LOUISIANA AGRICULTURE

Assuring Our Future Through Scientific Research and Education

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Top Honors Go To 13 at Annual Awards Ceremony

The LSU AgCenter honored six individuals and a team of seven research and extension faculty members during the 2003 annual conference in December in Baton Rouge.

■ Calvin Shelton, a maintenance employee at the Hammond Research Station who received the AgCenter's highest honor for classified employees, the Ganelle Bullock Staff Outstanding Service Award. There were 17 nominees for this award, the second year it has been offered. Shelton's nominators lauded his creativity and innovation in keeping equipment in tip-top shape.

■ Glen Gentry, a research associate at the Idlewild Research Station in Clinton, received the Outstanding Service Award for Associates. This is the first year this award was offered. Gentry was recognized for his outstanding work in upgrading the research capabilities at the station. His biosecurity plan serves as a model for other research stations.

■ Kenneth Whitam, plant pathologist, received the Floyd S. Edmiston Award. Whitam, who has been with extension nearly 30 years, is responsible for the diagnosis of plant diseases and making recommendations for treatment. His suggestions help producers save both their money and their crops by leading them to use more disease-resistant plant varieties and fewer chemical treatments.

■ Michael Stout, entomologist, received the Rogers Excellence in Research Award. Stout's research has focused on finding an alternative to the pesticide Furadan for combating the rice water weevil – the No. 1 insect pest of rice. The scientist is also seeking ways to control mosquito breeding in rice fields.

■ Richard Goyer, entomologist, received the Doyle Chambers Research Award. Goyer specializes in forest pests, including the southern pine bark beetle and the forest tent caterpillar. Because of his expertise, he serves as the Louisiana Department of Agriculture and Forestry's forest pest advisor.

■ Shannan Zaunbrecher, 4-H agent in Vermilion Parish, received the Extension Excellence Award. Her nominators credit her success to her way of combining educational activities with "good, old-fashioned fun."

■ The seven individuals who are principally responsible for developing new rice varieties for the LSU AgCenter received the Tipton Team Award. The group is based at the Rice Research Station in Crowley. The AgCenter has released 13 major rice varieties in the past 10 years. One of those – Cocodrie – is the most widely grown variety in the southeastern United States. These rice varieties account for nearly two-thirds of all rice grown in the South and have boosted rice yields by nearly 15 percent in the past five years. ■ **Abby Jones**

Photo by Mark Claesgens

Winners of the Tipton Team Award at the 2003 annual conference awards ceremony were, left to right, Richard Dunand, professor; Xueyan Sha, assistant professor; Steve Linscombe, professor and director of the Southwest Region; Pat Bollich, professor; Qi Ren Chu, associate professor; Larry White, overseer of the foundation seed program; and Don Groth, professor and research coordinator. All are at the Rice Research Station, except Bollich who has newly moved to Central Stations in Baton Rouge to serve as resident director.

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On the cover: *This is a female adult European corn borer on rice stalks. This past year was the first year this insect was reported in rice in Louisiana. A cloud of these insects as well as heavy larval infestation were found in Morehouse Parish in August 2003. This may be the first instance of seeing this insect causing damage to a rice field in the world, said Boris Castro, LSU AgCenter entomologist. See the article on page 4. Photo by Boris Castro.*

Borers Galore

Emerging Pests in Louisiana Corn, Grain Sorghum and Rice

Boris A. Castro, Thomas J. Riley, B. Rogers Leonard and Jack Baldwin

Stalk borers are becoming more of a problem in corn, grain sorghum and rice fields in Louisiana. The most common insect borer species found in these crops include the southwestern corn borer (Figure 1), the sugarcane borer (Figure 2) and the European corn borer (Figure 3). Although these borers cause severe damage to corn and grain sorghum, only the sugarcane borer and European corn borer have been observed recently at damaging levels in rice fields in Louisiana. Increased adoption of minimum tillage and several years of mild and dry winters contributed to the growth of borer populations. In addition, corn, sorghum and rice fields frequently lie in close proximity to one another and are sequentially planted in the northern half of the state. This creates an array of suitable host crops available for the development and expansion of borer populations throughout the growing season.

The southwestern corn borer was considered a secondary corn pest for many years in northeastern Louisiana, but its populations have moved towards the northern and central areas of the

Boris A. Castro, Assistant Professor; Thomas J. Riley, Professor Emeritus, Department of Entomology; B. Rogers Leonard, Professor, Macon Ridge Research Station, Winnsboro, La.; and Jack Baldwin, Professor, Department of Entomology, LSU AgCenter, Baton Rouge, La.

Photos by Thomas J. Riley

Figure 2. Adults of the sugarcane borer are straw-colored moths with a distinctive inverted V-shape marking on wings.

Figure 1. Southwestern corn borer larvae have black spots along the body and a reddish head and shield shape at its base.

Photos by Boris A. Castro

Figure 3. Larva of the European corn borer.

Figure 4. Sugarcane borer larva feeding on a developing ear.

state, affecting corn and sorghum. The sugarcane borer, a key pest of sugarcane, was considered a sporadic pest of corn and rice in southern Louisiana. Recently, this borer species has advanced into central and northeastern Louisiana, damaging corn, sorghum and rice.

In 2002, approximately 3,000 acres of rice in Concordia Parish were infested with high sugarcane borer densities that destroyed 70 to 95 percent of the rice crop on some farms. The European corn borer had not been found infesting Louisiana corn fields for 41 years until it was reported on June 11, 2003, causing significant injury to a corn field in Morehouse Parish in northern Louisiana. On Aug. 5, 2003, the European corn borer was also found to be causing significant damage to rice in Morehouse Parish. This is the first record of European corn borer in Louisiana rice fields and the first severe infestation in rice in the United States. European corn borer adults soon were reported in rice and corn fields in Franklin Parish during August and in Concordia Parish during September.

Borers survive the winter as diapausing (hibernating) larvae and then pupate in early spring. The first generation of moths emerges in mid March and continues through early June. Corn is the first cultivated crop infested in the spring and is susceptible to economic injury from early-whorl (6th-leaf stage) until physiological maturity of the ear (dent stage). Infestations in corn by the first generation of borers typically occur from April through May during corn vegetative development. Flat egg masses are deposited on leaves, and larvae hatch in five to seven days. Newly hatched larvae feed on young leaves near or inside the whorl and may cause windowpane scars or shot holes, which are noticeable as the leaves expand. Larvae continue feeding on the inside surface of leaf sheaths. The amount and size of leaf scars can provide information on larval development and severity of infestations. Leaf feeding, however, rarely results in economic losses.

After seven to 12 days of leaf and leaf-sheath feeding, larvae bore into and tunnel up and down the stalks and may destroy the immature tassel. The economic impact of infestation by first-generation borers depends primarily on the density of the borer population and the stage of plant development during infestations. First generation larvae pupate inside corn stalks, and adult borers emerge from near the end of May through June. These adults initiate a second infestation in corn or grain sorghum. Early signs of a second-generation infestation are windowpane scars on leaves near the ears, on ear leaf sheaths and on ear husks. Second-generation larvae also bore into stalks and feed directly on developing tassels and ears (Figure 4).

