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LOUISIANA Agriculture

Assuring Our Future Through Scientific Research and Education



Celebrating
Excellence in Research



Bring on the next 125 years!

Agriculture in Louisiana is an intricate tapestry whose richness is rivaled by few other states. Our broad array of agricultural enterprises ranges from the traditional to the regionally unique – from soybeans and corn to rice and sugarcane, from beef and dairy to alligators and turtles, and from catfish to crawfish and oysters. This complex fabric of agricultural production systems, along with the resultant challenges that arise from these systems, has been the driving force behind agricultural research in our state for 125 years. We are extremely proud to celebrate our quasiquicentennial anniversary of service by releasing this special edition of Louisiana Agriculture.

This commemorative issue will capture in broad strokes some of the major research milestones accomplished by the Louisiana Agricultural Experiment Station. Beginning with the grower-focused Audubon Sugar School in New Orleans in 1885 and continuing all the way through development of the industry-changing herbicide-resistance trait that would become Clearfield rice, our experiment station scientists have marched to a single, simple drumbeat – identify production constraints, develop and implement solutions, and enhance profitability of Louisiana's agricultural enterprises. This formula has helped define 125 years of agricultural research success in Louisiana.

Such a history of success would not be possible without some key ingredients, foremost of which are Louisiana's many organized producer groups. From the earliest sugar producers who sought help with cane production and processing to today's rice farmers who sought help with red rice control, Louisiana's producer groups are among the most engaged and supportive that you'll find. Over the years these groups have evolved into effective partners for our scientists, providing not only guidance regarding their most pressing research needs but also support, both direct and indirect, that has made many of these advances possible. My hat is off to these producer groups – both to the current leaders and to the original trailblazers on whose shoulders they stand.

None of these successes would be possible without the visionaries who fueled a national discussion on the need for applied agricultural research in the late 1800s, which resulted in passage of the Hatch Act in 1887, authorizing federal funds to be distributed to state experiment stations. The allotment back then was \$15,000 per year per station. To these leaders and their contemporary successors we owe a continuing debt of thanks. The past 125 years are a testimony to what can be accomplished when engaged producers, scientists and legislators partner for the common good.

As director of the Louisiana Agricultural Experiment Station, I have the daily privilege of viewing portraits of my predecessors and considering the challenges they overcame to build our organization to its current size and scope. Beginning with W.C. Stubbs in 1887, these directors have led our research efforts through times of economic prosperity and hardship, two World Wars and the Great Depression. Despite these daunting circumstances, these leaders demonstrated the vision, courage and determination to advance the mission of agricultural research against what must have seemed at times like insurmountable odds. They succeeded, and their accomplishments formed a solid foundation on which future directors could build.

For 125 years, the Louisiana Agricultural Experiment Station has worked steadily to develop the best use of natural resources, conserve and protect the environment, and enhance development of existing and new agricultural enterprises, thereby enhancing the quality of life for all Louisiana citizens. We are proud of our heritage. Bring on the next 125 years!

John S. Russin, Vice Chancellor and Director of the Louisiana Agriculture Experiment Station



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Contributors

This special edition of Louisiana Agriculture is an attempt to capture some of the rich history of agricultural research since its beginnings with the Hatch Act of 1887. In addition to this print form, we also offer an expanded version on the magazine's website. Go to www.LSUAgCenter.com and click on Louisiana Agriculture Magazine. The Web version includes additional information, more photos and more stories. We hope to keep adding to this site because we anticipate it will spark interest, and people will come forward with more facts and anecdotes.

Many people contributed to this special edition. The list includes the following:

James L. Griffin, weed scientist, wrote a comprehensive history of weed science contributions, which is on the website, and a brief biography of Chester McWhorter. See page 31.

Lawrence Datnoff, head of the Department of Plant Pathology and Crop Physiology, diligently went through past issues of Louisiana Agriculture and other departmental documents to compose a guide to the many contributions of plant pathologists to the research history. His article is on the website.

Don La Bonte, head of the School of Plant, Environmental and Soil Sciences, and **Tara Smith**, extension specialist and coordinator of the Sweet Potato Research Station, captured the history of the sweet potato in an article on the website. A shorter version is on pages 16-17.

Michael Blazier, forestry researcher, wrote a history of the forestry research at the Hill Farm Research Station; **Randy Sanderlin**, pecan researcher, wrote about the history of pecan research and the

Pecan Research and Extension Station; and **Michael E. McCormick**, dairy scientist, provides a history of the Southeast Research Station and the beginnings of research on dairy science in the state. These articles are on the website, and shorter versions are on page 29.

For a history of the Hatch Act, go to the website and read the article by **David Morrison**, who is the recently retired assistant vice chancellor and assistant director of the Louisiana Agricultural Experiment Station.

Kenneth Gravois, sugarcane scientist, provides the fascinating history of sugarcane research in Louisiana. His complete article, along with more photos, is on the website, and a shorter version is on pages 4-5.

Guillermo Scaglia, animal scientist; **Allen Owings**, horticulturist; **Cathy Williams**, dairy scientist; **Witoon Prinyawiwatkul**, food scientist; and **Lane Foil**, entomologist, provided milestones. **Timothy D. Schowalter**, head of the Department of Entomology, wrote a biography of L.D. Newsom, which is on the website. **Rogers Leonard**, associate vice chancellor and associate director of the Louisiana Agricultural Experiment Station, and **Eric**

Webster, weed scientist, made significant contributions to the text.

Robert Romaine, aquaculture researcher, pulled together the history of aquaculture in the state from accounts written by **James Avault**, aquaculture researcher, now retired.

In addition to the scientists, members of the communication staff made significant contributions. **Tobie Blanchard** wrote the history of cotton; **Rick Bogren** pulled together entomology milestones and wrote copy for other sections; **Craig Gautreaux** wrote the history of wildlife and fisheries; **Randy LaBauve** provided photos he had gathered for the documentary he produced about the research history and also served as an editor; **Kathy Kramer** created a lively design for the magazine; **Johnny Morgan** wrote the history of soybeans and feed grains and served as an editor; **Bruce Schultz** wrote about rice, animal science and William Dalrymple; and **John Wozniak** scoured his photo collection to provide a pictorial account of the milestones. ■

Linda Foster Benedict

The handwriting on these pages is from some notes kept by William C. Stubbs. In one note from October of 1888, he mentions dispersing of Hatch funds. Read more about Stubbs on page 4.

Louisiana Agriculture Research begins with the Sugar Experiment Station



By October 1885, William C. Stubbs had established sugarcane research areas to systematically investigate means of increasing sugar yields. With a background in chemistry and soils, he was uniquely qualified to analyze both plants and soils. Experiments were initiated to determine how manures could enrich soils and what form of nitrogen was most beneficial to the sugarcane plant. He also wanted to determine if surface drainage was adequate or if tiles would be necessary.

"Gentlemen, remember that whenever humanity broods over a problem, sooner or later it will be solved. Combine and concentrate your efforts in a first-class experiment station, and you will find the difficulties now encountered in sugar making, before its investigations, melting away, like streaks of morning light, into the infinite azure of the past."

– William Carter Stubbs

This is a quote from a speech given by Stubbs in May 1885 before the Louisiana Sugar Planters Association. The group was desirous of improvements in their ability to produce sugar from sugarcane and get ahead of the growing competition from Europe's beet sugar. Sugarcane had been planted in Louisiana since 1795, when Etienne de Boré and Antoine Morin were able to granulate sugar from sugarcane on de Boré's plantation in New Orleans.

Later that summer the planters hired Stubbs, who had been working at the Alabama Experiment Station, as director of the newly formed Sugar Experiment Station. This action officially launched agricultural research in Louisiana. The station's purpose was "to develop and improve the agricultural interests and resources of Louisiana, especially the

cultivation of sugarcane and rice by scientific and agricultural and chemical experiments and to disseminated information connected therewith."

In February 1886, the Louisiana Board of Agriculture established an experiment station on Louisiana State University property in Baton Rouge. To placate concerns of the north Louisiana legislators, the Calhoun Experiment Station was also established. By the summer of 1886, Stubbs had signed a contract with the commissioner of agriculture whereby he was appointed official state chemist, director of the State Experimental Stations and professor of agriculture at LSU. Stubbs would remain in New Orleans and manage a budget that included local support from sugar planters, state funds and federal funds from the Hatch Act of 1887, which



Stubbs' vision for agricultural research was not limited to production agriculture. He felt that manufacturing and diffusion process trials should also be conducted. In 1891, the Audubon Sugar School was established at the Sugar Experiment Station in Audubon Park in New Orleans.



The Audubon Sugar School closed in 1896 but was reestablished on the LSU campus in 1897 under the direction of Charles E. Coates, who would serve as its dean for the next 40 years. The school became renowned for training sugar factory technicians from around the world in sugar processing techniques.

provided federal funds to states for their agricultural experiment stations. This three-way partnership would pay dividends for many years to come.

The work of the Sugar Experiment Station came to the forefront in the 1920s. The American Sugar Cane League was chartered on September 28, 1922, by the consolidation of the Louisiana Sugar Planters Association, American Cane Growers Association, and the Producers and Manufacturers' Protective Agency. The U.S. Department of Agriculture established a Sugarcane Research Laboratory in Houma, La., in 1923.

Louisiana Agricultural Experiment Station scientists Preston Dunkleman and Richard Breaux initiated recurrent selection sugarcane breeding methods in the mid-1950s that led to the development of high sucrose varieties, such as L 60-25, L 62-96 and L 65-69. The L in the name stands for Louisiana. Strains of the mosaic virus were becoming increasingly problematic. Pathologists and breeders devised a basic sugarcane breeding program in an effort to capture disease resistance from wild sugarcane clones. Dunkleman joined the USDA to lead that effort, which continues to pay dividends for today's sugarcane breeders in Louisiana.

Read a longer version of the sugarcane story on the magazine website at www.LSUAgCenter.com.



LCP 85-384 revolutionized the sugarcane industry. Because of its size and weight, it required a different harvester – one that cut the stalks into billets rather than leaving them whole. The variety had the ability to provide additional cuttings of stalks, termed stubble crops because the new crop of stalks develops from the stubble remaining after harvest. The typical rotation for Louisiana sugarcane had been to plant in late summer for harvest the following fall or winter followed by two stubble crops in subsequent years. With LCP 85-384 farmers were able to obtain three to four stubble crops with a single planting. By 2004, it was growing on 90 percent of the sugarcane acreage. Because it was so widely grown, it became vulnerable to disease. But it has proved to be an excellent parent, and new and better varieties have been developed from it.

Freddie Martin, a researcher who went on to become director of the School of Plant, Environmental & Soil Sciences before his retirement in 2010, led a team effort for the development of LCP 85-384, which was released in 1993. The CP in the name stands for Canal Point, Fla., the location of another sugarcane research facility. LCP 85-384 was a high-yielding cold-tolerant variety that gave a tremendous boost to the Louisiana sugarcane industry. This progress continued under Kenneth Gravois and Keith Bischoff, both students of Martin, as they ushered in a return of L varieties into the Louisiana sugar industry. Gravois is now the LSU AgCenter sugarcane specialist; Bischoff retired in 2010.

In addition to producing new varieties for sugar content, Louisiana Agricultural Experiment Station scientists also develop new high-fiber, low-sugar varieties for use as an alternative fuel. Research is under way to develop an economical method for turning “energy” cane into ethanol, butanol and other industrial products.

■ Kenneth Gravois

- In 1888, USDA assistance enabled William Carter Stubbs, the first director of the Louisiana Sugar Experiment Station, to test more than 70 sugarcane varieties obtained overseas by U.S. consuls. In 1893, Stubbs brought to Louisiana 500 sugarcane seedling varieties from overseas to try to increase sugar yield, which he did. This was the beginning of the concept of continual variety development to sustain the agricultural industry in Louisiana.
- One hindrance to sugarcane breeding in Louisiana was the plant's lack of flowering because of low fall temperatures. St. John P. Chilton, plant pathologist and sugarcane breeder for the Louisiana Agricultural Experiment Station, established artificial photoperiod schedules that would allow sugarcane to flower in Louisiana. This groundbreaking research in the 1940s and 1950s was carried out in photoperiod facilities on the LSU campus. This meant sugarcane crossing could be conducted locally instead of relying on facilities in Canal Point, Fla.
- In the 1970s, Freddie Martin began evaluating use of glyphosate as a sugarcane ripener to increase sugar production per acre. Louisiana Agricultural Experiment Station research continues on the use of ripeners, which have increased sugar yields substantially.
- Jeff Hoy, plant pathologist, helped reduce the incidence of ratoon stunting disease, the most important disease of sugarcane, from 51 percent in 1997 to less than 1 percent today through a public and private sector partnership to produce healthy planting material for farmers. The Sugarcane Disease Detection Laboratory was established.
- Gene Reagan, entomologist, leads the research effort to prevent the Mexican rice borer from causing major crop damage in Louisiana's sugarcane fields. This invasive species is a threat to both rice and sugarcane but has been particularly devastating to sugarcane in Texas as it moved into the United States from Mexico. Reagan's efforts helped stem its entry into Louisiana and keep it from causing major damage once it arrived, which it did in 2008. Since then it has not caused detectable losses to any sugarcane in Louisiana.

