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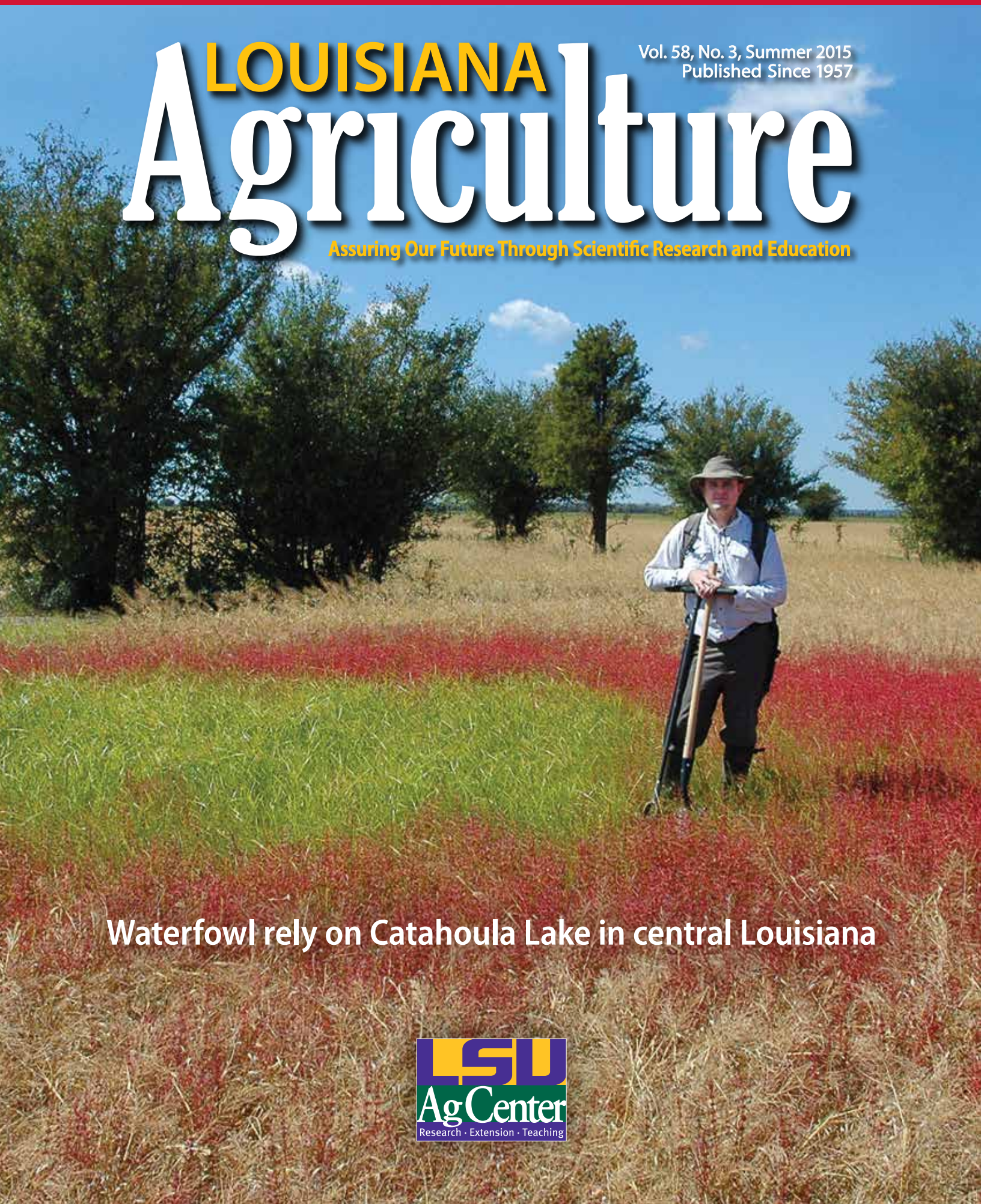

Waterfowl rely on Catahoula Lake in central Louisiana

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Enforcement of new Clean Water Rule still unclear for farmers

Olivia McClure

Although a rule that revises which bodies of water are subject to Clean Water Act regulations has taken effect, the agricultural community continues to be concerned about how strict federal scrutiny will be.

Agricultural water has always been exempt from Clean Water Act regulations, but the new Clean Water Rule incorporates several types of water that were never regulated before and are common on farms.

Tributaries and waterways adjacent or connected to a previously jurisdictional waterway must now comply with the Clean Water Act, said LSU AgCenter economist Naveen Adusumilli. Drainage ditches and irrigation runoff, for example, are not specifically regulated by the act but drain into those that are.

"Can farmers dig a ditch now, and how will it be regulated? It is unclear right now," Adusumilli said.

The changes are spelled out in the Clean Water Rule, which was written to clarify a vague term in the act that caused uncertainty in interpretation of regulatory authority.

LSU AgCenter economist Naveen Adusumilli is trying to help Louisiana farmers understand and implement the new rules under the Clean Water Act. Photo by Olivia McClure

Both the Environmental Protection Agency and the U.S. Army Corps of Engineers jointly enforce the act, which applies to "waters of the U.S.," which includes wetlands and navigable waterways used for commerce. The original definition is vague about whether regulations apply to seasonally flowing streams and waterways near regulated waters.

The Clean Water Rule brings waters in 100-year floodplains under jurisdiction. But those areas are dry most of the time, Adusumilli said, so it is unclear when exactly they would be subject to Clean Water Act standards.

Under the new rule, any waterbody with a "significant nexus" to a navigable waterway is also jurisdictional. The nexus is considered significant if the waterway performs any of nine functions, including trapping sediments or nutrients, Adusumilli said.

"There's a lot of uncertainty with some of those definitions," Adusumilli said. "How do farmers identify if those functions are there? Who's going to help? At this time, we don't know who the final authority will be to assess those situations."

Though the rule has been finalized, the EPA and Corps must now determine how to enforce it, he said. Meanwhile, attorneys general from 27 states are challenging the rule in a lawsuit.

EPA officials have said their agency will not regulate agriculture activities or expand its authority to waters not already under its jurisdiction. They maintain that exemptions made for agriculture in the Clean Water Act, such as waiving Section 404 permit requirements for farms, ranches and forestry operations, will continue. But, determining physical, chemical and biological connectivity among waters could require extensive case-by-case analysis, which involves substantial time and money.

Olivia McClure is a graduate assistant with LSU AgCenter Communications.

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DEPARTMENTS

FEATURES

SCIENCE NOTES

ON THE COVER: Richard Keim, associate professor in the School of Renewable Natural Resources, stands on the bed of Catahoula Lake during low water in the fall when much of the lake is dry. Small variations in the lake bed and water levels cause patchiness in plant communities. Establishment of woody plants, such as the water-elm and baldcypress seen here, reduces cover of the herbaceous plants that are important for wildlife habitat. Photo by Karen Latuso

Leodrey Williams. Photo by Olivia McClure

SU Ag Center chancellor retires after 50 years

After 50 years of service, Leodrey Williams, chancellor of the Southern University Agricultural Research and Extension Center, retired on June 30, 2015.

Williams grew up working on his family's farm in Pinckneyville, Mississippi, and was a member of the New Farmers of America Program in high school. After graduating, he enrolled at Southern University and majored in vocational agriculture.

"I wanted to work internationally in developing countries," he said.

However, things did not work out as planned. Just before his graduation, Williams was drafted into the Army. After three years and a couple of months, "that was enough foreign service for that time. I was ready to go to my professional job," he said.

In 1965, after being hired by LSU as the assistant county agent for work with Negros in Richland Parish, Williams began his professional career in agriculture with Cooperative Extension. Six weeks later, the title was deemed illegal after the passing of the Civil Rights Act.

In 1971, Southern University established its own extension office and hired Williams as an agricultural specialist. In 1980, he was named extension director.

In the early 1990s, he was called to Washington, D.C., to serve in a national capacity with Cooperative Extension. He led the effort to merge two agencies into one, which was named the Cooperative State Research, Education and Extension Service. This agency later became the National Institute of Food and Agriculture.

He returned to Southern in 1995 as the extension director and in 2001 was asked to lead the newly formed Southern University Agricultural Research and Extension Center. **LaKeeshia Giddens, Donna Badon and Olivia McClure**

Louisiana 4-H team places second in seafood cook-off

A team of young chefs from Ascension Parish earned second place in the Great American Seafood Cook-Off 4-H Edition on Aug. 9 in New Orleans. Their creation, called Seafood Eggs Benedict, featured crawfish and crab meat.

A team from Starr County, Texas, won the competition. Third place went to a team from Saluda County, South Carolina. Other participants included 4-H teams from Benton County, Arkansas, and Pearl River County, Mississippi.

During the competition each team was given one hour to prepare their dish using American seafood. The Louisiana participants were Eden Schexnayder, Kassie deVeer and brother and sister Jared and Hannah Barrilleaux. The team was coached by Katie deVeer, Kassie's sister.

"Parents played a huge role," said Ascension Parish AgCenter 4-H agent Stephanie Gravois. **Rick Bogren**

The Ascension Parish team of Eden Schexnayder, Jared Barrilleaux, Kassie deVeer and Hannah Barrilleaux captured second place in the Great American Seafood Cook-Off 4-H Edition on Aug. 9 in New Orleans. Photo by Rick Bogren

Teachers rewarded for school gardens

Teachers who started gardens at their schools last year were recognized for their progress at a workshop on July 29 at the LSU AgCenter Botanic Gardens at Burden.

Ten south Louisiana schools were awarded grants last summer to implement gardens at their schools, said AgCenter gardening specialist Kiki Fontenot. The teachers returned for the workshop to learn how to continue the gardens without the financial backing of the AgCenter and to receive trophies as congratulations on being an excellent school gardener.

At the workshop, each teacher gave a progress report on their project and recommendations for what can be done to make the gardens better this year, Fontenot said.

The schools involved in the program included five in East Baton Rouge Parish, two in Iberville Parish, two in West Feliciana Parish and one in Jefferson Davis Parish. The sponsors included the Pennington Family Foundation, Blue Cross Blue Shield of Louisiana, East Iberville School Group and the Albemarle Foundation.

Fontenot said she hopes to receive additional corporate sponsorships to bring in another group of teachers to begin their school gardens. **Johnny Morgan**

Ten teachers participating in the LSU AgCenter school gardening program received awards for completing the project. Front row: Elizabeth Norwood, Central Middle School, Central; Michelle Grantham, Villa del Rey Elementary, Baton Rouge; Lanya Mayer, Bains Lower Elementary, St. Francisville; Ivy Jones, Martin Luther King Christian Jr. Academy, Baton Rouge; Second row: Casey Maryman, Bains Elementary, St. Francisville; Maddi Aguillard, Fenton Elementary, Fenton; Diana Hammond, Villa del Rey, Baton Rouge; Ellen LeBlanc, MSA-East Academy, St. Gabriel; Maisa Shelmire, Baton Rouge Juvenile Detention Center; and Ronald Grace, East Iberville Elementary, St. Gabriel. Photo by Johnny Morgan

AgCenter trains Chinese on port inspection, food safety regulations

LSU AgCenter International Programs completed a two-week (July 18-Aug. 2) cross-country training program on port inspection and food safety regulations for eight officials from China.

The group included personnel with the China Inspection and Quarantine Service in Guangdong Province, which oversees 25 percent of American agricultural imports into China, said David Picha, director of AgCenter International Programs. The visitors are fellows in the U.S. Department of Agriculture Cochran Fellowship Program, which educates representatives from numerous countries about American agriculture and trade.

Picha led the training, which focused on how U.S. product inspection and food safety regulations are created, monitored and enforced. The group spent several days in Washington, D.C., with federal agencies and trade associations and visited seaports in Baltimore; New Orleans; Portland, Oregon; and Long Beach, California.

The fellows also attended the International Association for Food Protection conference and trade show in Portland, Oregon.

Olivia McClure

A group from the Chinese Inspection and Quarantine Service visit the U.S. as part of an LSU AgCenter training program led by AgCenter International Programs director David Picha, center in purple shirt. Photo provided by David Picha

A pair of combines cut rice on the J&L Lawson Farm north of Crowley. Farmers in south Louisiana are reporting yields are down slightly this year, and LSU AgCenter experts are blaming the wet spring. Photo by Bruce Schultz

2015 proves challenging year for rice

South Louisiana rice farmers have had excellent weather to get the 2015 crop out of the field, but the yield is a decline from the two exceptional harvests of the past two years, according to LSU AgCenter experts.

"This is not going to be one of the harvests for the record books," said Steve Linscombe, director of the LSU AgCenter Rice Research Station, adding that this year's harvest in south Louisiana is down an estimated 10-15 percent from last year.

The north Louisiana rice crop has endured unusually hot, dry weather that could affect grain quality, he said.

"This has been one of the most difficult years for rice producers that they've seen in a long time," said AgCenter rice specialist Dustin Harrell.

Both listed heavy rainfall from March until May, and frequent overcast skies as major reasons for lower yields. More clouds mean less sunshine for photosynthesis, and that resulted in fewer and smaller grains per plant, Linscombe said.

Harrell said the excess rainfall complicated the season because farmers were not able to make fertilizer applications on time.

Disease was a factor in the harvest, Linscombe said. Blast disease was comparable to the 2012 levels, and it resulted in lower yields. Bacterial panicle blight also showed up, he said, but sheath blight was not as bad as usual, probably because fungicides worked well against that disease.

"Quality seems to be OK, especially on our earlier-planted rice," Linscombe said. But later-planted rice that matured during the hotter temperatures will probably have quality problems, especially with chalk, he said.

Even though planting was delayed by weather, harvest went smoothly in south Louisiana with few rain interruptions. Dry weather prevented farm equipment from rutting the fields, Linscombe said. That means a good start for farmers growing a second crop of rice. **Bruce Schultz**

Sisters turn old recipe into new food business

Some people turn to family recipes for comfort during stressful times. Others, like Linda McAdams, from Prairieville, Louisiana, turn them into a new career.

When McAdams was laid off in 2013, she interviewed for several jobs but was rejected from all of them. Then, she realized, "maybe what we needed to do was right in front of us all this time."

For about 30 years, McAdams and her sister, Karen Daigle, had been making a salty-sweet treat using crushed pretzels and melted chocolate for family and friends. They decided to turn the popular snack into a business.

They joined the LSU AgCenter Food Incubator months later in July 2014. In just a year, Truly Southern Pretzel Crunch became one of the incubator's most popular products. It is now sold in 34 Associated Grocers stores in Louisiana, Texas and Mississippi. **Olivia McClure**

Truly Southern Candies and Confections makes four flavors of Pretzel Crunch in the LSU AgCenter Food Incubator. The products are sold in 34 Associated Grocers stores in three states, including Louisiana. Pictured clockwise from left are Nancy McAdams, Karen Daigle, Linda McAdams and James McAdams. Photo by Olivia McClure

Louise Wicker

Wicker named director of nutrition, food sciences

Louise Wicker, a food scientist who spent much of her career on the faculty at the University of Georgia, was named director of the LSU AgCenter and College of Agriculture School of Nutrition and Food Sciences. She started on July 1.

She spent 27 years at the University of Georgia in food science and technology. She coordinated the Master of Food Technology, a part-time degree program for full-time working professionals in the food industry, and managed the transition to a fully online degree program.