Borers reduce yield in corn through a combination of stalk and shank tunneling, ear destruction, poor ear development, plant lodging (Figure 5) and ear dropping. A few second-generation southwestern corn borer larvae may move to the base of the corn plant to overwinter; however, most southwestern corn borers, sugarcane borers and European corn borers pupate in corn and develop into adults. When adult moths emerge, they migrate from the less attractive maturing corn to lay eggs on younger crops such as late-planted corn, grain sorghum and rice, marking the beginning of the third generation.

In sorghum, newly emerged larvae cause windowpane scars in expanding and unfurled leaves before entering the stalk. Larvae tunnel the stalk and may feed on and destroy the immature

Figure 5. Corn stalk lodging caused by tunneling of a combination of borer species.

Photo by Boris A. Castro

Figure 6. Empty panicles, known as whiteheads, are caused by larvae feeding on the panicle neck.

panicle. Sorghum is susceptible to economic injury from early-whorl to soft dough stage. The southwestern corn borer continues to overwinter in sorghum; however, most sugarcane and European corn borers move into a fourth generation encouraged by Louisiana's warm fall temperatures. This generation attacks suitable hosts such as late-planted rice. Young sugarcane borers and European corn borer larvae feed on rice leaves and inside leaf sheaths for seven to ten days before entering the stalks. Rice is susceptible to economic injury from panicle differentiation through the dough stage. Yield loss in rice results from plant tunneling, lodging, "deadhearts," "whiteheads," and "partial whiteheads" (Figure 6).

The most effective means for reducing overwintering borer populations is area-wide destruction of crop residues after harvest. For this to be effective, plant stubble must be destroyed close to or below the soil surface. Crop rotation is not an effective tool for managing borers because the field-to-field mobility of moths allows them to infest newer areas. Pheromone traps are useful for monitoring the emergence and movement of southwestern corn borers and European corn borer, but no pheromone is currently available to monitor sugarcane borer moths; therefore, plant inspections still are needed to detect sugarcane borer infestations.

Field experiments conducted in Louisiana indicate that Bt corn hybrids containing YieldGard technology from Monsanto Agricultural Company are effective in controlling the first and second generations of the southwestern corn borer and sugarcane borer in corn. Bt corn hybrids with YieldGard technology were initially developed against European corn borer and have been very effective in controlling this pest in the corn belt; therefore, growers can expect Bt corn hybrids with YieldGard technology to be effective against European corn borer in Louisiana.

Several foliar insecticides are labeled for borer control in corn and sorghum. It is important, however, to control the young larvae while they are feeding on the leaves and leaf sheaths and are exposed to foliar insecticides. Once the larvae tunnel into the stalks, they cannot be controlled by currently labeled insecticides. It is imperative that field-scout personnel be able to recognize egg masses, windowpane scars, shot-hole damage, and leaf sheath and husk lesions caused by borers before they tunnel into the stalks.

Planting corn early may help avoid damage from the second and third generation of borers; however, during years with mild winters and high rates of overwintering borer survival, early-planted corn may not always escape attack. Early planting is also important for sorghum and rice grown near corn in areas with a history of borer infestations. Early planting allows those crops to mature before the beginning of moth migration from maturing corn fields. ■

Sugarcane Farmers Finish 'Good' Season

Although the sugarcane harvest season often stretches past New Year's, Louisiana mills finished processing the 2003 harvest on Dec. 28.

"For the most part, it was a relatively good harvest season," said Ben Legendre, sugarcane specialist with the LSU AgCenter's Sugar Research Station at St. Gabriel.

Legendre said the Louisiana yields were somewhere between 30 tons and 31 tons of cane per acre, which was off two to three tons from last year's harvest. On the other hand, the average sugar yield per ton of cane was between 212 pounds and 215 pounds – up from 179 pounds of sugar per ton of cane last year.

"Sugar recoveries per ton were much better than last year," Legendre said. "But it was about average for the previous five years, excluding the low yield of the 2002 crop."

Legendre also pointed out tropical storms and late-season rains in 2002 hampered harvest and reduced sugar yields and mill efficiencies.

Industry observers estimate the 2003 crop will yield approximately 1.47 million tons of sugar, which was produced on more than 480,000 acres in the state. If those projections hold true, the gross farm income from sugar and molasses for 2003 will total nearly $360 million. Value-added income of approximately $240 million will bring the total economic contribution from Louisiana sugar production to approximately $600 million.

Sugarcane fields generally provide three to four years' worth of crops harvested annually from mid-September through mid-January before they must be replanted.

In 2002, Louisiana farmers grew nearly 495,000 acres of sugarcane in 25 parishes. That same year, they harvested more than 455,000 acres with a total production of almost 1.3 million tons of sugar.

The gross farm income from the 2002 crop was $334.3 million for sugar and molasses, and value-added income was an additional $214 million for a total contribution of $548.3 million to the Louisiana economy. ■ **Rick Bogren**

Seed Treatments

An Alternative Pesticide Delivery System for Managing Early Season Stink Bugs in Field Corn

Melissa M. Willrich and B. Rogers Leonard

In Louisiana, southern green stink bugs and brown stink bugs (Figures 1, 2 and 3) have become common pests of corn, cotton, grain sorghum, soybean and wheat. In corn, an infestation can cause injury to the plant from seedling emergence through ear formation and grain development. Seedlings punctured by stink bugs exhibit small holes surrounded by localized dead tissue. These symptoms are most evident when new leaves emerge and completely expand from the center of the plant. Sufficient feeding on young corn may kill a plant or cause tillers to grow at the base of the plant. Tillers divert water, nutrients and light from the stalk and ear.

From 2000 to 2003, LSU AgCenter researchers evaluated the efficacy of neonicotinoid insecticides against stink bugs when applied to corn seed as a seed treatment. The neonicotinoid class of chemistry has become widely used against agricultural and urban pests because of its specificity to insects and safety to humans, livestock and pets. Seed treatments have become a popular method of delivering crop protection products for control of early-season crop pests. This method has several advantages over in-furrow and foliar application methods. Because insecticides are coated on the seed and not applied to the soil, seed treatments deliver minimal active ingredient of pesticides into the environment, and calibration of insecticide application equipment is not required. Additionally, many of these products are systemic and translocate throughout the plant, thereby providing a system that protects seedlings.

In field microplot studies, corn seed were treated with the following neonicotinoid insecticides: clothianidin (Poncho) at 0.25, 0.35 and 1.25 milligrams active ingredient per seed,

Photos by Melissa M. Willrich

Figure 1. Stink bugs are most commonly associated with injury to corn ears. This is a Southern green stink bug on an ear of corn.

Melissa M. Willrich, Graduate Student, and B. Rogers Leonard, Professor, Department of Entomology and the Macon Ridge Research Station, Winnsboro, La.

Figure 2. Brown stink bugs have become a common pest of corn.

Figure 3. Brown stink bug on an ear of corn.

Photos by Melissa M. Willrich

Figure 4. Field microplots were created by pressing a metal template onto a seedbed and then planting the seeds.

Figure 5. Individual stink bugs were "caged" on corn seedlings in field microplot studies.

imidacloprid (Gaucho/Prescribe) at 0.165, 0.6 and 1.35 milligrams active ingredient per seed and thiamethoxam (Cruiser) at 0.1333 milligrams active ingredient per seed.

Field microplots were created by pressing a metal template onto a seedbed and then planting the seeds (Figure 4). Stink bugs (one brown stink bug or southern green stink bug adult per plant) were caged on corn seedlings at the V2 growth stage, when the collar of the second leaf was visible, to the V4 growth stage, when the fourth leaf was visible (Figure 5 and Figure 6). Stink bug mortality was evaluated at 120 hours after infestation and corrected for natural mortality that occurred on nontreated corn seed.

