

LOUISIANA Agriculture

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Assuring Our Future Through Scientific Research and Education

Louisiana
forestry still feels
effects of the
Great Recession.
page 8

Endangered Roseau Cane Key to Mississippi River Delta Survival

Bruce Schultz

Louisiana's coastal marsh has been under siege by erosion and subsidence. Now comes another threat: the Roseau scale insect, an invasive species from Asia. It is suspected of playing a major role in the die-off of Roseau cane in the southeast Louisiana marsh.

The insect preys on the Roseau cane, the main vegetation in the vast Plaquemines Parish marsh. The plant is the front line of defense against coastal erosion with an extensive root system that holds the fragile marsh soil.

Meanwhile, the scale insect has claimed large swaths of the cane. The scale has been found in areas where the cane has regrown after a die-off from scale infestation.

Rodrigo Diaz, LSU AgCenter entomologist, said it's possible the insect alone is not responsible for the Roseau cane die-off. He said it's likely that the Roseau has been subject to several stresses, such as excessive saltwater, before the scale insect bores a hole into the plant to feed.

The LSU AgCenter, in conjunction with several state and federal agencies, is researching ways of controlling the insect.

Losing the Roseau cane would be disastrous for Plaquemines Parish, which has been imperiled by coastal land loss for decades.

The banks of the Mississippi River in Plaquemines Parish are held in place by Roseau cane. The banks maintain the river channel, forcing the swift water to carry sediment through the delta and out to the Gulf of Mexico.

Without the river banks to restrict the Mississippi's flow, the water would be dispersed and the current would slow to a sluggish speed. Sediment would fall out of the water before reaching the Gulf, resulting in siltation in the channel that would threaten the Mississippi's viability for large oceangoing ships.

Also, the loss of Roseau cane would mean valuable wildlife habitat would be threatened, since the marsh is the wintering home for migratory and resident waterfowl.

James Harris, manager of the 48,000-acre Delta National Wildlife Refuge, said Roseau cane is the key to the delta's survival. "As the Roseau goes, so goes the refuge" he said.

Bruce Schultz is an assistant specialist with LSU AgCenter Communications.



LSU AgCenter coastal ecologist Andy Nyman shows reporters how the roots of Roseau cane are more extensive than another aquatic plant known as bull tongue. Photo by Bruce Schultz

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LOUISIANA Agriculture

- 2 **Endangered Roseau Cane Key to Mississippi River Delta Survival**
Bruce Schultz
- 4 **AgCenter News**
- 6 **College of Ag News**
- 7 **New Faculty Profile: Livestock Education Program Grows by Two**
Tobie Blanchard
- 8 **Trials and Tribulations of the Logging Industry in the U.S. South after the Great Recession**
Richard P. Vlosky
- 11 **Louisiana Sugar in a Global Context**
Michael Deliberto and Mark J. Schafer
- 14 **Development of Simulation Models to Support Louisiana Sugar Mills**
Daira Aragon
- 16 **Sugar and Salt from Sugarcane**
Franz Ehrenhauser and Daira Aragon
- 18 **LSU AgCenter 'Hot' Intellectual Properties**
Dirk Benedict
- 20 **Insect and Disease Challenges for Growing the Tea Plant, *Camellia sinensis***
Yan Chen and Allen Owings
- 23 **'Food Warriors' Fight Obesity**
Emelia Clement and Melissa Cater
- 24 **Growing Olives in Louisiana: An Initial Evaluation**
Jason Stagg
- 26 **Youth Learn Nutrition, Food Safety, Healthy Lifestyle at CHEF Camps**
Linda Foster Benedict
- 28 **Development of Alternative Strategies to Manage Crop Diseases**
Jong Hyun Ham
- 31 **Greaxing Up in the Garden**
Kathryn K. Fontenot
- 33 **Measuring the Economic Futures of Louisiana's Rural Children**
J. Matthew Fannin and Vikash Dangal
- 34 **New Herbicide Systems Give Farmers Options for Better Weed Control**
Olivia McClure



8



14



16



31



ON THE COVER: Logs are being moved at a RoyOMartin timber cutting site off state Highway 10 outside of Oakdale, Louisiana. Read more about how the Louisiana forestry industry is recovering after the Great Recession of 2007-2008, starting on page 8. Photo by Olivia McClure

Researchers hope to develop opportunities for aquarium fish production



Christopher Green, LSU AgCenter aquaculture researcher, is among a group of scientists evaluating how to improve the production of native aquarium fishes under a two-year, \$150,000 U.S. Department of Agriculture grant through the Southern Region Aquaculture Center, which is headquartered in Stoneville, Mississippi. The other institutions that are part of the grant are the University of Florida and Virginia Tech.

The scientists are studying minnows and other similar-size fishes popular with aquarium owners to help fish farmers improve their production and discourage enthusiasts from capturing them in the wild and causing problems to the environment.

The production of ornamental fishes on nearly 300 U.S. farms was worth \$41.5 million in 2013, according to the USDA Census of Aquaculture. Fish farms in the South are mostly in Florida for the aquarium fish trade.

"In our neck of the woods, farms in Louisiana and Arkansas produce mostly koi and goldfish for aquariums and ornamental ponds," Green said. "Our focus is on native ornamentals," he said. "While the ornamental trade is primarily with tropicals, there is a market for native fish, too."

Green's work is with golden topminnows, which were selected from a list of "pilot" species identified by farmers.

7 new plants added to 'potential' choices

Seven new plants were named to the LSU AgCenter Plants with Potential program in 2017, including the turnera above. The LSU AgCenter Hammond Research Station inaugurated this program two years ago to introduce unfamiliar,



nonpatented plant material free from propagation restrictions can present a significant cost savings and lower the cost of offering these new selections, he said.

Using nonpatented plant material free from propagation restrictions can present a significant cost savings and lower the cost of offering these new selections, he said.

The turnera, commonly called buttercup, is an annual that begins flowering mid-to-late spring and will reliably flower through fall until first frost. The flower, a good pollinator, reaches 18-24 inches tall by fall and grows well in full sun to partial shade.

For a complete list of the 22 plants, go to www.LSUAgCenter.com and search for Plants with Potential.

Healthy living focus of LaSalle summer camp



LaSalle Parish families who participated in a summer day camp program found the perfect recipe for fun: walking, yoga, games, tasty snacks and health lessons.

It was all part of the Healthy LaSalle! Summer Day Camp in the Park program. LSU AgCenter rural development agent Cynthia Cockerham helped organize the camp, which was part of the Healthy Places LaSalle initiative funded by a \$600,000 grant from the Rapides Foundation.

Cockerham collaborated with parish leaders and elected officials to design the eight-session summer day camp, which ran through June and hosted nearly 200 youth ages 4 to 10.

The primary goal of the camp was to spur increased use of six parks in the parish, Cockerham said, but also to teach children and families

about making healthier lifestyle choices. The day camp sites included Jena Town Park, Jena Band of Choctaw Tribal Center Park, Potty Tannahill Park, Olla Recreational Complex, Tullos Park and Ward 10 Park.

All camp instructors were certified classroom teachers contracted through the LaSalle Parish School Board. "We planned the framework of the camp to include funding to pay instructors just as if they were teaching summer school," Cockerham said.

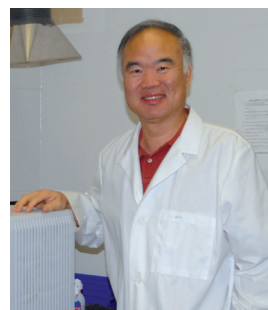
Children ages 4 to 7 had a daily half-mile goal, while older youth walked a full mile, said Annie Steen, a LaSalle Junior High School physical education teacher who directed one of the camp sites.

"The camp encourages children and families to use the parks and get out and do things together instead of staying inside and playing video games all day," Steen said.

The day camp is only a small part of the grant project. Cockerham said 75 percent of the funds have been invested in infrastructure. About \$210,000 of the grant funding has provided park lighting at the Jena, Olla and Ward 10 parks, she said.

"The lighting will increase park usage and provide a safer environment for families who may not find time to get to park until later in the day," she said, adding that another \$70,000 has been used to purchase portable restroom trailers.

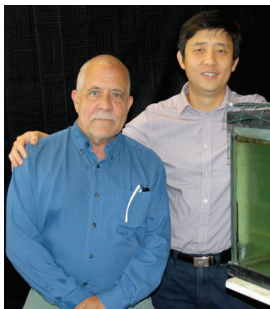
3 researchers get \$62,500 in promotional grants



Three LSU AgCenter researchers have been awarded \$62,500 in grant funding that will help them promote their inventions to industry partners. The grants are from

the Leverage Innovation for Technology Transfer, or LIFT2, Fund, which began in 2014 to stimulate technology transfer between LSU and the marketplace.

Jim Wang, a soil chemist in the AgCenter School of Plant, Environmental and Soil Sciences, has developed a low-cost, efficient magnetic magnesium oxide-impregnated biochar composite for capturing and removing phosphate from surface water and wastewater. The product has applications in removing phosphates from municipal wastewater, from surface water in agricultural fields and from animal-waste lagoons. The \$27,500 grant will help him develop an elastomeric foam product that



could be impregnated with the biochar and used to filter agricultural runoff to remove phosphates. The biochar also could be used as a "bedding" material in a wastewater

treatment facility to capture phosphates.

Greg Lutz and Wei Xu, researchers at the AgCenter Aquaculture Research Station, are using a 12-month \$35,000 grant to refine commercial probiotics for fish aquaculture, which will encourage fast growth and enhance immune responses. The researchers hope to enhance the bacteria in the fish gut with natural probiotic compounds to improve the balance of bacteria. They are concentrating on naturally occurring, plant-based oligosaccharides to find the compound or combination of compounds that will improve fish production at low cost. They are working with tilapia as a model fish, but the results could be applied to farming any finfish.

New rice lines featured at field day



More than 400 people attended the LSU AgCenter H. Rouse Caffey Rice Research Station field day on June 28 to hear about the latest work being done to help rice farmers. The group included 54 chefs and staff members from restaurants in New Orleans and Baton Rouge, who learned about rice production and how rice is milled. They examine a tray of brown rice in the above photo at the station's mill.

During the field tour, Steve Linscombe, LSU AgCenter rice breeder and station director, said the new Provisia rice technology has taken five years to develop, with one line ready for release as a variety and three new lines in the works. The Provisia system will help farmers fight weedy rice that cannot be controlled by

Clearfield technology. "Having a different mode of action is certainly going to allow us to go in to these fields with weedy rice," he said.

False ragweed becoming major row-crop pest



Daniel Stephenson, LSU AgCenter weed scientist, warned farmers about ragweed infestations in their fields during a field day on July 13 at the Dean Lee Research and Extension Center. Ragweed parthenium, also known as false ragweed, has gone from a nuisance in pastures to a major pest in Louisiana row crops. The weed can become a major problem quickly if it is not controlled early, Stephenson said. Ragweed parthenium often germinates after spring burn-down herbicide applications and is not discovered until after crops have emerged. "If a producer sees it in their field, they need to remove it," he said.

Local restaurant enlists Food Incubator for nutrition analyses



LSU AgCenter food scientist Ashley Gutierrez, second from left, takes notes as Harrison Decker, far left, manager of the Walk-On's Bistreaux and Bar in Denham Springs, Louisiana, places ingredients on a scale in the restaurant's kitchen. Gutierrez, along with LSU food science graduate students Pitchayapat Chonpracha

and Valentina Rosasco, at right, are analyzing Walk-On's dishes so nutritional information such as calories can be printed on menus. Walk-On's has enlisted the help of the AgCenter Food Incubator to conduct nutrition analyses of its dishes. Federal regulations that will take effect in May 2018 require restaurants with more than 20 locations to publish calorie counts for every item on their menus, plus have additional nutrition information available if customers request it. Walk-On's, a Louisiana company that operates or is planning to open locations in six states, falls into that category.

Research results reported at Sugar Station field day



The LSU AgCenter sugarcane research program is aggressive about finding varieties resistant to mosaic disease, said AgCenter plant breeder Collins Kimbeng during the annual field day on July 19 at the Sugar Research Station in St. Gabriel, Louisiana. The researchers have identified three clones resistant to mosaic, leaf scale and smut that will be used as parents in the crossing program, he said. A portion of the research is supported by grower funding from the American Sugar Cane League.

Jim Simon, general manager of the American Sugar Cane League, spoke about the renegotiated Mexican suspension agreement related to antidumping and countervailing duties against Mexican sugar imports into the United States. "The trade agreement is only as good as the enforcement behind it," he said.

Simon said the league funds about \$1 million in research at the AgCenter Sugar Research Station and the Audubon Sugar Institute.

AgCenter entomologist Rodrigo Diaz talked about the Phragmites scale, which has damaged a considerable amount of marsh cane in Plaquemines Parish from Venice to the mouth of the Mississippi River. Because the insect may be a danger to Louisiana crops, Diaz is inoculating sugarcane, corn, rice and sweet sorghum plants to see if the scale reproduces and damages the plants.

The scale, native to Asia, has natural enemies in three small parasitic wasps.

College of Ag NEWS

Students study tropical horticulture in Honduras



A group of six LSU students traveled to Honduras in April to learn about tropical horticulture in Latin America through a grant obtained by LSU AgCenter International Programs from Partners of the Americas. Pictured above are students Cesar Guardado, Cheston Shayot and Cristina Serrano; professor David Picha; International Programs coordinator Susan Karimiha; and students Reno Myers and Morrill Scott.

Picha teaches international horticulture and tropical horticulture. His students on the trip got to see first-hand in Honduras what they are learning in their class.

"This study abroad experience presented an opportunity to see crops that don't grow in the continental United States and to see the entire value chain from growing to packing and marketing and to enrich cultural experiences for our students," Picha said.

The students visited coffee, palm oil and cacao farms; Dole pineapple and banana production facilities; a crop germplasm bank; and the Honduran Fund for Agricultural Research.

MANRRS partners with Natural Resources Conservation Service



Students from the LSU chapter of Minorities in Agriculture, Natural Resources and Related Sciences (MANRRS) helped set up fresh fruits and vegetables for the public to buy at Sankofa Market in New Orleans. This volunteer activity was part of a newly formed partnership between MANRRS and the U.S. Department of Agriculture Natural Resource Conservation Service to perform outreach activities targeting minorities, minority agricultural producers and landowners.

"This market is in a food desert, which is a place where resources for fresh fruits and vegetables are scarce or nonexistent, so it is valuable to the community," Norlethia Harris, a MANRRS member said, adding that she and the other students were able to talk to locals who visit the market regularly and see how important it is to the community.

Students conduct marine research in Mozambique



Nine LSU students journeyed to Mozambique in May to conduct marine research in the small coastal village of Praia do Tofo, and in their month-long stay had encounters with whale sharks that one student described as almost spiritual.

"I was swimming eye to eye with it," said Sydney Cottingham, a senior from Bowling Green, Kentucky, studying natural resource ecology and management in the LSU College of Agriculture. "It was breathtaking and humbling to be so close to something that majestic."

Reagan Errera, assistant professor in the college's School of Renewable Natural Resources, at left in the photo, led the field studies class. Scuba diving off the coast of Mozambique is part of the class experience. LSU biology student Kathleen Rodick, at right, is estimating fish size.

The group collaborated with researchers with All Out Africa, a nonprofit organization that implements social and conservation projects. The students ended the trip with an excursion to Kruger National Park in South Africa, where they observed a wide variety of savannah wildlife species, including elephants, giraffes, cheetahs, lions and a suite of antelope species.