A Storied History of Cotton in Louisiana

Few crops have the storied history of cotton. Grown in Louisiana for hundreds of years, this crop has been a vital part of the state's economy. In the early 1700s, cotton cultivated in the state was used mainly for home spinning and weaving. It wasn't until the invention of the cotton gin later that century that cotton became a cash crop in Louisiana.



As recently as the 1950s, cotton farms were small with individual farmers growing fewer than 20 acres. But as farms became more mechanized in the 1960s and 1970s and effective pesticides reduced the need for manual labor, farm sizes grew. Now a typical cotton farmer manages around 500 to 600 acres. The largest acreage ever produced in Louisiana was nearly two million acres planted in 1930.



LSU AgCenter entomologists advanced integrated pest management strategies by studying prescription pesticide applications that limit sprays only to those areas of a field which actually need the pesticide. The first demonstration of an aerially applied prescription treatment in the United States was done in Tensas Parish on cotton in 2002. Other scientists have used similar techniques to study and implement technologies that apply crop inputs to restricted field zones only when needed. Agronomists and nematologists have developed soil-sampling protocols and application technologies to more efficiently apply products.

Pest Management

For many years cotton was one of the most management-intensive and expensive field crops to grow in Louisiana. A big factor in the cost of production is controlling insect pests. Until recently, the key pest in cotton was the boll weevil, which plagued farmers in the state since the early 1900s, causing farmers to rely heavily on pesticides that created other pest issues and environmental problems.

LSU AgCenter scientists served as the technical advisers to the Louisiana Department of Agriculture and Forestry's Boll Weevil Eradication Commission, which began working to eliminate the pest in the 1990s. The researchers worked out technical procedures such as what chemicals to use and trapping protocols. The boll weevil was considered officially eradicated in 2011.

In the early 1990s, transgenic technologies were introduced into cotton plants. Genes from a naturally occurring soil bacterium, *Bacillus thuringiensis*, which is toxic to certain insects including the tobacco budworm and the boll worm, were inserted into cotton plants. This cotton is known as Bt cotton.

"This technology was truly a revolutionary development in the history of pest control in agronomic crops," said Larry Rogers, former director of the Louisiana Agricultural Experiment Station, now retired.

Rogers, who also served as the resident director of the Northeast Research Station, said entomologists at that station were regarded as some of the best cotton entomologists in the world.

"As a result of their expertise and their commitment, the Northeast Research Station with expertise in entomology and agronomy was selected as one of the few sites in the United States where the effectiveness of transgenic Bt cotton lines was field-tested," Rogers said.

Because of the success of this technology, the Louisiana cotton industry further reduced the need for synthetic pesticides to control caterpillar pests. With Louisiana's subtropical climate and the diversity of cotton insect pests, cotton production still requires the use of insecticides to maintain optimum crop productivity.

Cotton Breeding

Some of the first trials in Louisiana were designed to evaluate the adaptation and performance of cotton varieties. Original research reports from the first experiment stations in New Orleans, Baton Rouge and Calhoun during the late 1800s provided information to the cotton industry on which varieties were the best fit for their conditions. Those evaluations continue today for cotton at AgCenter research stations.

"This is the sole source of unbiased data that producers have," said John Kruse, AgCenter cotton specialist. "When it comes to which varieties to grow, this information is vital to their decision-making process."

Cotton Tradition Continues

Cotton acreage in Louisiana has dwindled in the past 10 years with lows falling below a quarter of a million acres. Farmers have switched to planting more corn as markets shifted and corn varieties improved.

This practice of shifting crops has long-term overall farm productivity effects as well. Original research during the first years after forming the Louisiana Agricultural Experiment Stations focused on crop production by rotating annual crops. These research results collected 125 years ago support the actions of farmers today. Rotating cotton with other adapted crops continues to produce the most sustainable income stream in many Louisiana regions.

Despite the changes, Louisiana's cotton industry remains stable. "I don't see the return to king cotton days we had for many years, but Louisiana farmers will remain substantial producers of cotton," said John Barnett, LSU AgCenter Northeast Region director and former extension cotton specialist.

The crop retains its proud legacy as farmers who grow more soybeans or corn still see themselves as cotton farmers and uphold the tradition of cotton as an important part of the state's fabric.

■ **Tobie Blanchard**

- In the mid-1950s, entomologists discovered boll weevil resistance to the insecticide DDT. This research documented the first large-scale problem of pesticide resistance shown in a major U.S. crop pest.
- Discovery by L.D. Newsom and graduate student J.R. Brazzel of a winter hibernation state of the boll weevil, known as diapause, helped lead to eradication of the boll weevil.
- In trying to help cotton farmers use less pesticide, L.D. Newsom did some of the pioneering work in integrated pest management, which is the term used to describe a system of moderating the use of chemicals in agriculture by taking into consideration all aspects of production and the control of insect pests, weeds and disease.



Bt cotton includes genes for bacteria toxic to the tobacco budworm and boll worm, both pests of cotton.



The ability to control weeds without negatively affecting crop stand or yield led to the adoption of reduced-tillage programs and conservation-tillage practices that contributed to reduced soil erosion. Adoption of reduced-tillage, "stale seedbed" programs contributed to greater profitability of cotton, particularly when grown on heavy clay soils. Conservation tillage minimizes the use of equipment in farming and thus saves on fuel costs and minimizes disruption of the soil, which prevents erosion.



Jack Jones, pictured here at a 2004 field day at the Northeast Research Station in St. Joseph, is one of the pioneers in cotton research in the Louisiana Agricultural Experiment Station. Jones conducted cotton breeding work from the 1950s to 1990s. In the 1970s and 1980s, Jones released three varieties with unique narrow leaf shapes – Gumbo, Pronto and Gumbo 500. "They were released to control boll rot," Jones said. "These leaf shapes were similar to okra leaves and would open up the canopy and let the cotton dry out after rainfall events." Another significant cotton line released during Jones' tenure was Louisiana 887, which had resistance to root-knot nematode and Fusarium wilt. Even though it was released in 1990, this line would go on to be crossed with other popular varieties released over the next two decades, including transgenic varieties that have the Bollgard gene for insect resistance and the Roundup Ready gene for herbicide resistance.

Read a longer version of the cotton story on the magazine website at www.LSUAgCenter.com.

Research Soon Follows As Rice Growing Begins

Rice farming on a widespread commercial basis in Louisiana began in the late 19th century, and rice research soon followed.

Farmers who came to Louisiana from the Midwest were attracted to the warm climate, cheap land and the realization that rice could be grown with the same equipment and agricultural practices used for other grains. Besides the ample supply of flat ground, Louisiana also had something else needed for growing rice – water.

But it became obvious that new rice varieties had to be developed for the Gulf Coast, and the research effort began.

One of the first improved varieties was Blue Rose developed by Salmon “Sol” Wright, a Crowley area rice grower and entrepreneur

“Blue Rose was a dramatically improved variety over the then current varieties such as Japan and the old Carolina Gold that had been used for

almost 200 years,” said Steve Linscombe, director of the Rice Research Station.

In addition to the migration of farmers to Louisiana, many farmers already in Louisiana had turned to rice after sugar prices crashed in the 1800s. By the late 1800s, developers were advertising land for sale in southwest Louisiana, boasting of the area’s abundant water and mild climate. Acadia Parish, where the Rice Experiment Station would be located, became the leader in the rice industry with some of the best yields.

The 1890 crop was a record breaker at 80 million pounds, making Louisiana the No. 1 rice producing state, surpassing the former leader, South Carolina.

In the early 1900s, more Louisiana farmers switched to rice because of the damage caused by the boll weevil to their cotton crops. The U.S. Department of Agriculture established a substation for rice culture at Crowley in 1909.

The Louisiana Legislature appropri-

ated \$15,000 for maintenance during the next two years. A 60-horsepower gasoline engine to pump water was installed for \$2,500 in 1910. Research included testing of 300 rice varieties and studies of insects, irrigation and evaporation.

In 1949, the station bought 720 acres of land northeast of Crowley, the site of the current station. One of the important functions at the new location was to establish the Rice Research Station’s Foundation Seed Program to ensure a pure source of seed for rice farmers.

- The first disease-resistant rice variety, Saturn, was developed by Nelson Jodon at the Rice Research Station and released in 1964. He is considered a pioneer in the use of genetic markers for rice breeding.
- Milton “Chuck” Rush, plant pathologist, initiated a comprehensive fungicide testing program for rice in the 1970s and 1980s, demonstrating the potential for economically controlling fungal rice diseases. He identified and reported new rice diseases in Louisiana and the United States, including the causal agents of rice panicle blight.
- The practice of land-leveling was perfected at the station in the 1960s. This increased production efficiency.



This photo looks to be from the early 1900s, said Steve Linscombe, director of the Rice Research Station, because the wagons are being pulled by horses. The man standing on the right is placing shocks of rice, which had been drying in the field before they were loaded on the wagon, into the thresher. The rough rice is separated from the vegetation in the thresher and is being loaded into bags. Through another chute, the straw is piled to the side. This method for harvesting rice lasted until combines came along, which was after World War II.

Since then, the program has sold almost 200,000 pounds of seed.

In 1963, the station expanded by 320 acres with the South Farm, located two miles south of Crowley. Crawfish research, which takes place on the South Farm, began at the station in the 1970s and is the largest facility of its kind in the world. Eventually, the U.S. Department of Agriculture phased out its role at the station, now run entirely by the LSU AgCenter.

In 1972, Louisiana rice producers took the initiative to have more research done, forming the Louisiana Rice Research Board. Growers agreed to pay 3 cents for every 100 pounds of their rice crop sold at the mill to fund research projects. Louisiana rice growers approved increasing the assessment to 5 cents per cwt. in 1992. That program has generated more than \$30 million in research projects.

Any major insecticide or fungicide labeled for use in the southern United States was tested thoroughly at the station, including the herbicide propanil that allowed rice breeders to develop shorter rice less susceptible to falling over.

The varieties developed at the station during the past 15 years dominate the southern U.S. rice growing regions. Clearfield acreage could exceed 70 percent of rice grown in the south in 2012, Linscombe said.

In total, a century of rice breeding at the station has resulted in 49 varieties.

"We have close working relationships with rice stations all over the world," Linscombe said. The Rice Research Station obtains new breeding lines and germplasm from all over the world. In recent years, lines acquired from Chinese breeding programs have given a boost to the hybrid rice project at the station.

Rice is unique among commercial crops, Linscombe said, because many rice varieties are still developed through publicly funded research while other commodities, such as corn and soybeans, rely mostly on commercially produced varieties.

Research at the station has changed drastically, thanks to improvements in technology and knowledge. Linscombe said rice breeders 40 years ago would have chosen experimental lines from 4,000 rows a year. Now, breeders make

selections from more than 100,000 rows.

The use of DNA markers to determine if a line has desired characteristics has decreased the time required to develop a new variety. The use of a winter nursery in Puerto Rico also enables varieties to be available sooner, decreasing the time by several years.

■ **Bruce Schultz**

Read a longer version of the rice research story on the magazine website at www.LSUAgCenter.com.

The varieties developed at the station during the past 15 years dominate the southern U.S. rice growing regions.



