACEBOOK | Follow the AgCenter on Facebook at facebook.com/LSUAgCenter



FEB 20 | Hundreds of young people from across Louisiana were named state champions during the 85th annual LSU AgCenter Livestock Show.

FEB 18 | Learn how to increase your bass fishing success in the Atchafalaya River Basin, one of Louisiana's top fishing destinations, with tips from Mike Kaller, faculty member in LSU's School of Renewable and Natural Resources!



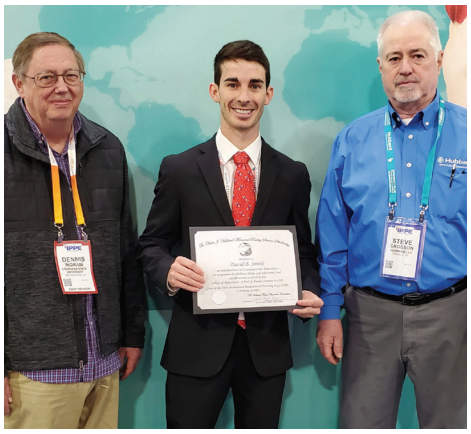
INSTAGRAM | Follow the AgCenter at instagram.com/LSUAgCenter

JAN 16 | Yumm! Who wants ice cream? The LSU AgCenter Dairy Store offers ice cream, meats and cheese! Located on the LSU campus in Baton Rouge. #GEAUXAG #LSUAGCENTER #AGRICULTURE #DAIRY #MILK #DAIRYSCIENCE #COWS #THANKFULTHURSDAY



College of Ag NEWS

Smith awarded national poultry scholarship



David Smith, LSU College of Agriculture senior studying animal sciences, center, was awarded a $2,000 scholarship from Hubbard Breeders. He received the award at the International Production and Processing Expo in Atlanta on Jan. 29, 2019. At left is Dennis Ingram, retired LSU College of Agriculture poultry professor, and Steve Crosson, with Hubbard Breeders.

Sustainable Harvesters owner speaks to students



Matthew Braud

Matthew Braud, who owns the largest aquaponics operation in Texas, spoke to students about his business as part of the LSU College of Agriculture's Alumni Speaker Series. Braud owns Houston-based Sustainable Harvesters with fellow agricultural business alumnus Andrew Alvis. Braud said they learned a lot at LSU that helped them with their business.

"People thought we were crazy when we started," he said.

The pair uses aquaponics to grow their produce in a 12,000-square-foot greenhouse. Their operation combines aquaculture and hydroponics to give the lettuce they grow extra nutrients from fish. In 2018, they were named one of LSU's 100 Fastest Growing Tiger-led Businesses. In 2019, they received the Early Career Alumni award from the College of Agriculture.

The two have partnered with schools in the Houston area to create small-scale aquaponic growing systems for educational purposes.

McKinzie receives University Medal



Whitney McKinzie

Whitney McKinzie received the university medal at the LSU College of Agriculture Fall Commencement on Dec. 20, 2019, at the LSU Maddox Field House.

McKinzie, of Slidell, Louisiana, received a degree in agricultural business with a concentration in food industry management and a minor in agriculture. During her undergraduate career, she was the recipient of numerous scholarships and honors and was a member of the national award-winning Agricultural and Applied Economics Quiz Bowl Team.

The University Medal was established as an award for LSU undergraduate students graduating with the highest grade-point average in their class.

College of Ag graduate student studies tiger genetics

Ask any LSU football fan what makes up a tiger and answers might include passion, determination and hard work. But one LSU student is conducting research on what truly makes up a tiger.

Alessandra Bresnan, a graduate student in the College of Agriculture School of Renewable Natural Resources, is studying conservation genetics of captive and wild tigers with the hope of bringing awareness to their plight.

Bresnan's research is funded by LSU through the Tigers United University Consortium, which also includes Auburn University, Clemson University and the University of Missouri, all of which have tiger mascots. The universities have joined forces to help save wild tigers worldwide.

"Since the start of the last century, the world has lost 97% of its tigers," Bresnan said.

More tigers live in captivity than in the wild, with fewer than 3,900 tigers in the wild. While the exact number of captive tigers in the U.S. is unknown, it is estimated at 5,000 to 10,000. Bresnan said only a small population of the captive tigers is managed through species survival plans in accredited zoos.

Inbreeding of tigers in captivity and crossbreeding tigers with other species, such as lions, have caused a host of genetic and health issues in captive populations, Bresnan said. Many inbred tigers are born with deformities, vision problems and other health concerns.

Bresnan plans to conduct a genetic analysis of U.S. tigers, including generic tigers or tigers of unknown or hybridized subspecies as well as purebred species found in accredited zoos. She has already done preliminary work with the tigers housed at the Baton Rouge Zoo.



Alessandra Bresnan

New Faculty PROFILE

Jeb Fields Gets Dream Job at Hammond Research Station

Kyle Peveto

It seems like Jeb Fields has been preparing for his career at the LSU AgCenter his entire life.

Fields, 34, grew up around his family's tractor dealership and retail plant nursery and then built his knowledge in college and graduate school while working in research labs and fields.

Since joining the AgCenter as an assistant professor and extension specialist in 2018, he serves as the director of the ornamental trial gardens at the Hammond Research Station and is the chair of the Louisiana Super Plants program.

"The position I have now was the exact dream position I could have at any university," Fields said.

Raised in central Florida, Fields became an Eagle Scout and worked in the citrus groves, ripping out vines and other odd jobs. He also was employed at his uncle's golf driving range. This all led Fields to become interested in agriculture and the environment.

When Fields started college at the University of Florida, his love of plants and background in agriculture lured him to major in horticulture and study citrus and turfgrass.

"I just love being in nature," Fields said. "I love being outside. I love big ag and working together with growers."

After graduating he worked at a University of Florida citrus research station and then moved to North Carolina State University, where he focused on container plant production and greenhouse floriculture for his master's degree.

While earning his doctorate at Virginia Tech, Fields studied with the state nursery extension specialist. Fields enjoyed the role of extension — conducting research with growers in mind and helping nurseries and farmers solve problems.

Through his research, Fields became interested in helping the nursery industry become sustainable by reducing water and fertilizer in production. His doctoral research focused on engineering potting soils and soilless media — the substrate, as horticulturists call it — to retain and distribute water and fertilizer more efficiently so less of these crucial resources leach away.

Sustainable production benefits the environment, Fields said, but it also reduces production costs.

"Our nursery industry, especially in Louisiana and the South, is growing at a rapid pace," Fields said. "We have to focus on sustainable environmental production to keep this industry thriving."

After finishing his doctorate in 2016, Fields considered job offers from several universities. The position at the AgCenter seemed tailor-made for him.

Managing the verdant trial gardens at the Hammond Research Station was a dream position for Fields. He continues to research sustainable nursery practices, and he has been named the AgCenter contact for citrus production, too.

Also, as the chair of the Louisiana Super Plants program, Fields feels privileged to promote the eye-catching ornamental Louisiana-friendly plants tested by AgCenter researchers.

"People are very excited about Super Plants," he said. "I constantly get asked to go talk about them throughout the state."

An avid hunter and fisherman, Fields felt at home in Louisiana, and it was close to his family in Florida. Plus, the Hammond Research Station is one of the most picturesque postings at the AgCenter, with its huge live oak trees and sprawling gardens.

"If you're having a bad morning or anything," Fields said, "when you drive past these gardens to work every day, I mean, you can't beat that."

Kyle Peveto is an assistant specialist with LSU AgCenter Communications and the assistant editor of Louisiana Agriculture.



Jeb Fields manages the trial gardens at the AgCenter Hammond Research Station. Photo by Kyle Peveto

Specialty Crop Plant Diseases on the **Rise in Louisiana**

Raj Singh

Louisiana's long growing season and mild winters allow growers to cultivate a large number of specialty crops, including fruits and nuts, ornamental plants and vegetables. However, Louisiana's hot and humid weather provides a conducive environment for plant pathogens to quickly establish and spread. As a result, several plant pathogens are threatening a wide variety of the state's specialty crops. This article summarizes the current status of several new, high-impact plant diseases:

ARMILLARIA ROOT ROT

This is an aggressive disease of trees and woody ornamentals. Some important host species include apple, blueberry, citrus, fig, peach, pecan, persimmon, azalea, bald and Leyland cypress, bottlebrush, camellia, crape myrtles, elms, Italian cypress, magnolia, pine, oaks and weeping willow. The disease can be caused by several species of *Armillaria*. However, *A. mellea* and *A. tabescens* are the most commonly associated species with this disease. Both species have been found in Louisiana. The pathogen can survive in decaying stumps and roots in the soil for several years. Armillaria root rot has been detected in almost all parishes in the state. There is no cure for this disease. Once a plant is infected and the fungus is established, little can be done to save it.



Figure 1. Dead Italian cypress (right) infected with Armillaria root rot disease.
Photo by Raj Singh

BOXWOOD DIEBACK

This fungal disease is caused by *Colletotrichum theobromicola*. Currently, this pathogen is known to cause disease in English, Japanese, Korean and Baby Gem boxwoods. Boxwood dieback has been detected in boxwood liners, which are thought to introduce the disease to new locations. The disease spreads from plant to plant by poor pruning practices and by the dispersal of spores via rain or irrigation water. Recently, the causal agent has been isolated from the roots, suggesting that it may spread through intertwining boxwood roots.

Although environmental conditions suitable for boxwood dieback are not known, Louisiana's hot and humid weather appears extremely conducive for dieback development. The disease has been confirmed in several southeastern parishes and Rapides Parish, which is in the center of the state and where many nurseries specialize in boxwood. Because boxwood dieback is a recently discovered disease, control measures, such as fungicides, are limited. Therefore, landscapers and nursery workers should follow good management practices and create an environment likely to decrease the spread and development of boxwood dieback. Because removing dead and dying twigs from plants infected by the pathogen is not known to control this disease, all symptomatic plants in the landscape should be removed and destroyed.