15 scholars participate in Governor's School for Ag Sciences

Fifteen high school seniors spent two weeks on LSU's campus July 9-20 participating in the Louisiana Governor's School for Agricultural Sciences. The LSU College of Agriculture created the program in 2016 to educate students interested in agriculture about majors and career possibilities, according to Leslie Blanchard, assistant dean, who coordinates the program. Activities included mini lectures from professors, tours of agricultural facilities on and off campus, and training session on leadership and professional development.



New Faculty PROFILE

Livestock Education Program Grows by Two

Tobie Blanchard

Two new faculty members, Crystal Ahrens and Tyler Braud, plan to expand 4-H and the LSU AgCenter and College of Agriculture School of Animal Sciences livestock programs.

Ahrens, 4-H youth development livestock specialist, will be a resource for 4-H agents working with youth on animal projects and teach undergraduate courses. Braud, an instructor in the School of Animal Sciences, will assist with the 4-H livestock program, mainly during the summer.

Originally from Arkansas, Ahrens wants to build more livestock opportunities into 4-H University, an event held annually each June on the LSU campus. She has worked in the animal industry, training feedlot workers on quality assurance and as an animal welfare specialist. She has also worked on the academic side as an instructor and livestock judging coach in Wilburton, Oklahoma. She said this job combines her passions.

"This is my dream job," Ahrens said. "I've always wanted to get into extension, and to get to do it at a big land-grant university is an exciting opportunity."

Braud grew up showing beef cattle in Ascension Parish. While a student in the LSU College of Agriculture, he was active in the Block and Bridle Club and served as a student worker at the horse and sheep research units. He was an agriculture and natural resources and 4-H extension agent in Mississippi before returning to LSU.

"I would like to see undergraduate students more involved in student organizations and taking advantage of educational opportunities, such as judging and quiz bowl teams," Braud said. "Our department offers a wide variety of opportunities for students to become involved and gain valuable skills and knowledge related to animal agriculture."

Tobie Blanchard is the assistant director of LSU AgCenter Communications and the communication coordinator for the LSU College of Agriculture.



Crystal Ahrens and Tyler Braud, plan to expand 4-H and the LSU AgCenter and College of Agriculture livestock programs. Photo by Tobie Blanchard



Crystal Ahrens is the new 4-H youth development livestock specialist. Photo by Tobie Blanchard



Tyler Braud is a new instructor in the School of Animal Sciences. He will be active in the 4-H livestock show program and will advise student organizations. Photo by Tobie Blanchard

Trials and Tribulations of the Logging Industry in the U.S. South after the Great Recession

Richard P. Vlosky

The Great Recession of 2007-2008 marked two consecutive years of loss in many forest products supply chain sectors, from timberland owners to sawmills and wood product manufacturers. Housing starts, the dominant demand sector for wood products, have never fully recovered. Single-family housing starts fell nearly two-thirds from their peak of 2.3 million in January 2006 to 872,000 starts in 2008, the lowest annual pace since January 1991.

In 2007, Southern forests, known collectively as the “wood basket” of the nation, accounted for 58 percent of the total timber volume harvested in the United States. Softwood output fell 22 percent and hardwood output fell 30 percent during the recession years. Between 2005 and 2009, the three primary forestry sectors — wood manufacturing,

paper manufacturing, and forestry and logging — lost more than 110,000 jobs in the Southern United States. The Gulf South was hit hardest by the recession and has not yet recovered (Figure 1). Southern Arkansas, northern Louisiana and southern Mississippi are still 20-35 percent below 2006 levels despite recent mill expansions. Similarly, Louisiana’s 2008 total sawlog harvest decreased by 29 percent from 2007. Pine sawtimber harvest decreased by 30 percent while hardwood sawtimber harvest fell 21 percent. The Southern U.S. logging sector was also negatively affected by the recession with an estimated loss of 7,000 employees.

In 2016, 2,500 randomly selected logging companies were surveyed by mail in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina,

South Carolina and Tennessee. Of these, after adjusting for undeliverable surveys, deceased survey recipients and incomplete surveys, 350 surveys were usable for a 17 percent response rate. Undeliverable surveys are typically companies that have gone out of business. In this study, they represented 16 percent of surveys mailed, accounting for an estimated loss of 3,328 jobs, and were relatively smaller firms compared to those that responded, averaging nine employees.

On average, respondents that weathered the recession have been in the logging business for 29 years. Across all respondents, 39 percent of employees are over 50 years old; 57 percent are white; 33 percent are African-American; and 8 percent are Latino or Hispanic. American Indian and Asian employees account for the balance. Regarding gender, 77



Sawdust flies as timber is cut into more manageable pieces at a RoyOMartin timber cutting site off state Highway 10 outside of Oakdale, Louisiana.

Photo by Olivia McClure

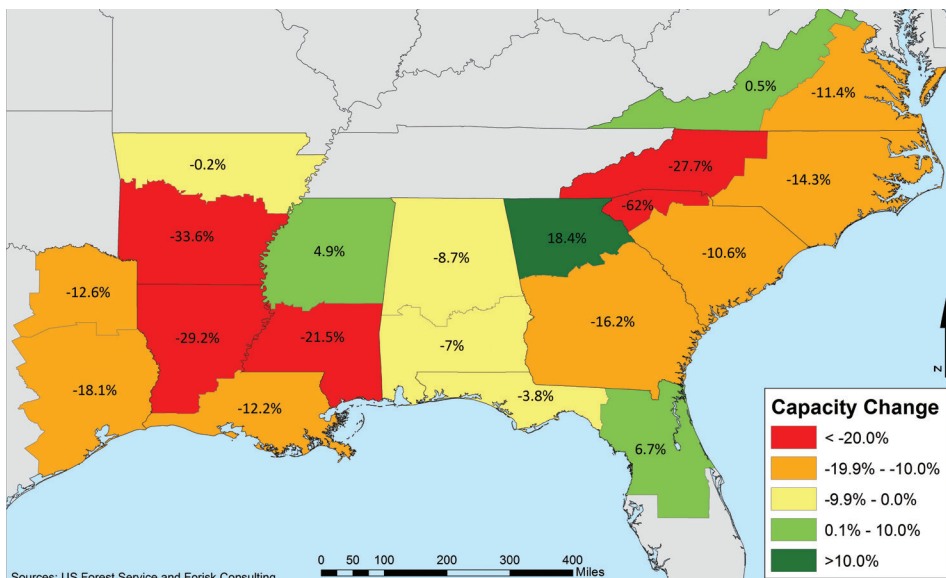


Figure 1. Change in Southern pine grade capacity (Sawmills and Plywood Plants) 2006 to 2016. Sources: Forisk Consulting and U.S. Forest Service

percent of employees are male and 23 percent are female.

The questionnaire focused primarily on what had transpired since the recession for respondent companies across a number of dimensions. Sixty-four percent of respondents said the recession negatively impacted their logging business. During the past eight years, 48 percent saw a reduction in employees and 35 percent saw a decrease in workload. More than 50 percent of respondents said hauling distances from the forest to customers increased, and 34 percent changed their customer base, many attempting to enter export markets or provide the biomass sector small-diameter logs for products such as pellets (17 percent of respondents). The average respondents were operating at 80 percent of capacity. Respondents experienced an estimated decline in employees of 13.3 percent since the beginning of the recession. Relative to out-of-business firms with an average of nine employees, current organizations had an average of 13 employees pre-recession and have 11 employees today.

Those companies that made it through the recession were asked to rank the significance of 14 possible causes for current constrained business operations and downtime. The top five current issues are shown in Table 1. Respondents also were asked to evaluate the significance of 19 variables regarding barriers

they expect to face in maintaining or expanding their logging business in the next five years. The top five most significant issues are shown in Table 1.

Gaining or maintaining competitive advantage can be accomplished through many business practices. In this vein, 80 percent of respondents said they had Master Logger Certification. The top five reasons why they became Master Loggers are shown in Table 2. The Master Logger Program in Louisiana recognizes a logger's conformance with Louisiana Recommended Best Management Practices for safety, environmental stewardship on harvested sites, and compliance with all federal, state and local laws. Earning Master Logger status shows the logger's commitment to professionalism and sustainability of Louisiana's forest resources.

Another way to gain competitive advantage is through training and education. From a list of 15 possible training areas, the top five are shown in Table 3. This is valuable information for Extension Service specialists to tailor workshops and outreach materials to address client needs.

Overall, 65 percent of respondents said they expected to be in the logging business in five years while 21 percent said they didn't expect to continue logging. The remaining 14 percent were unsure. Results from this study support previous work and government statis-

Table 1. Constraints to business operations, ranked from most important to least important.

Current Constraints:	
1	Weather
2	Mill quotas
3	Inefficient operations
4	Road conditions
5	Mill closures
Constraints in Next Five Years:	
1	Cost of replacing equipment
2	Workers compensation costs
3	Low market prices for logs, pulpwood
4	Health insurance costs
5	Fuel costs

Table 2. Eighty percent of survey respondents said they had Master Logger certification for these reasons, ranked from most important to least important.

1	It is required to be competitive.
2	Keeps me current on industry trends.
3	Improves the way I log.
4	Helps me gain respect from the landowner.
5	Helps me gain respect from the public.

Table 3. Training and educational needs, ranked from most important to least important.

1	Logging safety
2	Equipment operation/maintenance
3	First aid/CPR
4	Logging efficiency
5	Insurance for loggers

Logs sit on a truck at a RoyOMartin timber cutting site off state Highway 10 outside of Oakdale, Louisiana.

Photo by Olivia McClure

tics that examined the logging industry in the South since the Great Recession. All sectors in the forest products supply chain were negatively impacted, with many enterprises not surviving. The housing economy remains weak, and as such, the logging and wood products sectors tied to housing will remain in a holding pattern until housing activity increases.

Richard Vlosky is director of the Louisiana Forest Products Development Center and the Crosby Land & Resources Endowed Professor of Forest Sector Business Development in the School of Renewable Natural Resources.

Acknowledgments: Funding for this study: Crosby Land & Resources LLC, Weyerhaeuser Company, Plum Creek Timber Company, RoyOMartin Company, Hancock Timber Resource Group, the Louisiana Forestry Association and the Louisiana Logging Council. Survey instrument material and guidance: Bob Tjaden, University of Maryland; Dalia Abbas, University of Georgia; and Shaun Tanger, LSU AgCenter.



Stephen Dye, a land management forester with RoyOMartin, displays the piece of wood he removed from a tree using an increment borer at a 16-year-old pine plantation near Oakdale, Louisiana. The forest was thinned for the first time in 2015. Foresters drill into trees with increment borers to remove pieces of wood so they can count the number of rings and determine age. Photo by Olivia McClure

Louisiana Sugar in a Global Context

Michael Deliberto and Mark J. Schafer

The global sugar trade played a key role in the historical emergence of a world economy in the 16th century. Originally domesticated thousands of years ago, sugarcane cultivation slowly spread first through Asia, then through the Middle East to Europe, and then globally with Spanish and Portuguese exploration and conquest. Early global sugar production centered in the Caribbean and Brazil; it was one part (along with African slaves and rum) of the Trade Triangle that formed the early global economy. Since then, global trade in sugar has continuously expanded, a trend that is projected to continue for the next several decades. Today, however, nearly all the increase in demand for sugar is in the developing world while there is little or no change in demand in the United States and other developed nations.

Louisiana sugarcane farmers entered this global system in the late 18th century and became a large supplier of cane sugar in the emerging United States. Because domestic demand has always been high, Louisiana farmers have principally produced

sugar for the local market. Still, the Louisiana sugar industry has both contributed to and been influenced by the global sugar trade in multiple ways. For example, slavery was critical to the early success of cane sugar production throughout the Americas, including Louisiana. Louisiana's sugar industry has been, and continues to be, affected by global, regional and bilateral trade agreements that potentially influence the future of Louisiana sugar.

Historical and Comparative Perspective

Louisiana farmers have produced sugarcane since 1795. Within a few decades, Louisiana became a critical sugarcane supplier for the United States and has continued to fulfill that role. Over the past two centuries, technological advancements have contributed to the continued viability of Louisiana's sugar industry. Some important examples include the development of steam-powered sugar factories, the research that developed frost-resistant cane varieties, and the inventions of the evap-



■ Sugarcane billets are being loaded onto the feeder table for further processing at Alma Plantation in Lakeland, Louisiana.

Photo by Olivia McClure

orator, condenser and polariscope, an instrument used to measure the percent of sucrose or amount of sugar in a sugar-containing plant. Louisiana's most important contribution to the world's sugar industry was the multiple effect evaporator, invented in 1834 by New Orleanian Norbert Rillieux, one of the world's first chemical engineers and a French-speaking Creole free man of color. Rillieux's invention, still used in the industry today, enables the production of high-quality sugar at a lower cost.

“ While Louisiana's raw sugar is critical for the U.S. market, it is only marginal to the global sugarcane supply. ”

For more than 100 years, sugar has maintained its position as a critical economic driver in southern Louisiana despite increasing competition from other global sugar producers and new sweetener products. With expansion, key organizations, such as the American Sugar Cane League, the LSU AgCenter and the U.S. Department of Agriculture, have all made substantial contributions to industry innovation in numerous ways. These organizations and others continue to support the Louisiana sugar industry.

Louisiana is the northernmost sugarcane-producing area in the world. From 1940 to 2000, harvested acreage doubled from about 250,000 to 500,000 (Figure 1). During the same period, production tripled from 4 million to 12 million tons (Figure 2). Since 1975, the Louisiana sugarcane industry has seen significant consolidation. The number of farms declined by two-thirds from 1,200 to 400, while the average farm size tripled from 300 to 900 acres (Figure 3). In addition, the number of sugar mills declined from 37 in 1974 to 11 in 2015.

Florida and Louisiana are the main producers in the United States for the domestic sugarcane market at about 45 percent and 40 percent, respectively. Texas produces smaller amounts, and the sugar industry in Hawaii has ended due to flat prices, declining sugarcane production and increasing processing expenses. Sugarcane is first processed into raw sugar and then refined white sugar. Sugarcane products compete directly with refined white sugar extracted from sugar beets, an industry that thrives in northern states, including Michigan, Minnesota and Montana. Sugarcane also competes with other sweeteners, such as high fructose corn syrup, honey and artificial sweeteners.

While Louisiana's raw sugar is critical for the U.S. market, it is only marginal to the global sugarcane supply. Brazil produces more sugarcane than any other nation — 40 percent of the global supply — followed by India, China, Thailand, Pakistan and Mexico. The United States as a whole accounts for 2 percent of the world total, and Louisiana produces less than 1 percent.

U.S. Sugar Program

The U.S. Sugar Program, which is administered by the U.S. Department of Agriculture and operated under the farm bill, emerged in 1981 in response to wildly fluctuating global sugar prices, European nations' programs that protected the cane sugar industries in their former colonies, and heavily subsidized foreign sugar production in Brazil and elsewhere. First, the U.S. system adopted price floor guarantees. Second, the sugar program set an overall allotment quantity (OAQ) at 85 percent or more of the estimated U.S. consumption of sugar. This critical program affects the U.S. cane sugar industry in two ways: It guarantees a domestic market for the vast majority of the yearly production, and it also closes off the domestic market to global production.