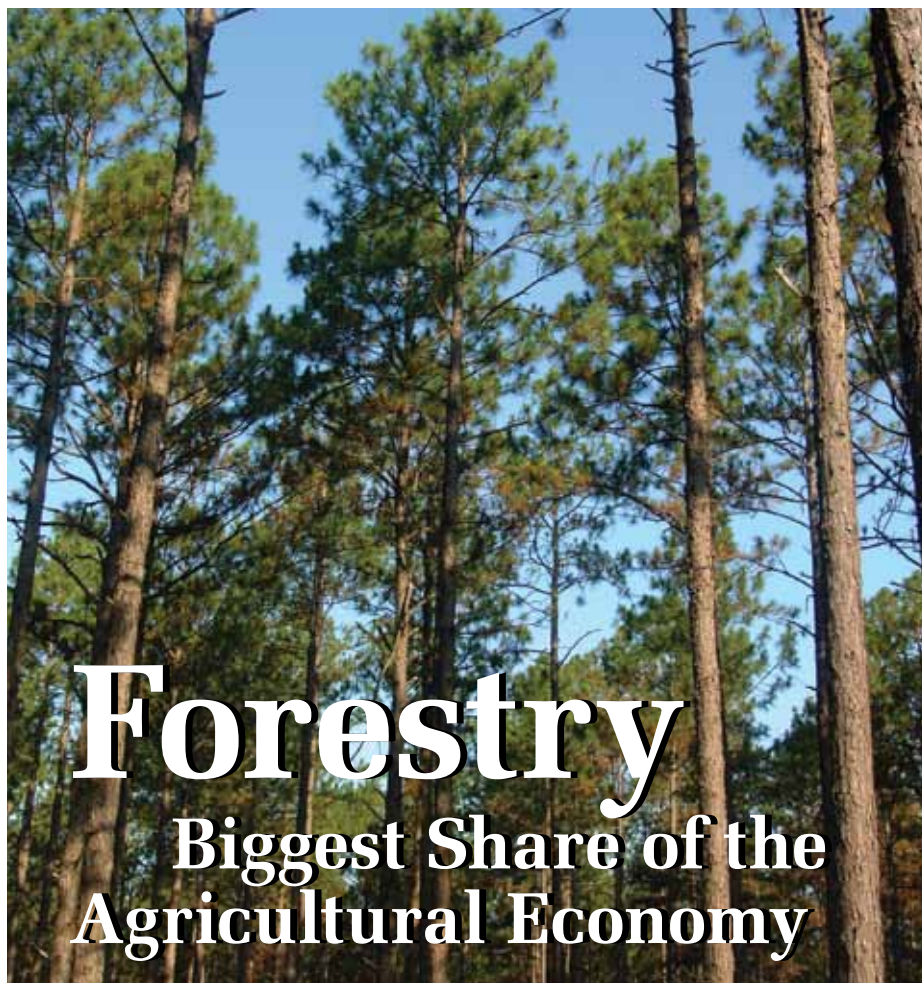
Eric Webster, weed scientist, developed timing and application rates for Newpath and Beyond herbicides for Clearfield rice in drill-seeded and water-planted rice. This knowledge has been vital to the success of this technology.



Clearfield technology, developed at the Rice Research Station in the late 1990s, resulted in rice varieties that enabled farmers to make considerable progress against the weed red rice. Clearfield rice is herbicide-resistant, so farmers can use herbicides to kill the red rice without harming the commercial rice. This technology allowed farmers to drill-seed rice into dry soil instead of water-seeding from the air, which is more expensive and can lead to more soil loss from fields.



Jazzman rice was developed by rice breeder Xueyan Sha using genetic markers that identified which genes are responsible for aromatic flavoring of rice. It was released in 2008 after 12 years of research. This was the first U.S.-adapted rice variety that is competitive with Thai jasmine aromatic rice. Jazzman 2, which has superior aromatic and quality characteristics, was released in 2010. Jazzman is marketed by several companies.



Forestry

Biggest Share of the Agricultural Economy

Southern pine forests are a major part of the Louisiana landscape, covering nearly one-third of the state's land. This abundant resource is the predominant source of timber for Louisiana's forestry industry, which provides the Louisiana economy with \$3 billion to \$5 billion per year and nearly 21,000 jobs.

Louisiana has not always had the plantations of southern pines. This is especially true for the hills of north central Louisiana. Before World War II, this area grew cotton and corn but struggled because of fertility and topographical issues. As the demand for housing increased after the war, much of this land was converted to timber through incentive programs provided by the federal government. Because of this increase in acreage, forest production has grown 800 percent from the levels of the late 1940s. This growth is partially due to research conducted at the Louisiana Agricultural Experiment Station.

Early research focused on growing timber efficiently. Thomas Hansbrough,

forestry researcher at the Hill Farm Research Station, studied the effects of planting density on the establishment of pine plantations. His findings indicated that a rate of 400-500 trees per acre yielded better results than the conventional wisdom of "plant 'em thick" of the time of more than 700 trees per acre.

In the 1960s, Robert Merrifield, forestry researcher at the Hill Farm Research Station, determined the optimum time for fertilizing loblolly pine. Hansbrough and Merrifield collaborated on pruning techniques and established that removing limbs lower than 16 feet resulted in wood relatively free of knots.

Rodney Foil, forestry researcher at the Hill Farm Research Station, focused on

In the 1990s, Joseph Chang, professor in the School of Renewable Natural Resources, developed the generalized Faustmann formula for even-aged management, which accurately estimates stumpage prices, stand volume, regeneration cost and annual income or expenses as well as the interest rate variation from one harvest rotation to the next. In the 2000s, the generalized Faustmann model was extended to uneven-aged management.

thinning practices as related to pulpwood. His recommendations of thinning trees when the diameter of the end of the log was 2 inches as opposed to the industry standard of 4 inches proved to enhance the growth of pine plantations. This earlier thinning proved beneficial to the trees because of reduced competition for light, nutrients and water at a crucial stage of development.

AgCenter research also examined coastal wetland forest stands and the benefits provided by them. Scientists found that cypress-tupelo stands in permanently flooded conditions or exposed to salinity failed to regenerate if harvested. These stands would convert to marsh or open water reducing the long-term sustainability of these forests.

New Directions

In 1993, the LSU AgCenter established the Forest Products Development Center in an effort to add value to the forestry industry through the use of wood in nontraditional ways. The center serves as an incubator of ideas of how wood products can be used as medicinal plants, in the energy sector and the role of recycled wood products.

Many wood products such as telephone poles and treated lumber possess chemical components. Hui Pan, assistant professor in the School of Renewable Natural Resources, is conducting research that would keep these chemicals from entering landfills. One process involves liquefying the wood to facilitate the removal of harmful chemicals such as chromated copper arsenate. The liquid wood can then be turned into other products such as biodegradable polyurethane foam that can be used to manufacture products such as spray foam insulation. ■ **Craig Gautreaux and Michael Blazier**

Read a longer version of the forestry story on the magazine website at www.LSUAgCenter.com.



In the 1960s, forestry researchers found dramatic increases in loblolly pine growth in response to fertilization at the time of planting and demonstrated that wood quality was improved by pruning limbs from the lower 16 feet of the tree, resulting in wood relatively free of knots. This is a newly planted loblolly pine plantation at the Hill Farm Research Station, 1960.



Wood samples were collected at the conclusion of a 48-year study on loblolly pine spacing and thinning schedules at the Hill Farm Research Station in 2007. In the late 1940s, a 50-year forestry project was begun at the station in Homer. This study had major implications on how pine plantations would be managed. Management techniques such as the number of trees planted per acre, fertilization timing, pruning techniques, thinning practices, spacing recommendations between trees and the herbicides used to manage competing vegetation would be altered.



Zhijun Liu, professor in the School of Renewable Natural Resources, is looking to the forest for a cancer cure. He examines medicinal properties in plants including sweet leaf tea. The leaves from the sweet leaf tea shrub have been found to contain an anti-angiogenic property, which means the compounds found in tea leaves prevent cancer tumors from receiving the nutrition they need to grow. Liu says the sweet leaf tea also possesses natural properties that prevent cancer from recurring. Liu said the leaves also show potential for relieving symptoms of diabetes and antibacterial effects.

- In the 1920s and 1930s, forestry research focused on production techniques that led to higher timber yields. Scientists found that forests could be managed and become sustainable and profitable in the southeastern United States.
- In the 1970s, forestry researchers compared planting loblolly pine seedlings to allowing forests to regenerate from seed of nonharvested trees, which was gaining some popularity at the time because of its lower cost. They showed that by the time trees reached harvest size, those planted from seedlings had greater yields and better tree uniformity than those established by natural seeding.
- Researchers in the 1970s worked on wood shrinkage and swelling of southern pine and hardwoods. This research led to the improvement of modern kiln drying operations, leading to more uniform lumber.
- Researchers developed internal-defect-based sawing optimization software (TOPSAW), which is designed to maximize the value of the lumber produced from a hardwood log. Studies in the 2000s showed that internal-defect-based sawing optimization could increase the value of hardwood lumber produced by more than 30 percent.



The development of wood composites has led to the use of wood in nontraditional applications. One such application is called TigerBullets developed by Qinglin Wu, professor in the School of Renewable Natural Resources. The product is made up of recycled plastic material and wood fibers and is used in oil drilling to plug cracks and fissures to reduce the loss of drilling fluids. TigerBullets is used by Exxon, BP and Chevron at more than 300 wells in 10 states. TigerBullets is manufactured in Columbia, La., and has provided an economic stimulus for rural Louisiana.

Food Science turns 50

In addition to celebrating 125 years of agricultural research since the Hatch Act of 1887, the LSU AgCenter is celebrating 50 years of the Department of Food Science, the only such department of its kind in higher education in Louisiana. In 1962, under the administration of LSU President Troy Middleton and College of Agriculture Dean Norman Efferson, a Department of Food Science and Technology was approved by the LSU Board of Supervisors.

The first research in this department targeted Louisiana seafood and aquaculture – blue crab, oyster, shrimp and crawfish. Various processing techniques that affected nutritional, chemical and sensory characteristics of seafood, rice, soybeans, peanuts, corn and sugar were also investigated. Research soon turned to food safety and finding uses for seafood and aquaculture processing wastes.

The department has continued to conduct research with a business application to help grow Louisiana's economy.

"Food scientists deal with food from the farm gate to the dinner plate," said John Finley, department head since 2007. "No food gets to you that hasn't been through a food scientist."

An emphasis has been development of healthier foods with reduced sodium, fat and cholesterol and increased fiber.

"We try to put healthful components in foods that people already enjoy eating," Finley said.

The scientists have tried to take advantage of waste byproducts from food processing and find new value for Louisiana commodities. For example, Subramaniam Sathivel, associate professor, has taken biodegradable material from catfish skin that contains a fish attractant for sport fishing, which has been licensed. He has also developed a cost-effective process to produce purified fish oils enriched with healthy fatty acids.

Joan King, professor, developed a process to increase resistant starch in rice and sweet potatoes and showed how functionality of sweet potato and rice starch can be altered with the addition of amino acids. She also discovered that lutein could be extracted more easily from corn.

Jack Losso, professor, has developed a bread enriched with fenugreek, a plant believed to have medicinal value. Clinical trials at the Pennington Biomedical Research Center have shown that consuming two slices of the bread increased insulin sensitivity in individuals with diabetes.

Witoon Prinyawiwatkul, professor, is developing salt substitute mixtures that will help reduce people's daily sodium intake. His work has shown that more than 35 percent of salt in the diet could be replaced with no-sodium salts in various food formulations without compromising sensory acceptability.

The food industry represents one of the most important areas for economic enhancement of Louisiana. A strong food science research program assists not only existing food processing facilities to remain competitive, but it encourages other industries to locate in the state.



In 1997, Louisiana dropped its mandatory retail warning sign requirement for raw oysters that underwent the AmeriPure Process.

Prinyawiwatkul and his international collaborators in Thailand, Mexico and Honduras are developing sensory methods appropriate for children. This is important because children and adults differ in their acceptance and preference of various food products.

Finley and a team have identified a bitterness blocking compound that can be used in a number of food applications without creating off flavor. For instance, it can be used to improve flavor of sport rehydration drinks, to remove the "beany" flavor of soy beverages without having to add a high level of sugar, and to spray on vegetables such as broccoli, Swiss chard and collard greens to mask the bitterness, thus making these products more appealing.

Zhimin Xu's research is focused on discovering, evaluating and using health promoting compounds in Louisiana agricultural products and byproducts. His work helps increase economic benefits from Louisiana commodities and their byproducts. Xu is an associate professor in the Department of Food Science.

The food industry represents one of the most important areas for economic enhancement of Louisiana. A strong food science research program assists not only existing food processing facilities to remain competitive, but it encourages other industries to locate in the state. ■ **Linda Foster Benedict and Witoon Prinyawiwatkul**

Read a longer version of the food science story on the magazine website at www.LSUAgCenter.com.



Jack Losso, professor, has taken the collagen from alligator carcasses and found uses for the cosmetic and food industries. He has a patent for collagen isolation from calcified tissue.



EX5 is a sports drink developed by H&B Beverages, a new company in Louisiana. The beverage uses technology developed by food science researchers to boost flavor and add more nutrients.



Marlene Janes, associate professor, heads up the area of food safety in the department. She and her team have developed rapid antibody-based methods for enumeration and detection of *Vibrio parahaemolyticus* and *Vibrio vulnificus* in seafood products. Another significant piece of Janes' work is the safety of cooked seafood consumption. Her research revealed that boiling shrimp and crab until they float will significantly reduce foodborne pathogens, and color change must not be used as an indicator to ensure the elimination of foodborne pathogens.