Figure 2. Boxwood exhibiting random dieback of foliage caused by *Colletotrichum theobromicola.*
Photo by Raj Singh

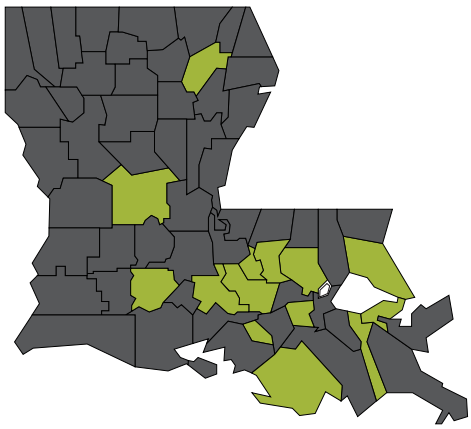


Figure 2a. Current distribution of boxwood dieback in Louisiana.

CITRUS CANKER

This bacterial disease, caused by *Xanthomonas axonopodis* pv. *citri*, is highly infectious, and lesions appear about 10 to 14 days after infection. Frequent heavy rains facilitate the movement of bacteria from tree to tree, but long-distance dispersal is generally attributed to human movement of infected or exposed citrus material as well as hurricanes and tornadoes. Currently, the parishes of Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. James and St. John the Baptist are quarantined. Recently, citrus canker has been identified from East Baton Rouge and Livingston parishes. Timely application of copper-based fungicides before disease development may suppress the bacterium.



Figure 3. Sweet orange fruit showing raised canker lesion caused by citrus canker disease.
Photo by Raj Singh

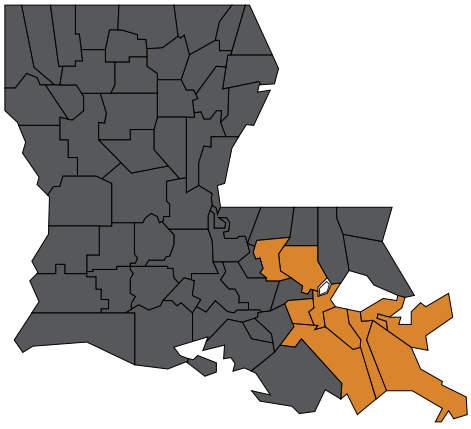


Figure 3a. Current distribution of citrus canker in Louisiana.

CITRUS GREENING

Also known as yellow shoot disease or huanglongbing, this bacterial disease is caused by *Canididatus* Liberibacter asiaticus. The pathogen is transmitted by the Asian citrus psyllid — a sap-sucking insect — or by grafting. All citrus cultivars are susceptible. Citrus greening is a systemic disease, and affected trees may not show symptoms for years. Depending on the citrus cultivar, the symptoms can vary greatly. These parishes are quarantined for citrus greening: Jefferson, Orleans, Plaquemines, St. Bernard and Washington. Parishes quarantined for the Asian citrus psyllid include Jefferson, Orleans, Lafourche, Plaquemines, St. Bernard, St. Charles, St. James, St. Tammany, Tangipahoa and Terrebonne. Manage over-wintering populations of the Asian citrus psyllid with timely application of insecticides labeled for citrus production, and use clean plant material to graft citrus trees.



Figure 4. Lopsided grapefruit caused by citrus greening disease.
Photo by Raj Singh

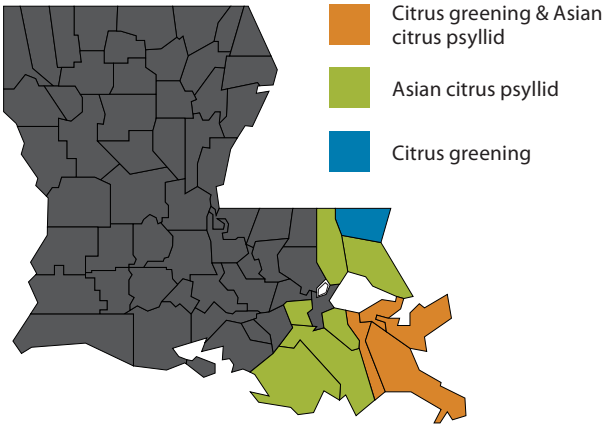


Figure 4a. Current distribution of citrus greening and Asian citrus psyllid in Louisiana.

LAUREL WILT

This devastating disease of trees, in the family *Lauraceae*, was confirmed from sassafras in Union Parish in the fall of 2014. The disease is caused by the fungus *Raffaelea lauricola*, which clogs the water-conducting tissue, or xylem, of the tree. As a result, the infected tree wilts and eventually dies. The pathogen is transmitted by the redbay ambrosia beetle *Xyleborus glabratus*. Trees currently susceptible to laurel wilt include avocado, camphor tree, California laurel, pondberry, pondspice, redbay, sassafras, spicebush and swampbay. Laurel wilt is present in 12 Louisiana parishes. There is no cure for this disease. People must avoid moving infested firewood from areas where laurel wilt and redbay ambrosia beetle are prevalent.



Figure 5. Sassafras tree infected with laurel wilt exhibiting black discoloration of sapwood.
Photo by Wood Johnson, USDA Forest Service

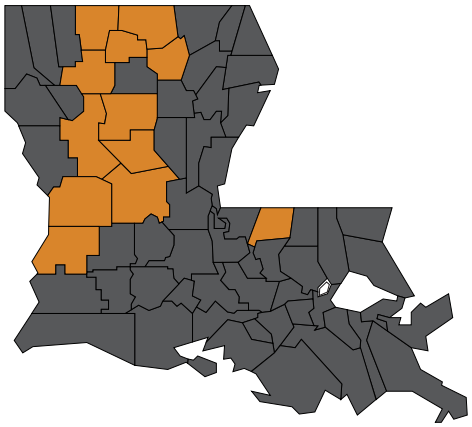


Figure 5a. Current distribution of laurel wilt in Louisiana.

ROSE ROSETTE DISEASE

This disease was first discovered in Louisiana in 2015 in Bossier City. Rose rosette is a devastating disease of roses, and all cultivars are susceptible including Knock Out, drift and wild multiflora rose. The disease is caused by the *Rose rosette virus* and transmitted by a tiny eriophyid mite, *Phyllocoptes fructiphilus*, or by grafting. During 2018, a major disease outbreak occurred in Shreveport and Bossier City, and all major plantings of roses in the home garden and commercial landscapes were infected. Once roses are infected, there is no cure. Several precautions can be taken to avoid introduction of rose rosette or to reduce its spread from infected to healthy roses. Remove infected roses completely, including roots.



Figure 6. Drift rose infected with rose rosette disease exhibiting severe witch's broom symptoms.
Photo by Raj Singh

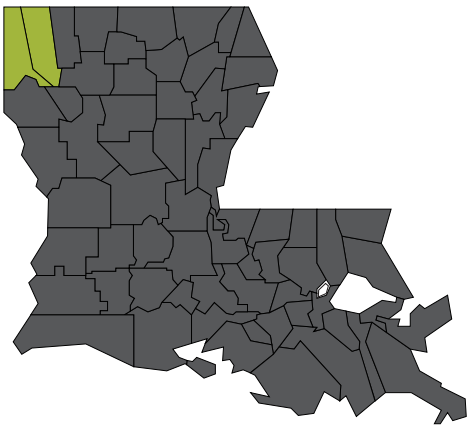


Figure 6a. Current distribution of rose rosette disease in Louisiana.

LETHAL BRONZING AND LETHAL YELLOWING

Two new fatal diseases of palms have been detected in Louisiana — lethal bronzing and lethal yellowing. Lethal bronzing was first detected in 2013 from *Pheonix canariensis* in Orleans Parish. Later, bronzing was found in Jefferson and St. Bernard parishes. More recently, this disease was detected from *Trachcarpus fortunei* in East Baton Rouge, Iberia and West Baton Rouge parishes. The disease is caused by a phytoplasma, *Candidatus* Phytoplasma palmae 16SrIV-D, an unculturable bacterium with no cell wall that is closely related to but genetically distinct from phytoplasma strain 16SrIV-A, which causes lethal yellowing of palms. Lethal yellowing has been detected from East Baton Rouge and Jefferson parishes on *T. fortunei* and *P. sylvestris* in 2018 and 2019, respectively. Both lethal bronzing and lethal yellow are terminal diseases, and symptomatic palms that tested positive or palms with dead spear leaf must be removed immediately. Palms that look healthy or asymptomatic near infected palms should be tested to be free of phytoplasmas.

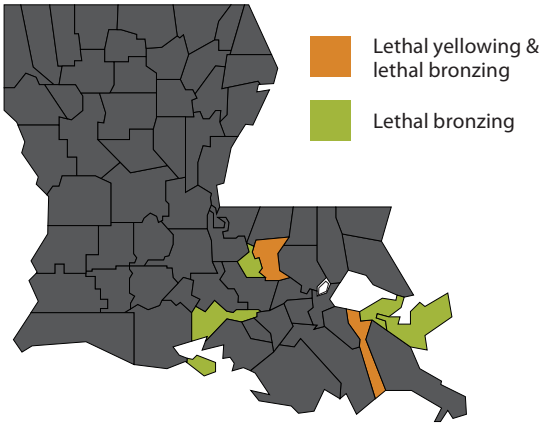


Figure 7. Current distribution of lethal yellowing and lethal bronzing in Louisiana.



Figure 8. Canary island date palm infected with lethal bronzing disease.
Photo by Raj Singh



Figure 9. Chinese windmill palm infected with lethal yellowing disease.
Photo by Raj Singh

Raj Singh is an associate professor and director of the Plant Diagnostic Center in the Department of Plant Pathology and Crop Physiology.



Apple snail egg mass on a rice plant.
Photo by Blake Wilson



A large apple snail in the entrance of a crawfish trap.
Photo by Mark Shirley

Invasive Apple Snails Threaten Louisiana Rice, Crawfish Production

Blake Wilson, Julian Lucero and Mark Shirley

Invasive apple snails — sometimes called giant, golden or channeled apple snails — are native to South America but have been introduced into many regions. Several species of apple snails are invasive pests in many parts of Europe, Asia, and North and South America. But the species that has been introduced along the U.S. Gulf Coast is *Pomacea maculata*. The snails have been in Louisiana for more than 10 years and have been the focus of ecological research because of their consumption of vast quantities of subaquatic vegetation, eliminating habitat for fish and aquatic invertebrates. Apple snails are not picky eaters. They consume many types of living and decaying vegetation in addition to protein sources such as the eggs of frogs and other amphibians. Apple snails reproduce rapidly and are known for reaching high population densities in freshwater habitats including rivers, bayous, ponds and swamps. The first sign of apple snail invasion into new bodies of water is often the appearance of bright pink egg masses laid on structures and plants emerging from the water.