The U.S. imports sugar to meet the remaining demand from 40 countries (the breakdown for 2015 is shown in Figure 4). Each country has a tariff rate quota (TRQ) that restricts how



Raw sugar made in Louisiana. Photo by Olivia McClure



Massecuite flowing through the crystallizers. Massecuite is a mixture of molasses and sugar, just before their separation. Photo by Olivia McClure

much it can export to the U.S. domestic market. The various TRQs reflect commitments made to the World Trade Organization, the Central American Free Trade Agreement (CAFTA), the North American Free Trade Agreement (NAFTA), and to bilateral trade agreements with specific countries.

NAFTA involves Mexico, and although the agreement was signed in 1992, the effects on the sugar industry did not come into play until 2008. This free trade agreement created a degree of disruption and uncertainty in the U.S. sugar market from 2008 until 2014 when a suspension agreement was signed that modified the terms for Mexican sugar imports. In essence, an antidumping investigation determined that the Mexican government was improperly subsidizing sugar exports to the U.S. market. The suspension agreement re-established quotas and floor prices for Mexican sugar imports.

Future of Louisiana Sugar

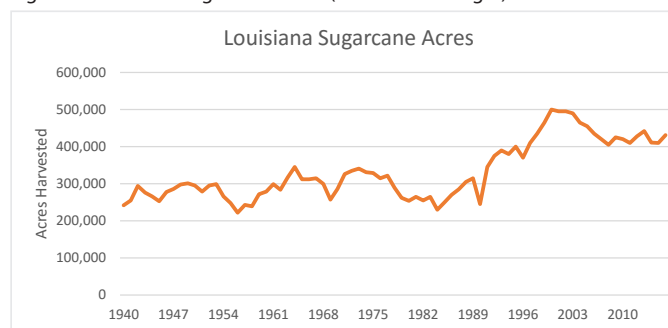
The Louisiana sugar industry has persevered in the age of globalization despite the tremendous growth in international production and threats from competing products such as high fructose corn syrup and artificial sweeteners. The U.S. Sugar Program has been the primary contributor to stability in the Louisiana sugar industry over the past 35 years, and it will likely remain important for the foreseeable future.

Domestic sugar industry leaders will continue to assess the impacts of existing and proposed regional and bilateral trade agreements. Domestic industry leaders are concerned with the ability to maintain a U.S. sugar industry that produces sugar in an environment not subject to trade distortions that could potentially be used by other world producers of sugar in an effort to gain domestic U.S. market share. A third concern to the industry might be a shift in public perception that would deem new types of artificial sweeteners as potentially viable substitutes for sugar.

In sum, uncertainty caused by globalization and technological change characterizes the future of cane sugar production in Louisiana, and this has essentially been a reality since the emergence of the industry some 220 years ago.

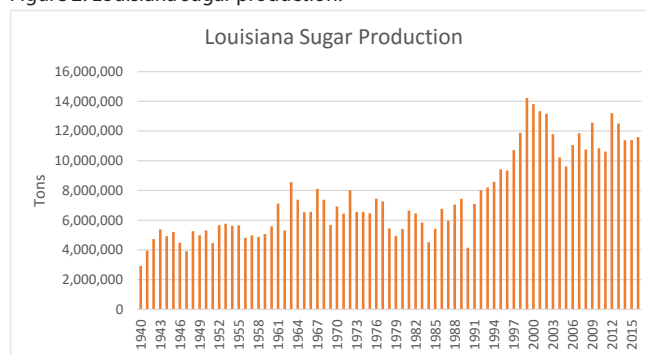
Michael Deliberto is an assistant professor and Mark J. Schafer is an associate professor in the Department of Agricultural Economics and Agribusiness.

Figure 1. Louisiana sugarcane acres (for seed and sugar).



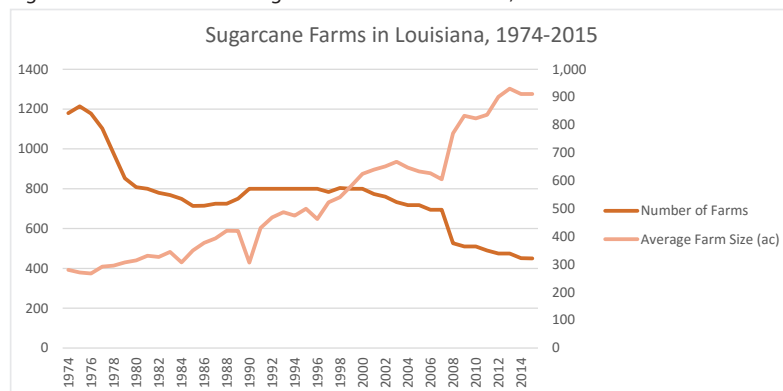
Source: U.S. Department of Agriculture, National Agricultural Statistics Service

Figure 2. Louisiana sugar production.



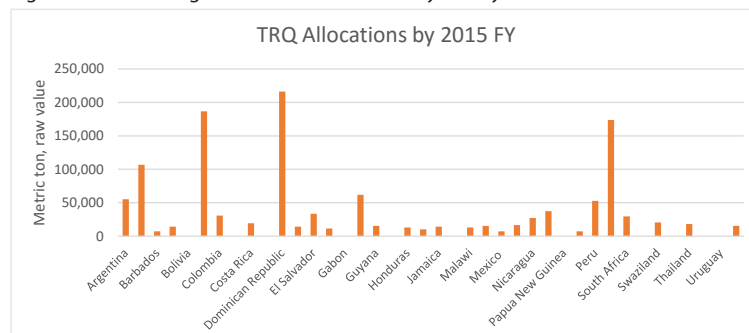
Source: U.S. Department of Agriculture, National Agricultural Statistics Service

Figure 3. Size and count of sugarcane farms in Louisiana, 1974-2015.



Source: U.S. Department of Agriculture, National Agricultural Statistics Service

Figure 4. U.S. raw sugar TRQ WTO allocations by fiscal year.



Source: U.S. Department of Agriculture, National Agricultural Statistics Service



■ Inside Alma Plantation
in Lakeland, Louisiana,
in December 2015.

Photo by Olivia McClure

Development of Simulation Models to Support Louisiana Sugar Mills

Daira Aragon

Scientists at the LSU AgCenter Audubon Sugar Institute develop sugar factory production models to assist Louisiana's 11 sugar factories in becoming more efficient. The sugar factories operating in Louisiana are: Alma Plantation, Cajun Sugar Co-op, Cora-Texas, Enterprise Factory (M.A. Patout & Son), Lafourche Sugars, Louisiana Sugar Cane Co-op, Lula Sugar Factory, Raceland Raw Sugar, St. Mary Sugar Co-op, Sterling Sugars and Westfield Sugar Factory.

A raw sugar factory recovers sugar (sucrose) from the sugarcane plant in a complex process. A simplified version of this process is shown in Figure 1. The process starts by squeezing the raw juice from the cane in a set of roller mills, or a diffuser. Then, suspended solids settle and are removed in a clarifier. Next, the clarified juice is concentrated into syrup in a set of evaporators. Finally, the sugar in the syrup is crystallized by further evaporation in an arrangement of vacuum pans (boiling house), usually in three stages, also called strikes: first or A, second or B, and third or C.

In a simplified description, once the crystals have achieved a desired size in each stage, the mixture of crystals and mother liquor (massecuite) is passed through centrifuges, known in the sugar industry as centrifugals, to separate the crystalline sugar from the molasses. Molasses moves from one stage to the next (molasses from the third stage is called final molasses). Some of the crystalline sugar is mixed with water (magma) and recycled back into the process. Raw sugar from the first and second

stages (three-boiling scheme) or from the first stage only (double magma scheme) is shipped to a refinery where refined table sugar is produced. Control criteria for juices, massecuites, magma and sugar throughout the process include solids content (Brix), sucrose content (approximated by the "pol"), ratio of sucrose to solids content (purity) and color.

Simulation is the use of a model to obtain an output response for specified input values. Simulation can provide better understanding of the process and reduce costs and risks associated with experimentation because there is no need to make changes in physical equipment or operating conditions for every case. In the sugar industry, for example, a model of the entire factory can be used to study changes in the amount of pol in raw sugar produced for different crushing rates and cane pol. A model of the boiling house can be used to study purity of final molasses for different syrup or magma purities. In general, simulation can be used in the design, operation and optimization of the raw sugar factory for:

- Balancing the factory so that energy usage, water requirements and waste generation are minimized.
- Obtaining massecuite and magma purities, wash water ratio at centrifugals or amount of backboiling molasses (molasses from one stage returned to the feed on the same stage) that would result in lower final molasses purity, lower color sugar color and higher sugar pol.

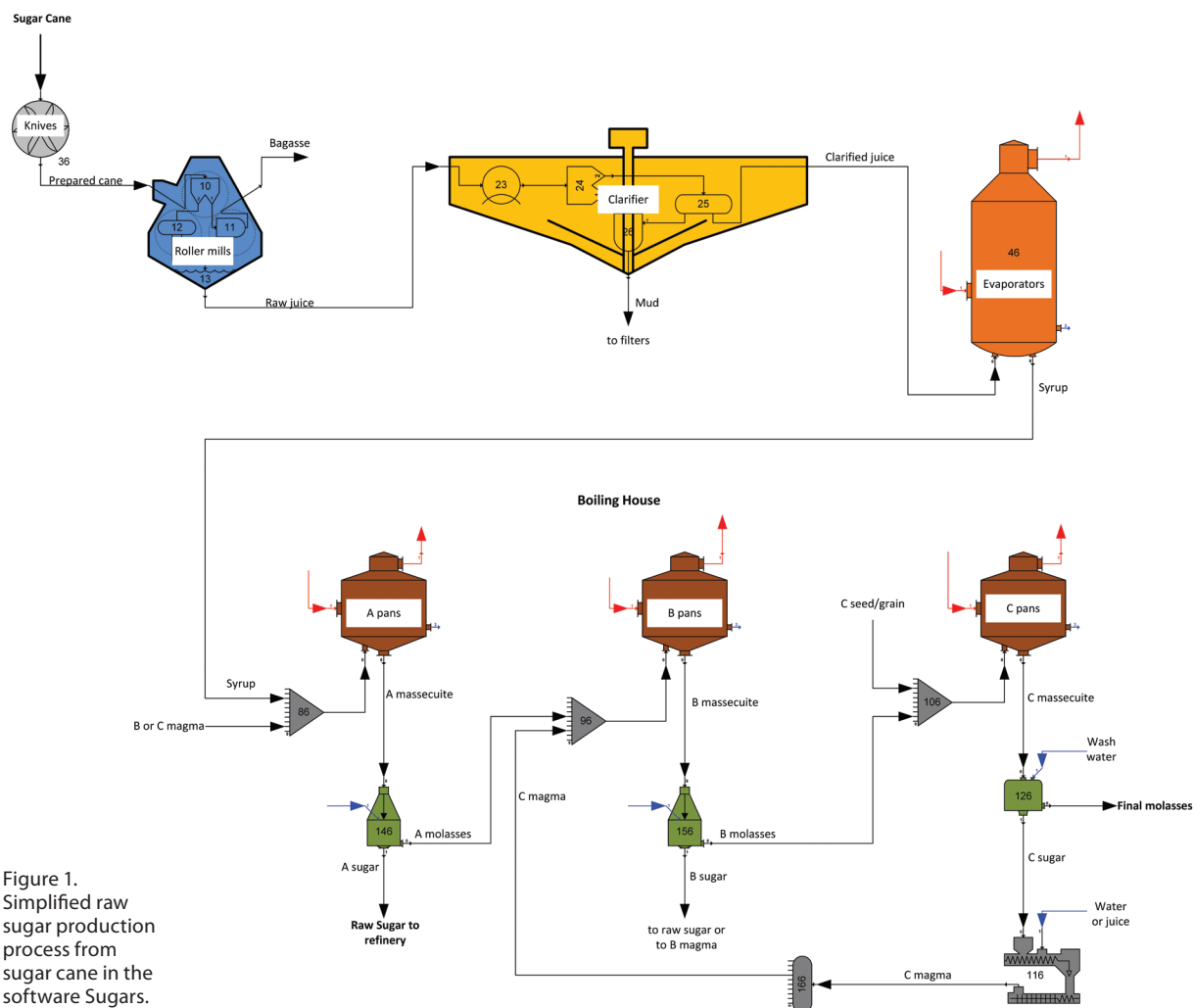


Figure 1.
Simplified raw
sugar production
process from
sugar cane in the
software Sugars.

- Determining additional pan capacity and steam requirements when switching to a different boiling scheme or increasing crushing rate.
- Training of operators.
- Evaluating expected performance before installation of new clarifiers, bagasse burners and pans, among others.

The Audubon Sugar Institute has led efforts to develop simulation models for all Louisiana sugar factories using the software Sugars. This software is specialized in simulation for the cane and beet sugar industries. Models developed thus far include Enterprise's diffuser section (diffuser, clarifier and evaporators), boiling house models for Cajun, Westfield, Lula, Alma, Sterling and Raceland, and complete factory models for Westfield, Lafourche and Lula. Information used for model development was taken from factory reports, personal communication with plant personnel, and samples analyzed at Audubon Sugar's laboratory. Model parameters were adjusted to match factory data as close as possible.

An example of deviations between the factory data and the simulation results is presented in a table on the Louisiana Agriculture Magazine website. The table was created from 2015 data. Deviations up to 41.2 percent were observed in quantities of massecuite and final molasses because some values presented in factory reports are estimated rather than measured. A maximum purity deviation was 12.5 percent. These models

have been used to simulate close to 100 cases to study expected raw sugar production and final molasses purity before major changes in boiling schemes or to evaluate changes in process streams. Results were discussed with factory managers and engineers to assist them in evaluating their systems.

An example table showing the differences for the diffuser model of Enterprise factory is also on the Louisiana Agriculture Magazine website. Deviations of simulation purities from factory data were less than 6 percent, indicating that the model is a good representation of the diffuser section.

Large and variable processes will generally have simulation results with higher deviations from factory data than simple processes. In the raw sugar factory, there are uncontrolled changes in the impurity content of juice, viscosities and pH, among others. Additionally, there are intentional changes in operating conditions such as an increase or decrease in crushing rate, backboiling molasses, increasing wash water in centrifugals, bypassing mills or stopping equipment for maintenance. Oftentimes, these voluntary changes are not recorded explicitly in the manufacturing report, so it is challenging to represent them in the simulation. Nonetheless, simulation results provide useful information to improve operation.

Daira Aragon is an assistant professor at the Audubon Sugar Institute.

Sugar and Salt from Sugarcane

Franz Ehrenhauser and Daira Aragon



Sugarcane is the largest agricultural crop in the world in terms of tonnage and provides an annual impact on the Louisiana economy of nearly \$3 billion. In 2016, Louisiana produced 1,612,000 tons of raw sugar, equivalent to more than one third of the domestic cane sugar production. This amount was produced from sugarcane planted on 431,000 acres.

Louisiana sugarcane is processed in 11 raw sugar factories. The bottom line of the sugar industry ultimately depends on the crystallization of granular sugar (sucrose) from syrups. While these syrups contain typically more than 85 percent sucrose, complete recovery is not possible because natural impurities, such as other sugars (fructose, glucose) and inorganic compounds (ash), limit the recovery of crystalline sucrose. In particular, the inorganic ash hinders the complete recovery and is detrimental to the process. Typical ash levels in Louisiana range from 1.5 percent to 2.7 percent in syrups. When the raw sugar is crystallized from the syrup, the ash components

remain in the molasses and reach a level of up to 15 percent. At this level, ash and other impurities limit the commercial recovery of sugar, and up to 10 percent of the initial sucrose in the syrup remains in blackstrap molasses.