- Louisiana Agricultural Experiment Station food scientists published the first U.S. study examining the prevalence of methicillin-resistant *Staphylococcus aureus* in retail meats.
- Food scientists are leaders in developing a rapid molecular method using loop-mediated isothermal amplification to detect *E. coli* strains in food, which will help prevent widespread food poisoning.
- Food scientists have developed processes to increase resistant starch in rice and sweet potatoes, which adds value to these two commodities. Resistant starch is a type of starch that resists digestion and, thus, functions like fiber in the diet and can help prevent cancer and weight gain.



Douglas Park became department head in 1994. He and Sam Godber developed a heat and cold shock treatment to significantly reduce *Vibrio vulnificus* and *Vibrio parahaemolyticus* in Gulf Coast oysters to a nondetectable level safe for raw consumption. Oysters treated with this process have comparable flavor, aroma and texture to untreated samples, but need to be refrigerated to ensure continued safety and quality. This treatment, known as the AmeriPure Process, has been the crowning achievement of research in the department.



Keeping Louisiana a Sportsman's Paradise

Louisiana has long been known as a Sportsman's Paradise. Its many bayous, swamps and coastal marshes provide excellent fishing and wildlife viewing opportunities. Upland and bottomland forests afford hunters of all ages the chance to harvest small-game animals such as squirrels and rabbits and allow big-game hunters the prospect of taking a trophy deer or turkey.

To continue these recreational and commercial opportunities, management decisions must be made regarding the harvest of recreational and commercial species and maintaining and preserving the habitat necessary to support these animals. These important decisions involve research from the Louisiana Agricultural Experiment Station through the School of Renewable Natural Resources.

Importance of Water

Michael Kaller, a researcher specializing in fish and stream ecology, is looking at ways to best preserve Louisiana's water resource. "We are at the bottom of the hill. We need to make informed decisions about how much we need to support our ecosystems and our economic activities as well as what we could part with if the economic opportunity was there," Kaller said. He cited the discussions of the sale of Toledo Bend water as a prime example of how water resource management will be a major issue in the future.

At nearly 600,000 acres, the Atchafalaya Basin is the nation's largest bottomland swamp. Because of its abundance of natural resources including fish, wildlife and oil and gas, it is a center of commercial and recreational activity for the state. The interaction of humans within the system has led to some problems.

One problem is dealing with the flow of water through the basin. Many human-made canals and levees have disrupted the natural north-south water flow. When the spring floods come, water overtops these levees but is trapped behind them. Eventually, this water becomes devoid of oxygen, but

it is reintroduced to the system when water levels drop, pulling the water into the system, thereby reducing water quality throughout the basin.

"The idea is to breach or notch levees that inhibit the natural north to south water flow. We want to notch the levees so that the water comes out," Kaller said. The notching of the levees has been occurring for nearly 10 years, and AgCenter scientists have been studying the effects. Kaller cites the Grand Lake area as a prime example where a more natural north-south flow contributes to better water quality than areas like the Bayou Sorrel area that has many east-west running canals.

Invasive Species

A recent phenomenon that may have a major influence on the future of hydrologic ecosystems relates to invasive species such as giant salvinia, Asian carp and feral hogs.

Salvinia, an invasive aquatic weed from South America, has the ability to overtake water bodies and other native aquatic vegetation, turning these water bodies into a liquid desert. A ripple effect would make these places unsuitable for migrating waterfowl. Kaller said the AgCenter has experts in many disciplines, and they are capable of tackling complex issues from many different approaches. For salvinia, researchers are looking at solutions from multiple approaches including chemical and biological control.

Asian carp consist of two species, the bighead and silver. Originally imported to the United States for use in wastewater treatment lagoons in the 1970s, Asian carp escaped and are found in 23 states, primarily in the Missouri and Mississippi river watersheds.

Asian carp can reach high population density numbers and crowd out native fish populations. They are also a safety hazard because silver carp have a tendency to jump when startled leading



Wildlife research by Robert Chabrek, a wetlands ecologist in the 1970s through the 1990s, focused on the coastal plains environment and the interaction between both plants and animals. The vegetative maps developed by Chabrek and his survey methodology techniques laid the groundwork for future studies.

to either injury to unsuspecting boaters or property damage.

Eradication of carp is not practical because of their widespread establishment. AgCenter researchers indicate that commercial fishing along with implementing management strategies to control their populations appears to be the most feasible approach.

Feral hogs have been in Louisiana for decades, but their environmental impact has escalated. Their increasing numbers harm crops, wildlife and livestock. Hogs have damaged rice, grain sorghum and sweet potatoes. They have destroyed shrub nesting bird nests and consumed young turkeys and deer fawns.

Feral hogs also carry several diseases that are threats to both humans and livestock. Some of the diseases include brucellosis, trichinosis and E. coli-related illnesses. Most human infections attributed to feral hogs happen during the cleaning of the animals. Wildlife and livestock infections happen when these animals venture into areas in which hogs have been feeding or watering.

AgCenter scientists have determined that feral hogs can contribute negatively to water quality. Researchers have found that hogs introduce harmful bacteria and reduce beneficial aquatic insects and mussels in upland streams. The damage to upland streams means impaired water is being carried downstream into coastal ecosystems, which are already suffering from saltwater intrusion and nutrient deficiencies.

The Future

Researchers are continuing to look for ways to improve wildlife and the environment. The recent BP oil spill has scientists within the school looking for less toxic dispersants that will be available for future spills. Louisiana's ongoing battle with coastal erosion has researchers looking at the impact of vegetative strips or terracing on the coastal environment.

Keeping Louisiana a Sportsman's Paradise requires diligent research not only in Louisiana but in areas across the continent. Scientists within the School of Renewable Natural Resources are making sure that the opportunity to work and play in Louisiana's outdoor environment continues to contribute to its rich heritage. ■ **Craig Gautreaux**



Over the past 120 years, many individuals have released aquatic plants into state and private waters in Louisiana with the best of intentions, only to find out that the seemingly innocuous and often attractive plants have completely upset the ecology of the receiving water bodies. Giant salvinia is one of these plants. It continues to clog Louisiana's waterways, making them unsuitable for recreation. The LSU AgCenter is finding success in reducing the invasive species through a combination of chemical and biological control. Biological control has been achieved through the importing of a black weevil from South America, which is a natural predator of giant salvinia, also from South America.



The tiny weevil, the black dot in the photo, is capable of slaying giant salvinia and clearing waterways. The method for doing this was developed by LSU AgCenter researchers Dearth Sanders, a weed scientist, and Seth Johnson, an entomologist. Nearly 3 million weevils have been released in more than 40 locations statewide.



LSU AgCenter researchers have used the knowledge gained from their reproductive biology work with cattle to improve the genetics of deer. Researchers developed the protocols for successful artificial insemination of white-tailed deer. This process increases the ability to extract valued genetic material from wild populations of white-tailed deer, such as the buck in the photo, which was killed in Illinois, for either improved animal development programs or to determine if poor genetics are responsible for undesirable characteristics in wild herds.



Bass fishing in Louisiana is a multi-million dollar business. LSU AgCenter researchers help ensure improved genetics to sustain largemouth bass. Brett Miller, graduate student in the School of Renewable Natural Resources, holds a largemouth bass from East Grand Lake.

- Bill Herke, a fisheries researcher, studied fish passage through human-made water control structures such as weirs and locks in the 1960s and 1970s. His work was the basis for federal policy in the Gulf of Mexico region and aspects of his work remain in effect today.
- Frankie Rohwer, avian ecologist, developed a large-scale area control method to dramatically improve the duck nesting success rate in the northern plains of the United States and Canada. Because of migration habits, this helps ensure Louisiana remains a top duck hunting destination.

Read a longer version of the wildlife and fisheries story in the online version of Louisiana Agriculture magazine at www.LSUAgCenter.com.

Sweet Potato

Louisiana's Most Popular Vegetable



During the 1920s and 1930s, consumers became increasingly aware of the nutritional qualities of sweet potatoes. In the 1930s, the Louisiana Agricultural Experiment Station released the Unit 1 Porto Rico, developed by Julian C. Miller. This new variety – which had an attractive skin and a moist, orange flesh high in vitamin A content – catapulted Louisiana into a national and international marketing campaign. Sweet potatoes were marketed with attractive labels for the crates, such as this one for Bayou Maid.

The sweet potato, which has grown to be Louisiana's most popular vegetable, had its beginnings as a commercial crop in the early 1900s, when commercial sweet potato districts in the United States were developed along geographic lines to serve local needs. The first commercial sweet potato district in Louisiana originated near Sunset in St. Landry Parish around 1910.

Popularity of sweet potatoes soared during the years following the Great Depression. Sweet potatoes were considered a subsistence crop during this time and were grown not only commercially but in home gardens. Inputs such as fertilizer were rarely used because of costs, thus yields realized in many cases were marginal. Acreage in Louisiana peaked in 1935 at 123,000 acres. During that same year, U.S. acreage approached 1 million acres. Over the next several decades, sweet potato acreage decreased, transitioning into a specialty crop industry. Louisiana acreage has averaged

about 14,000 over the past five years, while acreage in the United States in 2011 approached 134,000.

The development of today's high-yielding, delicious sweet potato varieties began in Louisiana more than 70 years ago. Julian C. Miller and others at the Louisiana Agricultural Experiment Station discovered how to induce flowering and seed set by trellising sweet potato vines onto fences. They found that this straightforward technique stressed the plant and caused it to flower. This created a world of opportunity to develop new varieties for the industry by genetic recombination. A fast-paced effort ensued to collect sweet potato varieties from throughout the world and to make as many crosses between them as possible. Many of the varieties resisted flowering, and just a handful of seed was produced. Ever so slowly, however, new varieties arose to replace the varieties from the Caribbean, which had little or no disease resistance, poor and erratic yield, and a muted orange flesh.

In the late 1980s, disease and pests had so dismantled sweet potato crops in Louisiana that the industry faced extinction. Larry Rolston, an entomologist, worked diligently to create a sweet potato with insect resistance. The product of his labors, which he named Beauregard after the Civil War general

The development of today's high-yielding, delicious sweet potato varieties began in Louisiana more than 70 years ago.

from Louisiana, P.G.T. Beauregard, was released in 1987. Its beauty and sweet taste made it so popular that it saved Louisiana's sweet potato industry. It was widely adopted throughout the U.S. industry. Because of its resistance to *Streptomyces* soil rot, this disease has diminished to a minor problem.



Sweet potatoes are one of the most profitable crops to grow in Louisiana, but production is highly labor-intensive. Agricultural engineers in the Louisiana Agricultural Experiment Station have been instrumental in developing improved mechanization for planting and harvesting.

Entomologists have conducted research on how insects affect sweet potatoes and have developed management strategies for these insects. Soil insects such as the sweetpotato weevil, white grubs, cucumber beetles, wireworms and the sugarcane beetle have all threatened the industry. Many of these insects, such as the sweetpotato weevil, are now effectively managed.

LSU AgCenter scientists also develop strategies for controlling weeds in sweet potato production. They screen and evaluate herbicides, giving producers the tools they need to manage many problematic weed species.



Larry Rolston, an entomologist, at left, developed the Beauregard sweet potato in his quest to find sweet potatoes with insect resistance. He and Don La Bonte, center, and Chris Clark are sorting through sweet potato plants in this photo from 1988.

The Sweet Potato Research Station focuses on foundation seed production, improving production efficiency, sweet potato breeding, pest management and understanding more about viruses and diseases that limit productivity. In 2009, the LSU AgCenter along with Mississippi State University, North Carolina State University and University of California at Davis received a \$2.8 million grant from the U.S. Department of Agriculture Specialty Crop Research Initiative program, which focuses on improving production efficiency and quality in the sweet potato production system.