In 2018, rice and crawfish farmers started reporting high populations of apple snails in their ponds. This discovery was of concern because apple snails are considered major pests of rice in Spain, Southeast Asia, the Philippines, Central America and other regions, where they consume seedling rice. So far, their damage to U.S. rice has been minimal. The widespread adoption of drill-seeding rice (planting into a dry seedbed) and applying the permanent flood approximately five weeks after planting seems to have mitigated the impact of snails in Texas rice.

Drill-seeding is also prevalent in southwest Louisiana, which suggests the snails may be of minimal impact here. However, water management practices are more variable in Louisiana, with some acreage flooded continuously during rice production. Pest potential under these conditions may be greater. The snails can also interfere with rice production by burrowing into levees, requiring farmers to do additional maintenance. There is also potential for beneficial effects because some reports from Texas indicate the snails consume problematic aquatic weeds, such as ducksalad, while leaving the rice alone. Ongoing cage trials are examining what the snails are feeding on in rice fields and under what conditions they may develop into pests. While evidence collected to date suggests the snails may not be terribly damaging to

rice in Louisiana, the situation appears to be more dire for the state's crawfish producers.

Apple snails are reaching high populations in crawfish ponds in some areas and are affecting production. The omnivorous snails are attracted to the bait in crawfish traps. Smaller snails can enter traps and accumulate in large numbers, while larger snails block trap entrances, greatly reducing the daily crawfish capture. Farmers also have to sort through the capture to remove the snails. At some farms, apple snails are caught in such high numbers that finding a place to dispose of them is problematic. Crawfish producers in parts of Vermilion and Jefferson Davis parishes have found the situation so severe that fishing had to be stopped and ponds drained early in the crawfish season. Laboratory and field trials are examining potential controls that can eliminate the snails without adverse effects on crawfish growth and development.

Expansion into rice and crawfish ponds from natural bodies such as the Vermilion and Mermentau rivers was facilitated by the 2016 flood. Following detection of this expansion, LSU AgCenter scientists initiated an invasive species monitoring program across nine southwest Louisiana parishes. This program aims to identify the snails' current distribution as well as determine the rates of expansion and modes of introduction into new ponds. Currently, apple snails are using the Vermilion River, Bayou Carlin and Delcambre Canal to extend populations north from Vermilion Bay into rice fields in eastern Vermilion, Lafayette and Acadia parishes. Other apple snail populations are moving from Lake Arthur and the Mermentau Basin into Jefferson Davis Parish and western Vermilion Parish (Figure 1).

Much of the region is not infested, but further range expansion is anticipated. Introduction onto new farms is likely to continue because many farmers use surface water connected to these major waterways as their primary irrigation source. While some introductions are unavoidable, farmers are being encouraged to prevent accidental transportation of the snails to new areas by checking equipment for egg masses before moving between ponds and by stocking ponds with crawfish only from sources known to be noninfested with apple snails. People are encouraged to contact their local AgCenter extension offices if they believe they have observed apple snails in new areas in southwest Louisiana.



Snails removed from a single pond during the 2019 crawfish season. Photo by Blake Wilson

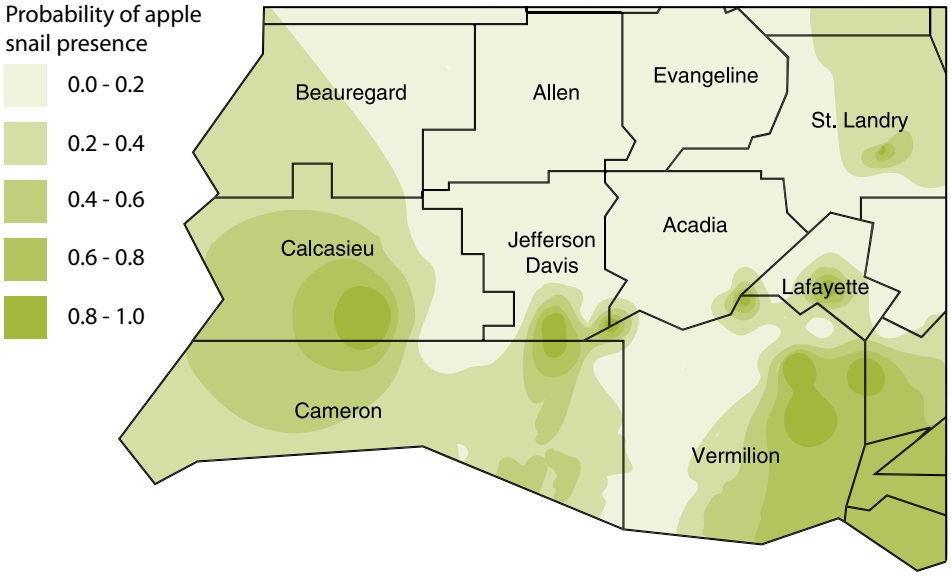


Figure 1. Estimated distribution of apple snails in rice and crawfish production regions of southwest Louisiana as of 2019. Map based on monitoring of 47 rice and crawfish sites in addition to detections provided by the USGS.

HEALTH RISKS ASSOCIATED WITH APPLE SNAILS

While many adventurous Louisianians may be wondering how to best prepare the snails for dinner, people considering consumption of these mollusks should exercise caution. The snails are edible when thoroughly cooked and properly cleaned by removing all intestinal material. However, raw or undercooked snails can contain rat lungworm, a parasite that can cause potentially fatal eosinophilic meningitis. Other health risks are associated with the pink egg masses. The hot pink color serves as a warning to alert potential predators that the eggs are toxic. The eggs contain a protein neurotoxin called PcPV2, which has been shown to be lethal to mice and it can cause irritation of the skin and eyes of humans. Destruction of the eggs should be done using an implement to knock egg masses into the water, where they are prevented from hatching. Skin exposed to apple snail eggs should be washed immediately.

Blake Wilson is an assistant professor at the Sugar Research Station in St. Gabriel. Julian Lucero is a graduate student in the Department of Entomology, and Mark Shirley is a crawfish specialist and marine extension agent in the Southwest Region for the LSU AgCenter and Louisiana Sea Grant.

For 38 Years, **Don Thompson Has Searched for Truth**

Kyle Peveto

Horses were Don Thompson's first love. Then came science.

For decades Thompson, 69, an equine physiologist, has dedicated himself to researching horses, even when grant money and attention were showered upon other fields of study.

"I got interested in science because of the pure search for truth," Thompson said. "What is the truth? Explaining nature — how exactly does it work?"

After 38 years as a professor at LSU and the LSU AgCenter, Thompson retired in 2019, leaving a legacy of research on which other scientists continue to build. Other researchers, including Erin Oberhaus, one of Thompson's former doctoral students, are following his example and building on his work.

"He was always in it for the science," said Oberhaus, who has taken over Thompson's lab. "He was never really interested in what was hot at the time or what was a fad."

Horses became a part of Thompson's life as a child. An old 190-acre dairy farm near his house in New Jersey was converted to a standardbred horse farm, and the owners' sons were around his age.

The long, muscular horses, which race while pulling a two-wheeled cart and rider, caught Thompson's attention. "It was like heaven for me," he said.

Thompson began working at the farm, mucking out the stalls, at 12 or 13. When he was older, he helped break yearlings, training young horses to pull carts. Eventually, the trainers trusted him to exercise the horses on weekends, taking them out with a cart and jogging for 3 miles.

At Rutgers University in New Brunswick, New Jersey, Thompson studied animal science, and for a few summers he worked at horse racing tracks in the state. A 1973 honor graduate with high test scores, Thompson was offered a graduate assistantship to study at Colorado State University, one of the top equine science programs in the country.

At CSU he studied the effects of daylight on stallions' sexual cycle for his Master of Science thesis. His doctoral dissertation analyzed the effects of estradiol, a major female sex hormone, and testosterone on castrated male horses.

"We were looking at what hormones control what," Thompson said. "That was novel work."

Thompson was hired as an assistant professor of animal science at LSU to teach and conduct research. He moved to Baton Rouge in the summer of 1980 with his family, his wife Melissa and two sons with one more on the way.

At LSU Thompson was impressed with his resources, which included a 150-acre horse farm and 125 horses. Thompson went to work, delving deeper into the study of hormones on horses.

In the '80s, he studied whether certain growth hormone treatments would benefit young horses. The horse industry was divided on the treatments. Some thought the treatments would enhance performance. Others thought they could create deformed giants, but Thompson and his team found no real benefit.

In his experimental methods class, Thompson would stress to students that research was simple. Just seek the truth, he said.

"The students said, 'That's it?'" Thompson said. "But think about all the implications of that. All of a sudden money is not a question and all these other things are not a question. It is only what is true — to the best of our ability to define it."

At one time Thompson assigned the class the book "Zen and the Art of Motorcycle Maintenance," a favorite text. One message of the book, a focus on the search for excellence, aligned with Thompson's research philosophy, said Oberhaus.

"In all things in life you should strive for excellence — not necessarily popularity and not necessarily what is considered success," Oberhaus said.

Thompson studied an array of topics from his lab. He developed an inexpensive, simple way to measure insulin sensitivity in horses, one of his proudest achievements because of its practical use.

For decades Thompson has also studied the seasonality of mares and eventually devised a way to get female horses to ovulate in winter. Mares' ovaries go inactive in the fall and remain that way until early spring. Because horses born in January or February have an age advantage in horse racing, breeders want their mares to become pregnant by mid-February so they can give birth the next January or February.

Thompson found a way to use inexpensive endocrine treatments that increase prolactin, a hormone Thompson learned was needed for a mare to begin ovulating.

Thompson lists these developments among his proudest achievements. Other scientists, including Oberhaus, continue to work on the foundation he built.