Wicker also served as the team leader of the university's obesity initiative.

Wicker was drawn to the AgCenter because the school includes both nutrition and food sciences as well as the school's relationship with Pennington Biomedical Research Center. She is interested in expanding the health and wellness programs to address obesity.

"Ensuring food safety with all players in the value-added chain from production to consumption is integral to our mission, with programs that work with private industry and regulatory bodies and those that teach people how to choose foods and to prepare them safely," she said.

Wicker received her bachelor's and master's degrees from Clemson University and received a doctorate from North Carolina State University. **Tobie Blanchard**

'Repro Rangers' honor Professor Robert Godke

Former students of LSU Boyd Professor Emeritus Robert Godke gathered for a reception on Aug. 8 at the Animal and Food Sciences Laboratories Building to honor him for his 40 years of overseeing the LSU AgCenter's reproductive physiology program.

The former students call themselves the "Repro Rangers," and many have contributed to a scholarship named in Godke's honor.

Daniel Berry, a professor at Stellenbosch University in South Africa, who studied with Godke in the 1990s, flew in for the event.

"He is a brilliant man," Berry said. "And he became a dear friend."

Stephen Pool, a cryobank director at Fairfax Cryobank in Fairfax, Virginia, said Godke had the ability to bring out the best in his students. He said he was grateful that Godke took a chance on him when he accepted him into his program in the mid-1970s.

"I wasn't the student with the top grades or the best SAT scores, but he took a chance on me, and I respect him for that," Pool said.

Godke said it wasn't the students with the best grades or scores who were the most creative. He stressed that they must have their own ideas and charged them with proving him wrong – a challenge that was intimidating to the students but rewarding when they succeeded.

Godke said he is proud of his students and grateful to have had the opportunity to work with so many.

The Repro Rangers have raised more than $100,000 toward the Robert A. Godke Jr. Endowed Graduate Scholarship.

Donations to the fund can be made by check payable to the LSU Foundation marked Godke Endowment in the memo. Checks can be mailed to Dinah Schuster, LSU AgCenter Office of Development, 101 J. Norman Efferson Hall, Baton Rouge, LA 70803-0106. **Tobie Blanchard**

Former students of Prof. Robert Godke gathered to honor him at a reception on Aug. 8. Pictured are former students Michael Crouch, Stephen Pool, Godke, Godke's former research associate Richard Denniston and former student Brett Reggio. Photo by Tobie Blanchard

Oct. 16 alumni event will benefit scholarship fund

The LSU College of Agriculture is hosting the 2nd Annual Cocktails and Cuisine on Oct. 16 at 6 p.m. at the LSU AgCenter's LaHouse. Proceeds from event will benefit the Dean's Scholarship Fund.

"Scholarships are critical to recruiting and retaining high-achieving students," said Bill Richardson, dean of the College of Agriculture and LSU vice president for agriculture. "We must grow the number of scholarships we can award to students interested in pursuing a career in one of the many agricultural fields."

Richardson said scholarships also are an important tool in encouraging students to study agriculture. He hopes college alumni and friends will see the value in making an investment in students who will advance the food and fiber industries.

The evening will include a silent auction, entertainment by the John Gray Jazz Trio, and food and beverages, some of which will be provided by tenants of the LSU AgCenter Food Incubator.

Tickets are $30 per person or $50 per couple. To purchase or for more information, contact Lindsey Kelly, Director of Alumni Relations, at lkelly@lsu.edu or visit www.lsu.edu/agriculture/alumni. **Tobie Blanchard**

Two students awarded teaching scholarships

Nicholas Adams and Chelsea Sutherland, both LSU College of Agriculture seniors studying agricultural education, have been selected for the Upper Division Agricultural Education Scholarship from the National Association of Agricultural Educators. Adams is from Gheens, Louisiana, and Sutherland is from Monroe, Michigan.

Each $750 scholarship is awarded to upper level agricultural education majors to help offset expenses during their student teaching experience. Fifteen students from across the United States were selected based on their academic performance as well as on leadership and service activities.

Adams will teach at Lakeview High School in Campti, and Sutherland will be at Opelousas High School in Opelousas – both in the spring of 2016. **Tobie Blanchard**

Nicholas Adams

Chelsea Sutherland

Students travel to Eastern Europe

Tim Sandles is not usually one to venture outside of his comfort zone. The LSU graduate student from Madisonville, Texas, studying agricultural education decided to push himself this summer when he signed up for a study abroad program in Europe.

"I knew it would be a good opportunity for personal development," Sandles said. "It definitely exceeded my expectations."

Sandles journeyed to Austria, Slovakia and the Czech Republic in June with three other students and J.C. Bunch, assistant professor in the Department of Agricultural and Extension Education and Evaluation.

"It is important to many companies and employers in the agriculture industry that potential employees have some international experiences with other countries and their cultures," Bunch said.

The group toured agricultural universities, farms, bakeries, breweries and wineries as well as cultural landmarks in the three countries. **Tobie Blanchard**

The tour group included, left to right, Timothy Sandles, student; Mary Claire Gilder, college recruiter; Myra Boudreaux and Chelsea Sutherland, both students; and assistant professor J.C. Bunch. They are in Bratislava, the capital city of Slovakia. Photo provided by J.C. Bunch

A team of LSU graduate students competed in the National Weed Contest held in Columbus, Ohio, July 21. Team members, from left, are Tommy Batts, Josh Copes, James McKibben, Eric Bergeron, Brandi Woolam, Matt Foster, Ben McKnight and Sam Rustom. Photo by Bruce Schultz

LSU team places third in weed science contest

An LSU team took third place in the southern division of the National Weed Contest on July 21 in Columbus, Ohio. More than 25 universities and 200 students from the U.S. and Canada participated.

"The LSU team placed third overall in the Southern Weed Science Society Regional Contest behind two Arkansas teams," said Eric Webster, LSU AgCenter weed scientist and coach of the team.

Josh Copes placed seventh in the Southern Weed Science Society contest, and Brandi Woolam placed first in herbicide identification. Members of the team that placed third were Ben McKnight and Copes, doctoral students, and Eric Bergeron and Tommy Batts, master's degree students.

Members of the second team, all master's degree students, were Woolam, Matt Foster, James McKibben and Sam Rustom.

The competition included sprayer calibration, written calibration, weed seed and plant identification, herbicide identification and a farmer problem scenario.

Assisting Webster was LSU AgCenter soybean specialist Ron Levy. **Bruce Schultz**

Water Management at Catahoula Lake

Richard Keim

Catahoula Lake is a Ramsar Wetland of International Importance in central Louisiana and one of the most important habitats for waterfowl in the Lower Mississippi Valley. In recent decades woody vegetation has been increasing at the lake and degrading herbaceous plant communities, which are critical food for waterfowl. LSU AgCenter researchers are investigating the hydrologic mechanisms of this change, and they are working with the Louisiana Department of Wildlife and Fisheries to develop water management strategies that better mimic the natural variability in the lake that originally created this important wetland. The lake has a large annual fluctuation in water level controlled by the Little, Tensas, Black, Red and Mississippi rivers. River management for navigation and flood control has changed lake sediments and water levels in the lake, and the expansion of woody vegetation has accelerated during the era of management. Management to restore the lake will require innovation because of the loss of natural hydrologic variation.

The water level at Catahoula Lake goes down in the summer. Frank Willis, of Willis Engineering and Scientific LLC in Alexandria, is a collaborator on the LSU AgCenter project. He is standing by ancient baldcypress. Photo by Charles Ayres

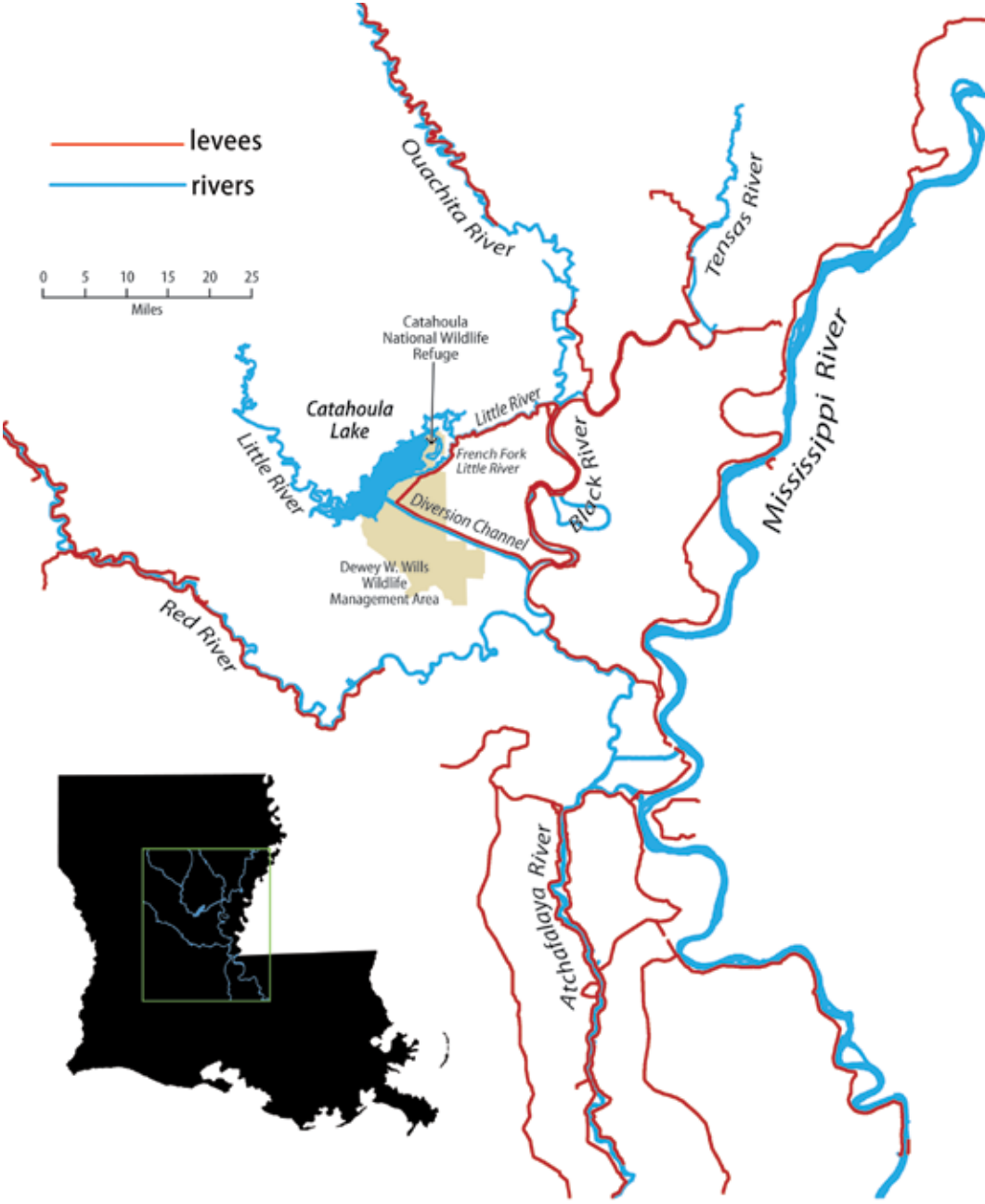

Figure 1. The area around Catahoula Lake is a highly managed floodplain with rivers, levees and the Diversion Channel.

Catahoula Lake, which covers about 30,000 acres in central Louisiana, is one of the most important habitats for water birds in the Lower Mississippi Valley. Because of this importance, the lake is recognized as a Wetland of International Importance under the Ramsar Convention of 1971 and receives special attention from agencies responsible for managing it, including the Louisiana Department of Wildlife and Fisheries, U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

The lake has a highly unusual hydrologic regime that is responsible for the quality of water bird habitat. The lake fluctuates from nearly dry to up to 20 feet deep each year, from deep water in the late winter through early summer to a mud flat in the later summer and fall when herbaceous plants important to wildlife habitat can grow. The position of the lake at the margin of the Mississippi Alluvial Valley and proximity to the Mississippi, Atchafalaya, Red, Ouachita, Tensas and Black rivers means the lake is subject to backwater flooding that creates the high water conditions (Figure 1). The lake also receives all of the flow of the Little River, which drains much of north central Louisiana, so times of high local rainfall can also cause the lake to rise. However, during the late summer and fall, the lake usually loses almost all of its water because of drier conditions.

Extensive modification of rivers surrounding the lake for flood control and navigation has changed the natural flooding patterns responsible for creating this unusual lake. Levees throughout the Lower Mississippi Valley have reduced overland flow between large rivers and the lake, and locks and dams have changed flows in channels that feed and drain the lake. The most important change at Catahoula Lake was a set of locks and dams in the Black River completed in 1972, which would have permanently inundated the lake.

For the seasonal drawdown, an 18-mile canal was constructed to allow the lake to drain below the locks, and a water control structure was added to allow control of water in the lake. Management of this structure has been according to a strict prescription for annual fluctuations in water levels developed by the agencies concerned and is presently accomplished as a cooperative endeavor by

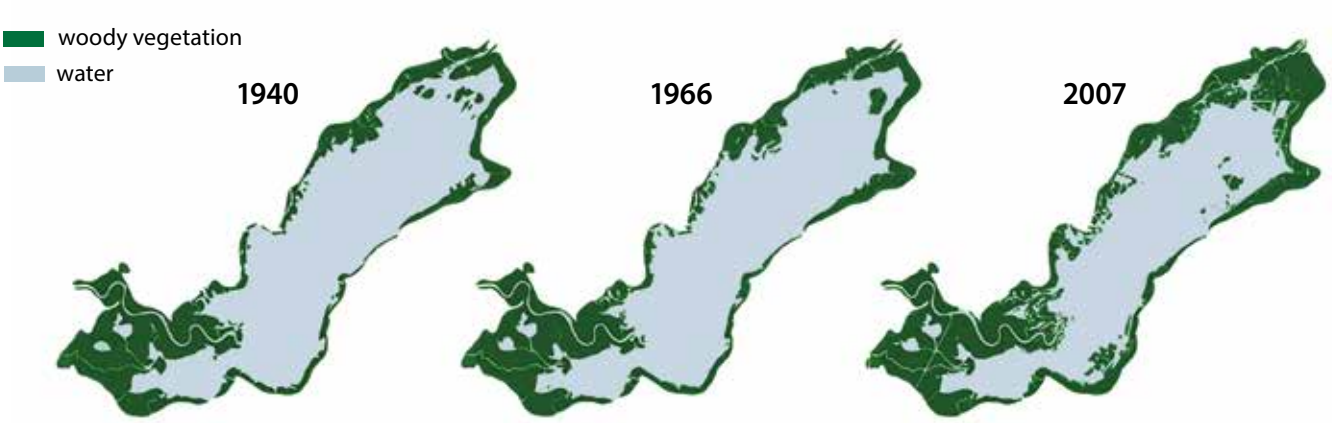

Figure 2. The woody vegetation at Catahoula Lake has increased over the years. In 1940, it covered 29 percent of the lake bed, 30 percent in 1966, and 38 percent in 2007, despite removal efforts that began in the 1950s and intensified in the 1990s.

the Louisiana Department of Wildlife and Fisheries and the Army Corps of Engineers. The goal of the plan is to manage water to produce the best habitat for water birds and waterfowl hunting, based on the historic fluctuations that define the lake. The focus of the management is on reproducing the predictable wetting and drying, but eliminating random variations – especially those that conflict with hunter success. Adherence to this plan has reduced overall variability in water levels, which is a common problem in wetland management that frequently results in plant community changes. However, it is not clear what role water level variability may play at Catahoula Lake.