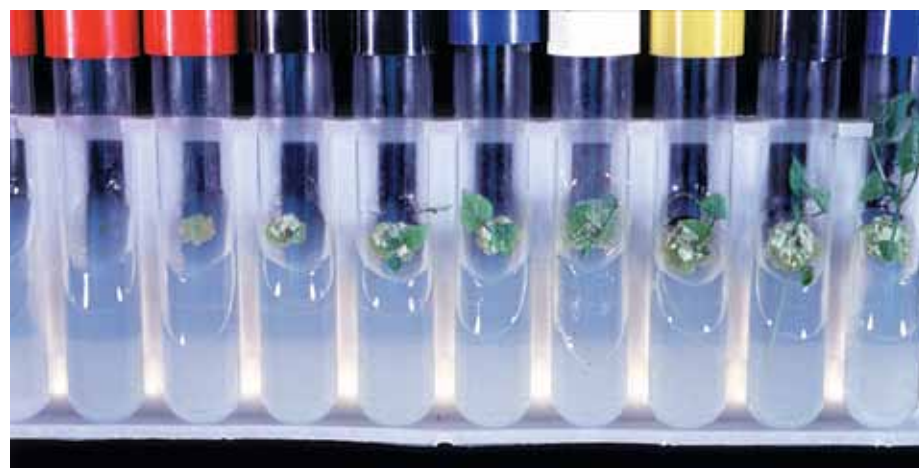
- In 1948, Julian C. Miller brought to fruition his idea of a separate research station just for sweet potato research. The 308-acre Sweet Potato Research Station was established in Chase, La., through a direct appropriation of the Louisiana Legislature. It is the only station devoted solely to the sweet potato in the United States.
- In the late 1940s and 1950s, Wes Martin advanced the understanding of sweet potato diseases. He was the first to discover the causal organisms associated with soil rot – a disease that almost decimated the U.S. sweet potato industry – and circular spot. In addition, he was a key member of the team of plant pathologists who identified the cause of bacterial soft rot. Martin actively cooperated with the sweet potato breeding program and developed methods to screen for disease resistance still used today.

An increasingly health-conscious public, combined with value-added product diversity, have brought the once lowly sweet potato to a respected and reserved place on everyday menus. The Louisiana sweet potato industry has experienced both prosperous and trying times throughout its history. Weather-related disasters, insect outbreaks, disease issues, struggling markets and variety decline have all threatened the integrity of the industry at various times in the past. However, the industry has always prevailed, sustained by the research and outreach efforts of the LSU AgCenter. ■ **Donald R. La Bonte and Tara P. Smith**

Read a longer version of the sweet potato story on the magazine website at www.LSUAgCenter.com.



In 2010, ConAgra's Lamb Weston division began operation of its sweet potato processing plant near Delhi, La. One of the principle reasons the company chose Louisiana for the facility was the ready access to the research conducted at the Sweet Potato Research Station in Chase, La. Tara Smith is the resident coordinator of that station and an extension sweet potato specialist. Company officials were impressed with the excellent working relationship between the LSU AgCenter and the Louisiana sweet potato growers. The facility produces frozen sweet potato fries.



The LSU AgCenter sweet potato foundation seed program, which began in 1949, has long served the Louisiana sweet potato industry by providing high-quality seed to commercial producers. In 1999, the foundation seed program was converted to a virus-tested program. Virus-tested tissue culture plants are produced by a process termed meristem-tip culture. Viruses can reduce sweet potato yields by 25 percent to 40 percent.

Dairy Research Made a Difference

Louisiana's dairy industry has experienced a decrease in both number of farms and number of cows in recent years. In 2010, there were 145 dairy operations and approximately 16,050 dairy cows in Louisiana. Only 10 years before, there had been 434 dairy farms and 54,640 cows in Louisiana. In 1981, there were 995 dairies and 107,000 cows.

Despite the declining dairy industry, Louisiana Agricultural Experiment Station research in dairy science, both in dairy foods technology and dairy production, has contributed greatly to the success of the dairy industry in Louisiana.

Dairy research has been conducted by scientists in three locations during the history of the Experiment Station. A Department of Dairy Science was established in 1949 and existed until it was folded into the School of Animal Sciences in 2009. Dairy scientists made numerous contributions to both the dairy foods and production areas. They have contributed to improvements in nutrition, genetics, reproductive physiology and calf growth and development. The research in dairy production has enabled producers to improve efficiency of production, which has led to more milk per cow during the past 20 years.

In addition to the research efforts in dairy science on the Baton Rouge campus, research at the Southeast Research Station near Franklinton, which was established in 1944, has contributed to improved dairy management in the areas of nutrition, waste management and agronomy.



Milk production in Louisiana doubled between 1950 and 1975, in part because of the research of the Louisiana Agricultural Experiment Station. Two of the pioneers in dairy research, pictured in about 1950 at the Southeast Research Station, were Billy Nelson, at left, and H. Dewitt Ellzey. Nelson went on to become the first director of the Forage Quality Laboratory at the station, which provided dairy and beef cattle producers with quick and accurate analysis to optimize production. Ellzey's research helped identify improved forage varieties, especially for annual ryegrass.

In addition to the research capabilities, the Southeast Research Station houses the LSU AgCenter Forage Quality Lab, where producers can submit samples for nutrient analysis of their feedstuffs. The forage quality and nutrient management research is extremely important not only for helping dairy producers improve milk production but also in minimizing nutrient runoff into the environment.

Environmental impact of agriculture production continues to be of concern. The contributions of LSU AgCenter dairy scientists have made a big difference not only in Louisiana but in other areas of the country as well.

While tremendous contributions have been made in nutrition, reproduction, genetics and calf management by LSU AgCenter dairy research scientists, another major component of dairy research has been conducted at the Hill Farm Research Station in Homer, La. The Hill Farm was established in 1946, but mastitis research did not begin until 1960 under the leadership of station director Nelson Philpot.

Since its beginning, research in dairy cattle mastitis has gained recognition not only in Louisiana, but nationally and internationally as well. In 1968, the Mastitis Laboratory was established and further expanded in 1985. This laboratory not only enhanced the research capabilities of the scientists but also provided dairy producers with a means of improving herd management through identification of mastitis-causing organisms.

Mastitis research conducted during the past 42 years has been conducted by four AgCenter scientists: Nelson Philpot, J.W. Pankey, Steve Nickerson and Bill Owens. Areas of research have included causes, prevention and treatment of this costly disease. The research efforts have also identified a problem with first-calf heifers and their susceptibility to mastitis prior to their first lactation, and thus management strategies for prevention have been identified. Now producers nationwide are using these management practices to improve animal health in their herds. ■ **Johnny Morgan, Mike McCormick and Cathy Williams**



The LSU AgCenter operates model dairy farms on the campus in Baton Rouge and at the Southeast Research Station.



Development of dairy waste lagoon systems by Jim Beatty and Vinicius Moreira greatly reduced the dairy industry contribution to point-source pollution and assisted in vastly improving water quality of waterways in the Florida Parishes, which ultimately assisted in returning Lake Pontchartrain to a body of water suitable for recreation and commercial fishing as well as swimming. Above is a "floating island" that was grown in the lagoon at the Southeast Research Station. The plants use nutrients from the waste to grow.



More than a third of the dairy producers in Louisiana and Mississippi have adopted the bale silage system, which was evaluated and adapted by Mike McCormick, at right telling farmers about the system at a field day at the Southeast Research Station. Bale silage has a higher nutritive value than hay because of seasonal poor hay drying conditions.



Dairy farms were thriving in northwest Louisiana in 1960, but problems with mastitis threatened to destroy the industry. A mastitis laboratory was established at the Hill Farm Research Station in 1968. Scientists there tackled the problem and were able to get it under control, which saved the industry in the state. When mycoplasma mastitis, a highly contagious form of the disease, was first detected in Louisiana in 2002, Bill Owens, above, developed a testing system that, once again, saved the Louisiana dairy industry.

- Research in the 1950s by H. Dewitt Ellzey and Buck Green conducted at the Southeast Louisiana Experiment Station found that dairy heifers at eight weeks could be raised on high-quality pasture without milk, grain, hay or silage.
- Lee Mason, who was at the Southeast Research Station from 1976-1988, developed a no-till corn production system on the highly erodible soils in the Florida Parish dairying area.
- Billy Nelson developed the Near Infrared Spectroscopy for Rapid Feedstuff Nutritive Value Analysis (NIR) and related equations necessary for rapid forage analysis. The system allows dairy and beef cattle producers to make quick and accurate ration adjustments to optimize milk and beef production. This system remains the backbone of forage analysis.

Invasive Fire Ants and Termites Spur Research

Because invasive, non-native plants and animals can cause havoc, Louisiana Agricultural Experiment Station scientists conduct research programs to bring these problems under control. Two that present particular challenges – especially in urban areas – are red imported fire ants and Formosan subterranean termites.

Red imported fire ants

Red imported fire ants have troubled people, pets and livestock since their introduction into the United States in the 1930s. They were accidentally brought here from South America, where they are held in check by competing organisms and environmental factors. That's not the case in the United States.

In Louisiana, entomologist L.D. Newsom and others raised the issue of ineffectiveness and environmental consequences of wide-area application of heptachlor in the 1950s. LSU AgCenter scientists began research efforts on fire ant control in urban areas in 1999. Their focus was the use of baits that have low doses of insecticides. In the case of ants, workers find the bait and carry it back to the colony, where it is fed to the larvae, other workers and queens, thus killing the colony.

A new research focus is biological control with natural enemies. One of these is the phorid fly. These tiny flies, which are less than 1.5 millimeters in length, are known as decapitating flies. They attack fire ants exclusively. The female fly lays a single egg in the thorax of a worker ant. When the egg hatches, the maggot moves into the head and consumes the contents, causing the head to fall off.

The first successful release of the phorid fly in the United States was by the U.S. Department of Agriculture

in Florida in 1997. The first successful release by LSU AgCenter scientists was in 1999 followed by releases around the state from 1999-2006. All the releases were in pastures. In a follow-up study in 2009, AgCenter scientists found one of the two types of phorid flies released remaining in 46 out of 64 parishes and the other type still surviving in 57 of the 64 parishes. It is expected that the reduction in fire ant populations will help mitigate their negative effects on humans, livestock and wildlife.

Despite the problems they cause, fire ants also provide numerous benefits as predators of agricultural pests. For exam-



At top are females of three of the four phorids released in Louisiana. The phorid is a natural enemy of the red imported fire ant, below. Early efforts to eradicate fire ants with chemical control were met with limited success. Louisiana Agricultural Experiment Station scientists have studied alternative methods of control, including biological control with the phorid fly.

ple, researchers have documented a major decline in tick populations as fire ant numbers have increased. The researchers found that dragging pastures with a metal harrow during winter significantly reduced the number and size of fire ant mounds for up to 15 months. The result was fewer fire ant problems in cattle while at the same time maintaining ant populations that countered the ticks.

Red imported fire ants are a natural deterrent to the sugarcane borer in sugarcane fields and help hold down the numbers of these pests, which can cause yield losses for sugarcane farmers. New research is showing that these ants are also a natural enemy of the Mexican rice borer, which is a new invasive species in Louisiana threatening both sugarcane and rice.

A recent AgCenter study shows that fire ants trapped under water escape by lifting themselves to the water surface using bubbles collected at the water's bottom. Fire ants have hairs that naturally hold air the researchers call "native bubbles" – smaller than the bubbles in a glass of champagne – that give them buoyancy. The study showed the ants have developed a defense mechanism by gathering together and intertwining themselves into floating conglomerations the researchers call "rafts." A raft is made up of worker ants that surround the queens and brood – eggs and larvae. While the brood holds bubbles, worker ants rotate through the raft keeping it in motion so it won't sink.

Formosan subterranean termites

Another invasive species that has been the target of Louisiana Agricultural Experiment Station research is the Formosan subterranean termite. Introduced to the United States in the 1940s in military equipment coming back into the country from the South Pacific following World War II, Formosan subterranean termites have had devastating effects in New Orleans, Lake Charles, Baton Rouge and Monroe.

AgCenter entomologist Bill Spink recorded the first Formosan subterranean termite infestation in the continental United States in a Texas shipyard in 1965. The next year he discovered large infestations around the Naval Training Center, Todd Shipyard and Camp Leroy Johnson in New Orleans.

In 1989, AgCenter entomologist Jeffery LaFage oversaw the first collection of swarming, winged termites – alates – in the French Quarter, finding an average of 502 adult insects per trap. LaFage was killed in a French Quarter robbery in July 1989, only months after that first survey was completed.

Ten years after LaFage's death, a termite control program was initiated in the French Quarter called Operation Full Stop. The LSU AgCenter worked with two other agencies to implement this program – the U.S. Department of Agriculture and the New Orleans Mosquito and Termite Control Board. The program began in a 16-block section and expanded into a wider area before it was curtailed because of a loss of funding in 2011.

Inspections of properties in 2003 found 26 percent of the buildings were infested with live termites, and inspections in 2005 showed 5 percent of the buildings infested.

Formosan subterranean termites expand their territories by producing winged “alates” that swarm each spring. Alate numbers were sampled using sticky traps placed on light poles. In-ground monitoring stations were installed in holes drilled through the sidewalks throughout the French Quarter. Using genetic analyses, researchers have shown the number of mature colonies has been reduced. DNA profiling identifies hereditary factors visible as a specific banding pattern – or fingerprint – of each individual and each colony. Using this information, researchers showed that the number of colonies contributing to swarms caught in traps dropped from an average of 13 in 2003 to seven in 2007 and only two per trap in 2008.