Southern green stink bugs were more sensitive than brown stink bugs to all seed treatments (Figure 7). At 120 hours after infestation, mortality of southern green stink bugs exposed to neonicotinoid insecticides ranged from 79.2 percent to 98.5 percent, and mortality of brown stink bugs exposed to neonicotinoid insecticides ranged from 43.4 percent to 76.7 percent.

Clothianidin-, imidacloprid- and thiamethoxam-treated corn seed resulted in similar mortality of southern green stink bugs, regardless of application rate. In contrast, a positive rate response to clothianidin and imidacloprid was observed for brown stink bugs.

High rates of clothianidin and imidacloprid (1.25 and 1.35 milligrams active ingredient per seed) are unlikely to be used in Louisiana. These rates are most economical for management of corn rootworm in the Midwestern states. In Louisiana, low to moderate rates of neonicotinoids are effective against other early-season pests, including chinch bugs and fire ants.

These studies indicate clothianidin, imidacloprid and thiamethoxam seed treatments are highly effective against southern green stink bugs on corn through the V4 growth stage. Only moderate control of brown stink bugs

Figure 7. Mortality of brown stink bug and southern green stink bug at 120 hours after infestation (HAI) on corn seed treated with neonicotinoid insecticides. These figures represent averages of at least three years (2000-2003).

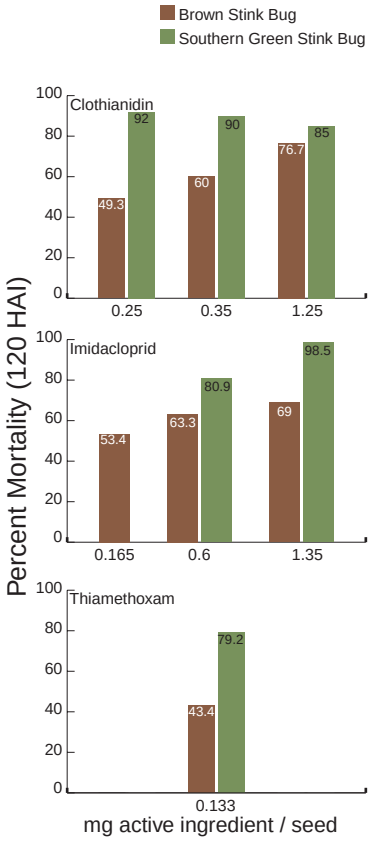


Figure 6. V2-V3 (left) and V3-V4 (right) growth stages.

Photo by Melissa M. Willrich

Because insecticides are coated on the seed and not applied to the soil, seed treatments deliver minimal pesticides into the environment, and calibration of insecticide application equipment is not required. At left are the treated seeds.

should be expected from corn seed treated with neonicotinoids at a rate growers can afford. In contrast to seed treatments, typical in-furrow granular treatments in corn (0.75 pound active ingredient per acre of Counter 15G) generally are not effective against brown stink bugs or southern green stink bugs.

Field corn producers must make several key decisions before planting. Historically, primary considerations were for high-yielding varieties adapted to the local environment. Today, however, corn seeds have become effective, multi-component delivery systems. Growers can select seeds that demonstrate insect- and herbicide-resistant traits and have on the seed coat pesticides that protect against diseases and insects. The neonicotinoids offer an alternative to conventional soil-applied pesticides and will improve the efficacy and efficiency of integrated pest management programs in corn. ■

Photo by B. Rogers Leonard

Researcher Melissa Willrich plants seeds in the plots created with the metal template.

Two Researchers Die in 2003

Two of the LSU AgCenter's researchers died during 2003—William Hallmark, professor of agronomy at the Iberia Research Station, and Michael Perich, an assistant professor in the Department of Entomology.

Hallmark died on Oct. 8 after a long battle with cancer. Hallmark spent his entire career at the Iberia Station in Jeanerette and had a number of research interests. They included identifying the reasons that nitrate accumulates in sudangrass, determining the effect of soil potassium, phosphorus and soil bulk density on the nutrient uptake and nutrient status of soybean seedings, evaluating early maturing soybeans in Louisiana, comparing dallisgrass and Alicia bermudagrass in beef grazing trials, identifying bermudagrasses recommended for production in Louisiana, evaluating sweet sorghum production in Louisiana, and evaluating seed and soil-applied inoculants for soybean production.

William Hallmark

Hallmark conducted research on wheat, kenaf and sugarcane. He attracted more than $2 million in grant monies during his tenure with the AgCenter. Some of his most recent projects involved the use of agricultural waste to enhance yields at the lowest cost in sugarcane. His most recent article in *Louisiana Agriculture* was "Fertility Research Helps Optimize Sugarcane Profits" in the fall 2001 sugarcane issue.

Hallmark earned degrees at three California institutions of higher education and a Ph.D. in agronomy at Purdue University. He came to LSU as an assistant professor in 1979. During the next 24 years, he would advance through the ranks to the level of professor and distinguish himself as a researcher and author of numerous scientific articles.

"Mr. Mosquito" is how Perich, an expert on mosquito-borne diseases, came to be known during his short tenure at the AgCenter. He died Oct. 11 in a one-vehicle accident on Interstate 12 east of Baton Rouge.

Perich's research concentrated on finding ways to better control the mosquitoes that carry disease to humans and other animals. He led a crusade to hold down the effects of West Nile virus and to get many of the state's parishes to work toward forming mosquito control districts.