Although the lake is surrounded by forest and ringed by baldcypress, water-elm, swamp privet and buttonbush, the majority of the lake bed has remained almost totally free of trees for centuries. In recent decades, however, woody vegetation has been increasing at the lake and degrading the important herbaceous plant communities. The Louisiana Department of Wildlife and Fisheries has implemented woody vegetation removal programs for several decades to fight this trend. However, the cost of this program is substantial, and the continual need for it begs the questions: Why was Catahoula Lake historically free of woody vegetation? Can water in the lake be managed to better mimic historic hydrologic processes and naturally control woody vegetation?

To address these questions, the Louisiana Department of Wildlife and Fisheries funded research in the LSU AgCenter School of Renewable Natural Resources. Researchers addressed the motivating questions with four linked research projects:

(1) Use tree rings and aerial photos to quantify occupation of the lake by trees over the past 70-100 years.
(2) Measure sediment quantity and chemistry to identify whether sedimentation may be contributing to vegetation change.
(3) Model historic hydrologic processes controlling lake levels and compare current regimes to historic regimes to identify whether flood stress on trees may have changed recently.
(4) Model wave disturbance of the lake bed and assess whether recent bed disturbance may have decreased in the recent past.

The combined investigation of historic aerial photos and tree rings revealed that woody plants have been encroaching into the lake bottom for at least 60 years, but that the rate has increased in the past 40 years (Figure 2). Woody vegetation covered 29 percent of the lake bed in 1940, 30 percent in 1966, and 38 percent in 2007, despite removal efforts that began in the 1950s and intensified in the 1990s. Thus, despite greater efforts to remove woody vegetation recently, coverage is increasing at a greater rate than in the past. This acceleration in the era of the Diversion Channel suggests that managed water levels may be fundamentally different from pre-modification water levels in a way that makes an ecological difference. However, previous work has shown that water-elm, the principle woody species expanding at the lake, is extremely resistant to flood stress and that

Catahoula Lake is an important habitat for waterfowl in the Lower Mississippi Valley. The lake fluctuates from nearly dry to up to 20 feet deep in the late winter through early summer. Photo by Karen Latuso

Herbaceous plants at Catahoula Lake provide critical food for waterfowl, but their existence is threatened by increasing woody vegetation. Photo by Karen Latuso

simple flooding is insufficient to control its spread. Therefore, we need to learn more about the nature of flooding changes in the lake and how they might be affecting habitat for water-elm.

Using concentrations in lake bed sediments of a radioactive isotope deposited globally during nuclear testing in the 1950s and 1960s, AgCenter scientists found that sediment deposition rates have not been appreciably higher in the past 60 years as compared to the previous two centuries (using rates determined from other sediment tracers in previous work). Thus, it appears that shallowing of the lake is likely not a major reason for increased woody vegetation. However, recent sediments are lower in pH and contain higher concentrations of zirconium and titanium than older sediments, which suggests a change in the source of sediments from mixed coastal-plain and Mississippi-alluvial sources to being dominated by coastal-plain sediments via the Little River. This change coincides in time with the decrease of connectivity between the lake and larger rivers by locks, dams and levees, although we do not yet know whether chemical changes are the cause of increased woody vegetation.

Using a sophisticated wave model modified from an ocean wave model in collaboration with researchers at the University of Miami, AgCenter researchers found the strength of wave forces on the lake bed varies by water depth and by seasonal variations in wind. Although still in the experimental phase, early results of this work indicate that locations most subject to wave stresses coincide – at least roughly – with locations with the lowest rates of woody vegetation encroachment. This modeling capability will be combined with the developing model of historic lake water level variability to estimate the effect of water management on wave action and thus woody plant establishment.

Management to restore the lake will require innovation because of the loss of natural hydrologic variation caused by extensive modification of the Lower Mississippi Valley. The LSU AgCenter is working with the Louisiana Department of Wildlife and Fisheries to develop experimental water level management schemes to both learn more about how water levels and lake ecology are related and to plan for better ecosystem-focused water management in the future. For example, there have been recent deviations from the strict water management guidelines in an effort to increase variability in the lake water regime. These deviations have been accompanied by complaints from lake users (e.g., waterfowl hunters and oil companies) who have grown accustomed to predictability in lake level. The LSU AgCenter and the Louisiana Department of Wildlife and Fisheries are communicating with stakeholders as planning continues.

Catahoula Lake is one of the most unusual geographic features in Louisiana and one that relatively few residents are familiar with or understand. This lack of understanding of how water levels in the lake control its ecosystem and the significance of the lake for wildlife habitat combine to increase the importance of work to ensure its conservation.

Richard Keim is an associate professor in the LSU AgCenter School of Renewable Natural Resources. His areas of expertise are hydrology of forested wetlands and watersheds and management of bottomland and coastal forests.

Parts of Catahoula Lake turn to mud flat in late summer and fall when herbaceous plants important for wildlife habitat can grow. Photo by Karen Latuso

Woody vegetation has been increasing at Catahoula Lake and degrading the herbaceous plant communities important for wildlife habitat. Photo by Karen Latuso

Richard Keim, researcher in the School of Renewable Natural Resources, measures sediment quantity and chemistry to determine whether sedimentation may be contributing to vegetation change at Catahoula Lake. Photo by Karen Latuso

Sugarcane Aphid: A New Invasive Pest of Sorghum

David Kerns, Sebe Brown, Julien Beuzelin and Kurt M. Guidry

The sugarcane aphid first appeared in Louisiana in 1999 in sugarcane. Although this aphid is a known pest of sorghum in other areas of the world, it was relegated as a pest of sugarcane in the United States. In 2013, sorghum producers in southwest Louisiana began reporting large numbers of aphids in their crops (Figure 1). Within a few months, the infestation had spread south along the Gulf Coast of Texas into Mexico, northeast through Louisiana and into Mississippi, and northwest to southern Oklahoma. By 2014, the infestation had further spread throughout the southern United States. Little is known as to why this aphid began feeding on sorghum, sorghum-related crops and weeds, but interestingly, LSU AgCenter entomologists observed that the new variant that feeds on sorghum does not survive well on sugarcane.

A new threat to sorghum production

Sugarcane aphids are small, soft-bodied insects that feed on plant sap (Figure 2). Plant sap is rich in sugars and water, and once nitrogen-containing nutrients are filtered from the sap, the sugary waste, or honeydew, is expelled. Feeding occurs on the underside of the leaves and stems, causing reddening, purpling and sometimes death of leaf tissue, and honeydew and subsequent sooty mold accumulation on plants (Figure 3). One of the interesting traits of the sugarcane aphid is its ability to cause injury and economic loss from the time the sorghum crop emerges through harvest. Seedling sorghum can be outright killed by the sugarcane aphid, or severely stunted. The most susceptible stage to sugarcane aphid injury appears to be at pre-boot, when heavy infestations will often cause sorghum to produce sterile seed heads (Figure 4). Significant loss can also occur during harvest. Because of sticky leaves covered in aphids and honeydew, combines become clogged and as much as 50 percent of the grain may be expelled from the combine discharge. Combining an aphid-infested field results in significant machine breakdown and time devoted to cleaning and repairing the machinery.

Although the sugarcane aphid can be a devastating pest to grain sorghum, research and extension efforts conducted by the AgCenter and others have demonstrated that it is a manageable threat. Several insecticide efficacy trials were conducted to evaluate labelled insecticides and several non-labelled alternatives for aphid control. Based on these trials, the only insecticide that offered acceptable control of the sugarcane aphid was the non-labelled product Transform. The LSU AgCenter worked with the Louisiana Department of Agriculture and Forestry to submit a Section 18 emergency exemption request to the U.S. Environmental Protection Agency to permit the use of Transform for managing the sugarcane aphid in sorghum. The cooperative effort exhibited by the AgCenter, the LDAF and the EPA was a textbook example of how research, extension, and state and federal regulatory agencies can work together to solve unexpected pest management problems for U.S. farmers.

Figure 1. Severe infestation of the sugarcane aphid on a grain sorghum leaf. Photo provided by the Melanaphis Task Force, a group of experts from the AgCenter, Texas A&M and Oklahoma State University who organize research and education efforts on the sugarcane aphid.

Entomologist David Kerns is exploring strategies for reducing sugarcane aphid injury to grain sorghum while preserving beneficial insects that attack aphids. However, development of resistant hybrids and use of effective insecticides are the most important tools in the arsenal. Photo by Bruce Schultz

Economic impact of the sugarcane aphid

In 2013 a survey was conducted among Louisiana sorghum producers to quantify the economic impact of the sugarcane aphid. The survey showed a 27 percent reduction in sorghum yield and increased production costs due increased usage of desiccants, slower harvest speeds (22 percent reduction) and machinery breakage (more than 40 hours on average). Results of the survey were used in conjunction

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Figure 2. Sugarcane aphids are small, soft-bodied insects that feed on plant sap. Photo by Pat Porter, Texas A&M AgriLife Extension

Figure 3. Honeydew-coated leaves and subsequent sooty mold growth. Photo by David Kerns

Figure 4. Sterilized seed head as a result of sugarcane aphid feeding. Photo provided by David Kerns

Table 1. Estimated Sugarcane Aphid Economic Impact In 2013

	Economic Impact Per Affected Acre (30% of Total Acres)	Economic Impact Per Acre (Across All Acres)	Total Economic Impact for Louisiana Sorghum Industry
Revenue Loss (27% Yield Loss)	$119.00	$59.50	$6,842,744
Increased Costs			
Increased Desiccant Use	$8.40	$4.20	$483,000
Increased Harvest Labor	$1.06	$0.53	$60,950
Increased Harvest Fuel and Repair & Maintenance	$1.66	$0.83	$95,450
Increased Operating Interest Expense	$0.25	$0.13	$14,375
Increased Fixed Costs	$2.74	$1.37	$157,550
Total Increased Costs	$14.11	$7.06	$811,325
Total Impact From Sugarcane Aphid in 2013	$133.11	$66.56	$7,654,069

Table 2. Estimated Economic Savings From Increased Sugarcane Aphid Management in 2014

	Economic Impact Per Affected Acre (85% of Total Acres)	Economic Impact Per Acre (Across All Acres)	Total Economic Impact for Louisiana Sorghum Industry
Revenue Savings (50% Yield Saving)	$176.16	$149.74	$14,973,651
Increased Costs			
Increased Insecticide Costs	$12.00	$10.20	$1,020,000
Increased Application Costs	$10.80	$9.18	$918,000
Increased Harvest Labor	$1.27	$0.11	$10,795
Increased Harvest Fuel and Repair & Maintenance	$1.71	$0.15	$14,535
Increased Operating Interest Expense	$0.51	$0.43	$43,350
Increased Fixed Costs	$2.80	$2.38	$238,000
Total Increased Costs	$29.09	$22.45	$2,244,680
Net Economic Savings	$147.07	$127.29	$12,728,971

with AgCenter Enterprise Budget data to estimate economic impacts of the sugarcane aphid to the Louisiana grain sorghum industry. The total economic impact was estimated at $7.6 million (Table 1). In 2014, AgCenter entomologists estimated that 85 percent of the grain sorghum acres had economically significant levels of sugarcane aphids. Given the severity of the infestations, it was estimated that yields across the state were reduced by roughly 10 percent. However, on those acres with economically significant levels, the improved management tactics and availability of a more effective insecticide, thanks to the Section 18 registration of Transform, were estimated to protect roughly 50 percent of yield potential. In other words, the improved management tactics were able to result in yields that were as much as 50 percent higher than without those tactics.

To determine the total economic impact of the improved management strategies available in 2014, both the positive impacts (revenue savings) and the negative impacts (increased costs) were considered (Table 2). Revenue savings were estimated at $14.9 million while increased production costs were estimated at $2.2 million. The net results show that AgCenter efforts in providing improved management tactics resulted in a net positive impact of $12.7 million, nearly 33 percent of grain sorghum's total farm gate value in 2014. AgCenter efforts helped to turn a situation that caused more than $7.6 million in economic harm in 2013 into a situation that helped pro-

This field of grain sorghum near Marksville, Louisiana, suffered 100 percent grain loss in 2013 because of sugarcane aphids. Photo by David Kerns

tect more than $12.7 million in net returns to the state's grain sorghum industry.

Research for management of the sugarcane aphid

In 2014, AgCenter entomologists greatly expanded their research effort in the management of the sugarcane aphid in sorghum. Efforts included identifying alternative insecticides, evaluating insecticide seed treatments, managing insecticide resistance, screening sorghum germplasm for resistance and determining an economic threshold for timing insecticide applications. It was obvious that managing sugarcane aphid populations would require an integrated approach, including a combination of management tactics used when needed.

Early or timely planting will help avoid early sugarcane aphid infestation, and research at the Macon Ridge Research Station and Dean Lee Research and Extension Center has demonstrated that commonly used neonicotinoid seed treatments may provide as long as 40 days' control of the sugarcane aphid. AgCenter entomologists have also identified several commercial sorghum hybrids with resistance or tolerance to sugarcane aphid feeding. Cooperative research by the LSU AgCenter and Texas A&M AgriLife has set a preliminary treatment threshold of 50 aphids per leaf colonizing 20 percent of plants in the field.

The long-term solutions for managing the sugarcane aphid in sorghum will undoubtable rely heavily on breeding resistant cultivars. But in the interim, the key to controlling the sugarcane aphid on susceptible hybrids is to not allow the aphid population to build to high numbers.

Detailed sugarcane aphid management recommendations are available at www.LSUAgCenter.com.

SCIENCE NOTE

Increasing Levee Protection from Wave Overtopping Erosion

Jeffrey Beasley, Christopher Thornton, Steven Hughes and Edward Bush

Starting this year the U.S. Army Corps of Engineers in New Orleans will be installing high-performance turf reinforcement mats on levees to reduce erosion and failure associated with wave overtopping. High-performance turf reinforcement mats are erosion products that gain part of their strength to withstand strong hydrodynamic forces through the establishment and interaction with vegetation. The application of the reinforcement mats is a part of the continued effort by the Army Corps to provide protection to the residents of the Greater New Orleans Metropolitan Area from future flooding. During Hurricane Katrina, which struck Louisiana in 2005, several levees were eroded because of waves overtopping levees, a process that involves wave action in which water flows down the protected side of the levee. Over time, the force of the flowing water can erode the back slope of a levee to the point of failure.

Through tests conducted at the Colorado State University Hydraulic Laboratory in Fort Collins, which contains the world's largest Wave Overtopping Simulator, the role of vegetation both alone and as a component of the reinforcement mats was investigated. Early tests showed levees constructed from clay differed in their ability to handle varying rates of wave overtopping depending on several factors. Bare soil failed shortly after being exposed to large waves generated by the Wave Overtopping Simulator, whereas vegetated soils increased wave overtopping erosion resistance, and vegetated reinforcement mats provided further resistance than vegetation alone. However, it was noted through additional testing that the performance of the reinforcement mats was influenced by changes in vegetative growth.