The level of remaining sucrose is governed by the impurities in the blackstrap molasses, where a natural limit — the so-called “target purity” — exists. At this limit, the impurities — especially the ash — prevent the sucrose from crystallizing and, therefore, its recovery. Current industry efforts aim at optimizing their operations to get as close as possible to the target purity within their given impurity restrictions.

LSU AgCenter scientists at the Audubon Sugar Institute are investigating an alternative approach. Instead of solely trying to meet the target purity, their research aims at moving the target purity to lower levels to allow more sucrose to be recovered. The key element is the reduction of the ash content because an ash reduction by 25 percent in a typical raw sugar



Shoveling sugar inside Alma Plantation in Lakeland, Louisiana, in December 2015.

Photo by Olivia McClure

membrane-based separation that uses electricity to move ions through ion exchange membranes out of the molasses or syrup into a separate stream (concentrate), thus de-ashing the syrup. Figure 1 shows the principle components of an electrodialysis cell, where membranes of alternating polarity are stacked between two electrodes, and the ions migrate based on their polarity to the individual electrode. The syrup is kept in one chamber and depletes in ions, resulting in de-ashed syrup. The ions concentrate in the other chamber, yielding a salt solution. As such, it is possible to de-ash syrups without using chemicals.

Initial tests indicate that up to 66 percent of the ash can be removed from a given stream, while sugar losses are within acceptable range. Typical energy consumption ranges up to 22.7 kilowatt-hours of electricity per ton of sugarcane syrup for a 66 percent de-ashing level. For the aforementioned 25 percent reduction in a sugar mill, an electric energy consumption of

factory in Louisiana would allow the recovery of an additional \$500,000 worth in sugar. While there are many technologies available, electrodialysis is being investigated as the most promising because it does not require chemicals and has greater flexibility when it comes to handling variable ash levels.

only 4.53 kilowatt-hours per ton of syrup is expected. The electricity cost of \$75,000 per sugar season compares favorably with the potential benefit of increased sugar recovery valued at \$500,000. Research is being conducted to improve the technology and to better estimate the cost.

While de-ashing with electrodialysis is in itself desirable because of increased sugar recovery, the process yields a salt solution as waste stream. Typically, the salts found in sugar syrups in Louisiana consist of 95 percent potassium, 2 percent calcium, 2 percent magnesium and 1 percent sodium and ammonium salts with chloride as the dominant anion. This salt solution is therefore particularly rich in potassium chloride, also known as muriate of potash. When this salt solution is concentrated through evaporation, muriate of potash crystallizes in high purity as a valuable side product. Muriate of potash can be either used directly as fertilizer or be further processed into chemicals such as potassium hydroxide or hydrochloric acid. The production of potassium chloride from sugarcane is a first for Louisiana and marks one of the few cases where an inorganic mineral is produced from a renewable, sustainable source.

The potential of this technology is promising because annual black strap molasses production in Louisiana reaches 407,000 tons, where an estimated amount of 61,154 tons of sulfated ash are present. If 25 percent of this molasses would be de-ashed, the Louisiana sugar industry would be able to produce 13,081 tons of muriate of potash (worth \$2.5 million), supplementing the fossil-based mining operation with a novel, sustainable plant-based source.

Franz Ehrenhauser and Daira Aragon are assistant professors at the Audubon Sugar Institute.

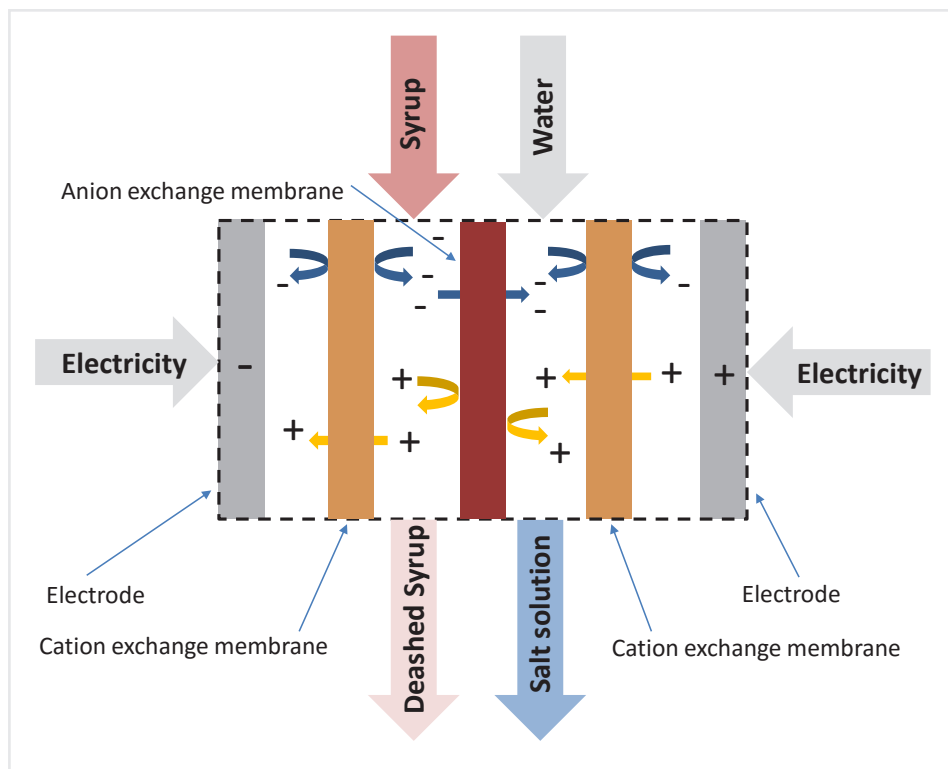


Figure 1. Schematic overview of an electrodialysis cell for de-ashing sugar syrups.

LSU AgCenter 'Hot' Intellectual Properties

Dirk Benedict

LSU AgCenter scientists continue to bring scientific discoveries to the world marketplace through the Office of Intellectual Property. Since 2000, 12 new companies have been started based on licensing technology from the AgCenter. Royalties from these companies and from other licensing agreements have generated more than \$70 million since 1999. Following are four of the current "hot" properties.

Bellevue Sweet Potato (LA 06-52)



Don La Bonte, sweet potato breeder, talks about new sweet potato varieties, including the Bellevue, at a field day for producers at the Sweet Potato Research Station, Chase, Louisiana. Photo by Olivia McClure



Bellevue Sweet Potato. Photo by John Wozniak

The Bellevue sweet potato (LA 06-52) was developed by Don La Bonte, professor and director of the LSU AgCenter School of Plant, Environmental and Soil Sciences. Bellevue was released in 2013 and has since become a commercial success across the world.

"Normally, varieties are very location-specific," La Bonte said. "We were able to modify the genetics through cross-breeding to create a variety that was very adaptable. This variety is unique in that it can grow in both sandy and heavy soils in various weather conditions with a stable output. Stability is a big thing for growers."

Australia in particular has seen an increased use in the variety. Nematodes, a type of plant parasite, are a major problem for the country because of its sandy soils. Previously, AgCenter varieties were grown there free of charge, but growers are now paying for the newer varieties, like Bellevue, because of their superior output. The variety is also being grown in several U.S. states, including Louisiana and California, and in several other countries including Canada and Honduras.

In addition to its resistance to nematodes like the southern root-knot nematode, the variety is also resistant to several major fungal diseases such as Fusarium wilt and Streptomyces soil rot. Plant production from bedded storage roots is not ideal, and research is underway to improve plant production.

Yield and disease resistance are not the only concerns for growers. They also want a plant that appeals to a wide variety of consumers. Bellevue is sweet with a moist texture. It has a bright orange flesh and a copper-colored skin with few indentations. Storage longevity is excellent. The sweet potato also has a consistent shape and quality from the field to the plate.

TigerBullets



Qinglin Wu, a professor in the LSU AgCenter School of Renewable Natural Resources, displays TigerBullets, a lost circulation material product that he developed. TigerBullets are made from recycled wood and plastic, and they fill cracks inside oil wells so drilling fluid levels can be maintained and the drill can run more smoothly. The material also helps keep drilling fluid from seeping out of cracks. Photo by Olivia McClure

TigerBullets is a commercial product based off research by Qinglin Wu, professor in the LSU AgCenter School of Renewable Natural Resources. The invention is a new type of lost circulation material (LCM) based on recycled wood and plastic that fills earthen cracks inside of oil wells to maintain drilling fluid levels. TigerBullets is used as part of the drilling fluid and acts as a fluid loss control agent and lubricant to make the drill run more smoothly. The material also swells to fill cracks of various sizes on the sides of the drilling well and remains rigid to prevent seepage of drilling fluid through these cracks.

TigerBullets is made from natural, predominantly biodegradable, materials that would otherwise be thrown away as waste in combination with recycled water-bottle-grade plastics. One material that can also be used to make TigerBullets is the plastic from used motor oil containers. There are more than 3 billion quart-size HDPE (high-density polyethylene) motor oil containers being land-filled each year in the United States alone, containing over 150,000 tons of HDPE plastic.

TigerBullets is manufactured by Wallace Molding and Millwork Inc., of Columbia, Louisiana. The material is licensed and marketed by HolePluggers LLC, of New Iberia, Louisiana, and distributed by Alpine Specialty Chemicals. The material has been used by major oil companies including BP, Exxon, Chevron, XTO, Pioneer Natural Resources, OXY and others in more than 400 oil wells across the United States and in several other countries, including Australia, Brazil, Canada, Russia, Singapore, Thailand, Kazakhstan, Mexico and Saudi Arabia. Schlumberger, an oilfield services company, has used TigerBullets in deep-water drilling in Vietnam.

Drought Tolerance Gene SaADF2

Niranjan Baisakh, associate professor in the LSU AgCenter School of Plant, Environment and Soil Sciences, is working on conferring drought tolerance to new varieties of plants through a gene he has isolated called SaADF2. Drought is a condition where either there is not enough water available for plants to absorb or where soil conditions prevent water absorption. This particular gene was derived from smooth cordgrass because of its high tolerance to both drought and salinity. The ultimate goal is to develop new varieties of rice and corn that can survive harsh environmental conditions.

One method of granting resistance to new plants is transgenesis, where a gene that codes for a certain trait from one type of plant is moved into a different type of plant, giving the latter that trait.

Data from research studies performed under controlled conditions showed survival of rice plants containing the SaADF2 transgene for prolonged periods with no water supply and higher water absorption under salt stress for plants. This work is patent pending and received a grant from the LSU Leverage Innovation for Technology (LIFT) fund to advance the work toward development of a drought-tolerant corn.

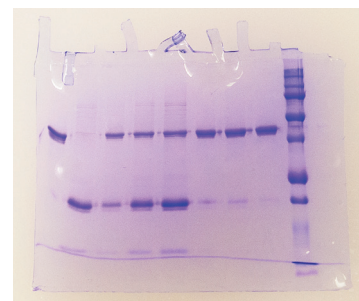
Because of concerns by some consumers about eating genetically modified food, Baisakh is taking a multipronged approach to plant breeding.

"We wanted to validate the gene not just at the transgenic level, in a controlled greenhouse, but also at the field level, through traditional crossbreeding, where it could be tested in natural conditions," Baisakh said.

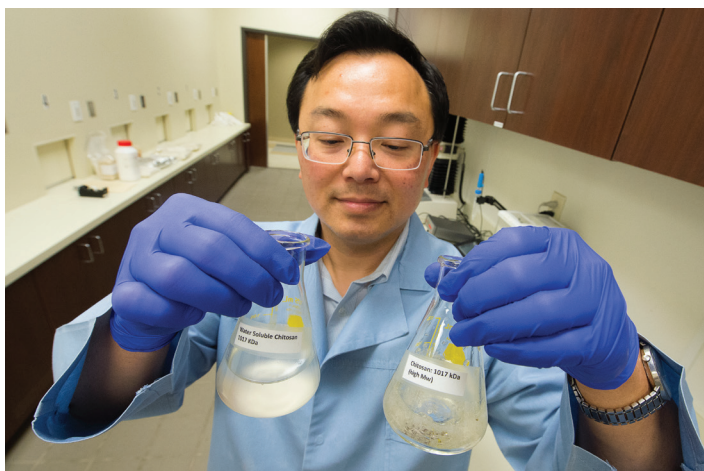
The traditional breeding approach can help reduce these concerns. Baisakh has also been crossing drought-sensitive and drought-tolerant varieties of rice and testing the progeny under natural field conditions at the H. Rouse Caffey Rice Research Station with hopes of creating drought-tolerant rice varieties that would show similar results obtained with SaADF2. New varieties developed from either method could go a long way in stabilizing food supply in regions of the U.S. and abroad where good quality water available for irrigation is limited.



LSU AgCenter molecular biologist Niranjan Baisakh holds a piece of gel that shows the expression of a protein from smooth cordgrass that can be used to confer drought tolerance to crops. Photo by Olivia McClure



High Molecular Weight Chitosan



LSU AgCenter food scientist Witoon Prinyawiwatkul holds beakers containing solutions with water-soluble chitosan, left, and regular chitosan, right. Prinyawiwatkul developed the water-soluble, high molecular weight chitosan powder, which has antimicrobial properties and can be used as a coating or film for foods and packaging materials. Photo by Olivia McClure

A new method to produce high molecular weight (HMW), soluble chitosan powder was developed by Witoon Prinyawiwatkul, professor, and his research team in the LSU AgCenter School of Nutrition and Food Sciences. Chitosan has been reported as an antimicrobial that can be applied as a coating or film to foods and packaging materials. Chitosan also inhibits some pathogenic bacteria. Chitosan is derived from chitin, which is mainly produced from crustacean (such as crab and shrimp) shell wastes. A high molecular weight allows the chitosan to form a more viscous gel when mixed with water. High concentrations of HMW chitosan solution are difficult to obtain when mixed with water, but the new method makes it possible.

The developed technique provides a simple preparation procedure for dissolving the HMW chitosan without any chemical modifications. It also eliminates the pungent acidic odor of the solution, making it more desirable for use in food. Research has been performed on food preservative applications using the material's film-forming and coating properties to prevent spoilage at room temperature, which can be valuable in regions where refrigeration is limited.

The HMW chitosan's applications are not limited to food preservation; promising research has also been conducted into its use as a unique antimicrobial. Recent studies by Marlene Janes, professor, and her team at the LSU AgCenter School of Nutrition and Food Sciences, yielded positive results using the HMW chitosan against food-borne pathogenic bacteria in fish. Since oysters are consumed raw, strong antimicrobial properties are important to minimize the risk of food-borne illness. Further studies are being conducted into the types of bacteria affected, which may provide valuable results for potential seafood industry partners.

"We are very excited about these results," Prinyawiwatkul said. "Crab, shrimp and crawfish are consumed all the time here, and our work can make consumption safer."

Dirk Benedict is the marketing coordinator for the Office of Intellectual Property.

Insect and Disease Challenges for Growing the Tea Plant, *Camellia sinensis*

Yan Chen and Allen Owings

Worldwide, tea is the most popular drink after water, and all types of tea — white, green, black, oolong and fermented (such as puerh) — come from leaves of one plant, *Camellia sinensis* (Figure 1). Estimated market value of tea in the U.S., including bagged tea, bottled tea, loose tea and tea consumed at restaurants, was \$12 billion in 2016, according to the Tea Association of the USA. This demand is almost completely met by imports, making the United States the second largest tea importing country only after Russia.