Although termites feed on wood and other cellulose products, they depend on bacteria in their digestive tracts, or gut, to digest the wood fibers and get the nutrients they need. AgCenter researchers have come up with a way of transferring genetically modified bacteria into termite populations. The researchers want to engineer bacteria found exclusively in the termites' gut to produce substances toxic only to Formosan subterranean termites, which don't have natural enemies in the United States. Bacteria naturally multiply as they're passed around a colony. Like a “Trojan horse,” the bacteria can intro-

duce and spread a killer gene throughout a termite colony.

AgCenter scientists have studied toxicants that do not repel termites. These nonrepellent toxicants act like baits, but the transfer is through touching rather than feeding. Contact toxicants can be more effective than baits because termites spend more time grooming each other than feeding each other.

The potential of vetiver grass as a termiticide was identified by a nursery and greenhouse operator in Metairie. The operator thought he might be on to something when he noticed a lack of

bugs in greenhouses where he was growing vetiver. He took his idea to the LSU AgCenter. AgCenter scientists extracted oils from the roots and discovered they contain a chemical called nootkatone, which is both a repellent and toxic to termites. A study to evaluate nootkatone showed that a 25 percent vetiver-root mulch treatment decreased tunneling activity and wood consumption and increased termite mortality. ■

Rick Bogren and Linda Foster Benedict

Read a longer version about entomology research on the magazine website at www.LSUAgCenter.com.



Claudia Husseneder's research involves the biological control of termites by using enhanced microbes delivered through yeast and cellulose powder bait. She calls the yeast a “Trojan horse” because the control agent is hidden within the yeast, which is not recognized as a threat by the termites, and is rapidly ingested and transferred to other termites in the colony to produce toxins and spread them throughout the termite colonies.



Among the studies conducted by LSU AgCenter entomologists to help control Formosan subterranean termites in New Orleans was a five-year study (1993-1998) in conjunction with a utility company to find ways of preventing the destruction of utility equipment by the termites. The termite will eat through anything in pursuit of cellulose, the major constituent in wood, even the polyvinyl chloride casings of telephone cables. The scientists devised a bait system, which proved effective. This photo is from 1999. Gregg Henderson, left, was the lead scientist, and Chris Dunaway was the research associate.



Entomologists developed a simple, inexpensive pop-up signal device, which was first licensed in 2003, that can be adapted to fit almost all commercially available monitors or bait stations. These bait stations intercept termites by luring them with foods and causing them to carry toxin-laced baits back to their nests where they feed other members of the colony.

Soybean and Feed Grain

Research Pays Dividends

Soybeans

The soybean has not only been responsible for improving Louisiana farmers' profit margin as a crop but has also been instrumental in improving soils for the production of other crops.

John Mitchell Jenkins, who was superintendent of the Rice Experiment Station – now the Rice Research Station – from 1917 to 1946, concluded that growing soybeans in rotation with rice improves the lands of southwestern Louisiana and increases the productivity and quality of rice.

Before 1957, approximately half of Louisiana's soybean acreage was grown for crushing for its oil content. LSU AgCenter agronomy professor John Gray's release of the Pelican soybean variety was the beginning of varieties good for forage and for crushing. One of the most outstanding strains of the Pelican 2x Ogden parentage was named the Bienville. It was released for 1958 planting. This variety averaged 40 bushels of seed per acre, which is only three bushels less than the state average for 2010.

Soybean acreage in Louisiana increased more than fourfold after 1960. Acreage planted in 1960 amounted to 216,000 acres, compared with estimated plantings of more than 900,000 acres in 1966. By the mid 1970s, acreage topped 3 million.

As the production of soybeans increased so did the yield-limiting problems of pests and soil fertility. From the record highs in the 1970s, soybean acreage dropped to a low of 640,000 acres in 2001.

Weed scientists have played a critical role in production success of soybeans in Louisiana. Now, the concern is how to effectively deal with herbicide-resistant weeds in soybeans. Research has shown that an extensive and effective post-emergence weed control program is essential for soybean production on most Louisiana farms. When planning a soybean weed management program

either in the absence or presence of herbicide-resistant weeds, it is imperative that multiple herbicides with different modes of action be used. Research shows that applying a combination of soil-residual herbicides at planting followed by a timely post-emergent application of glyphosate along with other herbicides can provide season-long weed control.

Corn

Corn is the most widely grown feed grain in Louisiana. It is believed that corn became a cultivated crop in Louisiana when the Spanish provided seed to the early Acadian immigrants, who became ranchers on the prairie lands of southwest Louisiana.

With a need to provide feed for their cattle, farmers needed better ways to grow corn. An intensive corn breeding project was carried on by the Louisiana Agricultural Experiment Station during the early to mid-20th century.



This photo of an early Louisiana Corn Club member was taken in the early 1900s. The Corn Club was the forerunner of 4-H, and it was started in Louisiana in 1908. Agricultural pioneer Seaman A. Knapp came up with the concept. Under the direction of agricultural researchers and county agents, youth would plant small sections of crops using innovative and progressive techniques. Their successes caught the attention of their parents, which helped persuade skeptical farmers to accept science-based recommendations.



In the late 1950s, agronomist Lee Mason said though corn had never been a major cash crop in Louisiana, "it has always occupied a considerable acreage in almost every section of the state. Until a few years ago practically all the corn produced was utilized as feed on the farm. The on-the-farm need for corn decreased as tractors gradually replaced mules."

In 1962, scientists at the Red River Research Station conducted a fertilizer rate and plant population study to determine the optimum fertilizer rate and plant population for maximum yields, the degree of response from the use of phosphorus and potassium, and the effect of the treatment on lodging. Corn yields increased in two of five years from plots receiving phosphorus. The response to potassium was erratic, and there were no significant effects on the degree of lodging from either inputs of fertilizer or plant population.

From 1992-2001, agronomist Rick Mascagni worked in corn hybrid performance testing and recommended varieties to growers.

Beginning in 2003, plant breeder Steve Moore, now retired, conducted experiments on 1,600 corn lines in his quest to reduce aflatoxin, a deadly toxin that develops in heat- and drought-stressed corn. Working at the Dean Lee Research Station near Alexandria, Moore said this toxin is the most potent natural carcinogen found in nature.

Ken Damann, plant pathologist, and others are focusing on three different technologies to reduce aflatoxin contamination in corn – breeding programs to develop resistant lines, chemical control and genetic control.

Wheat and Oats

There was a span of 58 years between the release of the Camellia oat variety in 1940 and the next Louisiana small grain variety release, the Secretariat LA495 oat, in 1998. Most of the wheat and oat research conducted in the Louisiana Agricultural Experiment Station between 1940 and 1985 focused on statewide variety trials and cultural and production practices for wheat.

Agronomist Ken Tipton's statewide oat variety research in 1967-69 showed that no real difference in grain yield was found from north to south Louisiana.

Grain Sorghum (Milo) and Millet

In the late 1980s, Dan F. Clower conducted research with grain sorghum and found that as production increased, certain species of insects attacked this crop. He studied these pests to develop practical and economical control measures.

Millet and sorghum are still some-



Agronomist Steve Harrison established breeding programs for wheat and oats during the 1980s. Since then, five oat and five wheat varieties have been developed for Louisiana producers.

Because of the alertness of plant pathologist Ray Schneider, Asian soybean rust was found in a soybean field at an AgCenter research station in 2004. This was the first discovery of this disease in North America – a disease that had caused devastation to soybean fields in other parts of the world, including South America and Asia. Since the discovery, research has been conducted to monitor and minimize damage from the disease. In addition, LSU AgCenter scientists also cooperate in an aggressive nationwide monitoring program for Asian soybean rust.

what smaller acreage crops but still have a place in Louisiana agricultural production. In the 1950s, H. DeWitt Ellzey and T.E. Davis studied green feeding pearl millet to dairy cows in three grazing systems – rotation-grazed, strip-grazed and green-fed or zero-grazed. Their findings showed that from a practical standpoint, rotation grazing was the best of the three methods.

From 1978-80, H.P. Viator and J.G. Marshall compared yields in a double-cropping system of wheat and sorghum. They looked at differences between no-till and conventional till, burned stubble and nonburned stubble and 20- and 40-inch row spacing. They found that conventional tillage yields were



Soybeans are being loaded onto a ship at the Port of Baton Rouge. Soybeans are grown on more acres in Louisiana than any other crop. Acreage is holding steady at about 1 million.

higher during years of adequate rainfall, but no-till yields were much higher in the dry year of 1980. They also found that burning wheat stubble resulted in higher weed populations. And finally, rows 20 inches wide had higher yields and more effective weed control because of shading. ■ **Johnny Morgan**

Cattle Raising Required Research

Cattle research in Louisiana has a long and storied past, and it's only fitting since some of the first Brahman cattle brought to the United States ended up in Louisiana.

In 1854, the British government presented two Brahman bulls to sugar and cotton farmer Richard Barrow of St. Francisville, who had helped teach cotton and sugarcane production to British officials establishing those crops in India. The Barrow cattle would achieve recognition, and their fame would soon spread around the globe. As early as 1860, Brahman cattle that probably originated from the Barrow cattle were shipped to Texas.

David Morrison, retired LSU AgCenter assistant vice chancellor for animal research, said Louisiana Agricultural Experiment Station scientists helped Louisiana lead the rest of the nation with crossbreeding and cattle

genetics. The focus was and continues to be adaptability of cattle to Louisiana's harsh summers and heavy insect pressure, followed by beef tenderness.

The Brangus breed was developed around 1932 from Angus and Brahman cattle by U.S. Department of Agriculture scientists at the Livestock Experiment Farm, later to become the Iberia Research Station in Jeanerette. Brangus cattle are 3/8 Brahman and 5/8 Angus. After the USDA work, a group of individuals used the data and produced the commercial line of the Brangus breed. From that combination, several others were developed including Braford, Santa Gertrudis and Beefmaster.

Morrison said the LSU AgCenter has made huge contributions to the field of assisted reproductive technology. Beginning in the 1970s, animal scientist Robert Godke led efforts in reproductive biology that resulted in groundbreaking

research on embryo transfers, enabling owners of high quality cows to obtain several calves from the same mother.

The work of John Chandler enabled cattle producers to get a better idea if their bulls are more likely to sire male or female calves.

In the field of cattle nutrition, the LSU AgCenter has had a significant impact on forages and grazing management, Morrison said.

Doyle Chambers, LSU AgCenter animal breeder, showed it is possible to produce cattle year-round on forages, using cool-season annuals and warm-season perennials.

Morrison said he was part of a team that worked on a body condition scoring system to help determine if cows are healthy enough for breeding.

Cattle research is expensive because large numbers of cattle are needed to obtain results and because cows are only able to have one calf per year. Multiple locations are necessary to get a more comprehensive picture for a research project, and he said a discovery is usually based on data and findings from several previously conducted studies. "One study leads to another and another study before you get an answer," Morrison said.

Sid Derouen, LSU AgCenter cattle researcher, said studies have been conducted by LSU AgCenter professors to find out if other tropically adapted breeds are suitable for Louisiana. So far, no strong alternatives to the Brahman have been found, he said.

"The goal has been to replace some of the Brahman to get more tenderness," Morrison said. "That research still has more potential."

Derouen said research can be credited for helping producers raise calves that are bigger and healthier than 30 years ago. "Our production has increased, and the major part of that has been the research."

Derouen said future research will focus on the core issues of breeding, nutrition and food safety.

Guillermo Scaglia, LSU AgCenter cattle nutritionist, said research will stress efficiency. "The focus is on trying to make the whole industry more efficient in its use of resources. We need to be more sustainable in our production system." ■ **Bruce Schultz**



This photo looks to be from the 1940s, based upon the cars in the background. David Morrison, LSU AgCenter animal scientist, now retired, said this is the way cattle producers would rid their animals of external parasites. The eradication of ticks was one of the first areas of research for the Louisiana Agricultural Experiment Station. In 1906, Congress appropriated funds that were to be matched by participating states. When the Louisiana Legislature failed to provide the money, cattle were classed as a crop and the tick as a crop pest so the appropriation of the state Crop Pest Commission could be used to continue the research and begin an eradication program. LSU professor Wilmon Newell advocated rotating animals in fenced pastures to eradicate the tick. Eventually, dipping cattle, horses and mules in a solution of white arsenic, caustic soda, sodium carbonate and pine tar in water was the method used to rid the state of the pest. The big campaign of eradication ended in 1936, but small infestations continued. Louisiana has been fever tick free since 1941.



Louisiana Agricultural Experiment Station scientists began work in the early 1980s on embryo and gamete biotechnologies using a variety of farm animals including goats. Robert Godke led the assisted reproductive biology research until his retirement in 2010.