Trays with only grass and grass-vegetated reinforcement mats, which had been previously tested and did not fail in the Wave Overtopping Simulator, were exposed to the harsh Colorado winter before being re-tested the following spring. The cold temperatures stressed the grass so that parameters such as plant density and rooting were reduced. When the tests were re-administered, the grasses by themselves failed at the previously tested overtopping rates whereas a grass-vegetated reinforcement mat did not. This clearly demonstrated the synergy of vegetation in conjunction with reinforcement mats provides greater wave overtopping erosion resiliency.

Colorado State University and LSU AgCenter scientists were able to show rooting of the grasses had decreased greater than 30 percent for all treatments (grass alone and reinforcement mats with grass) after winter exposure. This showed changes in vegetation significantly affected wave overtopping erosion performance. Vegetation with higher root architectural parameters such as root length and surface area, often associated with denser, healthier grass swards, provided greater wave overtopping erosion resistance compared to less dense grass swards. The interaction of the roots with the soil appears to provide a cohesive factor in retaining soil when subjected to dynamic hydrodynamic forces. This relationship of rooting architecture to erosion performance has also been confirmed for dikes constructed from sand in Florida. In tests conducted for the Army Corps for reinforcement mat application at Lake Okeechobee, differing grass ground coverages and reinforcement mats were evaluated. Again changes in rooting architecture influenced vegetative erosion resistance to wave overtopping and reinforcement mat performance.

From this research the scientists found that reinforcement mats can provide greater protection against erosion from wave overtopping and that managing vegetation may be an important factor in maintaining reinforcement mat performance.

Jeffrey Beasley and Edward Bush are both associate professors in the School of Plant, Environmental and Soil Sciences. Christopher Thornton and Steven Hughes are with the Engineering Research Center at Colorado State University, Fort Collins.

Environmental Impact and Forage Production of Various Ryegrass Planting Methods

Donna Morgan, Jeff Gurie and Glen T. Gentry

A large percentage of reported sources of water quality impairments in Louisiana are related to what is collectively known as nonpoint-source pollution. This source of pollution is a result of stormwater runoff from land uses including agricultural fields, construction, urban areas, forestry and any other source that can't be directly correlated with the impairment. As reported by the Louisiana Department of Environmental Quality, only 32 of the 1,074 reported impairments were determined to be related to point-source activities. In that report, beef cattle forage systems, such as managed grazing and rangeland grazing, negatively affected 12 rivers across the state. Soil type, topography, excessive rainfall and more than 10,000 named water bodies can make Louisiana uniquely vulnerable to impacts from agricultural runoff.

Cattle are ruminants and require large amounts of forage as a source of protein and energy. For cattle producers, providing this forage is more easily accomplished during the warmer months due to the availability of summer perennial pasture grasses such as bermudagrass, dallasgrass and bahiagrass. However, most warm-season grasses begin to lose nutritive value as they mature in late summer into early fall and become dormant by first frost. Therefore, winter forages play a key role in most livestock grazing systems found in Louisiana and the Southeastern United States. Annual ryegrass (*Lolium multiflorum*) is by far the most popular, accounting for an estimated 2.5 million acres of planted winter forage in the U.S. each year. If managed correctly, a good stand can provide 3-5 tons of dry matter per acre of high quality roughage, extending the grazing season and meeting nutritional requirements during a critical time of year.

Ryegrass planting methods vary, depending on factors such as available resources, location and conditions, but may prove to have an effect on the success of a winter grazing program. Conventional planting methods require soil disturbance and may cause possible erosion and nutrient loss, but may facilitate seed emergence and stand establishment sooner than other methods. However, because of increasing concern over environmental impacts and water quality, conservation tillage is now a widely used means to protect soils from erosion and compaction while reducing production costs. Additionally, winter-planted forages may also help to maximize soil protection during the heavier, seasonal rainfall months.

Soil tillage and erosion

Soil tillage involves the physical disturbance of the upper soil layers for a variety of purposes, including seedbed preparation, weed control, and incorporation and mixing of crop residues, fertilizers or other amendments. Tillage methods vary widely depending on climate and soil type, crop management objectives, and availability of technology, tradition, and the personal preference of farmers. These methods may include conservation tillage such as no-till and minimum till. Conservation tillage is an agricultural practice that reduces soil erosion and water runoff, increases soil water retention, and reduces soil degradation. By definition, conservation tillage is any tillage and planting system that leaves 30 percent or more of the soil surface covered by crop residues after planting. No-till leaves 50-100 percent of the soil surface covered from harvest to planting, depending on the crop residue. Until the mid-1940s, conventional tillage was historically the method of choice for seedbed preparation and weed control. It was during WWII that the first herbicide, 2,4-D, was used, and this changed the way farmers managed their crops. Over time, new technologies also proved that conventional tillage reduced organic matter and increased erosion dramatically.

Planting methods for winter forages may include overseeding, no-till drilling and aerating the soil. Overseeding and no-till drilling are common planting methods in cool-season forages, and both minimize soil disturbance. Overseeding, or sod seeding, is a practice that approximately 65 percent of Louisiana cattle and forage producers use. Though typically the most economical and practical, the overseeding method does not always ensure good seed-to-soil contact. Once grasses have emerged, they also may be competing for moisture and nutrients with already established forages. Prepared seedbed requires cultivation and, thereby, exposes topsoil to rainfall and other environmental conditions. Drill seeding

The water samplers use suction lines and water sensors to initiate sampling after rainfall events begin. A computer program inside the sampler is used to determine the amount of sample collected, how often, etc. Samples are collected and analyzed for solids, phosphates, total phosphorus, nitrates and potassium. Photo by Jeff Gurie

(no-till drilling) is not a common practice by Louisiana forage producers mainly because of the high costs of equipment. Drill seeding allows a predetermined amount of seed to be accurately placed while minimizing soil disturbance and possibly the amount of sediment that runs off during rainfall events.

Determining environmental impacts from fields, regardless of cropping system, is critical in reducing agriculture's contribution to nonpoint-source pollution. To help determine the impact planting methods may have on water quality, a study was conducted at the LSU AgCenter Dean Lee Research Station in Alexandria from Oct. 8, 2013, to May 8, 2014 (Year 1) and from Sept. 25, 2014, to April 27, 2015 (Year 2). The goal was to evaluate the effect of winter forage planting methods on nutrient runoff and forage production.

Methods

Ryegrass planting methods were compared, and tillage treatments included: 1) prepared seedbed; 2) overseeded; 3) no-till drilled; and 4) unplanted/untreated/ungrazed control. All plots were treated preplant with 1 quart per acre of glyphosate to reduce competition from summer annuals. Each plot received 175 pounds diammonium phosphate per acre and 90 pounds ammonium sulfate per acre, according to soil test recommendations at the beginning of the study. Plots were then grazed with 16 mature cows for four to six hours, once forage reached an average height of 8-10 inches, to reduce forage height to 2 inches. Prior to grazing, forage samples for dry matter determination were collected.

Additional post-grazing urea applications were applied at 30 pounds of nitrogen per acre throughout the grazing season. Composite water samples were collected and then analyzed for total solids (sediment), total phosphorus, phosphates, potassium and nitrates. In addition to sediment and nutrient runoff data, forage growth and forage production on a dry matter basis were recorded. Forage samples were collected prior to each grazing, with sample weights and dry matter calculations recorded.

Sample collections in both years began shortly after planting, following initial fertilizer applications in late September and early October. Although 153 rain events were documented throughout the study for both seasons, only 29 resulted in sufficient volume to cause runoff. The total rainfall amount for Year 1 was 21 inches and for Year 2, 36 inches. The average volume of each rainfall event across years was different. In Year 1 the average was 0.68 inches and in Year 2, 0.94 inches (Figure 1).

Effects on Water Quality

Results show the type of planting method did not affect concentrations of total solids, total phosphorus, phosphates or potassium in the runoff. However, there were higher concentrations of nitrates in runoff from the prepared plot compared with the untreated, but concentrations of nitrates from the prepared plot were not different from the other planting methods (Figure 2). This may, in fact, be related to the number of post-grazing applications of urea placed on the prepared plot compared with other planting methods, where 100 percent of all prepared plots were top-dressed four times, 50 percent of drilled were top-dressed four times and 50 percent three times, and the overseeded plots were top-dressed only three times. However, over 80 percent of the total nitrates collected during the study ran off during the first 66 days when forage mass was minimal, and almost all nutrient and sediment runoff showed different runoff patterns over time (Figure 3).

Runoff patterns of these substances may be different from year to year and month to month, depending on environmental conditions and the substance itself. Regardless of treatment, results show that more total solids and nitrates ran off all the plots in Year 2, while more total phosphorus and phosphates left the field in Year 1. Potassium showed no difference from year to year. Rainfall events were heavier in Year 2 compared with Year 1, indicating that increased concentrations of total solids and nitrates in runoff may be correlated with volume of rainfall. Because nitrates were applied multiple times to all plots post-grazing across the grazing season, with the exception of untreated, the finding that more nitrates ran off in a year with heavier rainfall events is not surprising. Likewise, because phosphates are applied only once at the beginning of the grazing season, the expectation is that runoff would not be correlated with volume of rainfall across the season but only to rain events that occur early in the season.

Effects on Forage Production

Forage production results from this study show the planting method did not affect the average yields of dry matter, which were 5,106, 4,750 and 5,808 pounds per acre pre-graze for sod-seeded, drilled and conventional, respectively. At each grazing, average pounds of dry matter per acre and average plant height were not different across treatments. However, the average number of days after grazing was lower for the prepared plot compared with the sod-seeded and drilled plots, indicating that the average day of each grazing occurred earlier in the grazing season. Figure 4 illustrates the grazing interval across planting methods and shows that it is lower for the prepared and drill-seeded plots compared with the sod-seeded plot. These findings show that ryegrass drilled or planted by prepared seedbed had the ability to recovery from grazing sooner than if planted by sod seeding. This scenario allowed the prepared plots to be grazed an average of five times over the two-year study while the drilled and sod-seeded plots were grazed four times.

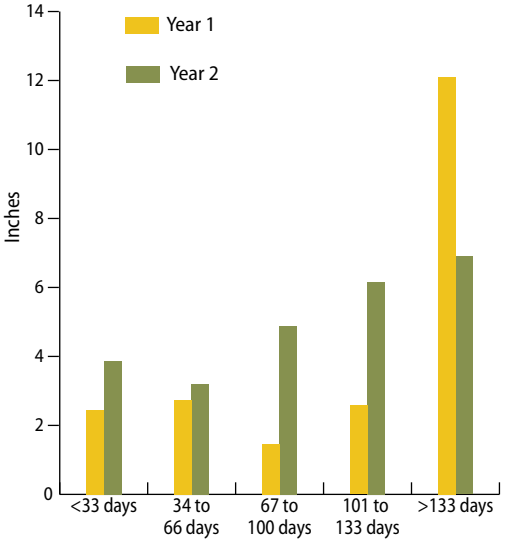


Figure 1. Rainfall expressed in inches across the season (days after planting) for both years.

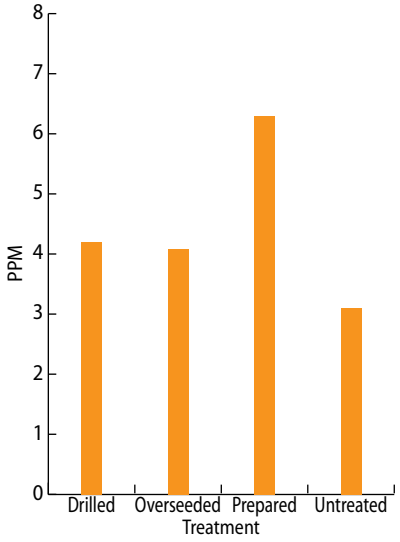


Figure 2. Average nitrates in collected samples across treatment, expressed in parts per million (PPM).

Conclusions

After two years of very different environmental conditions and rainfall, there was considerable variability within the treatments or replications for both years. The first year of the study included very little rainfall early in the season, snow and freezing temperatures, and heavy rainfall in the spring of 2014. However, the second year encompassed more evenly distributed, though heavier, rainfall events and milder winter temperatures. Regardless of the variation, there was little difference in runoff across treatments, with the exception of nitrates from the prepared plots. The prepared plot was the most productive of methods evaluated, with a shorter grazing interval allowing more grazing than other methods.

The data collected are not conclusive enough to state that these specific conservation tillage treatments do not have any beneficial effects on water quality, nor do they negatively impact them. Slope, soil type, rainfall intensity, time between rainfall events, grazing and nutrient uptake can all have an effect on edge-of-field runoff, and therefore, it is difficult to make broad recommendations based on this study. To that end, the objective of this study was to evaluate conservation tillage and conventional tillage planting methods and their effect on water quality and forage production. The data show that even though sod-seeding and drill-seeding are considered conservation practices and may reduce sediment and nutrient runoff in some situations, there was little difference on nutrients or sediment concentrations in collected runoff, while the prepared plot offered more grazing opportunities. Therefore, decisions on the ryegrass planting method used by a producer must be made on a case-by-case basis, keeping in mind topography and forage management needs.

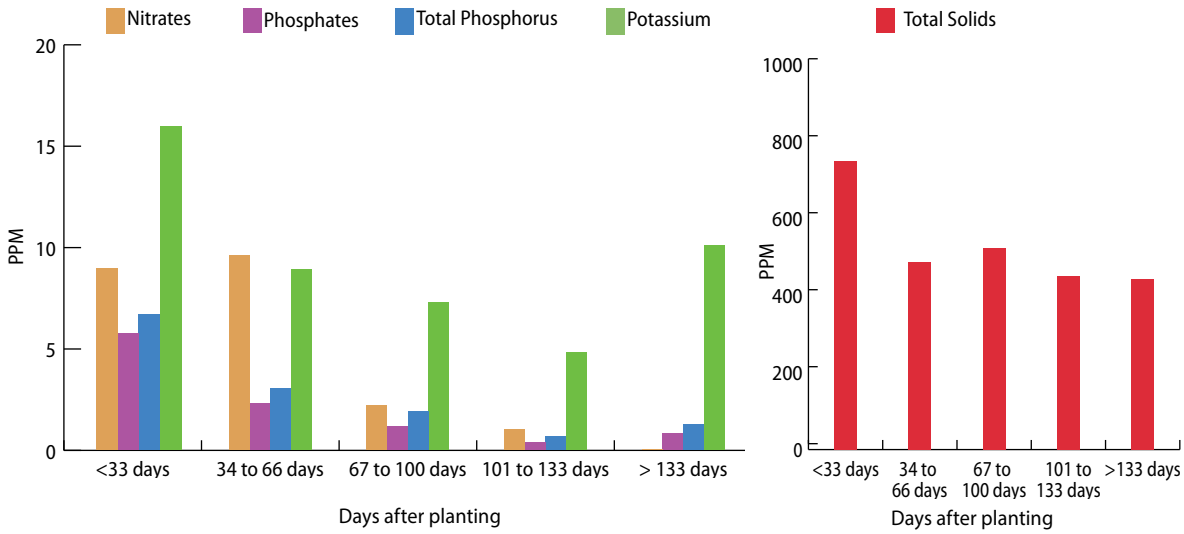


Figure 3. Mean concentration of analytes in pasture runoff for days after treatment regardless of treatment.