The microclimates and acidic soils in many areas across the country are suitable for growing tea, and commercial tea production has been growing in recent years because of demand for locally grown tea. Tea farms have been established in Mississippi, South Carolina, Texas and Idaho, in addition to farms in Alabama, California, Georgia, Florida, Hawaii, Michigan, New Jersey, Ohio and Washington State. In addition, growers of other specialty crops can add tea



Figure 1. Tea (*Camellia sinensis*) plants being evaluated at the Hammond Research Station.

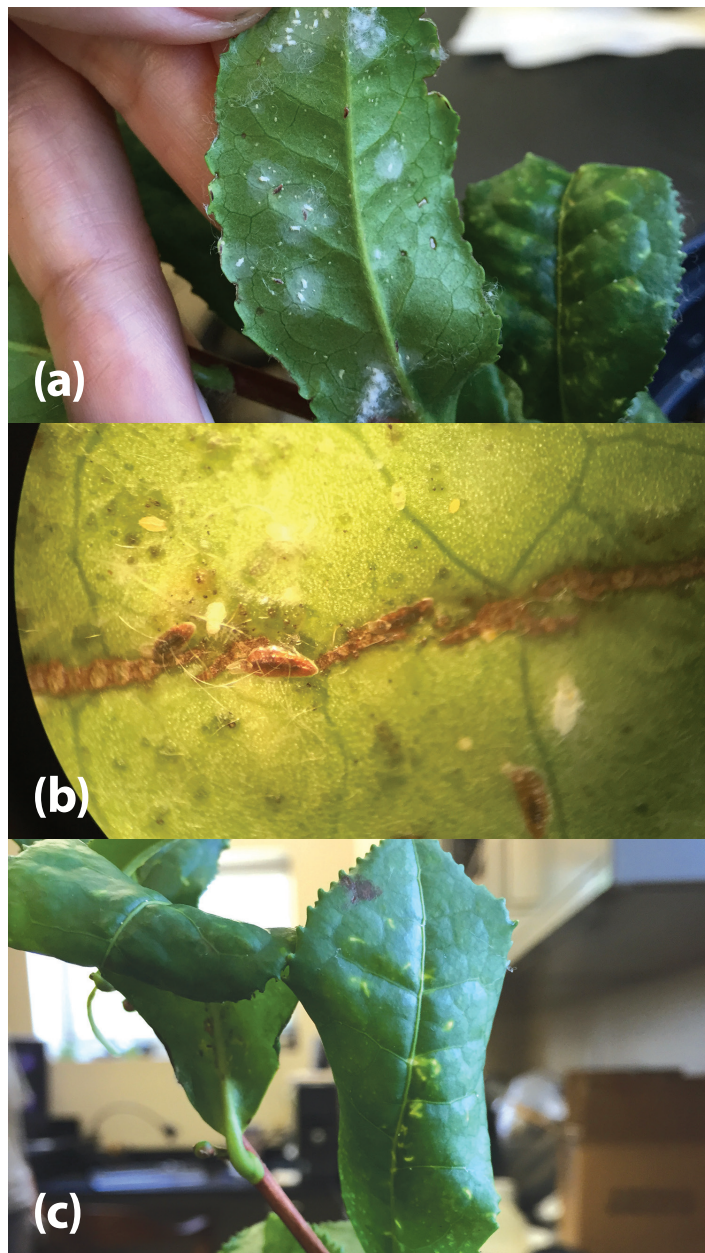


Figure 2. Tea scales with fluffy white exudes on the lower side of the leaf (a), scale adults under a microscope (b), and scales cause yellowing on upper side of tea leaves (c).

to their production because tea has similar growing requirements to blueberry and citrus.

Since 2013, the LSU AgCenter Hammond Research Station has worked with tea growers and enthusiasts in Louisiana. Two orchard growers recently planted tea as an additional crop in their citrus orchards, and two other growers are growing 1-gallon container plants for sale to potential farmers and the public. In addition, one grower has been collecting tea cultivars and is doing seedling selection and propagation for tea cultivars suitable for Louisiana conditions. The growers have just started growing tea, and it will take three to four years before they can harvest a large enough quantity to be sold commercially or processed for packaging.

Researchers at the Hammond station are evaluating a collection of named varieties, including Big Leaf, Small Leaf, Red Leaf and Golden Leaf, and seedling selections for growth habit, vigor, and pest and disease issues. The two most challenging pests and two most challenging diseases are listed below. Documentation of economically important pests helps prepare growers and gardening public for a more successful growing experience.

Tea scale (*Fiorinia theae*) is an armored scale infesting almost all species in the genus of camellia. A layer of a white fluffy substance on the underside of the leaves is a good indication of infestation (Figure 2a). Female adults and eggs hide beneath a dark brown waxy covering (Figure 2b). Young nymphs hatch from eggs and move about to find a new location to settle down and feed on plant sap through a mouthpart inserted into leaf tissue. Males are winged and rarely seen.

Damage on tea plants includes yellow spots (Figure 2c), curled leaves and defoliation. Without treatment, plants can be killed by severe defoliation. An insect growth regulator such as pyriproxyfen or azadirachtin mimics the effects of insects' own juvenile hormone and prevents developing into adults.

However, they will not kill adults. It is often suggested to mix them with a horticulture oil to control both immatures and adults. Many growth regulators and oil products are approved for organic vegetable production.

Because tea is a relatively new crop, it is often missing from insecticide labels, but products registered for vegetables are safe to use on tea.

Chilli thrips (*Scirtothrips dorsalis*) prefer feeding on tender tea leaves. This tiny thrips is only 0.03 inch in length and hard to see (Figure 3a). However, the brown, corky stripes on undersides of leaves are typical and can be confirmed with inspection under a microscope (Fig 3b). Other damages include leaf distortion and defoliation. Severely damaged plants may have no leaves suitable for harvesting.

Spinosad is very effective against chilli thrips, with several products approved for organic vegetable production. Horticulture oil can provide some suppression. Insecticides should be applied during the time of the day when thrips are active between 9 a.m. and noon and late afternoon when weather is not too hot.

Other pests observed on tea during the evaluations at Hammond include leafhoppers, flea beetles and inchworms (Figures 4a to c). Damage from these pests is transitional and insignificant. However, severe damage from leafhopper has been documented in traditional tea-producing countries, and feeding by a specific leafhopper, *Jacobiasca formosana*, actually contributes to the unique fragrance in some oolong and black teas such as Oriental Beauty.

Diseases on tea leaves directly affect harvest. Two diseases have been identified from plants grown in containers: blister blight (*Exobasidium vexans*) and black blight (*Corticium koleroga*). Symptoms of blister blight begin with circular blisters on leaf undersides, then become, velvety, circular brown spots (Figure 5). Black blight requires high humidity to occur. Leaves and twigs turn brown, and dead leaves hang on thin threads from the branches. Both diseases are more prevalent when plants are under pressure such as high pH or water stress.

No diseases have been observed on plants grown in raised beds in the evaluation garden where irrigation and partial shade are provided.

Yan Chen is an associate professor and Allen Owings was the resident director at the Hammond Research Station (now retired).

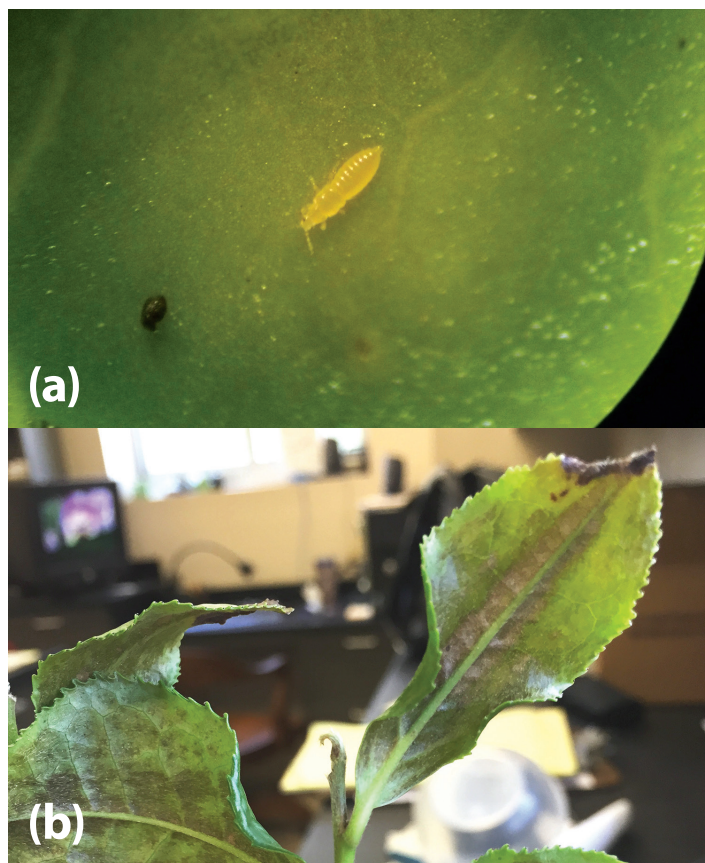


Figure 3. A chilli thrips nymph (a) and the typical brown corky stripes on the lower side of tea leaves caused by chilli thrips (b).



Figure 5. Blister blight found on tea plants grown in containers.



Figure 4. Leafhopper nymphs covered by white fluffy exudes (a), flea beetle damage (b) on tea leaf, and inchworm feeding on young tea leaves (c).

'Food Warriors' Fight Obesity

Emelia Clement and Melissa Cater

Childhood obesity is a public health problem nationwide. In 2014, the Centers for Disease Control and Prevention reported that almost one of every five children and one of every three adults are obese. According to a 2016 report, "The State of Obesity: Better Policies for a Healthier America," released by Trust for America's Health and the Robert Wood Johnson Foundation, Louisiana has the highest adult obesity rate at 36.2 percent. The state also ranks fourth in hypertension and fifth in diabetes rates, two important obesity-related chronic diseases. Overweight or obese children experience social stigma, bullying, low self-esteem and body dissatisfaction more than their peers who are not overweight. Obesity is an urgent situation in Louisiana that needs to be addressed.

“ More than 400 children in 11 parishes in Louisiana participated in an evaluation of the Body Quest program in 2015-2016. ”

High consumption of fruits and vegetables is associated with reduced risk of chronic diseases, but most people's intake is below federal recommendations. The Pennington Biomedical Research Center reported in 2012 that among children in Louisiana, just 6 percent ate fruits more than four times a day and 12 percent ate vegetables more than three times a day. Therefore, improving consumption of fruits and vegetables is important in the effort to reduce childhood obesity.

The LSU AgCenter responded to the need for reducing in childhood obesity in Louisiana by offering the "Body Quest: Food of the Warriors" program in 2013. This obesity prevention program, created at the Alabama Cooperative Extension System, targets third-grade students. It is funded by the Supplemental Nutrition Assistance Program-Education, known as SNAP-Ed. The objectives are to increase consumption of fruits and vegetables, increase physical activity, improve sleep habits and enhance family environments.

Body Quest has several unique aspects. First, it uses animated characters called Body Quest Warriors, who represent different food groups and promote healthy habits that students are encouraged to model through interactive sessions. They are Graino Supa (grains), Muscle Max (proteins), Body Doctor (fruits), Shining Rainbow (vegetables), Super Slurper (water) and Fiberlicious (fiber). Second, it provides the opportunity for a number of vegetable and fruit tastings to improve preference. Third, the lessons taught are reinforced through

interactive iPad apps based on the warriors along with pencil-and-paper activities and workouts. Students are encouraged to think deeper about the main idea of the lesson and present their thoughts as a showcase at the end of the lesson or at the end of the program. Examples of showcase activities are how they would share what they learned with family and friends, how they would keep their vow to try new fruits and vegetables, and how eating a variety of food is important to building a strong body.

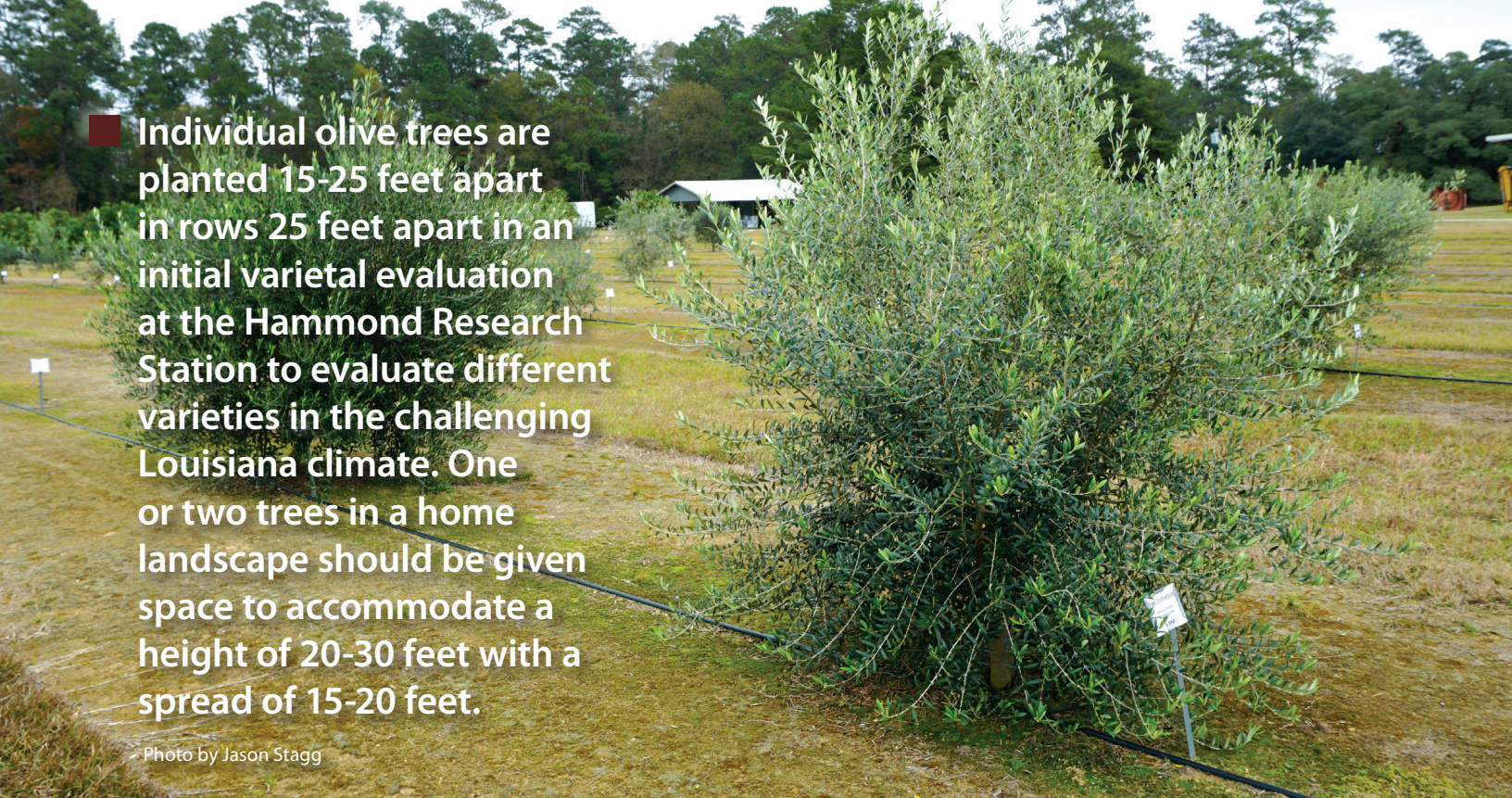
Four SNAP-eligible elementary schools in Orleans Parish participated in Body Quest between 2014 and 2016 for a total of 172 students reached. The schools included Dwight D. Eisenhower Academy of Global Studies, Joseph A. Craig Charter School, Pierre A. Capdau Charter School and ReNEW Schaumburg Elementary School. A SNAP-Ed agent delivered the six-lesson curriculum weekly for 17 weeks. Each third-grade student used the interactive iPad apps of the Body Quest warriors, tasted the food and completed assessments. Each student was provided with samples of four different foods for tasting with low-fat ranch dressing: broccoli, peppers, tomatoes and spinach. Students were asked to answer questions on whether they liked the food, if they would eat it again and if they would ask their family to buy it. At the first tasting, some of the students were reluctant to taste, but this improved with more tastings, especially when the foods were included in pasta salad. A few students asked for more vegetables and fruit to taste.