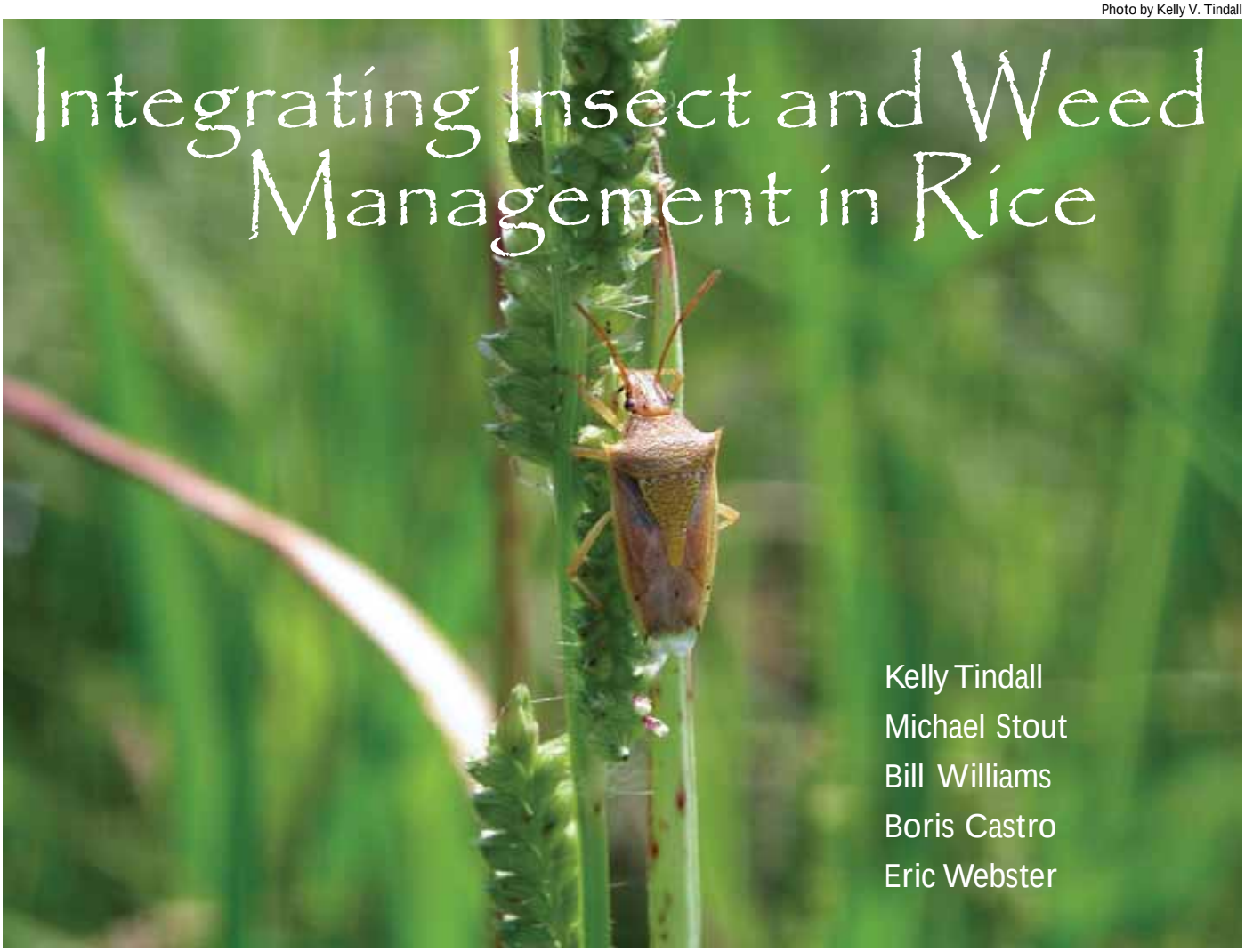
Michael Perich

Perich came to the LSU AgCenter in 2001, after spending more than 16 years as a civilian researcher for the U.S. Department of Defense and the Army. In 2001, he received the Superior Civilian Service Award from the U.S. Army, the highest military honor for a civilian. His assignment was protecting troops from the hazards of insects, and he was involved in 29 projects in 12 countries. He had been in more than 40 countries and spoke nine languages.

"I'm not sure whether he actually ever thought of himself as a life saver, but fellow entomologists and many others who worked with him knew Mike Perich's work certainly had the potential to save lives," said David Boethel, associate vice chancellor of the LSU AgCenter and a fellow entomologist.

Perich received his bachelor's degree from Iowa State University and master's and doctoral degrees from Oklahoma State University. ■ **Linda Foster Benedict**

Photo by Kelly V. Tindall



Integrating Insect and Weed Management in Rice

Kelly Tindall
Michael Stout
Bill Williams
Boris Castro
Eric Webster

Figure 1. Rice stink bug feeding on barnyardgrass, a weed pest of rice and a preferred host for the rice stink bug.

Weed and insect pests perpetually cause problems for Louisiana farmers. In addition to their individual effects, insects, weeds and their management practices can interact. Uncontrolled weeds can serve as alternate hosts for insect pests. Many insect pests of rice also feed on a broad range of other grasses, several of which are common weeds in rice fields. Additionally, cultural practices used for weed control can affect management of insect pests and vice versa. For example, flooding rice fields at the two-to-three-leaf stage to control red rice can increase the severity of damage by the rice water weevil, the most significant insect pest in south Louisiana. Conversely, delaying floods until the four-to-five-leaf stage allows the rice root system to become more tolerant to rice water weevil infestation, but compromises weed control.

Interactions between herbicides and insecticides may be toxic to plants and may require special consideration before pesticide applications are made. In rice, for example, injury can occur to plants when applications of certain insecticides (methyl parathion, malathion or carbaryl) are made within 15 days of application of the herbicide propanil.

An interdisciplinary team of LSU AgCenter scientists has been investigating these types of interactions between weeds, insects and pest management strategies in rice during the past three years at the Northeast, Macon Ridge and Rice research stations. Recent research has focused on interactions between rice stink bugs and barnyardgrass. Rice stink bugs feed on developing grains, causing partially filled seeds, reduced milling quality and "pecky" rice – rice with discolored kernels. Also, rice stink bugs can reduce yield by feeding on flowers, causing them to become sterile.

Barnyardgrass competes with rice plants, reducing the number of tillers, panicles and seeds per panicle. Because barnyardgrass is also a preferred host for the rice stink bug (Figure 1), experiments were conducted to evaluate the influence of barnyardgrass on rice stink bug population dynamics in a rice field. In addition, the potential impact of rice stink bugs on rice yield and quality in weedy fields was studied. Rice was grown in the presence and absence of barnyardgrass and examined for yield

Kelly Tindall, Graduate Assistant, and Michael Stout, Associate Professor, Department of Entomology; Bill Williams, Associate Professor, Northeast Research Station, St. Joseph, La.; Boris A. Castro, Assistant Professor, Department of Entomology, LSU AgCenter, Baton Rouge, La.; and Eric Webster, Associate Professor, Department of Agronomy, LSU AgCenter, Baton Rouge, La.

losses associated with weeds and rice stink bugs.

Two important findings were made with respect to rice stink bug behavior. Rice stink bugs were found in barnyardgrass-infested rice fields without damaging rice because rice panicles had not yet emerged. Barnyardgrass produced seed heads before rice panicles emerged, and rice stink bugs were feeding on barnyardgrass, not rice. But because rice stink bug densities were higher on rice when barnyardgrass was present than when it was absent (Figure 2), more rice plants suffered damage in barnyardgrass-infested plots as rice panicles began to emerge. Rice plants are most vulnerable to rice stink bug injury during the early stages of grain-filling.

Grain yields were reduced by more than 30 percent in the presence of barnyardgrass and rice stink bugs (Figure 3). Incidence of pecky rice was 30 percent greater in weedy plots than weed-free plots (Figure 4). These results show that barnyardgrass not only causes direct yield losses through competition with rice but also causes additional indirect losses (pecky rice) because of the greater numbers of rice stink bugs in barnyardgrass-infested plots.

The timing of barnyardgrass seed head emergence relative to rice panicle emergence is equally important. Rice stink bug infestations appear to be more severe in barnyardgrass-infested rice plots than in weed-free rice plots when barnyardgrass seed heads emerge and begin to reach late maturity before rice panicles emerge. If barnyardgrass seed heads are present at the same time rice panicles are present, however, rice stink bugs prefer to feed on barnyardgrass and remain on it until it becomes unsuitable. This allows some rice plants to escape early damage during panicle development.

Preliminary results from a large plot demonstration conducted at Woodsland Plantation in Richland Parish demonstrated that rice stink bug populations were up to 10 times greater in barnyardgrass-infested rice compared to barnyardgrass-free rice. Because barnyardgrass can influence rice stink bug populations, producers need to be proactive in scouting weedy fields for rice stink bugs to minimize stink bug injury to rice. If barnyardgrass seeds are present before rice panicles emerge, rice stink bug populations may build up and attack vulnerable rice as panicles emerge. On the other hand, rice may gain protection from rice stink bugs if rice panicles and barnyardgrass seed heads are present at the same time.