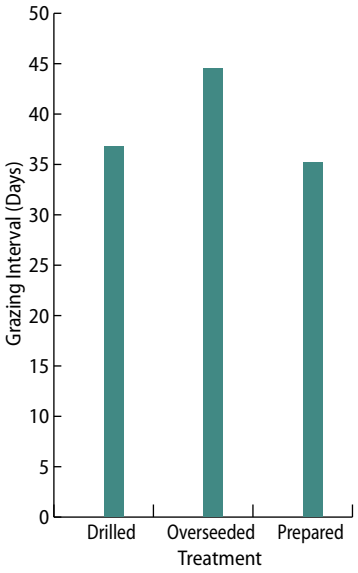


Figure 4. Grazing interval across treatments.

Sixteen mature cows graze the drill-seeded ryegrass plot at the Dean Lee Research and Extension Station. Off to the side are the automatic water samplers. Solar panels are mounted on the poles and are connected to the batteries used to run and maintain the sampling equipment. Photo by Jeff Gurie

Donna Morgan is an associate area agent for the Louisiana Master Farmer Program and county agent for Rapides and Grant parishes; Jeff Gurie is a research associate and livestock farm manager for the Dean Lee Research Station in Alexandria; Glen T. Gentry is an associate professor and interim coordinator at the Bob R Jones–Idlewild Research Station in Clinton. *Special thanks are given to J Stevens, associate professor and soil fertility specialist, for his support and expertise.*

Challenges of Corn Nitrogen Management During Saturated Soils Conditions

Josh Lofton and Beatrix Haggard

Corn grown in Louisiana has the potential to be very productive. Additionally, the Midsouth states, especially Louisiana, have the ability for corn to be planted and harvested much earlier compared to other corn-growing regions. This is due to warm conditions typically experienced in the latter part of February and early March. In Louisiana, however, this warmer weather is often associated with wet conditions. While moist conditions are needed for optimum early season growth and productivity, this excessive moisture cannot only be detrimental to the corn crop but can negatively influence corn nitrogen management and result in high nitrogen loss. This excessive rainfall can frequently occur during the early spring months, with events often exceeding 5 inches within a 24-hour period (Figure 1). This results in growers having to consistently decide on how to manage following these potential nitrogen-loss events. However, little information has been available on how much nitrogen is actually lost following these events as well as the effect on the corn growth.

Figure 1. Saturated conditions following a heavy precipitation event early in the corn growing season in 2014. On top was a grower's field near Crowville, La.; at bottom is a field at the Macon Ridge Research Station. Photos by Josh Lofton

To address the need for more information, trials were established to determine nitrogen loss and movement in the soil following saturated conditions as well as yield loss associated with high soil moisture. Simulated rainfall events were applied through irrigation to ensure nonhigh-precipitation plots were not saturated during the treatment application. Simulated high precipitation events occurred at two distinct times within the growing season, early and mid. The early season saturation event was intended to simulate saturation conditions experienced due to natural precipitation events that occur in early spring, while the later saturation event should simulate saturation that occurs near the irrigation pipe during initial irrigation events. Additionally, two nitrogen rates, 240 and 300 pounds per acre, were applied two to three days prior to the first saturation event. The typical rate is 240 pounds per acre, while the 300-pound rate was applied to represent a guaranteed nonlimiting nitrogen application rate. Soil samples and grain yields were used to evaluate the influence of saturated events on soil nitrogen and corn productivity.

Saturated conditions greatly affected both corn yields and nitrogen in the soil profile. These implemented saturated conditions negatively influenced corn grain yield, regardless of when the saturation occurred (Figure 2). When nitrogen applications were made at the current recommended rate, saturation events at either early season or

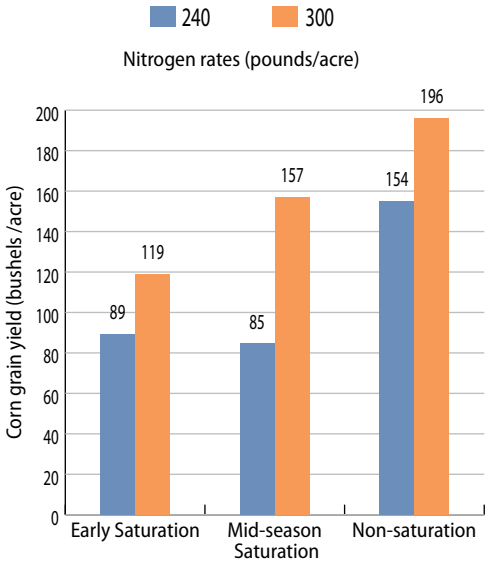


Figure 2. Impact of saturated conditions on corn yield.

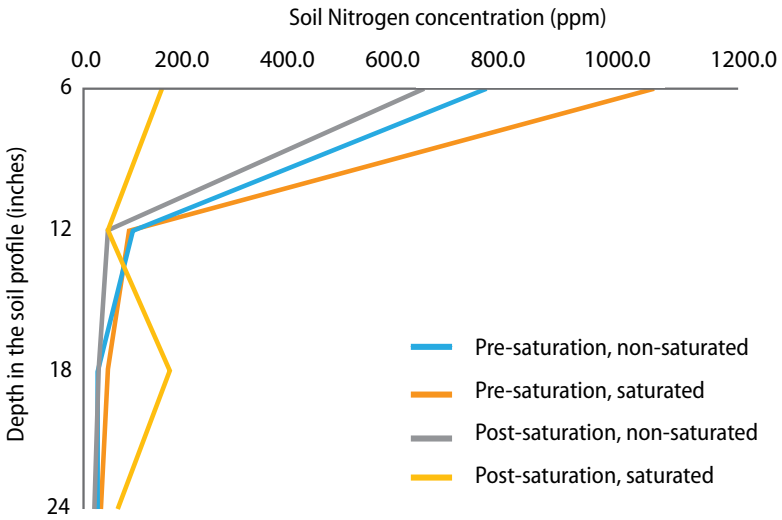


Figure 3. Nitrogen concentration in the soil profile pre- and post-saturation event for the saturated and nonsaturated treatments.

midseason decreased corn yield by nearly 90 bushels per acre compared to the unsaturated treatments. However, when application rates were increased to the nonlimiting rates, saturated conditions decreased corn yields by 77 bushels per acre when saturated conditions were experienced early but only decreased yields by 39 bushels per acre when saturated conditions were only experienced at midseason. These results demonstrated that corn that experiences saturated conditions early in the season is greatly affected, even with excessive nitrogen application rates. However, saturated conditions experienced during midseason still had a significantly negative influence on corn grain yields, but may be more associated with diminished available nitrogen compared to inhibited plant growth.

The concept of nitrogen loss during saturation events can be demonstrated when looking at soil profile nitrogen prior to and following saturated events (Figure 3). Immediately following nitrogen fertilization, high amounts of soil nitrogen were present in the top 6 inches with a drastic decrease in soil nitrogen at 12, 18 and 24 inches. As expected, following the saturation event, plots that were nonsaturated changed little in overall soil nitrogen profile, with higher concentrations of soil nitrogen in the top 6 inches and a sharp decline for the 12-, 18- and 24-inch levels. However, it should be noted that there was a slight decrease in total nitrogen concentration in the surface soil compared to pre-saturation. This indicates that nitrogen movement and loss within the profile are natural occurrences and can be expected with even modest precipitation events.

The largest differences were associated with plots that experienced saturated conditions. These saturated conditions resulted in a drastic decrease in surface nitrogen concentrations compared to pre-saturated conditions. Additionally, a notable increase in soil nitrogen concentration was evident at both the 18- and 24-inch levels. This indicated that deep translocation of the soil nitrogen from fertilization occurred in as little as one saturation event. However, the overall soil profile nitrogen concentration decreased as a result of these saturated conditions (1,192 ppm compared to 407.6 ppm for pre-saturation and post-saturation, respectively), indicating that nitrogen was lost through either deep leaching or denitrification.

With this somewhat somber information, what can we do to minimize this nitrogen loss due to these heavy precipitation events? Currently, research at the LSU AgCenter is investigating two management practices. First is a split or subsequent applications. As the crop productivity has drastically declined following these events, it is still unknown whether nitrogen applications following early-season saturation will allow the crop to recover. Second, enhanced-efficiency nitrogen fertilizers have been shown to be quite successful in Louisiana production systems and could be an option to manage around these saturated conditions because they maintain nitrogen in a safe but plant-available form and, therefore, minimize loss.

While both of these options have promise, when the crop has experienced these saturated conditions, yield loss should be expected. However, the goal prior to and following these events is to minimize productivity and nitrogen losses to ensure continued sustainable productivity of the system.

Josh Lofton and Beatrix Haggard are former researchers and extension specialists with the LSU AgCenter based at the Macon Ridge Research Station in Winnsboro. They have since both moved to Stillwater, Oklahoma, to take faculty positions at Oklahoma State University.

Students from Colfax Elementary School in Grant Parish get their hands wet and dirty during a Youth Wetlands Week activity. They are exploring a pond at 4-H Camp Grant Walker looking for insects and arthropods. Photo by Brandy Orlando

Youth focus on healthy water for productive wetlands

Randy LaBauve

Water, water everywhere! Huge quantities of the nutrient-laden wet stuff spilling through thousands of inlets and bays provide a popular perception of why Louisiana's coastal estuaries and waterways are some of the most productive waters in the world for seafood and fisheries.

But a more detailed view of the ecosystem shows that without healthy wetlands, the bountiful wildlife would largely go away. Unfortunately, since 1930, more than one million acres of Louisiana coastal wetlands have vanished.

Young people who have participated in the LSU AgCenter's 4-H Youth Wetlands program may be among the most well-versed segment of the population when it comes to the issue. Since the program began in 2007, more than 600,000 students statewide have gotten their hands wet and muddy, while actively learning about the delicate balance of wetland ecosystems and the importance of wise conservation and restoration practices. They have teamed up for service-learning projects and spread awareness of the problem of coastal erosion, demonstrating that there is strength in large numbers. A crucial part of their educational process has centered on sampling water and exploring the proper balance and qualities of a healthy water supply.

LSU AgCenter educators, with input from science teachers, created wetland lesson plans and activities that meet Louisiana's Grade Level Expectations and the Common Core Standards for third- through 12th-grade classes. More than 9,000 teachers statewide have incorporated the free materials and unique activities into their curriculum, implementing them in classrooms, school yards and field trip settings.

Throughout the school year, students dive into aqua-centric experiments like designing an ideal filter to simulate a wetland and show how it purifies dirty water and sediment or building their own watershed to observe how pollution moves through the landscape.

Optional teacher training sessions are held throughout the year, and older students can be trained to teach younger students as well. Annual hallmarks of the program are Youth Wetlands Week held statewide during April, coinciding with Earth Day celebrations, and summer environmental camps.

During Youth Wetlands Week, students participate in service-learning campaigns that help purify water systems. Activities include trash bashes, beach sweeps, invasive species removals and planting of vegetative species in wetland areas.

4-H'ers in one service-learning project built 3,000 feet of coastal fencing at Breton Sound – a feat that helped create 10 acres of wetland, according to U.S. Fish and Wildlife Service estimates.

Youth learn wetland concepts all over the state and not just along the coast. Students have, for instance, done

wetland work at upland and hardwood swamps and created schoolyard wetland habitats that capture rainfall, store water and cleanse runoff of pollutants.

Summer camps include the Louisiana Outdoor Science and Technology (LOST) Camp for seventh- and eighth-graders at the Grant Walker 4-H Educational Center in Pollock. Marsh Maneuvers is another summer camp that takes place at Rockefeller Wildlife Refuge in southwest Louisiana.

Marsh Maneuvers, started in 1989, is considered one of the premiere wetland camps in America. Adult educators take four groups of about 16 selected high school youth, one group per week, and immerse them in marine wetland ecosystems along the Gulf of Mexico, teaching them about marine ecology and hydrology.

The 4-H'ers ride through marshes on air boats and glide past the heads of bobbing alligators and splashing fish, cast nets for fish and crabs, hold baby alligators (not at the nest), learn about the life cycles of marine life and jump into muddy-bottom marsh waters to transplant vegetative grasses into strategic locations. Selective plants like bulwhip and smooth cordgrass not only hold soil together, decreasing the effects of erosion and quickly building up new wetlands, but they help purify dirt and sediments from the water.

In a year, the quick-growing plants will have clumped together and thickened significantly in diameter and height by several feet, sending down deep roots and creating an impressive new stand of wetlands. Since the inception of the Youth Wetlands Program, students have planted nearly 100,000 vegetative plugs.

Students are able to see with their own eyes the delicate natural mixture of nutrients and of freshwater and saltwater that creates an ideal concoction for marine creatures to thrive. This brackish soup is the lifeblood of Louisiana's coastal estuaries, but these youth realize healthy wetlands help make it possible. The campers discover that too many nutrients in the Gulf of Mexico, however, can cause hypoxic zones where fish are deprived of precious oxygen.

Louisiana is one of the only states that includes environmental science in its content standards. The Louisiana Science Teachers Association has endorsed the wetlands lessons, which fit into multiple subject areas like science, English, math and art.

Teachers can contact their local LSU AgCenter extension offices to get free packets, which include a curriculum binder, classroom materials, laboratory supplies and field materials. The educational materials also include a video series called "Wet Work," which highlights possible careers in environmental sciences.

"Wet Work" is a takeoff on the Discovery Channel television series entitled "Dirty Jobs." In these fast-paced, award-winning videos, teen hosts shadow professionals to places like the Davis Diversion Canal in St. Charles Parish – an architectural marvel and the only one of its kind in the world. The structure diverts freshwater from the Mississippi River into brackish wetlands to help minimize the destructive effects of saltwater intrusion from the Gulf of Mexico.

In another video the 4-H host takes a fast boat ride with two fisheries agents on coastal Lake Borgne. The teen helps test water variables and haul in oysters and fish samples, while learning the importance of proper fisheries management.

The Youth Wetlands program, which is funded by the Louisiana Coastal Protection and Restoration Authority, has received national recognition from the U.S. Fish and Wildlife Service as an outstanding program connecting youth to natural resources. The program was also named a national program of distinction by the U.S. Department of Agriculture and a program of excellence by the National Association of Extension 4-H Agents.

Mark Shirley, LSU AgCenter and Louisiana Sea Grant coastal resource specialist, explains benefits of marsh grass planting along Bayou Petit Anse as part of Marsh Maneuvers camp. Photo by Bruce Schultz

Evaluations show students gain a significant increase in knowledge from the Youth Wetlands program. They understand more clearly the precarious balance of a healthy wetland ecosystem. Their multiple efforts, in some way or another, have helped improve water quality and the overall health of wetland ecosystems throughout the state.

As 4-H campers at Rockefeller Refuge climb to the top of a viewing tower during the purplish-pink shades of sunset, they cast their eyes on an incredibly immense ecosystem and an unending panorama of water. This is the culmination of their journey from the classroom to the coastline.

But the peacefulness of the balmy evening breeze belies an increasing threat to marine fisheries, homes and communities. Now, because of what they've learned and done in the Youth Wetlands program, they know this place has its limits and that there is much more to the picture in front of them than meets the eye.

Randy LaBauve is an associate specialist in LSU AgCenter Communications and a video producer.

4-H'ers learn to make communities safer from disasters

Bruce Schultz

Members of 4-H from across the state are finding their voice in making their communities safer from disaster by participating in hazard mitigation projects aimed at strengthening public facilities.