The world's first cloned transgenic goats were born as part of a research program conducted by the LSU AgCenter and Genzyme Transgenic, now GTC Biotherapeutics. Although the goats made their appearance in 1998 at the Genzyme farm in Massachusetts, much of the research that developed them was done by Louisiana Agricultural Experiment Station scientists under the direction of Robert Godke, Boyd Professor in the School of Animal Sciences, now retired, and internationally known for his research in assisted reproductive technologies in animals. The transgenic goats produce a human anti-clotting protein in their milk. The goats pictured above are transgenic and were born in 2003 as part of the research project.



Entomologist Lane Foil worked with scientists at eight AgCenter research stations for more than 20 years studying horn fly control and resistance management strategies. Estimated annual U.S. losses from horn flies exceed \$1 billion. The most critical factor that affects chemical treatment is insecticide resistance, and Foil has developed bioassays and molecular tools to aid in diagnosing resistance.

- Louisiana Agricultural Experiment Station animal scientists conducted the first testing of the successful vaccine for brucellosis, a disease that causes a pregnant cow to abort her fetus, during the 1990s. Louisiana was declared brucellosis-free in 2000 and continues with that status.
- A product manufactured and marketed by a Louisiana company is the only "killed" vaccine available to prevent anaplasmosis, a disease that costs U.S. cattle and dairy producers an estimated \$300 million a year. Developed by LSU AgCenter scientists Gene Luther, Lewis T. Hart and William Todd, the vaccine is a "killed vaccine," which means it uses the dead organism to create immunity in cattle. When the vaccine is injected, the animal's body creates antibodies and immunity. A disease caused by an intracellular microorganism, anaplasmosis destroys red blood cells in cattle. Although it occurs primarily in warm tropical and subtropical areas and was once confined to the Gulf and West coasts, the disease has spread to other parts of the country.
- In 2010, LSU AgCenter scientists produced calves from Angus bull semen that had been frozen for more than 40 years, some of the longest-stored frozen semen ever reported in the scientific literature. Earlier achievements include the first calf produced from an in vitro fertilized embryo, where the egg was harvested from a live pregnant cow.



For nearly three decades beginning in the 1980s, Don Franke conducted crossbreeding research with the Brahman breed. More recently, he studied the meat quality of purebred Brahman steers and found that genetic markers can be used to identify those that will produce very acceptable carcasses based on quality grade and tenderness.

Louisiana Ideal for Aquaculture

Louisiana's abundant fresh, brackish and marine water resources, heavy soils, flat lands, temperate water and semi-tropical climate ensured that the state would be a leader in aquaculture.

During the 20th century commercial aquaculture industries developed in Louisiana for finfishes including channel catfish, baitfish, tilapia and recreational sport fishes; crustaceans including freshwater crawfish and soft-shell blue crabs; and reptiles including the American alligator and red-eared turtles.

The state's enormous estuarine-based oyster industry dates from the 19th century and entered the 21st century as the dominant source of cultured oysters in the United States. Research was done in the area of saltwater shrimp culture in the 1960s and 1970s.

Although research in aquaculture in the United States – and specifically Louisiana – dates much later than traditional agriculture, modern scientific principles used in farm animal husbandry are applied to the field of aquaculture. The Louisiana Agricultural Experiment Station has been a leader in allocating resources for commercial development of aquaculture in Louisiana.

Early Development

Aquaculture research had its origins following World War II in the School of Forestry (changed to the School of the Renewable Natural Resources in 2002). In 1949, two fisheries courses in pond and stream management were developed and added to the wildlife curriculum by professor Bryant Bateman. He started a program of sampling local recreational fish ponds near Baton Rouge and provided management recommendations to the pond owners.

The Louisiana Cooperative Fish and Wildlife Research Unit was established within the school in 1963. The unit is a federal research component of the U.S. Fish and Wildlife Service (Department of the Interior) and is contractually

partnered with the AgCenter and the Louisiana Department of Wildlife and Fisheries. William H. Herke assumed duties as the first acting unit leader, and R. O'Neal Smitherman became unit leader in 1964.

James W. Avault Jr. joined the fisheries faculty in 1966, and he directed the development of aquaculture. He taught the fisheries courses and with Smitherman began a research program that focused on crawfish, channel catfish and other coastal species.

Aquaculture Emerges

Within a year of his hire, Avault asked J. Norman Efferson, then dean of the College of Agriculture, for access to land to build experimental ponds to support the new aquaculture research program. At that time, the Ben Hur Research Farm, several miles south of the LSU campus, had an existing 17-acre lake and a 5-acre lake but no research buildings or support structures.

During the 1970s, with support from the Louisiana Department of Wildlife and Fisheries, a number of earthen ponds and above-ground pools were constructed at the Ben Hur Farm. Avault directed research activities on assessing the commercial potential for farming marine shrimp and several marine finfishes, including pompano and croaker.

Dudley Culley developed a research program in bullfrog aquaculture in the early 1970s, not to produce frogs for human consumption but rather to develop a better biomedical research animal. Many live bullfrogs captured in the United States are used in biomedical research. Culley was for many years the foremost authority on bullfrog culture in the country. Later in his career Culley initiated a research program with soft-shell crawfish aquaculture, and his research was instrumental in developing a soft-shell crawfish industry in Louisiana. Culley retired from the AgCenter in 1995.

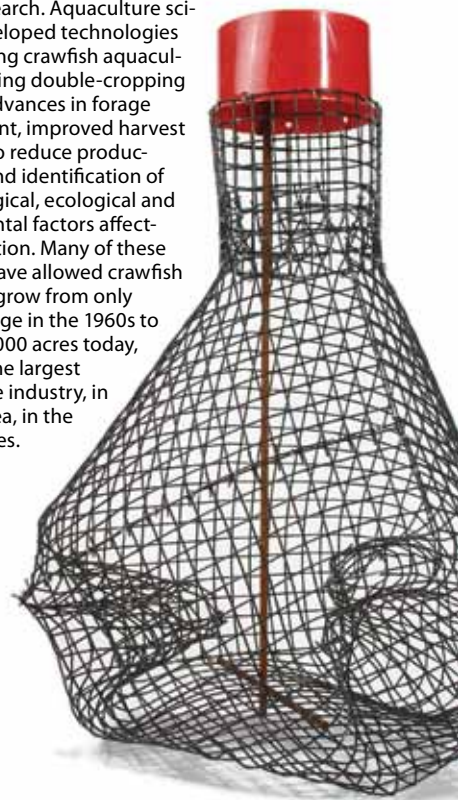
In 1980, Robert Romaine joined the aquaculture faculty as a researcher to help with an expanding crawfish farming industry. His early efforts focused on improving harvesting efficiency, population and reproductive ecology, water quality management and pesticide toxicology.

Louisiana Aquaculture Plan

In 1976, Congress passed a bill declaring the potential for aquaculture in the United States. Congressman (later U.S. Senator) John Breaux, of Crowley, was a co-author of the bill, which called for a National Aquaculture Plan and recommended that states develop their own aquaculture plans to coordinate state and federal efforts, which Louisiana did in 1980.

In 1987, the aquaculture faculty received a grant to purchase 100, 12-foot-diameter fiberglass tanks, aerators and electrical service to the station's 145 experimental aquaculture ponds. In 1992, construction of a 22,000-square-foot aquaculture research and office building was completed at the Ben Hur Research Farm. In 1988, the AgCenter acquired an annually renewable special aquaculture grant from USDA that supported many aquaculture research projects for 22 years.

The pyramid trap for crawfish was designed through Louisiana Agricultural Experiment Station research. Aquaculture scientists developed technologies for improving crawfish aquaculture, including double-cropping with rice, advances in forage management, improved harvest efficiency to reduce production cost, and identification of basic biological, ecological and environmental factors affecting production. Many of these advances have allowed crawfish farming to grow from only token acreage in the 1960s to nearly 200,000 acres today, making it the largest aquaculture industry, in terms of area, in the United States.



Aquaculture Station

In 1998, the AgCenter established the Aquaculture Research Station. The station has 146 experimental ponds, ranging in size from 0.02 to 19.0 acres and totaling 50 surface water acres; more than 200 outdoor above-ground fiberglass tanks; a fish hatchery, fish holding facility, and a greenhouse for overwintering tropical aquatic species; nearly 12,000 square feet of wet laboratories. These facilities are used for research in nutrition, fish genetics and breeding, water quality and toxicology, and



Jim Avault came to LSU from Auburn in 1966 and retired in 1996 as the undisputed "father" of Louisiana aquaculture.



The LSU AgCenter Aquaculture Research Station is a world leader in aquatic animal germplasm cryopreservation research and in the uses of this germplasm in selective breeding, protection of endangered fish species and maintenance of biomedical fishes used to advance human health research. Terry Tiersch, pictured here in 1999, has directed this research.

production systems, with a wide variety of tanks, aquaria, and recirculating systems to accommodate both freshwater and marine finfishes, crustaceans and mollusks.

The crawfish research facility at the Rice Research Station in Crowley is in the heartland of Louisiana's crawfish industry. The facility has 24, 1-acre experimental crawfish ponds and in excess of 1,600 square feet of wet laboratory space. The School of Veterinary Medicine has several laboratories assigned to aquatic animal disease research and houses the Aquatic Diagnostic Laboratory, whose staff provides disease diagnosis and control measure recommendations to Louisiana's commercial aquaculture industries and state agencies. Wet labs to support engineering research in aquaculture process control and re-circulating systems are in the Department of Biological and Agricultural Engineering. ■

Rick Bogren and Linda Foster Benedict

Read a longer version of the aquaculture story on the magazine website at www.LSUAgCenter.com.



In 1980, Ron Thune was hired to work on disease-related issues affecting the state's catfish farming industry. He and other scientists developed and patented vaccines to protect channel catfish and hybrid striped bass from the economically devastating diseases enteric septicemia catfish and pasteurellosis. This photo of Thune at the Aquaculture Research Station is from 2001.



Robert Romaine demonstrated that up to six tons of channel catfish could be produced with continuous aeration of the culture waters. Continuous aeration today is a common management practice in Southern U.S. catfish farming. This photo of Romaine at the Aquaculture Research Station is from 1999.

- Aquaculture researchers developed and commercialized formulated crawfish baits. Today a producer-mandated checkoff on formulated bait funds crawfish promotion and research activities. The efficiency of commercial fish diets, particularly catfish diets, was improved by identifying less costly feed ingredients and more efficient feed additives.
- Predictable and early spawning in channel catfish was developed by adapting mammalian ultrasound technology to identify females most ready to spawn and by regulating environmental conditions in ponds using geothermal water.
- Aquaculture researchers developed methods for management and control of the bacterial disease salmonella in baby turtles produced in Louisiana's turtle farming industry.
- Richard Cooper incorporated a disease-resistance gene into channel catfish, creating transgenic fish at rates previously not obtained in any species and demonstrating disease resistance and heritability. In 2000, he applied the technology to chickens to make human pharmaceutical proteins in the egg whites. Early success with transgenic chickens led to the formation of a biopharmaceutical manufacturing company. Research with chickens then led to a discovery in cell culture that has led to increased rates of protein expression that has produced growth factor proteins intended for use in new human biopharmaceuticals.

Research Covers the State at Off-Campus Stations

The prototype of the off-campus research station started in Louisiana even before federal legislation made money available for such facilities. In 1885, sugar planters set up a research facility in New Orleans, which was two years before passage of the Hatch Act in 1887. The sugar station soon moved to Baton Rouge and much later to St. Gabriel and is now the Sugar Research Station and one of the Louisiana Agricultural Experiment Station's 16 off-campus stations.

In 1888, a group of north Louisiana farmers pooled money to establish a station at Calhoun to study how to grow cotton, corn and vegetable crops and improve dairy production. The North Louisiana Experiment Station, later renamed the Calhoun Research Station, is one of three stations closed in 2011 because of severe cuts in the state budget. The other two were the Rosepine Research Station in Vernon Parish and the Coastal Area Research Station in Plaquemines Parish.

The third station to come into existence was the Rice Research Station in 1909. The rice farmers of southwest Louisiana recognized the need for research to sustain their industry. The fruit and vegetables industry did the same, and in 1922, the Fruit and Truck Experiment Station was established in Hammond. It is now the Hammond Research Station and serves the nursery and landscape industry in southeast Louisiana.

In 1929, the Northeast Research Station in Tensas Parish was established to serve the farming needs in the Mississippi Delta region in northeast Louisiana.

During the 1940s, six more research stations were added to the system to keep up with the rapidly expanding agricultural industry in Louisiana with the end of World War II. The Southeast Research Station was established as the Louisiana Pasture and Dairy Experiment Station in Washington Parish in 1944. The Hill Farm, Red



The Rosepine Research Station in Vernon Parish, which was originally called the West Louisiana Experiment Station when it was established in 1947, served the needs of the cattle industry in southwestern Louisiana with research conducted on cattle and forages. The station was closed in 2011 because of severe cuts in the state budget.