Future research plans include further investigating the effects of the timing of barnyardgrass emergence and determining the influence weedy field borders can have on rice stink bug populations on rice. ■

Figures 2, 3 and 4 show how the presence of barnyardgrass affected rice yield and quality in herbicide-treated and non-herbicide-treated plots. All plots were 15 feet by 5 feet. The stink bug data were collected on multiple dates and averaged. Other plots with and without insecticide treatments were evaluated, but those data were not used for this article.

Figure 2. Numbers of rice stink bugs collected in 10 sweeps from weed-free and weed-infested plots of rice.

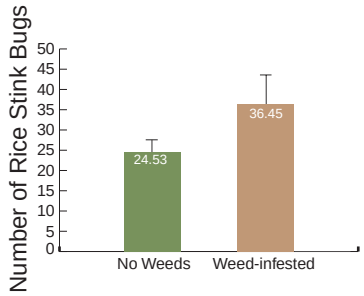


Figure 3. Yield of rice grown in weed-free and weed-infested rice.

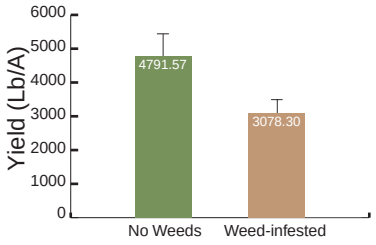
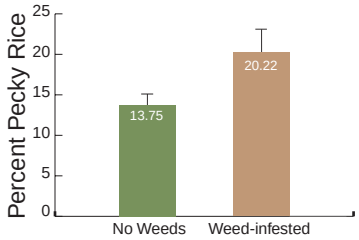


Figure 4. Percentage of pecky rice from weed-infested and weed-free rice.



Acknowledgment

This research was partially funded by the Louisiana Rice Research and Promotions Board.

Photo by Kelly V. Tindall

Severe infestation of rice stink bugs on rice at Woodsland Plantation in Richland Parish.

These are woody ornamental plants at Southside Nursery near Forest Hill, La. The greenhouses in back are owned by Doug Young Nursery.

Louisiana's Green Industry – *Evaluation of Its Economic Contribution*

Roger A. Hinson and Raul Pinel

Our society has a strong interest in the green industry, defined as the production, sale and maintenance of ornamental plants and their allied goods and services. During the 1990s, consumers' incomes increased significantly for most demographic groups. They used some of this income to improve their homes, including lawns and gardens. The baby boom generation was a factor. People in this age group became more interested in home improvement activities like gardening, and they changed their lifestyles and consumption patterns accordingly. A National Gardening Association survey indicated that retail sales of plant materials and allied goods increased from $190.92 per household in 1995 to $408.82 in 2001. Also, the pace of new residential, commercial and public construction was rapid during the 1990s, another factor favorable to the industry.

Both nationally and in Louisiana, sales grew significantly in the producer and service sectors. From 1995 to 2001, Louisiana nursery sales increased from about $105 million to about $120 million. Sales by horticultural service firms, such as landscapers, increased from $146 million to $266 million over the same period. Some outlets for this production included landscaping new homes, maintenance and re-landscaping of existing properties, and installation and maintenance at public and commercial facilities. A thriving "interiorscape" industry addresses the needs of many retailers to improve the ambiance of their indoor spaces. The green industry also produces significant economic activity through job creation.

IMPLAN Model

The impact of the green industry on Louisiana's economy was estimated using an input/output approach with software called IMPLAN. This software includes a database with sales estimates for 525 industries at the national and state levels, as well as information about the value of inputs required to produce goods and services. For example, when $1 in product value is sold by a nurseryman, part of that dollar comes from purchased inputs such as chemicals, fertilizers, machinery and labor. IMPLAN's most recent database at the time of the study was for 1999, but total sales for industries of interest were updated to 2001, when possible.

The IMPLAN software calculates economic impacts, which are assessments of changes in overall economic activity. These impacts can result from change either in one or in several specific industries or sectors of the economy, and they are commonly measured by gross sales, total personal income, gross state product and employment. The IMPLAN database combines standard industrial classifications of economic activity with the ability to aggregate results into useful summaries.

Photos by John Chaney

These are firepower nandina at Williams Nursery in Forest Hill, La. The green plants in the center are sasanque.

Roger A. Hinson, Professor, and Raul Pinel, Graduate Assistant, Department of Agricultural Economics and Agribusiness, LSU AgCenter, Baton Rouge, La.

Industries and sectors analyzed in the model were:

Producers. This included two IMPLAN industries. The first includes greenhouse, nursery and sod producers, also known as nurserymen, who grow the plants, including woody ornamentals, flowers, foliage, bedding plants and sod. The second includes landscape and horticultural services. These industries include the people who design, install and maintain landscapes.

Golf Industry. This is a major component of the green industry. All revenue and expense sources were included in sales estimates.

Related Horticultural Activities. This sector includes horticultural services within industries whose dominant output is something other than landscape installation and maintenance. Standard industrial classifications attribute all of an industry's output to its major activity. But in the construction and real estate industries, for example, there are people employed for grounds maintenance responsibilities. Also,

These are ferns and foliage plants at Hickory Hill Nursery in Forest Hill, La.

landscape activities by a variety of public and private institutions, such as churches, schools and other public agencies, are either contracted out or hired. The values of these activities were estimated from surveys.

Retail. This sector includes sales by retail garden centers, mass merchants and farm supply stores as well as sales by florists.

Photo by John Chaney

IMPLAN's data were customized to Louisiana when survey or secondary information – survey-based information from Louisiana, material in data collected for other purposes and published materials – provided a valid alternative.

Total Economic Impact Model

Models were created for the four sectors, and an overall model combined the impact from all sources. Only the overall model is presented (Table 1). The overall impact of the green industry was estimated by categories. Gross sales ($2.21 billion) include the four sectors' total impact on sales in all industries. Personal income ($1.15 billion) is the sum of employee compensation and proprietor income. Gross state product ($1.68 billion) adds other proprietary income and indirect business taxes to personal income. The green industry was responsible for 56,680 jobs in Louisiana.

The combination of related horticultural activities and golf had the largest impact on the Louisiana economy, followed by retail, landscape and horticultural services, and greenhouse and nursery products. The producers' value was lowest; however, producers are important because of strong linkages to secondary impact sectors not reported here. In summary, the picture painted by this model suggests the production and services sectors have substantial impacts on other sectors. ■

According to the LSU AgCenter's Ag Summary, the nursery stock and ornamentals industry contributed $154.7 million, including value-added, to the state's economy in 2002.

Table 1. Impact of the Green Industry on Louisiana's Economy

Industry/Sector	*Gross Sales*	*Total Personal Income*	*Gross State Product*	*Employment*
		million dollars		*jobs*
Greenhouse and Nursery Products	119.9	55.8	87.3	2,824
Landscape and Horticultural Services	266.1	110.5	166.0	9,361
Trade (Retail)	511.3	245.9	410.1	14,905
Related Horticultural Activities and Golf	685.9	524.1	656.0	22,394
Agricultural, Forestry, Fishery Services	7.0	2.4	3.2	167
Mining	8.1	2.0	5.4	31
Construction	27.9	12.1	12.7	371
Manufacturing	66.9	10.8	17.6	298
Transportation, Communication and Utilities	89.8	23.3	51.0	545
Finance, Insurance, and Real Estate	166.8	27.4	116.5	978
Services	248.7	130.5	153.8	4,684
Government	16.4	5.1	6.9	122
Total	2,214.8	1,149.9	1,686.5	56,680

The first four lines illustrate the impact of the industries or industry sectors included in the analyses. The other lines depict the cumulative effects of the models on other significant industries or industry sectors.