The students have learned hazard mitigation is a way of adapting to the damaging forces caused by a natural disaster. From there they move on to determining the best adaptation strategies for protecting a structure.

The teams so far have identified improvements for governmental buildings in Vermilion and St. John the Baptist parishes to reduce the chances of storm damage. Projects in the works include improvements for the Grant Walker 4-H Educational Center in Pollock and in Jefferson Davis Parish.

The team in St. John the Baptist Parish has recommended improvements for a safe room for emergency workers responding to a disaster. The need for a safe room became evident with Hurricane Isaac in 2012. Emergency responders had to sleep in their cars and work in an overcrowded Office of Emergency Preparedness in LaPlace.

After conducting a risk assessment, the team's list of items for planners to consider included a sloped roof for better drainage, sleeping quarters with showers, impact-resistant windows, reinforced doors and construction of the building shell with insulated concrete forms.

They presented their recommendations to parish officials on May 14, 2015. The team's estimated the cost of the building at just over $200,000, but that does not include foundation pilings, interior walls or electrical and mechanical services.

Deborah Hurlbert, LSU AgCenter extension associate, said the project was a good challenge for the students. "They have exceeded what they felt they could do. I can't say how proud I am of them."

The 4-H'ers learned about sea level rise, and they conducted a vulnerability assessment of parish emergency facilities, she said.

She said the students, all ninth-graders, met with engineers overseeing construction of the East St. John the Baptist High School, repairing the school buildings that were flooded by Hurricane Isaac in 2012. "They brought stacks of blueprints and volumes of details."

Shandy Heil, LSU AgCenter extension associate, said the students

Clay Zaunbrecher, left, and Dre' Boudreaux, both of Vermilion Parish, build a roof model. The activity was part of an innovative LSU AgCenter program to educate youth about disasters and teach them how to mitigate, or adapt, buildings so they have less damage during disasters. Photo by Debbie Hurlbert

St. John the Baptist Parish 4-H Club members made a presentation to parish government officials for building a safe room to house emergency workers during a disaster. Standing from left to right are Biarnetta Bell, parish 4-H program assistant; Shandy Heil, LSU AgCenter extension associate; Natalie Robottom, parish president; 4-H'ers Donald Fluker, William Ledet, Kyle Henderson and Jeremiah Smith; 4-H volunteer Patti Rodrigue; 4-H'er Korey Lee; Pat Skinner, LSU AgCenter disaster recovery and mitigation specialist; and Mike Coburn, parish chief administrative officer. Seated are, from left, 4-H'ers Emily Bartholomew, DaQuan Moore, Hannah Duhe and Coy Vodol. 4-H'ers not present who also participated in the project are Jeyha Allen, DeLloyd Gray and Dylan Rodi. Photo by Bruce Schultz

benefitted from the project in several ways. "They're going to be better prepared for the future."

Students who worked on the project were Jeyha Allen, Emily Bartholomew, Hannah Duhe, Donald Fluker, DeLloyd Gray, Kyle Henderson, William Ledet, Korey Lee, DaQuan Moore, Dylan Rodi, Jeremiah Smith and Coy Vodol.

The students are making a graphic novel to highlight what they have learned.

In Vermilion Parish, 4-H students Anne Catherine LeBlanc, Courtney Brasseau, brothers Ty Zaunbrecher and Clay Zaunbrecher, and Vermilion student Dre' Boudreaux conducted a risk assessment of the LSU AgCenter extension office in Abbeville.

They appeared before the Vermilion Parish Police Jury in 2014 to recommend a series of improvements that included elevation of the air conditioning units at the extension office to prevent them from being ruined by flooding. In addition, they recommended stronger doors and windows.

At the Police Jury meeting, the students brought a roofing model that displays proper materials and techniques for building a hurricane-resistant shingled roof.

The Police Jury implemented the improvements and went one step further by installing a new wind-resistant roof.

The students produced a 10-minute video, "Somewhere Over the Bayou," a spoof of the "Wizard of Oz," that depicts a fictitious rural area hit by wind and heavy rain. The characters find ways to make their property less vulnerable to future disasters. The video went on to receive an award at a national 4-H competition and can be seen on YouTube.

A statewide team made up of 4-H Club members from nine parishes has been evaluating what can be done at 4-H Camp Grant Walker to make it less vulnerable to severe weather. The team met at Camp Grant Walker in February and conducted a vulnerability assessment of camp structures. They wrote a report identifying structures needing additional protection from natural hazards, including a counselor cabin located near Big Creek, and the amphitheater known as the Greek Theater.

In May, the team met in Baton Rouge to work on an official hazard mitigation grant application for the camp facilities. Civil engineering and hydrology experts guided the students in development of a plan to prevent flooding of the camp structures during heavy rain events.

They will present a plan to the LSU AgCenter administration in October.

Members of the A-Team are Ty Price, Beauregard Parish; Ashlyn Tullis, Caddo Parish; Crystal Charrier, Clara Anderson, Aaron Young and Hallee Collins, Grant Parish; Lauren Broussard and Dylan Benson, Jefferson Davis Parish; David Dixon, Madison Parish; Terrance Grimes, Richland Parish; Emily Bartholomew, DeLloyd Gray and William Ledet, St. John the Baptist Parish; Peyton Arthur and Tristen Nicolas, Vernon Parish; and the two Zaunbrecher brothers.

Ty Zaunbrecher's involvement in mitigation projects contributed to his selection as one of 15 youths chosen for the national FEMA Youth Preparedness Council for 2015-16. The council supports FEMA's commitment to involving youth in preparedness-related activities, and it provides an avenue to engage youth by taking into account their perspectives, feedback and opinions.

4-H agents and volunteers providing assistance with mitigation projects include Pat Skinner, AgCenter disaster specialist; Shannan and Hilton Waits and Alex Leblanc, Vermilion Parish; Mike Sylvain, Bairnetta Bell, Andre Lee and Patti Rodrigue, St. John the Baptist Parish; Kori Myers, Jefferson Davis Parish; Kem Johnson, Vernon Parish; LeKeisha Powell, East Carroll Parish; KarVan Powell, Madison Parish; Xavier Bell, Concordia Parish; and Vicki Collins, Grant Parish.

The project is part of Louisiana's Statewide Hazard Mitigation Community Education and Outreach Program, which is funded by a Federal Emergency Management Agency Hazard Mitigation Grant to the Governor's Office of Homeland Security and Emergency Preparedness.

Bruce Schultz is a writer and photographer with LSU AgCenter Communications.

Robots and Artificial Reefs for Water Conservation and Management

Steven G. Hall, Daniel Smith, Randy R. Price, Melody Thomas and Jeanne Steyer

Bioenvironmental and aquacultural engineers are using smart and biological solutions to address water quality issues in rivers, lakes, ponds and coastal areas. Autonomous vehicles can help assess and enhance water quality, while bioengineered solutions such as artificial reefs may contribute to enhanced coastal protection as well as improved water quality.

Water quantity and quality are critical issues in Louisiana and around the world. Severe water shortages may be one of the most critical issues of the 21st century. In Louisiana, water quantity has not become an extreme problem yet, but water quality is already of significant concern. Smarter ways of approaching freshwater quality in streams, lakes and bayous include use of intelligent buffer strips, wise management of agricultural and industrial wastes, sustainable practices of ecological management. In the coastal zone, including salt and estuarine environments, engineered solutions that enhance local ecosystems, improve water quality and provide coastal protection are needed.

Being water-wise means using smart technologies. Some, like the robotic boats, are actually smart, in that they use microprocessors and programming to address certain water-related issues. Others, like the artificial reefs, are smart to use because they, while seeming simple, use resources wisely.

Smart Solutions: Robotic Boats

One LSU AgCenter invention, patented in 2006 and licensed in 2013, is a robotic boat originally targeted at reducing predatory birds on aquaculture ponds. The dual-pontoon, dual-paddlewheel automated boats are powered by the sun, are microcontroller driven and may have a variety of sensors including GPS and water quality sensors. The boats were effective at reducing predatory birds and have been developed further in recent years. Additional capabilities include communication and cooperation among boats in a fleet to address water quality issues. A second use relates to measuring effects of restoration projects, which may enhance water quality, for example, in the coastal zone.

Water Quality Testing

Water quality is important in natural and managed water bodies to protect wildlife and serve as a source for irrigation and drinking water. Parameters of interest include dissolved oxygen, temperature, nutrients such as nitrogen, total suspended solids and pollutants such as heavy metals or organic pesticides. By mounting water quality measurement devices on the boats, scientists have been able to track these parameters and how they change over time and space.

Steve Hall, researcher in the Department of Biological and Agricultural Engineering, with one of the robotic boats he has developed. The dual pontoon, dual paddlewheel automated boats are powered by the sun, microcontroller driven and may have a variety of sensors including GPS and water quality sensors. Photo by Olivia McClure

A new area of study is the use of multiple boats that can communicate with each other to track pollutants, allowing scientists to find locations of oil spills or areas of low oxygen. They can then use this information to investigate further and activate devices such as aerators to help restore acceptable dissolved oxygen levels. In other cases, this information may help with decisions to open spillways to allow greater water movement. In each case, the intention is to use the information on water quality to enhance decision making and ultimately improve water management.

Coastal Restoration Applications

Measuring the effects of coastal restoration efforts can help evaluate their sustainability and cost. A robotic boat equipped with a GPS and a depth-measuring device was developed to measure the erosion of land over time from coastal waterways. The prototype demonstrated the ability to measure depth within a 2-centimeter range, and a newer design being tested has a resolution in the 2-to-5-millimeter range.

Melody Thomas, graduate student in the Department of Biological and Agricultural Engineering, stands on the reef, which is at the Rockefeller Refuge in Cameron Parish in southwest Louisiana. The reef is about the length of a football field. Photo by Steven G. Hall

Artificial Reefs

In addition to the robotic boats, there are other technologies in use in Louisiana's coastal wetlands. While Louisiana has 40 percent of the nation's coastal wetlands, 80-90 percent of the nation's coastal wetland loss occurs here, primarily through subsidence, erosion and sea level rise. Many traditional coastal solutions use structures that tend to sink over time and are often not biologically or ecologically friendly. An alternative method is bioengineering to grow coastal structures. This led to the design of low-cost and environmentally friendly artificial reef systems aimed at providing a substrate to encourage the growth of the Eastern oyster. These systems, which often serve as intertidal breakwaters, can reduce coastal erosion, restore coastal habitats and protect wetlands, while the vertical growth of oysters can allow these structures to compensate for sinkage and sea level rise. This growth can simultaneously provide sustainable protection by reducing wave energy and ecosystem services, such as water filtration. Oysters can filter several liters of water per hour, removing carbon and nitrogen from the water column and storing them in their bodies and shells. This could potentially have an impact on local or even regional water quality. For example, the hypoxic zone in the Gulf of Mexico is attributed to a combination of solids and nitrogenous materials, which reduce available oxygen and thus sea life. The filtration by artificial reefs and other bioengineered applications could potentially reduce this problem.

The rings are 5 feet in diameter with 9-inch walls and provide habitat for barnacles, oysters and algae, while encouraging the settlement of sediment behind and below the structure. Photo by Steven G. Hall

Steven G. Hall is an associate professor and the graduate student coordinator in the Department of Biological and Agricultural Engineering. Daniel Smith, Melody Thomas and Jeanne Steyer are graduate students in that department. Randy R. Price is an assistant professor at the Dean Lee Research and Extension Center in Alexandria.

Achyut Adhikari, LSU AgCenter assistant professor, collects water samples from a surface water source. Photo by Thais do Carmo Vieira

Water Use and Food Safety in the Fresh Produce Market

Achyut Adhikari and Marlene E. Janes

Agricultural water is the water that is likely to contact the edible portion of fresh produce during growing, harvesting, processing or packing. Water quality is critical, especially when dealing with food that is consumed raw.

Agricultural water is considered a potential source for foodborne pathogen contamination. Recent outbreaks of *Escherichia coli* O157:H7 and *Salmonella* spp. point to irrigation water as the vector in the production environment of fresh fruits and vegetables. Once introduced, it is difficult to remove the pathogens from fresh produce because rough surfaces hinder the release of microorganisms during washing. Even with vigorous washing, there may be enough pathogen left to cause serious health hazards.

Proposed Requirement for Agricultural Water

With the recent enactment of the Food Safety Modernization Act (FSMA) produce safety rule, "all agricultural water must be safe and of sanitary quality for its intended use." Water used for pre-harvest practices of high-risk fruits and vegetables must meet the *Escherichia coli* requirements as proposed by the U.S. Environmental Protection Agency. Farmers with agricultural water that does not meet the proposed microbial standard would be required to take one or more of the following actions: 1) change the irrigation system, 2) establish an irrigation-to-harvest or harvest-to-end-of-storage interval to allow time for potentially dangerous microbes to die off, or 3) treat the water to reduce the microbial food safety risk.

Microorganisms exposed to environmental conditions, such as ultraviolet light from the sun or limited availability of nutrients,

Drip irrigation delivers irrigation water near the root of the plants and minimizes the risk of microbial contamination to the harvestable portion of the crops. Photo by Achyut Adhikari

may die. Studies show that waiting after irrigation until harvest will reduce the levels of bacterial pathogens. This factor is considered as an option in the FSMA agriculture water quality requirement. The rule allows growers to calculate a microbial die-off rate from the last day of irrigation until harvest. After each day, you can assume a roughly 67 percent reduction in generic *E. coli* as compared to the previous day.

In some cases, growers may not be able to wait for harvest because of adverse environmental conditions such as heavy rain or floods. In such situations growers can harvest their crops without waiting after the last day of irrigation but must apply a time interval in days between harvest and the end of storage, using an appropriate microbial die-off or removal rate. Washing or other antimicrobial treatments during post-harvest processing are also considered as microbial removal, which will reduce the waiting period.

Water Sources

There are three main sources of agricultural water: the municipal water supply, well water and surface water. The food safety risk associated with agricultural water varies depending on the source of water. Municipal water supplies potable water, but it is available in limited volume and locations. Vegetable production is water-intensive, and producers meet the production requirements usually by drawing water from ground and surface sources.

Well water is relatively safer than surface water. However, several factors affect the quality of well water. These include location, proximity to a sewage system, the well condition and soil porosity. Routine inspection and maintenance of the well will ensure that it is functioning properly to avoid possible contamination.

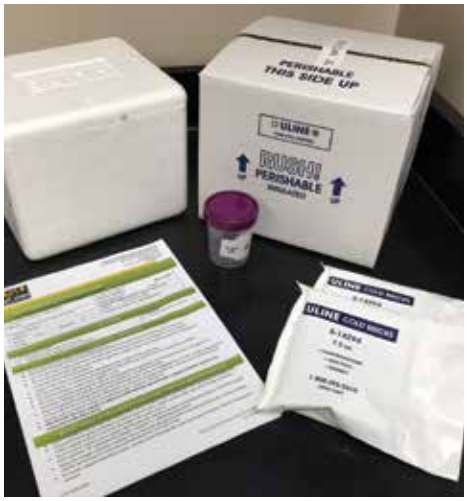
Surface water is regarded as high risk and should not be used for high-risk activities such as post-harvest processing, unless it is treated and converted to potable water. There are many environmental factors that affect the quality of surface water, runoff being the important one. Even for pre-harvest activities, producers must take steps to minimize the risk of produce contamination with surface water.