Students also did paper-and-pencil activities that involved writing or sketching a concept learned and how they would apply it to themselves. In-class presentations included meal planning with a variety of healthy food options and creative ways of incorporating fruits and vegetables in meals and snacks. The students were able to distinguish between healthy and unhealthy snacks. Students brought nutrition calendars and family discussion topics home to encourage family involvement and enhance the home nutrition environment.

More than 400 children in 11 parishes in Louisiana participated in an evaluation of the Body Quest program in 2015-2016. At the conclusion of the program, results showed that students had a significantly higher preference for three out of four vegetables tasted as compared to pre-program preferences: broccoli (64 percent to 67 percent), spinach (72 percent to 77 percent) and pepper (42 percent to 45 percent).

The implications of these results are important in extension education. Programs like Body Quest can influence vegetable preferences among youth. The Body Quest program has the potential to build preference for eating vegetables among elementary school youth.

Emelia Clement is an LSU AgCenter nutrition agent in Orleans Parish, and Melissa Cater is an assistant professor and program evaluation specialist with the Department of Agricultural and Extension Education and Evaluation.



Individual olive trees are planted 15-25 feet apart in rows 25 feet apart in an initial varietal evaluation at the Hammond Research Station to evaluate different varieties in the challenging Louisiana climate. One or two trees in a home landscape should be given space to accommodate a height of 20-30 feet with a spread of 15-20 feet.

Photo by Jason Stagg

Growing Olives in Louisiana: An Initial Evaluation

Jason Stagg and Allen Owings

While many Southern gardeners are familiar with the intoxicatingly sweet fragrance of the ubiquitous sweet olive tree in Louisiana landscapes, the true edible olive (*Olea europaea*) is beginning to find its way into many backyard gardens and commercial landscapes. Numerous retail nurseries are now offering 3-gallon container size olive trees for sale in south Louisiana. As an ornamental landscape plant, olives offer an unusual silver-green foliage color on an easily-pruned medium-sized tree.

More traditionally, olives are known as a useful orchard crop for producing culinary olive oil, table or eating olives, and olive oil-derived products for skin and hair care. The United States is the world's largest consumer of olive oil, but only about five percent is produced domestically. With more than 35,000 acres in cultivation, California has long been the largest domestic olive producer. However, the last decade has witnessed the growth of olive orchards in southern states such as Texas, Georgia and

Florida. Texas alone now boasts more than 4,000 acres of olive trees, putting a new twist on the old concept of an oil boom in that state.

This ever-increasing interest in growing olive trees in Louisiana began generating quite a few questions for the LSU AgCenter. But because olives had never been university-evaluated in Louisiana, researchers knew they had an opportunity to investigate a potential new specialty crop for the state. In fact, a 2015 survey of Louisiana Master Gardeners indicated great interest in learning about and growing olive trees, but there was little existing knowledge or experience with the crop.

In May 2015, the LSU AgCenter Hammond Research Station planted nearly 100 olive trees on about an acre of land to begin an initial varietal evaluation on establishment success in Louisiana's challenging climate. The project is funded by the Specialty Crop Block Grant Program administered by the Louisiana Department of Agriculture and Forestry.

Olive varietals (a synonym for varieties) represent a broad spectrum of fruit size and tree growth habit. The Hammond orchard includes 15 varietals, with four trees of each planted within the core evaluation area. They are Anglandau, Arbequina, Arbosana, Bouteillan, Chemlali, Coratina, Frantoio, Grossane, Koroneiki, Manzanilla, Maurino, Mission, Oueslati, Pendolino and Picual. Because of regional supply constraints, different varietals were not available in uniform container sizes and tree heights. Tree spacing in the trial area is classified as a traditional orchard layout, with 18 feet between individual trees and 25 feet between rows. This large spacing was used so the true tree shape can be observed. Olives can grow to be large trees when little pruning is done, easily reaching 15 feet wide and more than 20 feet tall. Most modern orchards plant trees much closer together in a high-density or super high-density orchard layout.

Olives have shallow root systems and require good drainage, so orchards should have raised planting rows that are at least 12-18 inches higher than the surrounding soil level. Olives prefer a neutral to slightly alkaline soil pH and should be planted in full sun.

Louisiana's humid climate and high annual rainfall totals pose significant

challenges to the Mediterranean olive tree, but occasional winter arctic cold blasts pose the most risk to growing olives in Louisiana long-term. In contrast, Texas has a fairly large “sweet spot” for more safely growing olives in the south central and southeastern areas of that state. Southeastern Georgia and central Florida also share this lower risk of these damaging winter temperatures.

Although olives require a certain amount of vernalization (cool but not cold) during winter, temperatures that drop below 15-20 degrees can cause severe injury to olives, especially young trees with small trunks.

Even though the full two-year trial period has not yet been completed, trends in the initial results are apparent. The evaluation orchard at Hammond experienced exactly the type of harsh climactic swings plants routinely endure every few years in Louisiana. March and August 2016 brought historic flooding at the station, with standing water in the olive orchard during the August event. Surprisingly, most olive varieties appeared to be unaffected by the historic rainfall totals in 2016. The research station has sandy soil that drains well, so this probably helped in their resilience. While some preliminary evidence has pointed to possible root rot fungal pathogens in a few specimens, those particular trees actually died before the major floods as a result of a leaky irriga-

tion valve at the lowest elevation of the planting area.

While the 2015-2016 winter was mild, the 2016-2017 winter season concentrated all its frigid nastiness in one weekend in January 2017. Unseasonably warm weather yielded to an arctic front that pushed south and dropped nighttime temperatures to 22 degrees two nights in a row. The resulting damage of burned leaves and bark splitting on some varieties was expected, but a surprising number of trees pulled through with barely any damage.

As with any new orchard planting, the disturbed soil exploded with extremely high weed pressure. Although a number of herbicides are labeled for use around olives, the trees are nonetheless quite sensitive to certain active ingredients, such as glyphosate. In Louisiana, typical recommendations are to keep the orchard floor clean of weeds and leaf matter. That goal was achieved but caused damage through herbicide drift to some of the smaller olive trees.

Damaging insect pressure was not widespread, with black scale (*Saissetia oleae*) insects being the most common. Winter temperatures and an application of horticultural oil and carbaryl insecticide significantly reduced the population.

Despite all these challenges, Anglandau, Arbequina, Bouteillan, Grossane, Manzanilla and Picual appear to be the best-established varieties

after the first year. Arbosana, Frantoio, Koroneiki and Mission established well but suffered greater cold damage as shown by splitting bark or excessive defoliation. However, Mission and Koroneiki appear to be recovering better than others. Bouteillan, Grossane and Picual lead in ornamental value so far.

With many promising varieties after nearly two rough years in the ground, olives may have the potential to be successfully established as a small orchard crop in south Louisiana, especially south of the I-10/I-12 corridor. With so much disease and insect pressure now weighing on citrus trees in Louisiana, some growers may find olives could potentially be a partial replacement crop. In addition, the ornamental value of certain varieties provides good cause for olives to be considered when choosing landscape plant material. So whether someone is interested in planting 100 trees or just one, olives may prove to be fairly adaptable to Louisiana's unique and challenging climate.

Jason Stagg is an instructor and Allen Owings was resident director and professor (now retired) at the Hammond Research Station.

Acknowledgements: Guidance and assistance from Charlie Johnson, retired horticulture professor; Raj Singh, assistant professor in the Department of Plant Pathology and Crop Physiology; and Dennis Ring, professor in the Department of Entomology.



Olives can be grown both for fruit and as an ornamental plant in the landscape. The fruits require six to eight months for full maturation. Table olives are harvested earlier, when they're firm, and oil olives are left on trees until oil content reaches 20 to 30 percent in late fall. Photo by Rick Bogren



LSU AgCenter horticulturist Jason Stagg stands in the olive evaluation area at the Hammond Research Station. Olives are primarily grown for the fruit, but many varieties have considerable ornamental value in a home or commercial landscape setting. They are related to ash, privet, jasmine, forsythia, sweet olives and fringe trees. Photo by Rick Bogren



As part of their CHEF Camp experience, students design their own “chef hat” and apron. These students were part of the camp in July 2017 in a kitchen lab at the Southern University Ag Center in Baton Rouge. Photo by Linda Foster Benedict

Youth Learn Nutrition, Food Safety, Healthy Lifestyle at CHEF Camps

Linda Foster Benedict

One way to teach better nutrition to families is to take aim at their children, and one way to do that is through a fun and engaging summer cooking camp.

That was the thinking of two extension specialists — one at the LSU AgCenter and the other at the Southern University Ag Center — back in 2012 when they started the first week-long CHEF (Cooking Healthy and Enjoyable Foods) Camps. Because of their initial success, 2017 is their sixth summer of offering these camps in select locations across the state, with demand exceeding capacity.

“We wanted to offer a low-cost cooking camp,” said Sharman Charles, LSU AgCenter extension specialist and manager of the Expanded Food and Nutrition Education Program (EFNEP) in Louisiana, one of the CHEF Camp creators.

“Young people have a way of helping the entire family change eating habits,” said the other creator, De’Shoin Friendship, SU Ag Center extension specialist.

To cover the food costs and find suitable kitchen space, the extension agents have found various ways to subsidize the camps through donors and partnerships. The first camps were offered in a kitchen laboratory at Southern University with funding provided through an extension grant for innovative funding administered by Gina E. Eubanks, who at that time was the associate vice chancellor at the SU Ag Center. She is now associate vice president at the LSU AgCenter.

“She wanted to ensure that the camp was affordable to avoid barriers for children who otherwise may not have been provided an opportunity participate in a cooking camp,” Charles said.

Eubanks provided the money for all the start-up equipment and materials. As the program expanded to more parishes, she continued to provide start-up funding.

The Epicurean Society of Baton Rouge also provided funding help for the camps in East Baton Rouge Parish for the first five years.

Participants pay a fee to attend the camp, which initially was \$15. “We felt we needed to require a fee to make sure there was commitment for the child to attend,” Charles said.

The rigorous camps run from 8:30 a.m. to 3:30 p.m. for five days. Besides food preparation, the students learn food safety and the importance of a healthy lifestyle, with time built in for exercise. Class size varies, but the maximum number recommended is 16 students, with one to two adults per four students.

“The children get lots of individual attention,” Charles said.

Camp participants, ages 9-11 for the beginner camp and 12-15 for the more advanced camp, were initially recruited from families eligible to enroll in federally funded nutrition programs, EFNEP and SNAP-Ed, the educational program for food stamp recipients. But the camps are open to anyone and are advertised at schools and in local newspapers and fill up on a first-come, first-served basis.

Students learn to fix nutritious after-school snacks, such as fruit salsa with cinnamon tortilla chips, quesadillas, vegetable pizza and oven-baked french fries. They also learn container gardening and how to use herbs.

They bake bread. “Sometimes the shape comes out a little funny. But the bread still smells and tastes good,” Charles said.

They learn about new foods, such as avocados to make guacamole. “Some have never eaten a fresh blueberry before,” Charles said.

She tells the story of one little boy who would only taste but not eat the food he prepared. He would pack up his food — along with any leftovers from the class — to take home with him.

“I never found out his personal situation, but I know some of these kids are latch-key kids. They grab what they can. They don’t know a lot about food,” Charles said.

Each camp graduate leaves with a tote bag of supplies including measuring cups and spoons, a knife and cutting board, vegetable brush and peeler, apron and a meat thermometer.

A new twist this year was a CHEF Camp offered during spring break in March at the Calcasieu Parish Extension Office in Lake Charles for foster care children. This came about because an AmeriCorps representative on an extension committee had a connection to the mayor’s office, said Shatonia McCarty, LSU AgCenter extension nutritionist, who along with Carol Sensley, SU Ag Center extension agent, conduct the CHEF Camps in Calcasieu Parish.

“The camp was a big hit, and we are making arrangements for more camps for these kids. Some of them are aging out of the foster care program and need to learn food preparation skills,” McCarty said.

Other partners for CHEF Camps include churches, and in Lake Charles there are three churches involved. The camps have been so popular that the churches want more than McCarty and Sensley have teachers to cover.

“It’s become a scheduling issue, but we’re trying to work through it,” Sensley said.

A member of one of those churches, who is a Walmart manager, was so impressed by the camp that she persuaded her



This participant at the CHEF Camp for children with sickle cell anemia in Lake Charles in April 2017 shows the pizza she made with whole wheat flour. Photo by Carol Sensley



This student shows off his Banana Boat creation as part of the week during the CHEF Camp for foster children in Lake Charles in March 2017. Photo by Shatonia McCarty

company to present a two-year \$1,500 grant to the camps in 2015, with the promise for more grants to come, Sensley said.

The Walmart representative has also arranged for CHEF Camp graduates to do cooking demonstrations at the new Walmart that opened in Lake Charles in 2016.

Another CHEF Camp sponsor in Lake Charles is the Southwest Sickle Cell Anemia Foundation. So far, one camp has been held for children with sickle cell anemia, and more are planned, McCarty said.

UnitedHealthcare has indirectly contributed support for CHEF Camps. This company provides funding to the Louisiana 4-H Food Smart Families program, where money for youth nutrition efforts is distributed across the state. Last year UnitedHealthcare presented a \$55,000 check to Louisiana 4-H during a CHEF Camp in New Orleans sponsored by the New Orleans Recreation Development Commission.

Besides East Baton Rouge, Calcasieu and Orleans parishes, CHEF Camps are offered in other parishes where there are joint LSU AgCenter and SU Ag Center programs, including Avoyelles, Evangeline, Lafayette, Madison, Richland, St. James, and East and West Carroll.

Camp teachers are extension agents and nutrition educators with the EFNEP and SNAP-Ed. But the camps depend heavily on volunteers, who include students from Southern University, LSU and Delgado Community College and older graduates from previous CHEF Camps.

The next step for the CHEF Camp initiative is an advanced camp for young adults so they can learn about entrepreneurship and opportunities to make food products into successful businesses, Charles said.

“We’re always looking for additional funding and ways to reach more kids,” she said.

Linda Foster Benedict is a professor in LSU AgCenter Communications and editor of Louisiana Agriculture.