River and Rosepine research stations were added in 1947.

In 1948, the Sweet Potato Research Station was started in Franklin Parish, well north of the zone in south Louisiana where the sweetpotato weevil, the nemesis for sweet potato growers, is active.

The Citrus Research Station came on board in Plaquemines Parish in 1949. That station was changed into the Coastal Area Research Station in 2005.

Because the soils on a geological ridge in northeast Louisiana are different from the soils in the rest of the Delta region, a separate research station was established at Franklin Parish in 1955. Aptly named the Macon Ridge Research Station scientists there provide site-specific research on crop production on lighter, poorer upland soils.

In 1958, the Bob R. Jones-Idlewild Research Station was established in East Feliciana Parish. In that same year, a research farm was established at the LSU-Alexandria campus, which in 1968 was turned over to the Louisiana Agricultural Experiment Station and became the Dean Lee Research and Extension Center.

Land in Baton Rouge to conduct hor-

tical research was made available to the Louisiana Agricultural Experiment Station in 1966. The facility was later named the Burden Center.

Both the Pecan Research and Extension Station and the Iberia Research Station started out as U.S. Department of Agriculture facilities and were transferred to the Louisiana Agricultural Experiment Station in 1973.

The Central Research Station became the administrative unit for the research farm near Baton Rouge in 1990. The facilities for the Aquaculture Research Station were set up nearby, and this unit became a separate entity in 1998.

Louisianians love pecans

Research on the pecan began in the early 1900s and was conducted through the LSU Horticulture Department. In 1930, the U.S. Department of Agriculture established the Pecan Field Laboratory near Shreveport, which was transferred to the LSU AgCenter in 1973, and became the Pecan Research and Extension Station. The research conducted at this station has helped the pecan industry thrive not only in Louisiana but the entire southeastern United States. Scientists

introduced Louisiana producers to leaf sampling for monitoring tree nutritional status. They identified management practices that help trees grow at a faster pace with greater early nut production. Other studies confirmed the usefulness of nut crop thinning and that it was possible to quickly bring old, abandoned Louisiana pecan orchards back into production with intensive management.

Entomologists have helped growers manage pecan weevils, the scorch mite and the pecan casebearer, a major nut pest. This research alone has saved tens of thousands of dollars annually by eliminating needless spraying for an insect in production areas where it is not typically a problem. A simple monitoring method for the pecan phylloxera insect pest using sticky cloth tape as a trap was developed at the station. Scientists have helped growers manage pecan scab disease and pecan bacterial leaf scorch disease. More information about the history of the Pecan Station is on the magazine's website.

The future of this station is unknown because of the impending construction of Interstate 69, which will go through the station destroying the research pecan orchard. Because it takes 30 years to develop a new orchard, it is unlikely this research station can be saved.

Post-war housing boom creates demand for timber

Cotton and corn farms had dominated the north central Louisiana landscape. But by World War II, this type of farming was being phased out because of the hilly topography and less fertile soils. The Soil Bank Program, predecessor to the modern Conservation Reserve Program, was created around this time to pay farmers to retire their land from farming. The program proved popular, and as farmers retired their lands from row-crop agriculture, their lands became forested through tree planting and natural seedling processes. Farmers were drawn to growing forests for timber on their retired lands because the housing market was rapidly expanding as suburbs were built across the post-World War II United States. It was this conversion of old fields into southern pine forests that would drive the research program of the Hill Farm Research Station, which was



Farmers in the Mississippi Delta region in northeast Louisiana have looked to the Northeast Research Station in St. Joseph to solve their production problems and increase their yields since 1929.

After World War II, 2,4-D, a phenoxy herbicide, was released to universities for research. This herbicide was active on broadleaf weeds and could be safely used on crops. Louisiana Agricultural Experiment Station researchers were responsible for determining herbicide rates and application timings necessary to control broadleaf weeds in sugarcane, rice and corn as well as to control aquatic weeds. They found that tolerance of rice and corn to phenoxy herbicides was dependent on growth stage. Their work was critical to the successful introduction of the herbicide to growers. The widespread adoption of 2,4-D revolutionized weed management in Louisiana and contributed to significant yield increases.

established in 1947. More information about the history of the station is on the magazine's website.

Station devoted to dairy

In the mid-1940s, several events occurred highlighting the need for an experiment station in southeastern Louisiana. Farm boys were coming home from World War II, virgin long-leaf pine forests were gone, and cotton and other row crops in the area were on the decline. At that time, open range laws still existed, and dairy cows were turned out into the woods for much of their forage needs. But the advent of the modern Holstein cow soon suggested a need for better pastures and feeds.



Researchers at the Pecan Research-Extension Station in Shreveport, including Randy Sanderlin, have identified the management practices essential to a thriving pecan industry in Louisiana and across the South. This station is the only facility of its kind in the nation.



Hanna Y. Hanna at the Red River Research Station has become a world leader in the production of greenhouse tomatoes.

In 1944, a research station was established on 844 acres of land formerly in timber and cotton that was renovated for pasture research. The station was charged with conducting applied pasture and management research in support of the growing dairy industry and was named the Louisiana Pasture and Dairy Experiment Station. For a longer story about the growth and development of the Southeast Research Station in Washington Parish, go to the magazine's website. ■ **Linda Foster Benedict**

Research Notables

Many notable scientists contributed to research milestones during 125 years of the Louisiana Agricultural Experiment Station. Here are five.



William Dalrymple

William Dalrymple: Father of Veterinary Medicine (1856-1925)

William Haddock Dalrymple was born in Scotland in 1856 and worked as a banker in London and South Africa before becoming a veterinarian. Considered the father of veterinary medicine in the south central region of the United States, he came to LSU in 1889 as professor of comparative medicine and veterinarian of the experiment stations, only three years after graduating from the Glasgow Veterinary College.

Throughout his professional career, he was a member and officer in numerous veterinary and agricultural organizations and in 1905 was one of the charter members of the Louisiana Veterinary Medical Association.

He represented the United States as its official reporter on anthrax at the 10th International Veterinary Congress in London in 1914. That same year, the Baton Rouge State Times reported that Dalrymple was recognized by the Baton Rouge Chamber of Commerce for his work. The newspaper wrote in an editorial: "While East Baton Rouge

has reaped much of the benefit from his labors, his work has not been confined to any locality. He has striven for the good of the state, and there are few sections of Louisiana that are not better off because of his efforts."

He wrote two books, one on livestock sanitation and another on veterinary obstetrics. One of the main entryways onto the LSU campus, Dalrymple Drive, is named after him. ■ **Bruce Schultz**



Julian C. Miller at right

Julian C. Miller: Horticulture Pioneer (1895-1971)

When Julian C. Miller came to Baton Rouge at the start of the Great Depression to become horticulture department head, he was one of only a few people in the state with a background in horticulture. The others were an extension agent, an instructor and a branch station professional. But Miller, who had been an ensign in the Navy in World War I, was a man with a mission to develop a horticulture program

for the state. Miller had also been an extension agent in South Carolina and a graduate student in New York. He held faculty positions at North Carolina State University and the University of Oklahoma.

Miller had an uncanny ability to attract scarce federal funds to support a burgeoning research program in sweet-potato, Irish potato and other vegetable crops. His efforts led to the development of the first breeding program in sweet-potato. Meticulous lab notebooks exist to this day documenting the lengths he took in a quest to find plant material as far away as Cuba and Russia.

It paid off; these varieties moved the industry from subsistence to a nationally recognized industry shipping to all corners of the United States. His Irish potato breeding program generated some of the top varieties in the United States at the time, and many are still grown today. He was also an educator; more than 200 students received an M.S. or Ph.D. during his tenure. Many went on to be leaders at major universities across the United States and the U.S. Department of Agriculture. We also credit Miller as a leader in developing the federal National Plant Germplasm Repository in Colorado. Seed to this day from a vast array of species is stored for safe keeping at this facility.

Miller was an inspiration to all to strive for something great. Miller Hall on the LSU campus is named for him.

■ **Don R. La Bonte**

L.D. Newsom: Promoter of Sensible Pesticide Use (1915-1987)

Entomologist Leo Dale Newsom contributed substantially to Louisiana agricultural productivity. He discovered (with graduate student J.R. Brazzel) the overwintering diapause of the boll weevil that became one of the key components, along with pheromone monitoring, crop residue management and limited insecticide use against residual populations, in the eventual elimination of this species as a major cotton pest. He also was instrumental in applying principles of integrated pest management of soybean pests as this crop grew in acreage in Louisiana. Newsom and co-workers pioneered and tested the concept of trap cropping for control of the bean



L.D. Newsom

leaf beetle and stink bugs in soybeans. By decreasing the total acreage sprayed with insecticides, trap cropping reduces negative effects on biological control agents and represented an important contribution to the development of integrated pest management programs for soybeans.

Newsom was an early and forceful advocate for the sensible use of pesticides. His first two decades of research involved studies of insects that affect field crops, and he witnessed firsthand both the benefits of pesticides for increasing crop yields and the serious problems resulting from overuse of broad-spectrum insecticides. Newsom documented the consequences of pesticide misuse: development of insecticide-resistant populations, resurgence of treated pest populations once natural enemies have been removed, adverse effects on nontarget organisms, and environmental effects of persistent residues of toxic chemicals. At the same time, he helped pioneer concepts of integrated pest management that have become the cornerstone of sustainable approaches to pest management.

He was particularly vocal in opposing the practice of applying pesticides based on plant growth stage or calendar date rather than on economic thresholds. His opposition to unrestricted use of pesticides for boll weevil eradication and fire ant control brought him into

conflict with powerful groups that considered his work damaging to their own interests. Despite threats to his career, Newsom retained his convictions and emerged as a leader in the development of integrated pest management. Read more about Newsom on the magazine website at www.LSUAgCenter.com. ■

Timothy D. Schowalter

Doyle Chambers: Leader Behind the LSU AgCenter (1918-2005)

Doyle Chambers joined LSU in 1964 and served as director of the Louisiana Agricultural Experiment Station for 21 years until he retired in 1985, adding the title of vice chancellor in 1979.

Chambers is most remembered for his role in helping create the LSU AgCenter as a separate institution with its own administration within the Louisiana State University System. He saw the need for directing funding of research and extension as critical to the future of agriculture in the state.

His plan proved correct. Though times have continued to be tough and funding always is inadequate, the separation boosted the visibility and effectiveness of all three branches of the land-grant system – research, extension and teaching.

Chambers' most significant contribution to research was to bring together a fragmented operation into one unified experiment station.

He was among the first experiment station directors to push for more grants and contracts, which ultimately led to the AgCenter's well-respected and envied intellectual property program.

Immediately upon his retirement in 1985, Chambers established the Doyle Chambers Research Award, which has been given every year since to recognize the lifetime achievement of a scientist.

Through proceeds of a life insurance policy and careful planned giving, Chambers also established several endowments and scholarships, which were approved by the LSU Board of



Doyle Chambers

Supervisors in 2005. His estate also made funds available to add to the endowments for both the Chambers research award and the Tipton team research award. ■ **Rick Bogren**

Chester G. McWhorter: Weed Scientist Extraordinaire (1927-2003)

Chester McWhorter was so revered as an agricultural scientist that on the day of his funeral, flags were flown at half-staff at each U.S. Department of Agriculture-Agricultural Research Station. Though never on the faculty at LSU, McWhorter is considered part of the history of the Louisiana Agricultural Experiment Station because he received his Ph.D. in plant physiology from LSU in 1958. McWhorter worked with the ARS in Stoneville, Miss., from 1958 until his retirement in 1992.

McWhorter was recognized internationally as the foremost authority on johnsongrass biology, ecology, taxonomy, physiology and control. The technology resulting from his research is widely used as a model for reducing losses caused by weeds, to lower costs of weed control, and to aid in conducting national market surveys.

His pioneering research led to the discovery that surfactants and other adjuvants increase herbicide activity and improve selectivity and safety. He discovered that a group of herbicides known as dinitroanilines selectively control the weed johnsongrass from both rhizomes and seed in soybeans. He also discovered that the postemergence activity of another widely used class of herbicides, the s-triazines, was greatly increased when applied in emulsions of paraffinic oil in water. This practice helped to reduce herbicide use rates. He invented several innovative herbicide application technologies, including the re-circulating sprayer, herbicide application in foam and wax bars, subsurface application of herbicides in soil with a subsurface blade, and soil injection of herbicides.

McWhorter will be remembered as a leader in weed science research and a great mentor and example to scientists throughout the world.

■ **James L. Griffin**



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