Water Testing

Routine inspection and monitoring of an irrigation water source will help to determine possible adverse environmental conditions affecting water quality. Most standards related to agricultural water require frequent water testing during the growing season. The number of tests and frequency of testing depend upon the source of water. It is recommended that water be tested at least quarterly if using surface water and at least annually if using well water for agricultural production.

This is an example of a poorly maintained well. The area surrounding a private well must be free of contaminants. Photo by Achyut Adhikari

Federal and state regulations and some buyers require producers to perform generic *E. coli* testing of their agricultural water rather than direct pathogen testing. Common foodborne pathogens may be present at low numbers in water but may go undetected during testing. Even at low numbers, some pathogens can cause serious health hazards. Human and animal fecal material is the main source of generic *E. coli* and other common bacterial pathogens. Thus, generic *E. coli* testing is performed to indicate potential fecal contamination.



Growers can buy this water sampling kit directly from the LSU AgCenter water testing lab or from any AgCenter parish extension office. Photo by Morgan Maite

The LSU AgCenter has a water testing laboratory in Baton Rouge to provide affordable and reliable water testing services for Louisiana producers. AgCenter extension agents and specialists also provide consultation services to producers if their water testing results do not meet the regulatory or buyers' requirements. Growers also can buy a water sampling kit from their local AgCenter parish extension office.

Research and Outreach

LSU AgCenter researchers and extension specialists are developing best practices for water treatment suitable for Louisiana producers. These practices include the use of ultraviolet light inactivation of microorganisms and modifying filtration systems to remove microbial contaminants from irrigation water. Louisiana producers have numerous opportunities to attend workshops and meetings to learn how to manage food safety risk associated with agricultural water. During 2015, the LSU AgCenter has been hosting a series of Good Agricultural Practices (GAPs), Good Handling Practices (GHPs) and food safety workshops. The workshops are presented in collaboration with LSU, the Louisiana Department of Health and Hospitals, the Louisiana Department of Agriculture and Forestry and the Southern University Agricultural Research and Extension Center.

Achyut Adhikari is an assistant professor in the School of Nutrition and Food Sciences and is in charge of training and education about the Food Safety Modernization Act. Marlene E. Janes is a professor in the school and a food safety expert.

Sediment and Nutrient Sluicing to Restore University Lake

Y. Jun Xu

Figure 1. Nutrient enrichment at the University Lakes increases algal growth rates, resulting in oxygen depletion. Siltation causes shallowing, reduction of water volume and suspended sediments in the water column, which impede light penetration. Photo by Y. Jun Xu

University Lake on the Louisiana State University Baton Rouge campus is an invaluable asset to citizens in the state's capital city. Beyond serving local residents, this lake is greatly enjoyed by out-of-town visitors. Like many urban lakes in the world, University Lake is faced with the twin problems of siltation and nutrient enrichment from the runoff of the drainage area (Figure 1). The accumulation of soil and organic particles can exacerbate internal release of nutrients, leading to a degradation of water quality and to the impairment of designated uses.

Many urban lakes face similar water quality problems. In the United States, 44 percent of all lakes and 59 percent of human-made lakes have been classified as impaired, and stormwater runoff has been attributed as the major cause of the impairment (Figure 2). When the water quality issue becomes imminent, dredging of the lake-bottom sediments is often used for urban lakes. However, dredging can be extremely costly as well as undesirable when a popular lake in a highly urbanized area must be dried out for an extended period of time. University Lake is a prime example of the situation.

University Lake, along with its five sister lakes, was created in the 1930s from a swampy bayou area through damming, timber harvest and earth moving (Figure 3). By the 1970s these lakes were silted up, and the depth of much of the open water areas became less than 2 feet. High nutrient levels, especially phosphorus, were found, and frequent fish kills occurred in the late 1970s. The lakes were then dredged during 1982 and 1983, removing approximately 600,000 cubic yards of lake sediments and increasing the average depth by more than 1 foot. Water quality conditions improved immediately after dredging.

However, the improvement of water quality of the LSU lakes system was short-lived. Studies showed that 10 years after dredging, the lakes' phosphorus level and turbidity reached the same level of pre-dredging. Water depth measurements conducted in 2009 found that much of University Lake is shallower than 2.5 feet. Water quality monitoring at the lake showed a considerable increase of nitro-

Figure 2. Stormwater drains around University Lake carry sediments, nutrients and other chemicals into the water body. Photos by Y. Jun Xu

Table 1: Comparison in costs and benefits between dredging and sluicing of the LSU lakes system

	Dredging	Sluicing
Siltation reduction	Immediate, mid-term	Intermediate, long-term
Water quality improvement	Immediate, short-term	Intermediate, long-term
Project costs	$20-$60 million	< $1 million
Project time	2-4 years	< 1 year
Impacts on neighborhood	High	Low
Educational opportunity	Low	High
Research opportunity	Low	High

gen and phosphorus from 2008 to 2014. The concentration of chlorophyll during summer months has increased by three to six times, causing supersaturation of dissolved oxygen in the lake. Based on the current condition, the lake can be classified as hypereutrophic, or very nutrient-rich, with frequent and severe algal blooms and low transparency.

The Baton Rouge Area Foundation recently contracted a group of firms to create a master plan for the restoration of the lake. As a chief solution, dredging of approximately 800,000 cubic yards of the lake bottom sediments is being proposed. However, the cost of such a large-scale dredging project would easily amount to tens of millions of dollars, which no agency or private entity would see as realistic. Apart from the unrealistic cost, dredging does not provide a sustainable solution. The LSU lakes system was created through damming a bayou. The current water quality problem is also caused by the dams that encourage siltation and nutrient enrichment (Figure 4).

A proposed engineering solution – sediment and nutrient sluicing – would cost only a fraction of the cost of a dredge project. A sluice gate can regulate lake bottom water flow by lifting the gate through valves, which can flush sediments as well as reduce nutrient-rich water. The height, frequency and duration of sluice gate lifting can be operated in accordance with the weather conditions, lake water conditions and management goals. Replacing the dams at City Park Lake and University Lake with sluice gates would work effectively in the long term in reducing both sediment and nutrient accumulations. In addition to its low cost and effectiveness, sediment and nutrient sluicing at the LSU lakes system would provide educational opportunities for students to learn about urban water quality and conduct research in hydraulics, hydrology and water quality (Table 1).

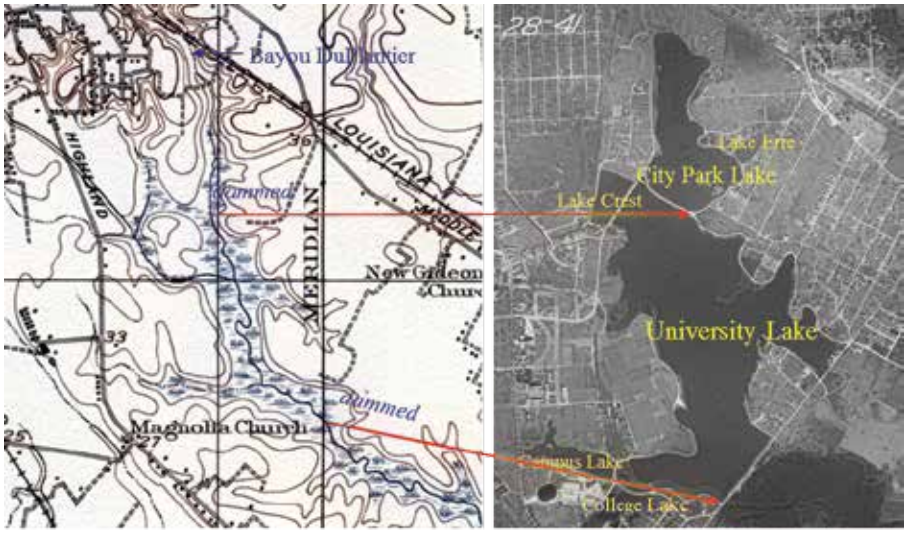


Figure 3. The map from 1908, left, and the aerial photo from 1941 show the transformation of the Bayou DuPlantier swamp area into the LSU lakes system through two dams, removal of trees and dredging of the swamp.

Y. Jun Xu is a professor in the School of Renewable Natural Resources.

Figure 4. The City Park Lake dam (left) and the University Lake dam encourage siltation and nutrient enrichment. Photos by Y. Jun Xu

SCIENCE NOTE

Long-term Nutrient Change in the Mermentau and Vermilion Rivers

Songjie He and Y. Jun Xu

The Mermentau and Vermilion river basins are among the most intensive agriculture areas in Louisiana. Previous studies conducted in the region by LSU AgCenter researchers have shown that crop, dairy and aquaculture production can cause higher nitrogen and phosphorus release into the bayous and streams in river basins. To reduce nitrogen and phosphorus inputs to aquatic ecosystems, the LSU AgCenter encourages the use of best management practices. BMPs include a set of guidelines and recommendations, such as nutrient management, pesticide management, irrigation management, grazing management, and erosion and sediment control.

In the past few decades, public education and technical assistance for agricultural BMPs have been provided by a group of agencies including the LSU AgCenter, the U.S. Department of Agriculture's Natural Resource Conservation Service, the Louisiana Department of Agriculture and Forestry, the Louisiana Department of Environmental Quality and the USDA Farm Service Agency. Although BMPs are widely used today, it is not clear how effective they actually are in protecting or improving water quality in intensive-agriculture river basins.

To determine the effectiveness of BMPs in Louisiana, AgCenter scientists completed an assessment of changes in nitrogen and phosphorus in the Mermentau and Vermilion rivers from 1980 to 2010. Researchers collected daily discharge data from the U.S. Geological Survey and monthly water quality data, including total nitrogen and total phosphorus concentrations, from the Louisiana Department of Environmental Quality to quantify changes in nutrient levels. The selected river gauge stations and water quality sampling locations on the Mermentau and Vermilion rivers were close to the river mouths to represent the realistic nutrient loads from the two river basins.

Songjie He, graduate student in the School of Renewable Natural Resources, takes measurements in the Mermentau River. Photo by Zhen Xu

Table 1. Average annual discharge of total nitrogen and total phosphorus in kilograms per square kilometer per year from five Louisiana's coastal river basins.

	Total Nitrogen	Total Phosphorus
	kilograms per square kilometer per year	
Mermentau	1,098	206
Vermilion	1,452	360
Amite	780	140
Tangipahoa	560	70
Tickfaw	710	110

Songjie He collects water samples in the Vermilion River. Photo by Zhen Xu

The assessment of the long-term total nitrogen and total phosphorus was done for three decades – the 1980s, 1990s and 2000s. Overall, researchers found a steady decline of nitrogen and phosphorus concentrations in both rivers, mainly in the 1990s. The Vermilion River showed a higher concentration of both total nitrogen (1.83 milligrams per liter) and total phosphorus (0.41 milligrams per liter) than the Mermentau River (1.57 milligrams per liter of total nitrogen and 0.27 milligrams per liter of total phosphorus). Annually, on average, the Vermilion River delivered a total of 1,829 metric tons of nitrogen, while the Mermentau River delivered a total of 3,925 metric tons of nitrogen because of its higher discharge. Similar to the concentration trend, the rivers showed a decline in total nitrogen and total phosphorus loads to the Gulf of Mexico.

Although there is no report on actual implementation of BMPs in various land use practices in these two river basins, the findings from the long-term assessment on riverine nutrient change indicate their likely positive effect. A study in 2011 showed varying adoption of BMPs in the crawfish industry in southwestern Louisiana, from 3 percent for streambank and shoreline protection to 79 percent for irrigation water management. The Mermentau and Vermilion river basins drain much of this area, and it is likely that the BMPs for irrigation management and nutrient management may have made the greatest contribution to the nutrient reduction because of intensive rice cultivation. Despite this improvement, when compared with other coastal rivers in Louisiana, the two river basins still show much higher nutrient discharge rates (Table 1). Further studies of nitrogen and phosphorus in the Mermentau and Vermilion rivers are underway, with the aim of having a better understanding of the current nutrient conditions of these two rivers and helping to improve agricultural BMP effectiveness.

Songjie He is a graduate student and Y. Jun Xu is a professor in the School of Renewable Natural Resources.

Acknowledgments
The National Fish and Wildlife Foundation and the U.S. Department of Agriculture for partial funding. The U.S. Geological Survey and the Louisiana Department of Environmental Quality for long-term river discharge records and water quality data.

Louisiana Master Farmer Program: A Bridge Between Regulatory Agencies and Agriculture

Bruce Schultz

The Louisiana Master Farmer program serves as a bridge between regulatory agencies and agriculture.

"We are the program that producers come to for environmental guidance and regulatory compliance, especially since we have the certification that presumes compliance with state soil and water regulations," said Ernest Girouard, Master Farmer coordinator.

Producers completing the program demonstrate regulatory compliance in three phases. First, they attend environmental classroom education, followed by the second phase of attending of field days to view commodity-specific best management practices. The final phase is the development and implementation of a farm-specific conservation plan. The certification is issued by the Louisiana State Commissioner of Agriculture and Forestry.

The program continues to grow, with 2,500 participants in some phase of the program. So far, 206 are certified as Master Farmers.

"More than 1.7 million acres in Louisiana now use conservation practices or have participated in current farm bill conservation programs," Girouard said.

A decision is expected soon on regulation of farm fuel storage tanks. Whatever regulations that come out of the decision will be included in the Master Farmer instructional material to help farmers comply with the new rules, Girouard said.

Recent Master Farmer activities include:

- The organizing of two listening sessions in Louisiana for public comment on a revision of the Clean Water Act, known as the Waters of the U.S.
- Partnering with Ducks Unlimited and the Natural Resource Conservation Service with a testing program for irrigation wells. A trailer with diagnostic equipment can determine pumping efficiency of a well and whether a pump should be repaired or replaced. Also, the testing can help a farmer decide if a diesel-fueled pump should be replaced with an electric pump, what size should be installed, and when the change would pay for itself.
- Developing a program with LSU AgCenter poultry researchers for poultry producers to comply with state and federal regulations for chicken production houses.

In addition, the Master Farmer program works closely with the LSU AgCenter Water Resource Center at the Red River Research Station near Bossier City to study how the state's water resources can be better managed to meet the needs of agriculture and a growing population.

The Master Farmer program obtained four grants totaling more than $150,000 to study several water-related issues, including sediment loss and irrigation efficiency. One grant was awarded to study use of reservoirs for storage of surface water and whether runoff water from fields contains enough nutrients to reduce the amount of fertilizer needed for a crop.

A Master Farmer University was started in 2014 at the request of producers to streamline the process of fulfilling the first two phases of the program. The first day is educational training on the basics of environmental stewardship and complying with regulations. On the second day, participants attend a field day or visit a farm related to their commodity.

James Hendrix, Master Farmer area agent in north Louisiana, is working with the Natural Resources Conservation Service and the Tensas-Concordia Soil and Water Conservation District on a project to improve water quality in Lake St. Joseph in Tensas Parish.

The partners are assisting agricultural producers with selection and implementation of site-specific best management practices (BMPs) in the 18,000-acre watershed that drains into the lake, as well as measuring the effects by monthly sampling water in the lake.