Development of Alternative Strategies to Manage Crop Diseases

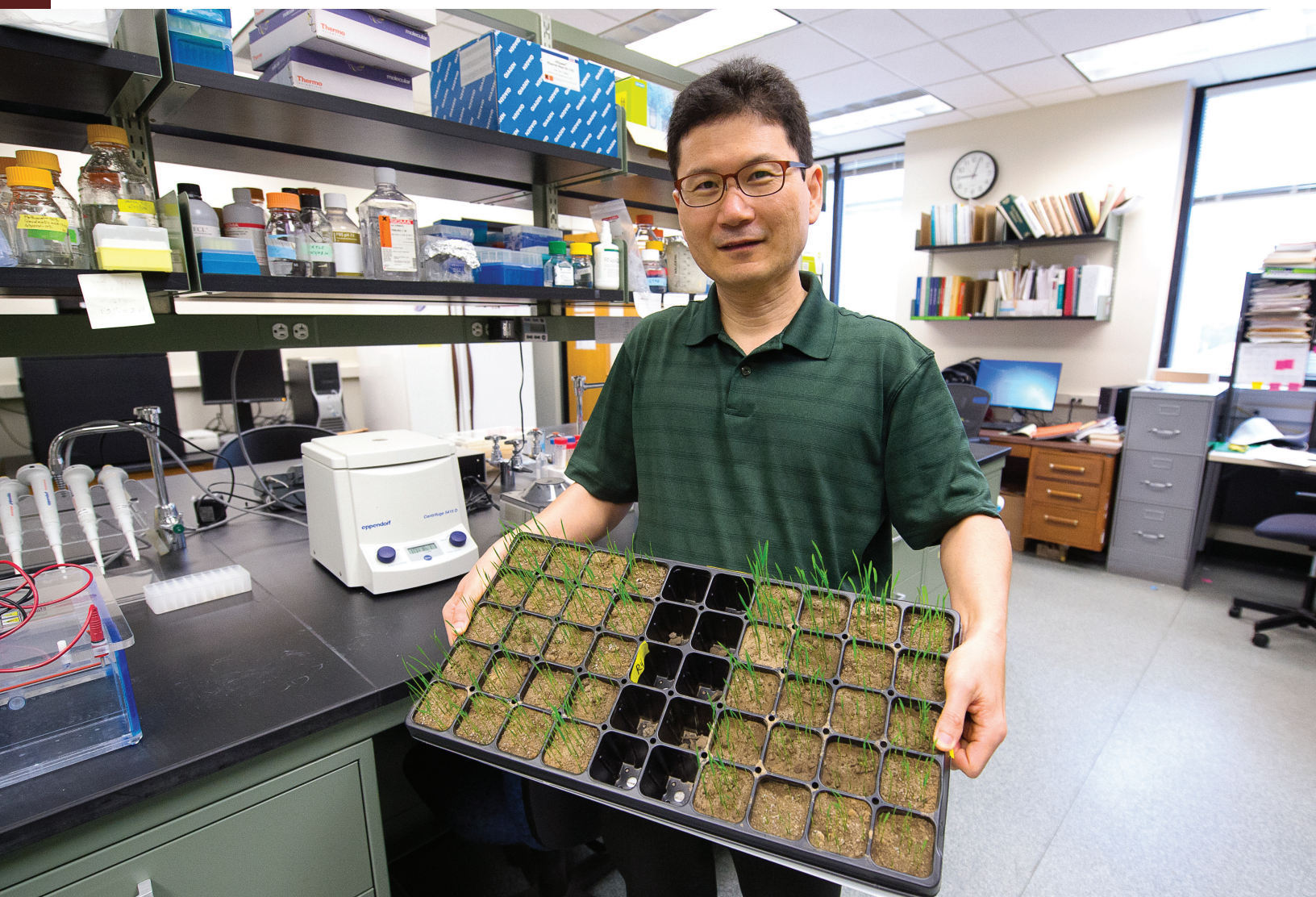
Jong Hyun Ham

Disease is a major limiting factor for stable and profitable yields of many crops, especially in regions with mild and short winter seasons, like Louisiana, due to higher survival rates of pathogens from overwintering. Plant diseases, like human and animal diseases, are caused by various types of pathogenic microorganisms, including viruses, bacteria, fungi, oomycetes and nematodes. Chemical control is usually a practical and effective way to manage

crop diseases caused by fungi, oomycetes and nematodes. Even though chemical control is the most common way to protect crops from many diseases, consecutive usage of similar types of chemical products often results in the occurrence of resistant pathogens, which substantially compromises the efficacy of the chemical agents.

For diseases caused by bacterial pathogens, relatively fewer numbers of chemical products for disease manage-

ment are available in the market compared to those for the diseases caused by eukaryotic pathogens like fungi, oomycetes and nematodes. Antibiotics used for medical purposes are commonly effective on plant pathogenic bacteria, but usage of antibiotics for agricultural purposes is highly restricted because of the risk of antibiotic-resistance traits, which can be gained by bacteria in the environment through selection pressure and subsequently transferred to clinical pathogens.



Jong Hyun Ham, associate professor in the Department of Plant Pathology and Crop Physiology, displays a tray of young rice plants in his laboratory. He conducts research to find new ways of treating crop diseases in Louisiana. Photo by Olivia McClure

Copper-based chemical products used as bactericides often show limited efficacy to bacterial diseases as well as phytotoxic effects on certain crops. In the case of viral diseases, there is no chemical available to directly control viral pathogens like human and animal viral diseases.

Because of the risks and limitations of the currently available chemical products, it is imperative to develop new tools and strategies for sustainable disease management. Several attractive alternative disease management options have been commercially available or under development to be released in the market in the near future. These include biological control agents (such as microorganisms antagonistic or pathogenic to pathogens), bacteriophages (viruses that kill bacterial cells), antimicrobial peptides (small peptide compounds produced by various organisms), nanomaterials, and plant defense inducers. However, each alternative disease management option still has its own limitations, including high costs, insufficient stability and activity, and risks to human health and the environment.

Crop production in Louisiana is heavily dependent on chemical products for disease management and, thus, has been facing the problems of chemical management practices and the needs of alternative disease management options addressed above. Especially, challenges are arising in the production of rice, one of the most economically important crops in Louisiana, along with sugarcane and soybeans, because of the current and impending problems in the management of two major rice diseases: bacterial panicle blight and sheath blight. Bacterial panicle blight caused by the plant pathogenic bacteria *Burkholderia glumae* and *Burkholderia gladioli* can hardly be managed by existing chemical control options because copper-based products show limited efficacy and phytotoxicity to rice, and antibiotics effective to the pathogens (such as oxolinic acid) are not registered in the U.S. Sheath blight caused by the fungal pathogen *Rhizoctonia solani* had been effectively managed by the strobilurin-type fungicides, such as Quadris, but fungicide-resistant pathogen isolates have recently been found in numerous rice fields of Louisiana, suggesting the impending

crisis of disease management for this chronic rice disease problem.

Research Activities

LSU AgCenter plant pathologists have been working on development of alternative strategies to manage rice diseases, especially focusing on bacterial panicle blight and sheath blight. Various types of materials have been tested for their disease management potential, and some of them have shown promising results as alternative disease management measures on their own or in combination with other materials.

Biological materials

Three types of biological materials have been studied in AgCenter laboratories: antagonistic bacteria, avirulent pathogens and growth-promoting bacteria. Antagonistic bacteria are non-pathogenic bacteria that can suppress the growth of pathogens through production of one or more antimicrobial materials. More than 100 bacterial strains isolated from various parts of rice plants and field soils have shown good antagonistic activities against fungal and bacterial pathogens in the laboratory condition (Figures 1A and 1B), and several of them have exhibited significantly high levels of disease suppression activities for bacterial panicle blight and sheath blight in field conditions as well. In addition, scores of avirulent strains of *Burkholderia glumae* (the major pathogen of bacterial panicle blight) have been identified in AgCenter laboratories. They lost the ability to produce virulence factors through natural mutation events and, thus, do not cause disease in rice even at a high population level. Some of these avirulent strains showed great antagonistic activities against the sheath blight pathogen *Rhizoctonia solani* and suppressed the development of sheath blight in the field. Finally, bacteria isolated from the rice root area (rhizosphere) are being tested through seed treatment for their beneficial influences on rice growth and defense. Though use of biological agents is an attractive option for sustainable disease management, there are still several problems to overcome in commercialization of this option, including limited shelf life and potential risk to human and animal health.

Natural chemicals

Application of nontoxic natural chemicals is an ideal option for disease management if the chosen material is effective, safe and economical. AgCenter plant pathologists have tested a variety of natural chemicals known to have biological activities, such as anti-oxidation and elicitation of plant defense responses, and a couple of them have shown a great efficacy for the suppression of bacterial panicle blight in field tests over multiple years. These materials are promising candidate agents to be used for the management of bacterial panicle blight by themselves or in combination with a bactericide, such as Kocide 3000, as a supplementary component to boost the limited efficacy of the bactericide. Current research activities are focused

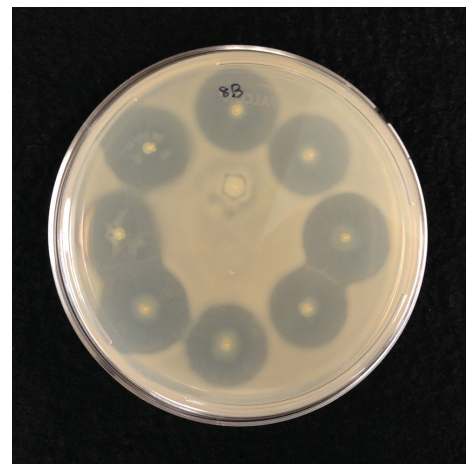


Figure 1A. Antagonistic bacteria exhibiting growth inhibition activities against *Burkholderia glumae* (the bacterial pathogen causing bacterial panicle blight of rice).

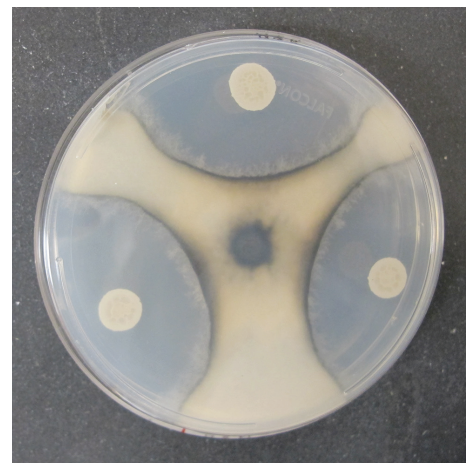


Figure 1B. Antagonistic bacteria exhibiting growth inhibition activities against *Rhizoctonia solani* (the fungal pathogen causing sheath blight of rice).



Figure 3. A rice line screened in LSU AgCenter laboratories that exhibits superior disease resistance to both bacterial panicle blight and sheath blight (the three rows of rice in the middle between the two rows of purple rice).

on this aspect, aiming to develop a more effective product for the management of bacterial panicle blight and other crop diseases caused by bacterial pathogens.

Nanomaterials

Nanomaterials are generally defined as the materials in a size range between 1 and 100 nanometers (one nanometer is a billionth of a meter). Nanomaterials are applied to a variety of products related to medicine, cosmetics and food engineering. Based on previous reports about the innate antimicrobial activities exhibited by certain nanomaterials, AgCenter plant pathologists have tested

various nanomaterials in terms of the antibacterial activity against the bacterial blight pathogen *Burkholderia glumae* and found that silver nanoparticles and zinc nanoparticles have strong antibacterial activities against the pathogen in the laboratory condition (Figure 2). Because the pathogen is known to be seed-borne, AgCenter plant pathologists are testing the effect of seed treatment of these materials to prevent the development of the disease in the field.

Disease-resistant rice lines

Even though growing disease-resistant varieties is the most economical and environment-friendly way to manage crop diseases, it is generally arduous to develop a crop variety having durable disease resistance. In case of rice, there are few commercial rice varieties showing satisfactory levels of disease resistance to bacterial panicle blight and sheath blight. In an effort to develop commercially valuable disease-resistant rice varieties based on better understanding of rice genetics, AgCenter plant pathologists have been performing genetic and genomic studies of rice, focusing on disease resistance traits for bacterial panicle blight and sheath blight, as well as screened rice germplasm showing higher levels of resistance to both diseases. The rice germplasm for screening has been generated from various procedures, including conven-

tional crossings, anther culture and mutagenesis. So far, several lines of rice germplasm have exhibited promising levels of disease resistance to both diseases (Figure 3). They will be an excellent source of disease resistance for the rice breeding programs in Louisiana.

Conclusion

Effective and sustainable disease management cannot be achieved through a single approach. Integration of multiple approaches influencing all the three elements of a disease (host, pathogen and environment) is an ideal disease management strategy, which minimizes economic and environmental risks. However, many of the current disease management practices are heavily dependent on chemical control methods only, such as application of fungicides or bactericides/antibiotics, which increases the risk of resistant pathogens and often encounters diseases for which effective chemical agents are not available. LSU AgCenter research achievements and current efforts will lead to the development of innovative strategies for sustainable disease management of the chronic rice diseases and, further, many other fastidious crop diseases caused by fungal and bacterial pathogens.

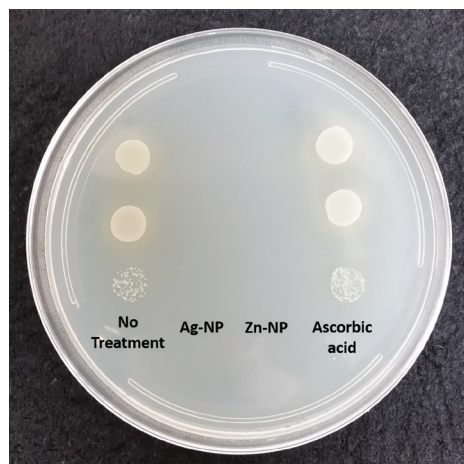


Figure 2. Bactericidal activities of silver-nanoparticle (Ag-NP) and zinc-nanoparticle (Zn-NP) to the rice pathogenic bacterium *Burkholderia glumae*. Bacterial cells treated with 0.1% Ag-NP or Zn-NP could not survive in contrast to those without any treatment or treated with 0.1% ascorbic acid.

Jong Hyun Ham is an associate professor in the Department of Plant Pathology and Crop Physiology.

Greauxing Up in the Garden

Kathryn K. Fontenot

The LSU AgCenter and East Baton Rouge Master Gardener Association have partnered to host a series of garden workshops for children at the LSU AgCenter Botanic Gardens at Burden, which began in 2016.

Activity themes for the Children's Garden Series are chosen to present gardening activities without making the 6- to 10-year-old participants feel they are participating in yard work or stuck in a classroom. The goal of this series is to engage young children in gardening so they enjoy being outdoors, develop an appreciation for nature and learn horticulture concepts.

Each activity begins by asking participants a simple yes or no question about the topic of the day. Information is presented on the topic, and then children

create a garden, plant or construct something garden-centric and use the grounds of the Botanic Gardens to explore the topic. Participants are provided snacks and drinks and end each activity with the same yes or no question to determine if they understand the basic concept being taught. For each of the first six workshops, an average of 40 percent of children knew the correct answer at the beginning of the activity and a minimum of 90 percent of children raised their hand for the correct answer at the end each workshop.