"It's a great tool. All these are tools we use to increase efficiency, to make things happen the way we want them to happen," Thompson said.

Though retired, Thompson still assists with research. Researchers and veterinarians from all over the world send him samples to analyze. At home he enjoys boating on the Amite River and building furniture for his family.

After nearly four decades at LSU, his absence is felt on campus and at the AgCenter.

"I appreciate all he has done for agriculture, and we miss having him around," said Phil Elzer, director of the School of Animal Sciences.

Oberhaus and Thompson still talk regularly about research and life outside the lab. She considers him a father figure.

"That man has no arrogance," Oberhaus said. "He truly loves what he does. He requires no recognition for it."

Even though he requires no recognition, she said, he still deserves it.

Kyle Peveto is an assistant specialist with LSU AgCenter Communications and assistant editor of Louisiana Agriculture.



Equine physiologist Don Thompson, right, spent 38 years at the LSU AgCenter studying horses. Erin Oberhaus, left, a former student of Thompson's, is continuing his research.

Photo by Kyle Peveto



A seasonally drawn-down wetland impoundment at Rockefeller Wildlife Refuge alone hosts thousands of waterfowl each year but has a much lower accretion rate than nearby unmanaged areas.

Photo by Ashley Booth

Researchers Work to Improve

Waterfowl Habitat Management

in Gulf Coast Chenier Plain

Ashley Booth

There's nothing quite like sitting in a duck blind on a chilly December morning waiting for first light. Wind moves the grasses around the blind as unseen mottled ducks call at the edge of the pond. Groups of green-winged teal buzz past on their way farther into the marsh, dark shadows against the greying sky. A cacophony of snow geese honk at each other, resounding from a rice field to the north. Then the sun rises, bringing with it group after group of birds searching for a spot to eat — and the possibility of shooting a bag limit before the morning is over.

The prospect of mornings like this is what brings duck hunters out in the marsh in the wee hours of the morning and a large part of what drives wetland management. For nearly a century, wetland management has centered on providing habitat and food for declining waterfowl populations. These management efforts, along with hunting regulations, have been successful in restoring waterfowl populations to historic numbers. Today, the Chenier Plain — a region of forested ridges called cheniers interspersed with freshwater marshes along the coast of southwestern Louisiana and southeastern Texas — winters millions of waterfowl each year.

Part of the reason the Chenier Plain of southwestern Louisiana and southeastern Texas is such good waterfowl habitat is that vast portions of coastal marsh have been blocked off with levees to control water levels. Within these impoundments, land managers can manipulate water levels to create optimal conditions for waterfowl. One such technique involves completely drying the marsh during the summer by draining or pumping water out of the impoundment. This encourages the growth of plants that produce high quality seeds and tubers that waterfowl love to eat. When waterfowl move in for the winter, managers re-flood the marsh, making it attractive to migrating birds in search of food. These seasonal drawdowns are excellent at creating highly productive marshes that provide abundant food for waterfowl. However, these same management efforts may be affecting the long-term health of the wetlands.

In the Chenier Plain, marshes maintain elevation through accretion of organic matter, adding height through root growth and accumulated plant litter. Flooded conditions slow down decomposition of the plant material, allowing it to be stored as soil carbon. However, during seasonal drawdowns, decomposition of plant material in the soil is accelerated. As decomposition increases, soil volume decreases and wetlands may lose elevation. Over decades of seasonal drawdowns, this practice may lead to dramatic elevation losses. As elevation declines, it becomes harder to manage water levels within impoundments, and marshes may eventually disappear entirely as plants become stressed and die off. When marshes lose elevation and water deepens, managers lose the ability to grow enough food



Ashley Booth and recent School of Renewable Natural Resources graduate Cameron Field (standing) evaluate millimeter-level changes in surface elevation using a surface-elevation table in the marsh at Rockefeller Wildlife Refuge.
Photo by Karis Ritenour

for wintering waterfowl and their usefulness as wetland habitat diminishes. In coastal areas that support large wintering populations of waterfowl, elevation loss endangers crucial waterfowl habitat.

We are already beginning to see this phenomenon in marshes of the Chenier Plain that have been intensively managed for waterfowl over the past few decades. While we have an excellent understanding of how management practices influence food resources and waterfowl use of managed wetlands, little research has focused on understanding how these same management practices affect elevation. In the LSU AgCenter School of Renewable Natural Resources, researchers are working to change that.

At Rockefeller Wildlife Refuge in Grand Chenier, Louisiana, researchers from the School of Renewable Natural Resources are studying how management practices affected historic rates of accretion within coastal impoundments. Taking cores of soil from managed and unmanaged marshes, researchers use cesium-127 dating to determine the age of soil layers and infer whether management changes how much soil accretes over time. In a heavily managed, seasonally drawn down unit, historic accretion was significantly lower than in an unmanaged unit. However, this technique does not provide insight into exactly how management is changing accretion or elevation.

To better understand the specifics of how management changes accretion and elevation, researchers are also studying the processes that drive elevation change in impounded coastal marshes in Louisiana and Texas. Surface elevation tables are used to measure millimeter-level changes in elevation along with root growth, decomposition and other processes known to affect elevation. In a seasonally drawn marsh, researchers also assess how carbon gas flow from the soil changes as the marsh is dried out. As carbon gas flow is directly related to decomposition, this experiment may help explain why seasonally drawn down marshes accrete less over time.

While managing wetlands for waterfowl is crucial for producing enough food and habitat for the millions of waterfowl that visit the Chenier Plain each year, seasonal drawdowns are affecting elevation of coastal marshes. In a region that already experiences significant wetland loss and sea level rise, managing wetlands for elevation should be a primary concern. In a future without wetlands to manage, there can be no waterfowl productivity.

Ashley Booth is a doctoral student in the School of Renewable Natural Resources.

Acknowledgements: Booth is researching waterfowl habitat management along with Andy Nyman, professor, and Sammy King, associate professor, and another graduate student, Scott Graham, all in the School of Renewable Natural Resources.

Climate Change and the Role of the Rivers

LSU AgCenter Scientist Studies Rising Levels of Atmospheric Carbon Dioxide from Flooding

Rick Bogren

Many scientists believe rising levels of carbon dioxide in the atmosphere are contributing to climate change. The increase may be related to the frequency that water moves from the ground into rivers and then into the air before returning to land as rainfall.

This water movement is called the hydrologic cycle, and an intensifying hydrologic cycle could increase global carbon cycling, said Yi-jun Xu, a hydrology researcher in the LSU AgCenter, who is conducting a short-term study of the carbon cycle on the Mississippi River.

Initially working with an earlier grant from the National Fish and Wildlife Foundation to study pollution and water quality, Xu began sampling carbon concentrations in the Mississippi River when the record-high flood began in February 2019.

With the sampling already in place, Xu applied to the National Science Foundation for a grant to study dissolved carbon in the river during the extraordinary long flood. He set up locations in Baton Rouge and Belle Chasse on the Mississippi River and in Morgan City at the mouth of the Atchafalaya River, which carries approximately 25% of the waters from the Mississippi from a point just south of the Louisiana-Mississippi state line.

"The river transported large amounts of carbon and nitrates," Xu said. "We found extremely high mass loading of dissolved inorganic carbon and dissolved organic carbon."

The total dissolved carbon could be detrimental to the ecosystem and water quality. "This is unprecedented. We found very high levels of dissolved carbon," he said.

The broader implication is more carbon dioxide is moving into the atmosphere, and the change in carbon dioxide will intensify and accelerate with the increasing biogeochemical cycle, Xu said.

> **"This is unprecedented. We found very high levels of dissolved carbon. –Yi-jun Xu"**

In streams and rivers, organic carbon comes from decomposition of terrestrial sources, such as trees and plants, while inorganic carbon can come from different sources, including the solution of atmospheric carbon dioxide, inorganic carbon bound in sediments, groundwater, and chemical and biological processes.

Water contains gasses, including oxygen and carbon dioxide, Xu said. When dissolved carbon dioxide is in an imbalance with carbon dioxide in the atmosphere, the exchange between water and the atmosphere, called outgassing, increases.

"Normal atmospheric concentration of carbon dioxide is 400 to 410 parts per million," Xu said. "During the flood stage, the river concentration of dissolved carbon dioxide was between 3,000 and 6,000 parts per million."

> **"Scientists estimate the volume of water flowing in the Mississippi River will increase by 11% to 65% by 2100."**

Demineralized inorganic carbon dioxide affects the biogeochemical cycle. "As climate continues to change, the hydrologic cycle intensifies," he said. "As the cycle becomes intensified, more carbon dioxide is discharged into the atmosphere. More carbon dioxide will lead to warmer temperatures."

The past 100 years have seen a 25% increase in flow in the Mississippi River, mostly as a result of changes in land use and river engineering in the watershed, allowing more water to drain off hard surfaces rather than being absorbed into the soils, Xu said.

Scientists estimate the volume of water flowing in the Mississippi River will increase by 11% to 65% by 2100. "Precipitation is increasing the Mississippi River Basin," he said.

The broader implication is that more carbon dioxide will move into the atmosphere through the increasing the biogeochemical cycle, and the National Science Foundation is interested in the scientific observations from his research and the long-term ramifications.

"Findings gained from this research will help coastal resources managers and policy makers make better-informed decisions," Xu said. "The research aims at an unprecedented flood event, and rapid measurements are vital for estimating the carbon movement during such extreme events in the Mississippi-Atchafalaya River System."

The findings can be helpful in investigating carbon dynamics in other river systems, he said. One aspect of this is whether these changes will intensify and speed up the carbon cycle between the land and the oceans.

Rick Bogren is a professor and science writer in LSU AgCenter Communications and associate editor of Louisiana Agriculture.

Annie's Project: Strengthening the Role of Women in Farm Businesses

Maria Bampasidou, Whitney McKinzie and Sara Shields

Women who are farmers and ranchers are critical to the success of Louisiana agricultural operations. Of all agricultural producers in the state, 35% are women, of which 65% are primary operators, according to the 2017 Census of Agriculture. These women managed 9,545 farms and operated 1,841,906 acres of farmland. They partake in a gamut of activities from making day-to-day decisions, managing their land, keeping and maintaining financial records and marketing their products, to caring for the future of their families and their operations. Navigating the modern farm business is complex, and women are partaking actively in decision-making. Across the state, the LSU AgCenter Annie's Project works to support women to become better farm managers and business partners.