"We are already witnessing successes from this three-year study," Hendrix said.

The state Department of Environmental Quality has classified the lake as an impaired body of water because of turbidity, or muddy water.

More than 90 percent of the producers are participating in the project, and monitoring data is indicating a significant decrease in turbidity, which is a major step toward the goal of declassification of the lake's impairment.

Hendrix said the farmers in the area have been working on improvements to reduce soil erosion that has contributed to turbidity.

Simple improvements such as installing drainage pipe have solved many erosion problems quickly, he said. Other improvements that involve major changes in historical farming practices, such as shifting to no-till or limited tillage and cover crops, will require more time to implement, he said.

"There's a lot of interest in this project as a model that can be used for other lakes in the state," Hendrix said, adding that new information from the project will be incorporated into the Master Farmer training program

Donna Morgan, LSU AgCenter county agent and Louisiana Master Farmer Program area agent, completed a two-year study this spring comparing different seeding methods for ryegrass pasture. She included no-till, prepared seedbed and overseeding, along with an unplanted check, all at the Dean Lee Research Station.

The forage available at each grazing did not vary by a significant amount when the different planting methods were compared, she said.

"There was a significant difference in grazing intervals," she said.

The prepared seedbed was available for grazing earlier, and less time was needed before the grass was tall enough for regrazing by the 16 mature cows used in the test.

Water quality was measured in the runoff after rains, Morgan said, and a higher concentration of nitrates was found in rainwater collected from the prepared seedbed plot. There were no differences in the other chemicals tested.

Morgan said the study's findings will be included in future Master Farmer classes.

She plans to do another test this fall to look at the effectiveness of urea treated with Agrotain compared to a slow-release fertilizer.

Bruce Schultz is a writer and photographer with LSU AgCenter Communications.

Young farmer award winner attributes success to good advice, thinking big

Linda Foster Benedict

"4-H builds character and teaches responsibility. You have to take ownership of a project whether it fails or succeeds."
Danielle Yerby

Danielle Yerby, of Colfax, was named the 2015 Outstanding Young Farm Woman by the Louisiana Farm Bureau Federation. Yerby attributes her success in part to the lessons about responsibility she learned in 4-H. She is shown with her daughter, Reagan Jewell, 2. Photo by Brandy Orlando

Two of the biggest challenges for today's Louisiana farmer are finding more land and getting public policy to fit the best interests of agriculture.

That's according to Danielle Yerby, 32, of Colfax in Grant Parish. She was recognized at the Louisiana Farm Bureau Federation annual meeting in New Orleans June 25-28 as the 2015 Outstanding Young Farm Woman.

She's the financial manager in the farming partnership she has with her husband, Ryan Yerby. They grow corn, soybeans, cattle and pecans on about 900 acres in the Red River delta of central Louisiana.

"I'm in charge of anything related to the dollar sign, and Ryan's in charge of anything related to the dirt," Danielle said.

They also have a partnership with Ryan's parents, Charles and Beth Yerby. The younger Yerbys operate Taureau Farms, named after a bayou that runs through the family's property. The older Yerbys have Keystone Farms. Their joint ventures are under the name of K&T Farms.

Danielle, whose hometown is Branch in Acadia Parish, did not grow up on a farm. And although she graduated from the LSU College of Agriculture in 2006, her goal was a career in

human resource management and not running a farm business.

"I didn't even take an accounting course," she said.

But when she and her husband – a 2004 LSU College of Agriculture graduate in ag business – got the offer from his parents to join them seven years ago, the young couple decided to take the leap. They left safe jobs in Gonzales – he with John Deere and her with Profiles International, a human resource assessment firm – and entered the risky world of farming.

The gravity of her decision sank in shortly after their move when her husband announced they had 11 months to pay back their initial $120,000 loan.

"I think I cried. It was such a shock. I was only 26 years old," she said. That seemed like a mountain of money back then.

She dug in, made contacts and drew upon all the resources at her disposal to learn how to run a farming business successfully.

"I'm not afraid to ask questions," she said.

She's also not afraid to let trusted experts see her financials. She thinks sometimes farmers guard their bookkeeping too closely, which prevents them from getting the help they need.

She also doesn't let sentimentality about family farm traditions get in the way of making good, hard decisions.

"You don't grow cotton just because your family always grew cotton. You have to look at the numbers," she said.

She attributes her can-do attitude and ability to tackle life changes partly to her years in 4-H, which spanned fourth grade through college.

"4-H builds character and teaches responsibility," she said. "You have to take ownership of a project whether it fails or succeeds."

As luck would have it, her part-time job all five years of college was working for LSU AgCenter wheat breeder Steve Harrison.

"I didn't realize I'd be able to put to use what I learned from him," she said, adding that she still calls on him with agricultural questions.

Her Acadia Parish county agent while in 4-H was Ron Levy, now the LSU AgCenter extension soybean specialist based at the Dean Lee Research and Extension Station in Alexandria. She calls on him, too, as well as the other AgCenter specialists at the station.

Other people she relies on for advice include crop consultants, chemical and seed salespeople, and her in-laws. She said her mother-in-law taught her the importance of keeping the farm business separate from home affairs.

"With farming you have good years and bad years," Danielle said. She doesn't believe in taking money from the farm business to splurge on a vacation, for example, if there is not enough money in the family account.

And 2015 has not been one of those good years for the farm with all the rain and weather problems that disrupted spring planting.

"This is one of those years you save for," she said. "We'll be lucky to break even."

The wet spring was good for the pecans, however. The Yerby family has 1,300 trees and should see a profitable harvest in the fall.

In addition to her farm responsibilities, she has a full-time, off-farm job. She's the events and communication coordinator for the Central Louisiana Chamber of Commerce in Alexandria, only about a 25-minute drive from her home.

"It's our safety net," she said of the job. In case things go wrong on the farm, she wants to be able to keep a roof over their heads, she said.

One of the frustrations of farming in today's contentious society is dealing with the ramifications of misguided public policy decisions. Danielle sees too many politicians being influenced by activist groups who do not have the facts straight.

To help address this lack of knowledge, she sees herself becoming more involved in the political discourse. She plans on applying for the LSU AgCenter's Ag Leadership Program, which is a two-year program in which members of the agricultural community are exposed to the information and contacts they need to become spokespeople for agricultural interests. Her husband, Ryan, is already a graduate of the program.

Her plans for her farming operation include expansion both in land and cattle. For example, she wants to upgrade the landing strip on their property so people can fly in from all over to buy cattle.

"I would like to become the King Ranch of central Louisiana," she said with a smile, in reference to the famous mega ranch in Texas. The Yerbys now have about 115 head of cattle. Future plans include custom breeding and online auctions.

Danielle would also like to acquire more land, which is difficult to do with the high demand, although they just recently bought 60 acres.

They also have plans to build a new, bigger house for an expanding family. Daughter, Reagan Jewell, is now 2.

"I have a long candle that I'm burning at both ends," Danielle said.

This Farm Bureau award that recognizes her management skills is most likely only the first of many she will receive during her farming career.

One of the frustrations of farming in today's contentious society is dealing with the ramifications of misguided public policy decisions.

Linda Foster Benedict is the associate director of LSU AgCenter Communications and is the editor of Louisiana Agriculture magazine.

Griffin's career spans agriculture's weed science revolution

Olivia McClure

About three decades ago, as fields in Louisiana choked on nearly uncontrollable weed populations, the 1981 state average soybean yield was a low 21 bushels per acre.

It's a far cry from last year's average of 57 bushels per acre – a milestone LSU AgCenter weed scientist Jim Griffin said is only partially due to modern high-yielding varieties.

"Soybeans have very high yield potential when they are watered properly, weeds are eliminated to reduce their competition with the crop, insects are controlled and diseases are managed," said Griffin, who plans to retire in 2016.

He has helped farmers navigate that constantly evolving equation since August 1979, when he arrived at the Rice Research Station in Crowley "on the edge of a great shift," he said. Farmers around Louisiana were growing more and more soybeans, and rice farmers in the southwest were just beginning to rotate them with their crop.

Griffin initially worked as a production agronomist, evaluating soybean varieties and tillage, irrigation and weed control practices.

Eight years later, when he moved to LSU's main campus to concentrate on weed management in Louisiana crops, the agricultural chemical industry was changing fast. Part of his job was to evaluate and determine application rates for new herbicides being released to control grass and broadleaf weeds.

Despite those advances, Griffin said, it was still common to see fields with heavy weed infestations.

In the mid-1990s, Monsanto rolled out Roundup Ready technology — soybean, cotton and corn resistant to glyphosate, the active ingredient in Roundup. Roundup Ready seeds were more expensive but enabled farmers to effectively control a host of weeds with a single affordable herbicide. Many eventually used glyphosate exclusively.

"With multiple applications being made in crops year after year, it was only a matter of time before Mother Nature would exert her influence," Griffin said. "Weed populations in fields began to shift toward weeds less sensitive to glyphosate."

Griffin was the first to document glyphosate-resistant johnsongrass in Louisiana, and colleagues later identified glyphosate-resistant palmer amaranth. Those two weeds remain major problems today.

"The Soybean and Grain Research and Promotion Board has been generous over the years in supporting weed management research in Louisiana," Griffin said. "This has been important because of differences in weed complexes, soil types and crop rotations around the state."

Farmers themselves revealed many of those intricacies. Taking time to talk with them, as well as to consultants and chemical company reps, about their concerns was often rewarded with a relationship and trust. They often call Griffin for his advice.

"You're being called on to make major decisions on that crop — a decision that will cost those growers a lot of money," Griffin said. "It is fulfilling to know that folks have that much confidence in your knowledge and experience."

Conversations with growers have helped Griffin see things differently, he said. Some of their questions and suggestions led to innovative research projects for his graduate students.

Griffin has mentored 50 graduate students, teaches courses in weed science and field research methods, and is the College of Agriculture's graduate student recruitment coordinator. Students, he said, have been both his biggest challenge and greatest reward.

Jim Griffin, weed scientist, will retire in 2016 after more than three decades with the LSU AgCenter. Photo by Olivia McClure

"To see students come in with little self-confidence and a perceived inability to speak in front of a group, and then to graduate, overcome those issues and be very successful is extremely rewarding," Griffin said. "The opportunity to conduct meaningful research and to work with clientele and students has truly been a blessing."

"The weed management strategies that Jim Griffin and his students have developed for Louisiana's soybean, feed grains and sugarcane industries are a primary reason these growers have been successful with profitable crop yields. Much of his basic work on weed ecology, crop tolerance and herbicide performance in Louisiana cropping systems formed the framework for strategies used across the Southern region of the U.S. His contributions to teaching, research and extension in weed science have been recognized not only in the state of Louisiana, but by his colleagues in national professional societies," said Rogers Leonard, AgCenter associate vice president for plant and soil science programs.

Olivia McClure is a graduate assistant with LSU AgCenter Communications.

Researchers continue quest to eradicate salvinia from all Louisiana waterways

Bruce Schultz

The LSU AgCenter is moving its facility for growing weevils to eradicate the aquatic weed called salvinia.

A location in Terrebonne Parish on the property of Michael St. Martin had been used for the past four years.

"We appreciate the St. Martin family for allowing us to establish a weevil population on their land," said Rodrigo Diaz, LSU AgCenter entomologist. "It provided an excellent location to maintain a healthy population of the insects." Diaz said three new locations will be used, all on LSU AgCenter property.

Salvinia is an invasive species that came to the U.S. in the 1990s from South America. It grows rapidly and forms dense mats on the water surface. Herbicides can be used to control salvinia, he said. But spraying is not completely effective, and enough plants survive to maintain a regrowth of the invasive species.

The weevils are originally from South America, too. "They are not good fliers, and they won't move to crops," Diaz said. "These weevils only attack salvinia."

Dearl Sanders, who ran the LSU AgCenter weevil program before retiring last year, said the weevil project for large-scale releases began at Gheens in 2008, and the weevils were harvested and released from that site through 2011.

"Most of the success was achieved in the Lafourche, St. John, St. Charles and Jefferson parishes," Sanders said. "On monitored sites in Lafourche Parish, infestation levels of giant salvinia were reduced by 90 percent within three years."

Sanders said the weevil nursery was moved to Houma in 2011, and salvinia populations had been reduced by 90 percent in that area.

Diaz said salvinia remains a problem in Cameron and Vermilion parishes. In addition, the weed is a big problem in lakes and streams in central and north Louisiana, such as Cross Lake near Shreveport and Lake Bistineau near Doyline.

But the weevils have difficulty surviving cold winters, so new strategies are being used to help maintain the insect's population in north Louisiana.

Research by another team member, Steve Micinski, is being done using pine straw and fabric to cover infested salvinia to help insulate weevils from the cold.

Seth Johnson, LSU AgCenter entomologist, said controlling salvinia with weevils on Cross Lake and Lake Bistineau has been inconsistent because of cold winters. "Control on those two lakes has been seasonal and intermittent with elimination or near elimination of the weevil population in three of the last five years due to winter temperatures below survival levels," he said.

Johnson said another research project is in progress to find weevils in southern South America or Australia that can tolerate the harsh winter temperatures that occur in north Louisiana.

Bruce Schultz is a writer and photographer with LSU AgCenter Communications.

SCIENCE NOTE

Scientists Optimize Nursery Irrigation Practices by Managing Water Output

Edward W. Bush and Jeffrey Beasley

Proper irrigation management is essential to producing a quality nursery crop, reducing cost and optimizing plant growth. Many believe the nursery industry uses excessive irrigation when producing a large crop, but irrigation analysis at the nurseries in both Forest Hill and Folsom indicated that in some cases below-optimum irrigation volume was used. Underwatering crops can be as harmful to plants as overwatering. Physiologically, plants that are underwatered become stunted and lose root and shoot growth. Underwatered plants also become more susceptible to insect pests and diseases. Overwatering crops can leach out necessary elements contributing to nutrient movement and runoff into waterways, while leaving plants deficient in nutrients for normal growth. Several leaf and root diseases are attributed to overwatering, and filling soil air space with too much water can suffocate roots. Managing irrigation requires years of experience and detailed management. The goal of this research was to develop a method of irrigation that would assist growers in determining the proper water requirement needed throughout a changing growing season.

Properly scheduling irrigation for nursery container crops can be difficult in substrates (soils) having low waterholding capacity. Therefore, a simple, automated, sensor-driven irrigation system was developed at the LSU AgCenter to better regulate irrigation application volumes. To test the device, known as Switch, researchers evaluated the August Beauty gardenia grown in one of two container sizes (1 and 3 gallons) and two pine bark substrates (fine and coarse) over a four-month period. Gardenias grown using the new irrigation system were compared to plants grown using a traditional timed overhead irrigation system. The traditional timed system applied one inch of water per day. Over the course of the study, gardenia had similar growth between irrigation systems within substrate treatments. Gardenia growing in coarse substrate had higher growth indices and greater biomass compared to gardenia growing in the finer substrate. Within four months of planting, all gardenia had reached marketable size. However, gardenia grown using the new Switch system reduced water application volumes greater than 30 percent compared to the traditional timed irrigation system. A provisional patent was granted on the device in 2015. It is expected that the patent process will be finalized by January 2016. This process was a cooperative effort between the nursery industry and the LSU AgCenter.

Jeffrey Beasley and Edward Bush are both associate professors in the School of Plant, Environmental and Soil Sciences.

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