Themes for 2016 included: Creating Fairy Gardens, How Are Frogs and Toads Important in the Garden? Making Your Own Terrarium, and Where in the World Do Vegetables Come From? The themes for 2017 included Attracting Native Song

Birds to the Backyard, Vermicomposting, Do You Know Your Fruits and Veggies? Buzzing Through the Garden with Bees, the Importance of Native Trees, and Raising Backyard Chickens. For 2018, participants have requested lots of butterfly activities, so the committee is preparing to flutter through the garden in 2018.

Some of the workshops that have been held include:

Fairy Gardens: Children are encouraged to create small garden spaces where mystical fairy figures can visit day or night. This requires well-kept plants that are properly watered, fertilized and managed for insects. Proper plant care is essential because fairies require plants for cover.

Cullen Curole, 8, waters sweet potato transplants that he and other children planted during a session of the LSU AgCenter Children's Garden program on May 20. Participants planted the sweet potatoes as part of a lesson on knowing your fruits and vegetables.

Photo by Rick Bogren





Master Gardener volunteer Angie Wall, back to camera, instructs children as they plant sweet potato transplants in a raised garden table during a session of the AgCenter Children's Garden program on May 20 at the LSU AgCenter Botanic Gardens at Burden. As the participants planted the sweet potatoes, they were told they could return to the garden later in the year and harvest their produce. Photo by Rick Bogren

Each child is given a large basket, soil, plants and tiny furniture and glass stones to create their very own fairy take-home garden. Participants visit the Children's Garden to examine a large fairy garden and look for treasures to add to their own take-home gardens.

Terrariums: Did you know terrariums were first discovered because a fern easily grew under a glass jar amidst lots of air pollution? Not long after the discovery, some terrariums became known as Wardian cases, named after the inventor Nathaniel Bagshaw Ward, and served as suitcases to transport plants on long journeys across the ocean. In the terrarium workshop, children learn about the uses of a terrarium and create one for their homes. They explore the gardens to discover special rocks, twigs, shells and other items to personalize each terrarium. Children were taught how to maintain plants and pot up or propagate new plants.

Frogs and Toads: Throughout the lesson, children learn the physical differences in frogs and toads, why they benefit people in the garden (eat pesky insects) and what important features are needed to attract frogs and toads into a garden. Children learn the differences between submergent, emergent and floating aquatic plants and how to care for these plants. They also learn about

invasive aquatic plants and how they can harm the environment. Children create individual miniature frog gardens to take home. The children and their parents explore the Barton Arboretum and Black Water Swamp and look for frogs and toads, find tadpoles and learn about a frog and toad habitat.

Where in the World Do Vegetables Come From? Children study maps and learn where fresh fruit and vegetable snacks originated, which in some cases was not the United States. Children are given fresh food to create "veggie people" using eggplants, squash and peppers as bodies, peas as eyes and carrot slivers as noses. As the children put together their veggie people, they recounted where each vegetable originated. Afterwards, children plant various vegetables and seeds into the Children's Garden and take home their veggie people and extra plants and seeds for their own garden.

Attracting Native Song Birds to the Garden: Participants observed pictures of Southeastern United States native birds and listened to the differences in their chirps. All the while, Master Gardeners showcased plants that would attract those birds to their yards. Children planted native wildflower seed into pots for their homes and painted dried gourds to hang as bird houses. Birds, like people, need shelter, food

(seeds from plants, worms and insects from our gardens) and water. Caring for the plants so that beneficial insects are not disturbed was a running theme throughout the lesson.

Vermicomposting: What is better than holding wiggly wet slimy worms? Not much, unless you build a special compost bin to bring home and keep the worms as pets. Children learned worm anatomy. They also were taught how to care for the worms, such as dietary do's and don'ts, and how to make a cozy living space that is not too hot nor too cold and has the proper amount of bedding. Children made compost bins and filled them with living worms. Then they went to the garden to play a game of camouflaged worms. Participant were assigned to groups, which were given bird names, and worked together to find fake worms hidden throughout the space. Many of the brightly colored worms were found, but not the brown ones. They learned blending into the environment can sometimes be a good thing.

While organizers are pleased that basic concepts are taught to the children, they are also excited to see smiling young faces as they explore the garden. The Children's Garden at Burden is free for anyone to enter and use. The garden is open seven days a week from 8 a.m. to 5 p.m. The entrance to the Children's Garden is planted with pollinator plants specific to butterflies, and the back portion is planted with fruit and vegetable crops. Visitors are encouraged to take home produce when it's ready for harvest. Children will often leave one of the workshops toting vegetables home.

Reservations for the Children's Garden Series are required in advance. The \$15 charge per child helps support the series. Parents and grandparents bring children to these events held on select Saturday mornings from 9 to 11 a.m. The adults are often as excited as children to participate.

More information about the Children's Garden Series can be found at the LSU AgCenter Botanic Gardens at Burden website.

Kathryn K. Fontenot is an extension horticulturist and an assistant professor in the School of Plant, Environmental and Soil Sciences.

Measuring the Economic Futures of Louisiana's Rural Children

J. Matthew Fannin and Vikash Dangal

Many local communities are concerned about the futures of their next generation. Individuals will often look to indicators such as poverty, per capita income or the unemployment rate as a yardstick of the success or failure of communities to provide a better future for their children. Louisiana has often struggled with having more than one-third of its parishes classified as persistent poverty parishes; that is, parishes that have had at least 20 percent of their population below the federally defined poverty income level for three consecutive decades.

However, using measures such as poverty or per capita income may be an imperfect approach to looking at a community's ability to provide for its children's economic success. LSU AgCenter economists are evaluating alternative measures of a Louisiana community's ability to provide a fertile environment for children's economic prosperity. In particular, the economists want to answer the question: "Will my children be economically better off than I am?"

AgCenter economists have taken advantage of newly available data from

Raj Chetty at Stanford University that measures intergenerational economic mobility, defined as the expected change in the economic performance of children compared with their parents. Specifically, a subset of parents were identified in each parish whose household income was at the 25th percentile of U.S. household income between 1996 and 2000 (approximately \$29,000). Next, the subset of their children born between 1980 and 1982 was identified by matching the children's tax identification numbers with the tax records of their parents, where they would be listed as dependents, between 1996 and 2000.

The incomes of these children were then measured based on their 2011-2012 income tax records when they were approximately 30 years of age. The incomes for each parish were then averaged and matched with the U.S. percentile that average represented. A parish's children would be considered upwardly mobile in income if their 2011-2012 income percentile was greater than 25, the income percentile of their parents.

A map of upward mobility by Louisiana parish is presented in Figure 1. Average U.S. countywide upward mobility is approximately 43.4. This means children from the average county whose family income was at the 25th percentile increased their income ranking by just more than 18 percentile points (43.4 - 25). The statewide Louisiana parish average was 41.2, or just more than two percentile points below the nationwide average. There were 14 parishes with upward mobility levels higher than the national average, led by LaSalle Parish with an upward mobility level of 50.8. The parish with the lowest upward mobility was Orleans Parish at 34.8. On average, rural parishes had higher upward mobility in income than urban parishes,

with the most rural parishes averaging 42.1 compared to metropolitan parishes averaging 40.9. However, like the overall U.S. measure, rural Louisiana had some of both the highest and lowest levels of upward mobility. In particular, many rural parishes in central and southwest Louisiana showed some of the highest levels of upward mobility, while parishes in the extreme northeastern part of the state had the lowest upward mobility.

It is believed that some of the same factors that affect upward mobility in income of the next generation also affect poverty levels. As a result, economists ranked from one to 64 both the upward mobility score and the poverty level in each parish in 2000. Place-based factors in each parish in 2000 that would contribute to high poverty levels may also influence lower upward mobility of children from these regions.

Of the 41 parishes in Louisiana with poverty rates of 20 percent or higher, 25 parishes ranked higher in upward mobility than poverty. The parish with the greatest difference in upward mobility rank was Evangeline Parish (upward mobility sixth, poverty 61st) followed by Catahoula Parish (upward mobility third, poverty 56th) and St. Landry Parish (upward mobility 15th, poverty 59th). In three parishes, the upward mobility rank and the poverty rank were the same (Desoto, Madison and Winn). The parishes where upward mobility ranked lowest relative to poverty were East Baton Rouge Parish (upward mobility 56th, poverty 16th), St. John the Baptist Parish (upward mobility 54th, poverty 14th) and St. Tammany Parish (upward mobility 34th, poverty first). Parishes that had a higher upward mobility rank than poverty rank are shown with crosshatching in Figure 1. Figure 1 shows that most of the parishes in northeast Louisiana, southwest Louisiana and the Acadiana region had upward mobility ranks exceeding their poverty ranks.

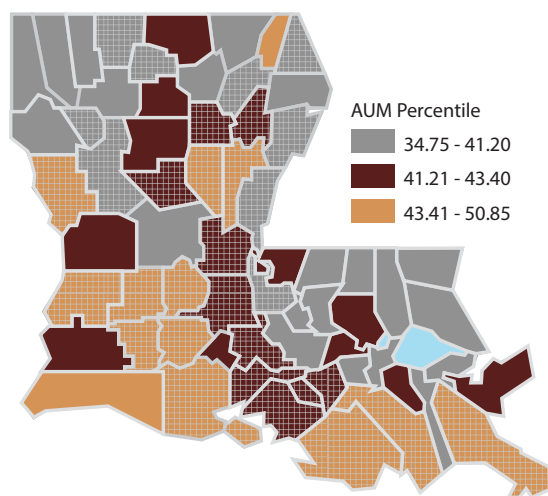


Figure 1. This figure shows the U.S. household income percentile of 30-year-olds in 2011-2012 who were teenagers in the respective parishes between 1996 and 2000. Parishes that are crosshatched ranked higher in children's upward mobility during the period than the poverty rank in 2000.

Future research for LSU AgCenter economists will focus on the factors that drive some parishes to outperform. In southwest Louisiana and parts of Acadiana, it is likely that the timing of the oil and gas boom during 2011-2012 resulted in children who remained in these parishes earning incomes sizably higher than their parents working in the same industry between 1996 and 2000, even after adjusting for inflation. In addition, because the upward mobility data do not distinguish the residential location of the children, a large percentage of children in some high upwardly mobile parishes may have migrated from the parish of their childhood to different parishes or states to live and work.

These results may suggest certain strategies for Louisiana parishes. In general, local and state policies that promote increased educational attainment and skill development will result in increased incomes for residents, especially for those willing to move (either to other locations in state or out of state). For the proportion of children who will continue to live in Louisiana when they become adults, both rural and urban parishes should continue to work collaboratively to strengthen regional job opportunities. Further, strategies that focus on improving transportation networks to reduce travel time will allow in-state residents to extract additional returns to their investments in education and skills.

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New Herbicide Systems Give Farmers Options for Better Weed Control

Olivia McClure

Three new soybean herbicide systems will give Louisiana farmers much-needed tools to fight increasingly resistant weed populations they have struggled with in recent years. However, LSU AgCenter weed scientists caution that the new products, which they have been evaluating in field trials, will only be helpful long term if applied according to label and in combination with other herbicides and good management practices.

Among the more problematic weeds in Louisiana and many other states is Palmer amaranth, a prolific seed-producing plant that often cannot be adequately controlled with glyphosate because of resistance development. Since the commercialization of Roundup Ready crops, over-reliance on weed management programs that only include glyphosate on weeds such as Palmer amaranth, as well as johnsongrass and Italian ryegrass, has resulted in development of a tolerance for the herbicide, resulting in the need for alternative control measures.

Palmer amaranth can be controlled with other herbicides, such as dicamba and 2,4-D. However, these herbicides have historically also killed crops that do not contain genetic traits that safeguard them. Soybean varieties

capable of withstanding over-the-top application of either dicamba (Xtend Cropping System) or 2,4-D (Enlist Cropping System) have been developed for commercialization. The Xtend system recently came on the market; the Enlist system has yet to be commercially released. Although effective in controlling weeds in labeled crops, concerns exist regarding off-target movement to susceptible and sensitive crops. Therefore, label-specific language that includes restrictions for application must be followed to mitigate potential off-target spray movement to these crops.

AgCenter weed scientist Daniel Stephenson has been studying the effectiveness of Xtend and Enlist Duo herbicides, among other technologies. While both show promise, he said, they work best in cases where additional pre-emergence herbicides had already been applied to the soil before planting.

Eliminating weeds as early as possible is critical, said AgCenter weed scientist Donnie Miller, who has been evaluating these technologies in addition to Balance GT, another soon-to-be-released technology. That system includes soybeans with a trait allowing pre-emergence applications of Balance Bean herbicide and over-the-top applications of glyphosate.

Balance Bean is an isoxaflutole-based herbicide that controls weeds by blocking an enzyme commonly known as HPPD, which stands for 4-hydroxyphenylpyruvate dioxygenase.

"It will essentially get the weeds before they ever come out, whereas with glyphosate, dicamba and 2,4-D, the weeds have to be emerged," Miller said. "When you're ready to make your application and weeds are at the optimum size, you always have that chance of



Soybeans in a weed science test plot at the Northeast Research Station in St. Joseph, Louisiana, infested with grass species barnyardgrass, broadleaf signalgrass and browntop millet. Photo by Olivia McClure



Farmers have to follow label instructions carefully before spraying herbicides in fields to avoid the problem of drift, in which air currents can carry the herbicides to other fields. They also have to make sure spraying equipment is thoroughly cleaned to avoid unintended herbicide injury.

Photo by Olivia McClure

a rain coming in and delaying you. You've gone from spraying optimum-size 1-to-3-inch weeds to spraying 6-to-7-inch weeds."

The arrival of additional ways to control weeds is good, but not because any of the new products alone are a perfect solution. Rather, having more options helps farmers combat not only weeds, but also the problem of herbicide resistance.

HPPD-inhibitor herbicides like Balance Bean — a relatively recent development in the weed science field — offer a mode of action different from any others currently available. Incorporating multiple modes of action is "the basis for any good resistance mitigation program," Miller said.

Using more than one product and making both pre- and post-emergence applications also ensures better results overall, so long as label directions are carefully followed and spraying equipment is thoroughly cleaned to avoid unintended herbicide injury, Stephenson said.

"There's a false assumption out there that dicamba, which can be used in the Xtend technology, is essentially going to be a silver bullet for resistant pigweed. It is not," Stephenson said. "We have to protect this technology. If you ride the dicamba horse and that's all you're using, we're going to follow the same path we did with glyphosate and end up with resistance."

Farmers also should consider implementing weed control practices following harvest. Josh Copes, AgCenter field crop production specialist, has begun a project to study how post-harvest decisions affect weed populations.

He wants to find out if late-season herbicide applications in

corn can delay when farmers have to get back in their fields to control weeds to prevent weed seed production after harvest.

"A lot of weed seed is being produced after harvest, especially with corn. Corn comes off as early as mid-to-late July in some cases," Copes said. "That's a long period of time for weeds to germinate, go to seed and create big problems for future crops in those fields."

He also is looking at how the timing of mowing and disking fields after harvest affects seed production.

Olivia McClure is an assistant specialist with LSU AgCenter Communications.



Donnie Miller, LSU AgCenter weed scientist, right, presents the latest information about herbicide systems to participants at a field day at the Northeast Research Station in St. Joseph, Louisiana, on June 20. Photo by Olivia McClure

Inside:

Trade agreements affect Louisiana's sugar industry. page 11

Researchers use simulation software to help sugar factories become more efficient. page 14

Researchers find a salt byproduct that potentially adds value to sugarcane. page 16

Four discoveries in LSU AgCenter intellectual property go to market. page 18

CHEF Camps help children learn about food safety and a healthy lifestyle. page 26



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