Annie's Project – Education for Farm Women is a 501(c)(3) nonprofit organization offering educational programs dedicated to strengthening the role of women by enhancing problem-solving and decision-making skills, building networks, and managing and organizing critical information. The program was launched in 2003 by a University of Illinois extension educator, Ruth Hambleton, as a tribute to her mother, Annette, for her entrepreneurship and her goal of raising a family and being an active partner in the family farm operation.

The program is active in 33 states and has two main curricula: Annie's I and Annie's II. Annie's I emphasizes the five areas of risk in agriculture (production, financial, marketing, legal and human), and Annie's II focuses on transition and estate planning. The workshops are tailored to the needs of the local participants, offering an array of presentations combined with hands-on activities and networking opportunities. An important aspect of the program is to provide a safe harbor for participants to learn in a stress-free, open environment, where they share experiences and relate to actual situations.

The Louisiana chapter has offered Annie's I in seven locations and Annie's II in one. In total, Louisiana, has 76 Annie's graduates. Previously coordinated by Capital Resource Conservation & Development Council Inc., the program came under the direction of the LSU AgCenter in 2017.

A two-day Annie's I workshop funded through an outreach agreement with the Natural Resources Conservation Service in Louisiana took place in September 2019 at the Dean Lee Research and Extension Center in Alexandria. Speakers included local attorneys and representatives from the Farm Service Agency, the Louisiana Department of Agriculture and Forestry, NRCS, Louisiana Farm Bureau, the LSU AgCenter and Southern University.

The 13 graduates from this workshop said their two top topics were estate planning (77%) and NRCS programs (54%) followed by communication style, marketing, Farm Service Agency programs and a web soil survey (38% each). They said the workshop created a safe environment where participants could share information, and the learning environment and learning experience encouraged discussion and interaction.

Annie's Project offers educational workshops and networking opportunities that will help empower women farmers and ranchers in Louisiana. More Annie's Project workshops will be offered in Louisiana in the future.

Maria Bampasidou is the Annie's Project state coordinator and an assistant professor, and Whitney McKinzie is a graduate assistant, both in the Department of Agricultural Economics and Agribusiness. Sara R. Shields is the Louisiana Master Gardener state coordinator and Central Region horticulture coordinator.



Graduates of the 2019 Annie's Project class include, left to right in the back row: Libby Karssen; Michael Campbell; Lisa Robilard; Sara Shields, the Louisiana Master Gardener state coordinator and Central Region horticulture coordinator; Donna Rico; and Maria Bampasidou, the Annie's Project state coordinator and an assistant professor in the Department of Agricultural Economics and Agribusiness. The graduates in the front row, left to right, include: Daisy Kerne; Vickie Mayeaux; Brandi Frey, LSU AgCenter extension agent in Pointe Coupee Parish; Lori Butler; Kristi Enicke; and Peggy Kessler. Not pictured are graduates Chris Karssen and Ervin Norwood. Photo provided by Maria Bampasidou

Artificially Enhanced Transport of Atmospheric Oxygen into Gulf of Mexico Water to Eliminate Hypoxia

Louis Thibodeaux, David Constant, Veda Thipparthi and Haosheng Huang

The purpose of this research is to develop an engineering-science-based solution enhancing the movement of oxygen-enriched surface seawater downward into the deeper oxygen-depleted Gulf of Mexico. A vast hypoxic water layer, with no or low dissolved oxygen concentration, develops every summer in the lower water column just above the seabed along the Louisiana-Texas continental shelf. Termed the "dead zone," it is the second largest such area in the world. Water density stratification, occurring annually along the entire length (260 miles) and width (48 miles) of the shallow (10 feet to 65 feet) shelf in the summer, restricts the vertical oxygen movement and may completely stop the efficient downward movement of atmospheric originating oxygen as illustrated in Figure 1. This oxygen reduction results in fish kills and fleeing fish and shellfish from the bottom layer because of the choked oxygen transport to Gulf of Mexico bottom water.

The current strategy put forth by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, which has been in effect since 1997, is to reduce the nutrient load in surface water streams including the Mississippi and Atchafalaya rivers. This task force includes leadership from federal, state and Native American entities, including the EPA, Departments of Agriculture and Interior, the Army Corps of Engineers and the National Tribal Water Council. In addition, a dozen states have members from several of their state agencies.

While this long-term strategy will continue, it is clear that an on-site alternative is needed because nutrient control has not resulted in substantial reduction in the hypoxic zone. Improved water quality helps both the environment and the local economy because fishing and ecotourism activities are vital to Louisiana. Natural processes and human factors influence the health of our fisheries, and LSU researchers are studying these influencing factors, learning ways to better measure changes and assist with recovery following disrupting events. The rather alarming term "dead zone" is appropriate because hypoxic regions exhibit oxygen levels too low to support aquatic organisms, including commercial and recreational species. Being able to increase oxygen availability should alleviate hypoxic effects on fish growth rate, reproduction, mortality and catch for this economically important living resource in addition to improving fisheries revenue.

A SOLUTION

Mechanical mixing of surface water is an effective oxygen re-aeration technology in common use worldwide, as in using propellers to mix wastewater, which adds oxygen from the

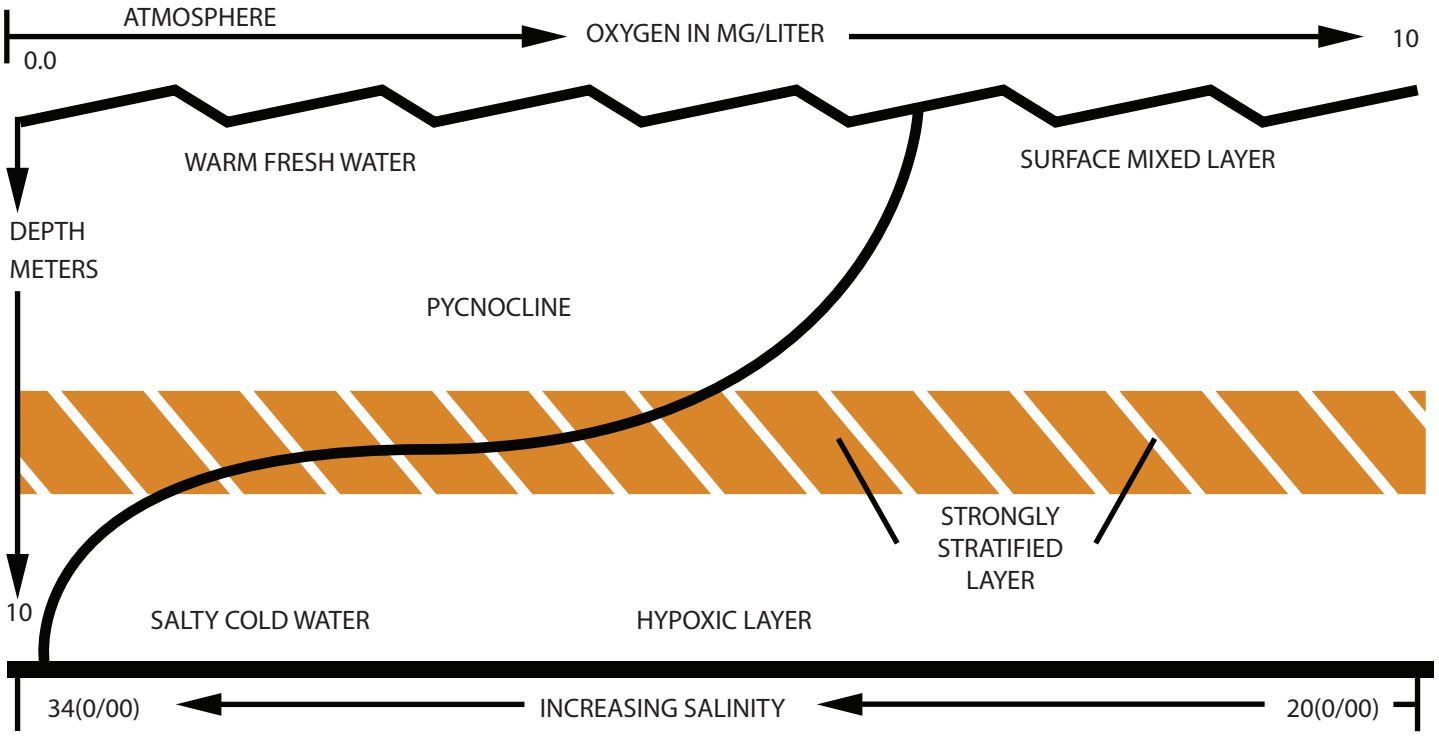


Figure 1. Sketch of typical oxygen profile. Seawater depth (0-10 meters) on y axis. Water salinity in parts per thousand and oxygen in milligrams per liter on x-axis. Strongly stratified water layer position indicated as pycnocline, the target of mixing to break oxygen transport resistance.

air. LSU researchers have demonstrated in laboratory experiments that mechanical mixing of specific layers below the surface but above the bottom is very effective at breaking the density-stratified water layers at depths that restrict rapid oxygen movement. The researchers have simplified a traditional nutrient eutrophication-type theoretical water quality mathematical model to the constant flux model (CFM). The CFM model assumes that the rate of oxygen movement (flux) through the various layers is the same throughout the water column. With the rate fixed, a high resistance zone will result in a large change in oxygen concentration. Likewise, a low resistance zone will display a small change in oxygen concentration passing through. With some field data from LSU and faculty at the Louisiana Universities Marine Consortium in Cocodrie, Louisiana, (LUMCON), the CFM model allows researchers to define oxygen transport from the surface down into the stratified Gulf of Mexico shelf water.