Technology, Mass Merchandisers Bring Dynamic Change to Nursery Industry

Roger A. Hinson and Sawitree Denvanich

This is a camellia at the George Hawkins Nursery in Forest Hill, La.

Photo by John Chaney

Market channels used by wholesale nursery growers in Louisiana have changed. Traditionally, growers sold their products to garden centers, hardware stores, feed and seed stores, landscapers and re-wholesalers. Although landscapers and re-wholesalers continue to be important sales outlets, retailers are the market component where dynamic change has occurred. Mass merchandisers (either general merchandise or home center) have replaced garden centers as the dominant type of retailer. Overall, this channel has captured more than 40 percent of the market, and the percentage of households making purchases of lawn and garden products from mass merchandisers grew from 32 percent in 1996 to 45 percent in 2001.

Three significant and related forces drive change in the nursery industry.

- Some mass merchandisers have become big enough, as measured by total sales and market share, to influence access to the consumer.
- Supply chains are increasingly integrated to gain efficiencies from increased volume and better coordination of the supply system.
- Electronic technology is used to manage product movement based on real-time information to better match store inventories with demand.

These latter two factors reduce transaction costs because large retailers ask suppliers (growers) to use electronic technology for order placement, inventory management, and reconciliation and payment. Growers who choose not to adopt these innovations may be shut out of this faster-growth component of the market. But regardless of channel, growers increasingly are taking the nontraditional role of managing the flow of product to market.

Mass merchandisers, by virtue of sales volume, influence the terms of trade with supplier companies. They prefer to purchase from suppliers who can provide large volumes of a broad selection of products. But few nursery growers in the United States are able to supply a significant portion of the products demanded by any one mass merchandiser. As in Louisiana, U.S. nurseries are far smaller than the large retailers, so the market relationship tends to favor the retailer.

These changes in retailer structure can influence nursery profitability several ways. Growers who do not sell to mass merchandisers lose access to a growing market segment. On the other hand, prices received from the large retailers often are at the lower end of the range, and these retailers can be unreliable partners, changing suppliers based on price. Finally, they may require specific terms of sale.

Historically, the sales agreement between growers and retailers included little more than price and quantity. Today, customers increasingly expect growers to provide additional services as conditions of sale. Because the industry is competitive, growers are hesitant to turn down a sale because of demands to pay a cost or provide a service.

In a survey conducted in 2002 by the LSU AgCenter's Department of Agricultural Economics and Agribusiness, Louisiana's nursery producers were asked to specify changes that had occurred in sales agreements over the five-year period from 1996 to

Roger A. Hinson, Professor, and Sawitree Devanich, Graduate Student, Department of Agricultural Economics and Agribusiness, LSU AgCenter, Baton Rouge, La.

2001. Nine requirements were studied as indicated in Table 1. Growers were asked to indicate which items were in the typical agreement in 1996 and which were in the typical agreement in 2001 for both mass merchandisers and garden centers.

Container growers reported that about 30 percent of sales were to retailers. Greenhouse growers reported that about 80 percent of sales were to retailers. Almost 45 percent of sales by greenhouse growers went to garden centers. Field growers were excluded from this analysis because they reported that almost 90 percent of sales were to landscapers and re-wholesalers.

Data in Table 1 indicate the occurrence of each requirement by type of customer and by year to provide an overall view of the relative importance of each item.

Container Growers

Information for 2001 suggests items of higher importance for mass merchandisers included product information tags, barcode stickers, transportation and continuous inventory replenishment. For the garden center channel, the product information tag also was important, but on-time delivery was next in frequency, followed by minimum order quantity. Dramatic differences were in the barcode sticker item, with values of 73 percent for mass merchandisers versus 14 percent for garden centers, and continuous inventory replenishment, with values of 53 percent for mass merchandisers and 14 percent for garden centers. Transportation also showed a significant difference.

Changes between years also are important indicators. For the mass merchandiser channel, the barcode sticker item increased from 33 percent to 73 percent. Custom container and returnable shipping equipment each increased by 20 percentage points or more. Other, smaller changes also occurred. For the garden center channel, changes were noticeably smaller. Product information tag requirements increased from 43 percent to 57 percent, and barcode sticker requirements went from zero to 14 percent. Custom container and returnable shipping equipment requirements actually declined.

For container growers, more change occurred in the mass merchandiser channel than in the garden center channel.

Greenhouse Growers

Mass merchandisers most frequently included product information tag, barcode sticker and transportation in 2001 sales agreements. All were at 33 percent. Garden centers, on the other hand, included several items at much higher frequency. These included transportation at 75 percent followed by product information tag at 58 percent and minimum order quantity at 50 percent. Except for barcode stickers and custom containers, garden centers were more likely than mass merchandisers to request the surveyed items in their sales agreements.

There were substantial changes between 1996 and 2001 for both marketing channels. For mass merchandisers, three items – custom container, take back unsold merchandise and barcode sticker – were higher by 17 percentage points. Both product information tag and minimum order quantity increased by 25 percentage points while transportation increased from 58 percent to 75 percent.

Top Requirements

Items more important to the market channels are those with higher frequency of inclusion in purchase agreements. At the top for sales agreements between container growers and mass merchandisers are product information tags, barcode stickers and transportation. To the garden center channel, important items were product information tags, on-time delivery and minimum order quantity. The higher levels for mass merchandiser do not mean that changes in garden center channel behaviors are unimportant to grower profitability.

The garden center and the mass merchandiser channels were more similar in terms of requirements on greenhouse growers, compared to container growers. Product information tags, barcode stickers and transportation were important to mass merchandisers while transportation, product information tags and minimum order quantity were important for the garden center channel.

Of the items included in this study, it can be concluded, particularly for the mass merchandiser channel, that there is some demand for all the items, especially in 2001. Garden centers, however, were less likely to include requirements for these items.

Finally, an indicator of adoption of computer-driven information handling is the continuous inventory replenishment item. Container growers report 53 percent of the mass merchandisers but only 14 percent of the garden centers require computer-driven information. Generally, larger retailers require that suppliers adopt this technology. Its use contributes to their efficiency and helps facilitate low-price strategies.

Garden centers, on the other hand, are smaller businesses and need different services from growers. In either market channel, the expansion of expectations on the part of nursery grower customers has implications for firm profitability. This is a component of the nursery business that should receive management attention. ■

Table 1. Changes in Sales Agreements from 1996 to 2001.

Requirements	Container producers				Greenhouse producers			
	mass merchandiser		*garden center*		*mass merchandiser*		*garden* center	
	1996	2001	1996	2001	1996	2001	1996	2001
Apply product information tags	67	73	43	57	25	33	33	58
Apply barcode stickers	33	73	0	14	17	33	0	8
Use custom containers	20	47	21	14	8	25	8	8
Arrange transportation to retailer	60	73	36	36	25	33	58	75
Supply returnable shipping equipment	13	33	21	14	0	8	8	8
Assure on-time delivery	33	40	43	50	17	17	25	33
Take back unsold merchandise	27	47	7	7	0	17	8	8
Supply minimum order quantity	33	27	29	36	17	25	25	50
Use continuous inventory replenishment	33	53	14	14	0	0	0	0

Numbers are in percentages.