Based on oxygen concentration versus water depth profiles, the model shows the best depth position to place the horizontal rotating impellers, which is the depth at where oxygen vertical downward movement is most restrained — the high resistance zone(s). These oxygen "choke points" are thus located and are now specifically targeted for mixing, which is key to the process. For example, researchers used the model results to predict downward mixing of oxygen-rich Gulf surface water off Terrebonne Bay. The oxygen content was projected to increase from zero to about 1.8 milligrams per liter above the bottom. At all depths in the water column, from surface to seabed, oxygen was predicted to be present and thus hypoxia is considered broken.

LSU researchers will use the results in a future development phase to guide the design of a proposed field test/study site demonstration, if funding permits. Impeller-induced downward flow has been demonstrated in two freshwater lakes, one at Lake Como in Italy and the other Lake Elsinore in California. Breaking hypoxia in the marine water at a location on the Gulf shelf needs to be demonstrated next.

The approach has the flexibility and positioning characteristics to target specific Gulf water locales requiring the need of timely remediation as shown in Figure 2. This approach combines the well-known 20th century propeller mixing re-aeration process, with 21st century emerging alternative power energy technologies, including wind, solar and wave sources. These technologies can provide the source power to a number of individual mixing propellers grouped to target a particular section of the dead zone. Others have successfully mixed stratified zones but input too much energy, disturbing the sediment below the sites. Also, previous work using bubble diffusers at depth were judged to be inadequate. However, a rotation-propeller-based mixing process has shown promise. A direct engineered solution to hypoxia may allow Louisiana to take charge of its coastal resources by increasing fish habitat and wildlife abundance.

Louis Thibodeaux is a professor emeritus in the LSU Cain Department of Chemical Engineering; David Constant is the Zaki Bassiouni Distinguished Professor and Chair of the Department of Biological and Agricultural Engineering; Veda Thipparthi is a graduate assistant in the chemical engineering department; Haosheng Huang is an associate professor in the LSU Department of Oceanography and Coastal Sciences.

Acknowlegements: The authors sincerely appreciate the assistance of Nancy N. Rabalais and R. Eugene Turner for providing water column profile data from northern Gulf of Mexico hypoxia cruises.

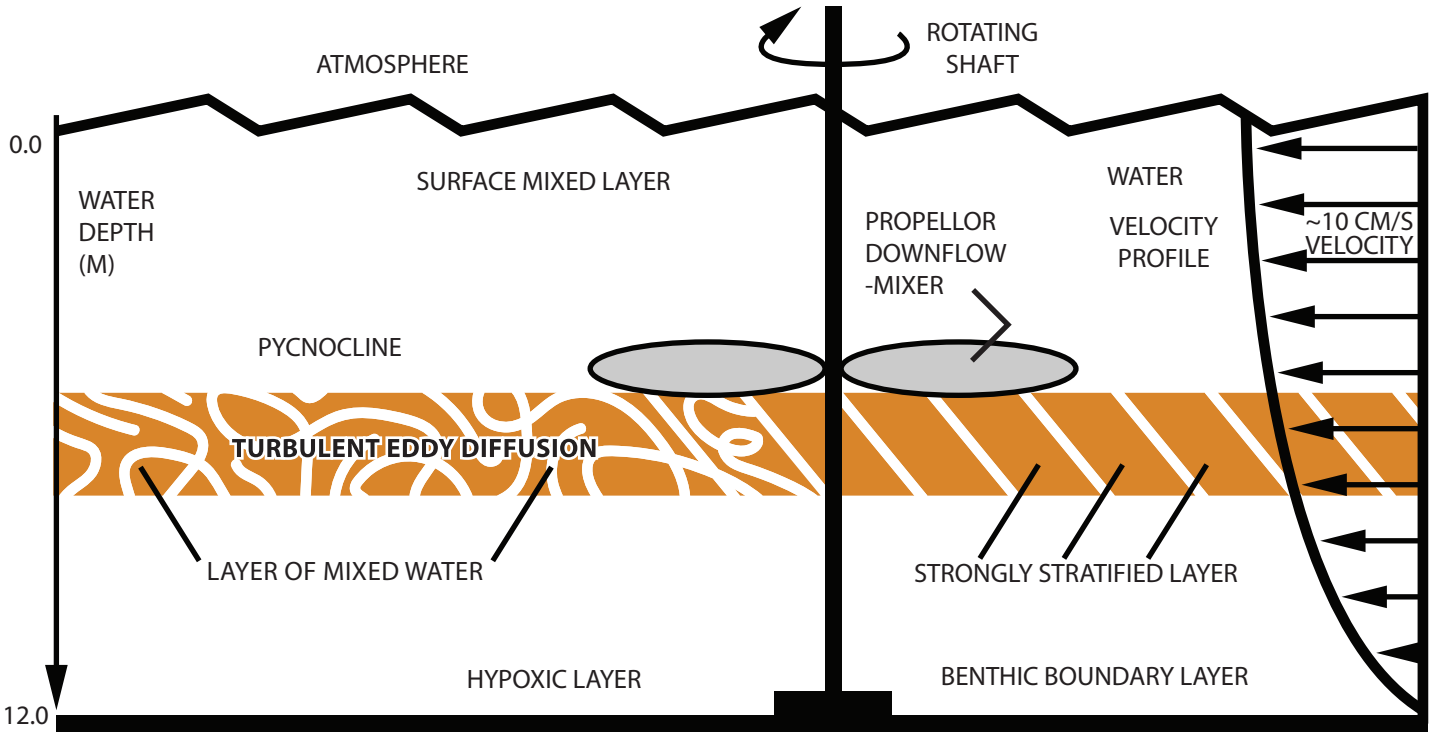


Figure 2. Side view of water column and impeller mixer. Gulf shelf water is shown flowing right to left. Orange water layer targeted for mixing moves with the current from right to left and into impeller "mixing zone." Water enters unmixed and exits mixed, breaking the resistant barrier for oxygen transport downward.

Evaluation of Procedures for **Emergency Disposal of Poultry Carcasses**

William E. Owens and Changyoon Jeong

The poultry industry in Louisiana and across the nation has grown rapidly, and poultry is now the No. 1 animal commodity in Louisiana. Poultry generates approximately $2 billion for the Louisiana economy and is second only to forestry for all commodities. With this increase, challenges have arisen with the handling and disposal of poultry waste, which has become a major issue for the industry.

Poultry waste includes poultry manure, litter, hatchery and processing waste, and dead birds. In addition to the considerable cost and time producers invest in bird disposal, the resulting organic load poses a risk to the environment if not properly handled. Regulatory agencies are increasingly concerned with potential point-source pollution of ground water from buried animal carcasses, including poultry. Recently proposed shallow burial methods may help protect groundwater by keeping the organic matter farther from the water table.

The recent outbreak of highly pathogenic avian influenza (HPAI) and the subsequent loss of 50 million chickens and turkeys in the United States brought the difficulties in dealing with each catastrophic death loss to the forefront. Since it was first identified in the U.S. in the Pacific Northwest in December 2014, HPAI has been detected in commercial and backyard poultry flocks, wild birds and captive wild birds in 21 states. With the latest case of the spring outbreak identified in June 2015, a total of 211 commercial and 21 backyard poultry premises had been affected in the U.S. This resulted in the depopulation of 7.5 million turkeys and 42.1 million egg-laying and pullet chickens, with devastating effects on these businesses and a cost to federal taxpayers of more than $950 million.

While the recent outbreak served to highlight the difficulties of handling catastrophic losses in poultry, this problem has been a major issue in the poultry industry for years. Catastrophic loss or loss of an entire house or multiple houses of poultry can result not only from disease but from other events, such as power loss from storm damage or other mechanical failures.

When a major die-off occurs, exceptional procedures must be put in place to handle the excess mortality. Previously used methods to handle large numbers of dead birds include rendering, landfills, incineration, com-



Test trench with 4-inch perforated pipes to allow air access. Photo by William E. Owens

posting and burial. Rendering and landfills are restricted to locations near enough to existing facilities to be practical. Incineration requires special equipment and is costly. This leaves composting and burial as the most practical alternatives.

Burial has traditionally served as the most convenient method for disposing of large bird numbers. It has the advantage of being relatively low-cost and usually can be accomplished at or very near the site of loss. Burial pit dimensions and depths vary with state regulations and are also dictated by soil types and number of birds to be buried.

In the 2016 HPAI Preparedness and Response Plan prepared by the U.S. Department of Agriculture-Animal and Plant and Health Information Service, state partners were encouraged to assess their ability to perform depopulation and disposal of birds in the event of catastrophic losses. In Louisiana, the broiler demonstration houses at the AgCenter Hill Farm Research Station near Homer were selected to demonstrate shallow or above-ground burial of poultry after a simulated depopulation of a broiler facility. This project was initiated based on discussions with the Louisiana Department of Agriculture and Forestry and the USDA and coincided with plans at the Hill Farm to investigate above-ground burial methods as a means to handle poultry losses. The demonstration was coordinated with the poultry company House of Raeford Farms of Louisiana in Arcadia.



Finished test trench covered with soil. Photo by William E. Owens

For the demonstration, two large trenches were dug, one for the test and one to serve as a control. The control trench had no air pipes and no wood shavings as a carbon source. The test trench had three rows of 4-inch sewer pipe with air holes and wood shavings as a carbon source. The test trench, fitted with 4-inch perforated sewer pipe to allow air access, reached temperatures above 120 degrees F by day 3, and temperatures remained between 105 and 110 degrees or above for approximately 50 days. The control trench with a similar bird load and no air or wood shavings had much lower temperatures. This trench reached a maximum of 104 degrees F but was below 100 degrees for the majority of the measured period. Periodic excavation of the two trenches revealed that decomposition in the trench with air access was greater than the control. The 4-inch sewer pipe and shallow burial allowed insects, primarily stone flies, access to the decomposing birds. Stone fly larvae are common in decomposing material and contribute greatly to decomposition of birds. Evaluation of trench temperature and core samples of trench material in September 2019 indicated that decomposition in the sewer pipe trench with air and wood shavings was essentially complete.

Results from the various trenches with and without air and shavings demonstrate that air and wood shavings greatly enhance bird decomposition. The shallow location of the trench allowed air and insects to enter the trench, resulting in rapid decomposition of birds. Wood shavings as a carbon source enhanced decomposition. This shallow burial design with air and wood shavings could prove to be a viable alternative to traditional deep burial for disposal of poultry. Further studies on a larger scale are needed to validate these methods.

William E. Owens is a professor at the Hill Farm Research Station in Homer, Louisiana. Changyoon Jeong is an assistant professor at the Red River Research Station in Bossier City, Louisiana.



Bald cypress trees.
Photo by Ashley Edwards

A New Year Brings New **Louisiana Super Plants**

Jeb S. Fields

The Louisiana Super Plants program is an LSU AgCenter educational campaign that identifies superior plant material for Louisiana landscapes. Louisiana Super Plants have undergone rigorous trials at multiple AgCenter locations across the state as well as being vetted and approved by the Louisiana horticulture and landscape industry. As such, Louisiana Super Plants are considered to be university-tested, industry-approved.

The Louisiana Super Plants program is becoming a recognizable brand across the state and surrounding region. In discussions with wholesale and retail growers, it is evident that consumers tend to choose Louisiana Super Plants and especially gravitate toward the newer inclusions. In fact, some retail nurseries report they can't keep new Louisiana Super Plants in stock. As 2020 marks the 10-year anniversary of the program, efforts have begun to develop a statewide impact study of the program's first decade. More information on this study will be available in a future issue of Louisiana Agriculture magazine.

Another relatively new development is that the Louisiana Super Plants program is now officially part of Certified Louisiana, a promotional campaign of the Louisiana Department of Agriculture and Forestry. Certifying the promotion, purchase and sale of Louisiana Super Plants from local nurseries directly benefits Louisiana agriculture.

In addition, the LSU AgCenter is in the process of developing regional trials and demonstration gardens to ensure that Louisiana Super Plants are highly rated across the state. Besides the main evaluation location at the Hammond Research Station, trial gardens are at the Dean Lee Research Station in Alexandria, the Red River Research Station in Bossier City, Scott Research and Extension Center in Winnsboro, and City Park Botanical Garden in New Orleans with additional locations planned.

The first inclusion into the program for 2020 is Lucky Star pentas, a more compact plant than Butterfly pentas, which are already in the program. Pentas are some of the best plants for attracting pollinators to a garden, and with their bright vivid colors, pentas attract people as well. Lucky Star Dark Red was one of the top winners in 2018 in the Hammond Research Station Ornamental Trials, and Lucky Star Lavender was one of the top performers in the 2019 Hammond Research Station Ornamental Trials. The six colors available in the Lucky Star series include Lipstick, White Improved, Deep Pink, Lavender, Violet and Dark Red.

FlameThrower coleus is the second series that will be announced as Louisiana Super Plants in late spring or early summer 2020. FlameThrower coleus can be spotted by its uniquely shaped foliage and bold, lasting colors. This medium-sized coleus works well in the landscape as well as in large containers. Flamethrower coleus joins Henna coleus as a Louisiana Super Plant. Flamethrower coleus thrives in full sun and does best in well-drained soils. Like most coleus, Flamethrower is a low-maintenance landscape plant and is one of the last to flower in the landscape. It is available in seven varieties: Salsa Roja, Serrano, Habanero, Chili Pepper, Chipotle, Spiced Curry and Salsa Verde.

The fall 2020 Super Plants include two woody plants that are well known throughout Louisiana and are popular among gardeners, landscapers, nursery growers and naturalists: American beautyberry and the bald cypress.

American beautyberry, a native woody shrub that grows across the state, is often found in wooded areas but also grown in the landscape. While sometimes considered an understory plant, American beautyberry prefers part sun or dappled shade to thrive. American beautyberry is adapted to many soils and is able to thrive in both moist and drier areas and prefers acidic soils. The lime green opposite-leaved foliage provides an excellent contrast to the vibrant and eye-catching purple fruit that surrounds the stem at leaf nodes. The late-summer fruit is often a deep purple, but forms are available in a variety of shades including white, pink and burgundy. Birds, especially songbirds, and other wildlife are attracted to the large berry clusters. American beautyberry is a low-maintenance landscape plant, only needing light thinning, if desired.

Bald cypress is the state tree of Louisiana and iconic across the state. These native trees are prominent and grow across the entire southeastern U.S. They do well in moist soils and flooded areas; however, they are also adapted to dry soils, allowing them to thrive in almost any Louisiana environment. Bald cypress trees thrive in very hot, humid environments, with faster growth during hot growing seasons, making it a perfect fit for Louisiana summers. Bald cypress is a deciduous conifer, which means it is one of the few cone-bearing plants that loses its leaves in the fall. At maturity, a bald cypress will grow up to 50 to 70 feet tall, and as much as 25 feet wide.

Bald cypress is known for its attractive pyramidal shape with lacy green needles. These needles turn a wonderful rust color in fall before dropping, where they provide natural mulch as well as serve as protection for a host of wildlife. Additionally, bald cypress is desired for its ornamental bark. When grown in wet conditions, bald cypress will form the ubiquitous "cypress knees," which provide additional aesthetics for ponds. A host of aquatic, avian and ground-dwelling wildlife rely upon these trees for nesting, food and shelter throughout the year.

Jeb S. Fields is an assistant professor at the Hammond Research Station.



FlameThrower coleus. Photo by Ashley Edwards



American beautyberry. Photo by Ashley Edwards



Lucky Star pentas. Photo by Ashley Edwards

Identifying the Fertilizer Management Practices of Louisiana Homeowners

Natalie Levy

In the U.S., lawn coverage has been estimated to be between 25 million and 40 million acres. The scale of synthetic fertilizer application has been increasing, particularly in southern states. Improper home lawn and landscape fertilizer management practices can lead to increased nitrogen and phosphorus runoff entering storm drains and waterways. Louisiana's government and environmental agencies have been working to implement a nutrient management strategy to improve water quality. The strategy includes stakeholder engagement within urban/suburban watersheds to enhance the use of best management practices.

The purpose of this study was to determine the current fertilization practices used by Louisiana urban and suburban homeowners and ways to encourage them to adopt the best management practices. To determine how to change behaviors, the researcher used an analytical tool known as Ajzen's Theory of Planned Behavior. The combined effect of homeowners' attitudes, perceived norms and perceived controls on their intention to perform fertilizer management practices was studied, as was the effect of intention and perceived control of their past fertilizer practices. There were 12 practices identified through a pilot study that were subsequently examined in an online questionnaire. The 12 practices were either a recommended fertilization practice or a practice that had the potential to affect water quality.

There were 260 respondents that met the eligibility requirements of being a Louisiana urban or suburban homeowner. They were asked if they had ever applied fertilizer to their home lawn and/or landscape at their current or former residence, and most respondents said "yes" (73.8%). The 192 homeowners that applied fertilizer were asked to select the types of fertilizer most used, and the largest number (42.6%) selected "weed-and-feed." The 192 homeowners were also asked to indicate the amount of fertilizer they would consider using in a single application to their lawn. Most respondents (77.6%) reported that they applied the amount on the product label. The response selected by the second largest group (18.2%) was that they applied the entire bag.

The results from the questionnaire also indicated which fertilizer practices had the greatest potential to change. The two most significant results were found for the "soil testing" practice and the "watering in lawn fertilizer" practice. The soil testing practice is recommended to determine the amount of nutrients to be added to the soil. The homeowners' mean response for past performance of a soil test was that they seldom did this. The results of the analysis indicated that enhancing communal support for soil testing could increase homeowners' likelihood of performing this best management practice.

It is not recommended that lawn fertilizer be watered in with rain because this imprecise method can enhance fertilizer runoff. However, the homeowners' mean response for perceived control was that they had "a large extent of control" watering in lawn fertilizer when rain was expected. Their mean response for intention was "maybe they do intend" to coordinate the application of lawn fertilizer when rain is expected.

Although the homeowners in this study may intend to use a rain event to water in lawn fertilizer, they have been experiencing uncertainty about intending to perform this practice. Therefore, homeowners could be persuaded to change their behavior through an educational program that teaches homeowners methods of irrigation that actually provide control.

Ultimately, to address the fertilizer management practices of concern identified in this study, it is recommended that the LSU AgCenter conduct more educational programs, including publications, social media and classes, on fertilizer management.

Natalie Levy was a postdoctoral researcher in the Department of Agricultural Extension Education and Evaluation. Her major professor was Michael Burnett, department head.



The LSU AgCenter offers educational information on lawn care and the correct and efficient use of fertilizer through the Get It Growing media program conducted by horticulturist Heather Kirk-Ballard. She distributes weekly video spots and newspaper articles, all of which can be accessed from LSU AgCenter social media, including YouTube, Facebook, Instagram and Twitter, and at www.LSUAgCenter.com. Photo by Olivia McClure

RESEARCH BRIEF

Implementation of a K-12 School Garden Leadership Workshop

Celine Richard, Kiki Fontenot, Edward Bush, Pam Blanchard and Carl Motsenbocker

The LSU AgCenter, which has been recruiting and constructing new gardens in Louisiana schools since 2010, has recently received a U.S. Department of Agriculture Specialty Crop grant to fund and train teachers and install 100 school gardens across the state. Additionally, funding was made possible through the Louisiana Farm to School Program and an interagency agreement between the AgCenter and the Louisiana Department of Education Division of Nutrition Services to create and implement a school garden leadership workshop for educators.

When developing the school garden leadership workshop series, the AgCenter addressed the most common knowledge areas necessary for educational success. This study targeted two of the barriers most commonly faced by school garden programs. First, participants were provided with basic garden knowledge. Second, participants were provided with curricula linking the garden to core subjects (math, science, technology, engineering, nutrition, physical education, social studies and art) using the Louisiana Department of Education approved Louisiana Student Standards.

MATERIALS AND METHODS

In 2019, a five-day school garden leadership workshop was conducted at the LSU AgCenter Botanic Gardens in Baton Rouge. Horticulture-based sessions included raised bed construction and irrigation installation; pest (insect, weed and disease) management; vegetable, fruit and herb garden basics; composting, soil and fertility management; pollination, pollinizers and native plants. Education-based topics focused on incorporating gardens into curriculum and included garden-based science and engineering; art and reading; history and social studies; physical exercise, health and nutrition; math and agriculture.