Biomedical Research Shows Tree Bark Reduces Hypertension

Zhijun Liu

A collaborative research project is taking place at three LSU campuses with the LSU AgCenter taking the lead. If it's successful, the project could identify a tree bark useful in maintaining a healthy blood pressure.

The tree is eucommia *(Eucommia ulmoides)*, a native to central China. It is also known as the hardy rubber tree because it produces gutta percha, a rubber-like resin. Eucommia is extensively cultivated in China for its medicinal value. The trees are regularly harvested for the bark, which is a key ingredient in traditional Chinese medicine. Recently, eucommia leaf tea has become popular in China, Korea and Japan for claimed benefits of being a tonic, reducing hypertension and managing body weight. The tea has no known side effects.

Eucommia's natural distribution is the warm, temperate regions of China. This tree can withstand periods of drought and has little or no disease or insect problems. In 1998, eucommia seedlings were brought to the LSU AgCenter and planted at the Burden Center in Baton Rouge for evaluation.

Eucommia's medicinal attributes include hypotensive, antioxidant, antimutagenic, antibacterial, laxative and diuretic properties. These are attributed to its rich and diverse secondary compounds, such as lignans, iridoids, terpenes, phenolics and alkaloids. At least 37 compounds have been isolated and elucidated structurally in the bark. Twenty-six of these compounds, including aucubin, chlorogenic acid, eucommiol, gutta percha, ulmoside and hydroxyresinol glucopyranside, are on the U.S. Food and Drug Administration's GRAS (generally recognized as safe) list.

Evaluating Eucommia Extract

A three-phase study was designed to evaluate the effect of eucommia extract on lowering high blood pressure. In Phase One, an extract standardization protocol was developed, and the required amount of extract was produced based on that protocol. In Phase Two, the standardized extract was studied for safety and efficacy in hypertensive rat models, providing data for evaluation in human subjects. In Phase Three, safety and efficacy were tested in human subjects based on the safety and dose information obtained from the rat study.

Standardization of eucommia extract is key to quality control and any relevant clinical utility. Lack of repeatability and consistency in medical evaluations often plague the dietary supplement market. Many of those problems have to do with quality control of botanical extracts. Different from the single-entity concept of an ethical pharmaceutical, a botanical extract is a mixture of naturally occurring compounds, which may be effective because of beneficial synergism. With the extreme importance of quality control in mind, an effort to achieve standardization was fully investigated in the Medicinal Plants Laboratory in the LSU AgCenter's School of Renewable Natural Resources.

First, analytical methods for the active chemical markers were established with a high-performance liquid chromatograph. These analytical methods were then used to guide the extraction methods. As a result, bark was used because it includes a key active compound not found in the leaves. The solvent and its concentration were determined using the chemical markers. With these parameters, a crude extract was obtained from the raw bark with maximum recovery of the active compounds.

Second, the crude extract was purified using chemical marker analyses. Liquid phase extraction and solid phase extraction produced desired levels of the active components.

Photo by Mark Claesgens

The bark of the eucommia tree is used in China for its medicinal value.

The standardization protocol was set to produce a bark extract that contains 8 percent of the key active compound and varied amounts of other active compounds.

Third, pilot-scale production was conducted based on the standardization protocol. A quantity of 3.3 pounds of finished bark powder was obtained from 110 pounds of raw bark.

Hypertensive Rat Models

The standardized eucommia bark extract was evaluated in hypertensive rat models at the LSU School of Veterinary Medicine. Three experiments established the maximum tolerated dose (MTD), acute toxicity dose and efficacy dose.

In the first experiment, groups of rats were treated orally with increasing amounts of extract. No clinical signs or tissue changes because of toxicity were noted, and the MTD was constrained only by the saturation limits of the extract.

In the second experiment, rats were given the standardized extract orally at rates of 200, 600 or 1,200 milligrams per kilogram of body weight daily for 28 days in an effort to determine acute toxicity. No clinical signs, tissue changes or serum chemistry alterations attributable to extract administration were observed.

Zhijun Liu, Associate Professor, School of Renewable Natural Resources, LSU AgCenter, Baton Rouge, La.

In the third experiment, spontaneous hypertensive rats were given standardized eucommia extract by stomach tubes at dosages similar to those used in the second experiment. Systolic blood pressure (the higher number representing the pressure while the heart is beating) was measured on treatment days 1, 8, 15 and 22 at zero, 1, 2 and 3 hours posttreatment.

Beginning on day 8, eucommia extract administered at the mid or high dosages lowered blood pressure in male, but not female, rats. Blood pressure declined within 1 hour. The mid dosage of 600 milligrams per kilogram of body weight was found to be the minimum effective dose. The effects of extract diminished within 24 hours.

Human Subjects

Further evaluation of the standardized eucommia extract has been approved on human subjects and will take place at the Pennington Biomedical Research Center in Baton Rouge. Researchers there will perform an eight-week, randomized, double-blind human clinical trial. Fifty healthy male and female participants will be given eucommia extract capsules. Participants are between the ages of 18 and 60 with fewer than two risk factors and an average blood pressure between 120/80 to160/100. Safety and efficacy data for human use for maintaining a healthy blood pressure will be generated at the completion of the clinical trial.

Market Plans

If the human clinical trial is successful, a manufacturer of herbal dietary supplements, plans to commercialize this product. That should be good news to Americans 55 years old or older who stand a 90 percent chance of developing high blood pressure. ■

Acknowledgment

This project has been jointly conducted with David Baker of the LSU School of Veterinary Medicine and Frank Greenway of the Pennington Biomedical Research Center. It is funded by the Louisiana Board of Regents and Shreveport-based Sage Pharmaceuticals.

Photo by Mark Claesgens

In 1998, Zhijun Liu brought back eucommia seedlings from China and planted them at the LSU AgCenter's Burden Center in Baton Rouge.

Farmers See Results with NewPath-Clearfield Combo

Farmers using BASF's NewPath herbicide and Clearfield 161 rice have seen remarkable results controlling yield-choking red rice weeds this year.

But, LSU AgCenter scientists say water – an old ally in the battle against red rice – remains critical. In fact, keeping rice fields damp in between applications of the chemical NewPath can be a big factor in slowing or stopping red rice seeds from germinating from 1-inch deep or more beneath the soil.

"You've got to use all the water you can to your best advantage," said Eric Webster, an LSU AgCenter weed scientist who has studied red rice control. "You've got to manage your water."

The timing of two separate chemical applications to control red rice is another factor. LSU AgCenter researchers now recommend a total postemergence use of the herbicide. Farmers using that method have seen 99 percent control of red rice in their fields in the past year.

Webster explains how it works:

In a drill-seeded situation, the first application of NewPath herbicide should go on at emergence of plant material from the seed.

"You assume you've got red rice coming as well," Webster said. In water-seeded rice fields, the first shot of chemical goes out at "pegging," when a tiny root emerges from the seed.

A second application of the herbicide should go out about 14 days later to catch larger red rice plants.

Between the two chemical applications, the trick is to keep fields moist, Webster said. If the area starts to dry out, either pump water on or stop pumping rain water off, he said.