Two, three-hour training sessions were offered each day via indoor and outdoor activities and lectures. One horticulture topic and one education-based topic were presented on each of the five days. To receive an official certificate for continuing education units, participants had to attend seven of the 10 sessions. Each three-hour session counted toward three CEUs for participants with complete attendance.

The workshop activities not only instructed teachers how to become better horticulturists but also provided materials to establish school gardens. For instance, when discussing native plants, all teachers went home with seeds, cuttings and divisions of native plants. Enough plants were provided for each teacher to establish a pollinator garden. Half of the teachers received a compost bin to use at their school, and the other half received a worm bin. All teachers constructed mason bee houses. All teachers constructed raised garden boxes and beds, and the finished products were distributed for use in participants' schools.

RESULTS AND DISCUSSION

Sixteen teachers completed surveys to assess knowledge gained during the workshop. Teachers were asked to rate each anticipated garden activity as seeing themselves "very likely," "slightly likely" or "not at all likely" to complete the specific task in the 2019-2020 school year. With the exception of the activities "plant a school garden" and "plant spring vegetables," all anticipated garden activities fell in the "very likely" category after teachers completed the School Garden Teacher Leadership Certificate.

The results indicated that overall teacher behavior related to school gardens was changed in a positive manner. Overall garden knowledge of the workshop topics increased significantly from 44% to 75% comparing pre-test and post-test scores. Average test scores significantly increased in 17 of the 24 questions, indicating knowledge gain. When comparing individual questions, average teacher knowledge increased in all 24 questions, although the gain was not significant for seven of the 24 questions. Additional teacher gardening leadership programs are planned for the summers of 2020 and 2021.

Celine Richard is a graduate student, Kiki Fontenot is an associate professor and extension specialist, and Edward Bush is an associate professor in the School of Plant, Environmental and Soil Sciences; Pam Blanchard is an associate professor in the LSU School of Education; and Carl Motsenbocker is a professor in the School of Plant, Environmental and Soil Sciences.



The LSU AgCenter has been helping schools develop educational gardening programs since 2010 and has recently been awarded a U.S. Department of Agriculture Specialty Crop grant to fund and train teachers and install 100 new school gardens in Louisiana. Photo by Betsy Jeansonne

LSU AgCenter Scientists Continue Search for

Cause of Roseau Cane Die-off along Coast



Johnny Morgan

Scientists from the LSU AgCenter and several other agencies met for the second annual Roseau Cane Research Summit in Baton Rouge in December 2019 as they continue to investigate the decline in the health of roseau cane, or phragmites, a vital marsh grass in the lower Mississippi River Delta.

AgCenter entomologist Rodrigo Diaz is leading the group of federal and state researchers who are looking at the possible cause of the die-offs.

"We're looking at a number of possible causes, but there's no way to be sure until we put all the pieces together," he said.

Diaz and the scientists began their study of the die-off in 2016, when it was first discovered.

Jim Cronin, a professor in the LSU Department of Biological Sciences, suspects multiple stressors could be affecting roseau cane health. One may be toxins in the soil.

"We are comparing soil chemicals from where it's died off to areas where it is healthy," Cronin said.

With the sediments and chemicals that come down the Mississippi River and are deposited into the marshes that make up the lower river delta, phytotoxic properties could be found in the soil, he said.

Cronin plans to analyze soil samples across coastal Louisiana to look for patterns in areas where die-offs are prevalent.

Diaz said research in the previous year focused on understanding the interaction of scale insects, cane variety and salinity.

"We exposed three cane varieties to different levels of scales and salinity using an open field at the LSU campus," he said. "After six months we found that the density of scales was much higher in cane growing at high salinity levels, and this was associated with browning of the cane. This shows the complexity of the die-back because the manipulation of one stressor, such as salt, led to greater impact of the scale."

AgCenter coastal ecologist Andy Nyman is looking at what follows roseau cane dieback. He has found that after the die-offs, there sometimes is no roseau cane to replace it — just open water. Other times, the roseau cane returns or is replaced with other wetland plants.

Nyman said another study is looking at when the die-offs started, which may have been as early as 2013, and how the die-offs may affect river navigation.

"The bulk of the dieback is occurring at the mouth of the river," he said. "If we lose the phragmites, it will become increasingly expensive to maintain the river for oceangoing ships," he said.

As the cane dies, more water will "escape" from the river. And as more water escapes from the channel, the river moves slower, causing it to carry less sand, which piles up and makes it harder for bigger ships to navigate, he said.

Glenn Suir, research agronomist with the U.S. Army Corps of Engineers, said his group is using remote sensing from satellites to collect data.

"We're able to look at larger areas and over a longer time period using satellite data than what a lot of folks can do out in the field," Suir said.

When the group began their study, they were mainly interested in roseau cane scale, an insect known to damage the plant. Results demonstrated that scale attacks only roseau cane and not crop grasses. In the second year, other scientists joined to look at other plant stressors, including soil toxins and pathogens that may be responsible.



Johnny Morgan is a writer and photographer with LSU AgCenter Communications.



Members of the research team studying the causes of the roseau cane die-off are, left to right, Leslie Aviles, LSU AgCenter research associate; Jim Cronin, LSU professor in the Department of Biological Sciences; Nick Uzee, student worker; Rodrigo Diaz, AgCenter assistant professor in the Department of Entomology; and Madeline Gill, AgCenter research associate. Photo by Trebor Victoriano



The research team is growing the roseau cane in cattle tanks at the LSU Innovation Park, south of the LSU campus, and subjecting these plants to a number of stressors including flooding, pathogens and variations in nutrients to look for possible causes of the die-off. Photo by Rodrigo Diaz

Inside:

Even in retirement, Don Thompson, an equine physiologist, helps further the cause of science and mentor new scientists. *See page 16*

Managing wetlands for waterfowl is crucial for producing enough food and habitat for the millions of birds that visit the Chenier Plain along the Gulf of Mexico coast of southwestern Louisiana. *See page 18*

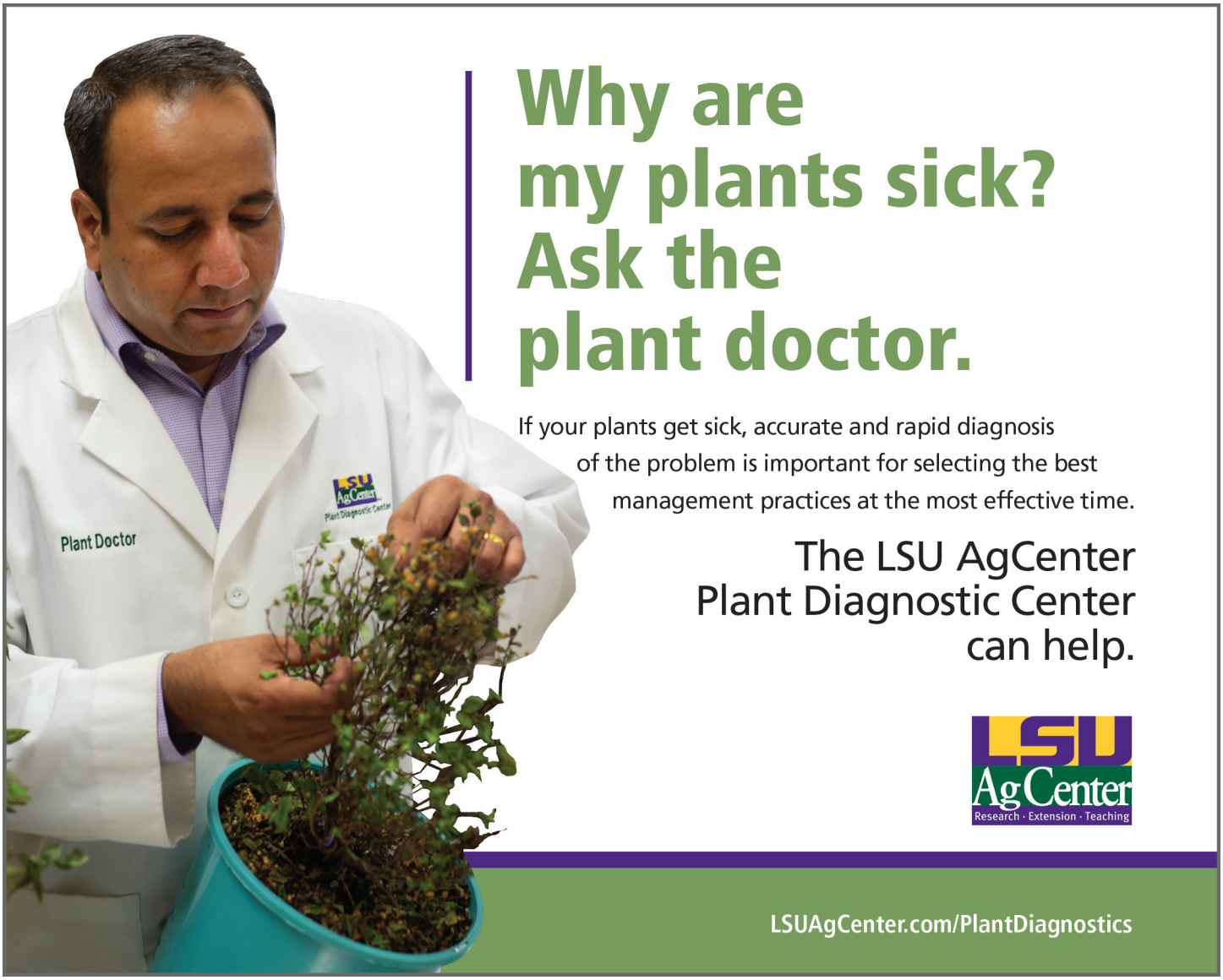
Yi-jun Xu, an LSU AgCenter hydrology researcher, is studying the effects of record-high flooding of the Mississippi River and climate change. *See page 20*

David Constant, professor and head of the Department of Biological and Agricultural Engineering, is working with a team to develop an engineering-science-based solution enhancing the movement of oxygen-enriched surface seawater downward into the deeper oxygen-depleted Gulf of Mexico. *See page 22*

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