"Use that water to your advantage. You don't want the soil cracking. You just need to manage the water a little closer. With a good rainfall, hold that water on the field a little longer," Webster said. "Managing your water is probably more important now than it's ever been – even with the Clearfield technology." ■ **Randy McClain**

Replication of Prehistoric Footwear and Bags

Jenna Tedrick Kuttruff, Marie Scott Standifer and Sandra Gail DeHart

Although prehistoric textile remains have been recovered in South Louisiana from Avery Island (Iberia Parish) and Bayou Jasmine (St. John the Baptist Parish), no examples of prehistoric footwear or bags are known from Louisiana. However, European accounts and illustrations of Louisiana natives indicate their use here, and examples have been found in dry caves and bluff shelters in Arkansas and Missouri.

Photos by Jenna Tedrick Kuttruff

Figure 1. Researchers are growing Eyringium yuccifolium *Michaux, also known as rattlesnake master or button snakeroot (foreground) at the Burden Center in Baton Rouge. This plant was used in prehistoric times in Louisiana for footwear and bags.*

Footwear and bags are often more easily identified than other prehistoric textile remains because their shape reflects their functions. Beyond their functional aspects, footwear and bags may also reflect individual preferences and those that are regionally, culturally and temporally based. LSU scientists are investigating the production and use of these artifacts made in the Mid-South at least 8,000 years before Europeans came to this area in the 16th century. Replication of selected artifacts provides information about materials, tools, construction techniques and labor input.

The fiber source plant was identified by comparing the anatomy and morphology of known plants with samples taken from the artifacts. All of the fibrous specimens and the cord tie in one leather specimen were made from the unprocessed leaves of a plant known as rattlesnake master or button snakeroot (Figure 1). These plants would have been common in the local environment, but their growth near habitation areas could have been encouraged by prehistoric peoples.

As part of our study, we collected leaves and plant specimens in Louisiana, Missouri and Florida and are now growing rattlesnake master in an experimental plot at the LSU AgCenter's Burden Center in Baton Rouge, La. Close examination of the field plant and archaeological specimens indicate that leaves at different stages of maturity were selectively harvested for use. The narrow immature leaves were used in bags, and the wider, more mature leaves were used in footwear.

The first bag to be replicated (Figure 2) was recovered from Arnold Research Cave in south-central Missouri. It has been radiocarbon dated to approximately 900 B.C. and is attributed to the Early Woodland cultural period. A part of

Figure 2. On the left is the original twined, flat-bottomed bag from Arnold Research Cave in Missouri (circa 900 B.C.). At right is the replication created by the researchers.

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one lower corner of this bag is missing; it has a flat bottom and measures 9.5 inches across at the rim and 10.25 inches deep at the complete side.

Two bags from northwest Arkansas were also replicated, a small flat-bottomed bag from Montgomery Shelter (Figure 3) and a curved-bottomed bag from Arch Vaughn Cave (Figure 4). These bags have not been radiocarbon dated, so their age and cultural affiliation are still unknown. The small

Figure 3. Undated, small, flat-bottomed bag from Montgomery Shelter, Arkansas, (left) and replication (right).

bag with a handle measures 2.5 inches at the rim and 3.5 inches deep. The curved bottom bag measures 10.25 inches deep and is 4.75 inches at its widest point. The rim is missing but may never have been completed because the top of the bag appears to have been cut. The tops of some bags are known to have been left unfinished. A variety of construction techniques, including twining, braiding and twisting, were used to make the bags.

Before starting construction of the bags, a bundle of dried rattlesnake master leaves was soaked in water. This increased flexibility of the leaves, making it easier to bend the leaves in the warp (lengthwise elements) to construct the base. As the twining progressed, the warps started to dry and became more rigid. This actually made the twining process easier. The leaves used for wefts (crosswise elements) remained soaking until needed for twining so that they would remain flexible enough to make tight twining stitches. The ends of the warps along the top of the bag were soaked again before constructing the rim, because flexibility was needed for this step in the construction process.

The slip-on style fibrous shoe from Missouri chosen for replication (Figure 5) has been radiocarbon dated to approximately 2400 B.C. (Middle Archaic cultural period). It

Photos by Jenna Tedrick Kuttruff and John Wozniak

Figure 5. At left is the fibrous footwear found at Arnold Research Cave in Missouri (circa 2400 B.C.). The researchers replicated it at right.

has a round toe and a sling heel. Repairs had been made to re-stitch the top of the shoe to the sides of the sole. It is similar in style to three other known Ozark specimens. An undated fibrous sandal from Spiker Shelter in northwest Arkansas was also replicated (Figure 6). It is a complete sandal with a square toe and a flat round heel. The sandal is in good condition with some wear at the heel and ball of the foot.

In all the fibrous replications, the structure of the yarns or elements varied according to how they were used in the design and construction. The rattlesnake master leaves were combined or split to produce elements with the proper width, and length was increased by overlapping the ends of the leaves within the warp and weft bundles. In some instances the leaf bundles were twisted to produce single yarns and 2-ply cordage. All of the specimens studied incorporated multiple

Figure 4. Undated curved-bottomed bag from Arch Vaughn Cave, Arkansas. The original is at left and the replication is at right.

Figure 6. At left is undated fibrous footwear from Spiker Shelter, Arkansas, and the replication.

Photos by Jenna Tedrick Kuttruff

Figure 7. Two examples of leather footwear were found at Arnold Research Cave, Missouri. The specimen at left with a drawstring was dated to A.D. 1100. The specimen with padding in the center is undated. At right is the replication.

construction techniques that included weaving, twining, braiding and twisting.

The two leather, slipper-style moccasins recovered from Arnold Research Cave in Missouri were of a similar style. The reconstruction was based on information obtained from both specimens (Figure 7). Only one example of leather footwear from all of the collections under study has been radiocarbon dated. This specimen dated to the Mississippian cultural period at about A.D. 1025, and was the latest of the seven footwear specimens dated from Arnold Research Cave. The fibrous footwear from that site dated from Early Archaic to Late Woodland cultural periods with dates starting as early as approximately 6300 B.C. Whether or not all of the leather footwear will prove to be later in date than the fibrous specimens remains to be seen, but it does suggest the possibility of a change in materials and techniques through time.

Through our studies, we have determined that the only tool needed when working with either the fibrous or leather materials was a cutting tool. It could have been used to cut the leaves to length or trim the ends. However, leaves of the proper length could have been selected and picked, and, if needed, leaves can be easily split to the desired width by hand. No specialized tools were needed for either the yarn or fabric construction.

Either of the larger bags can be constructed by a skilled person in two hours or less. A similar amount of time is needed to make a single fibrous sandal or slip-on. The rattlesnake master leaves for either can be picked from a good stand in 10 minutes or less.

We do not know whether women, men or both genders produced the bags and footwear. The actual construction is simple, and both products could have been made by older children as well as adults. These items could have been produced on the spot or made ahead of demand by using dried and soaked leaves.

Replication of prehistoric footwear and bags using the original materials has led to a greater understanding of the characteristics of prehistoric textiles. Our research has identified the fiber source used, indentified the probable steps required to produce such artifacts and clarified specific or detailed aspects of their construction processes. Many of the decision-making processes required to design and construct these artifacts became more apparent. This new knowledge increases our understanding of lifestyles in the prehistory of the Mid-South. ■

Investigations of from

Because fiber products are extremely perishable, it is rare to find examples of prehistoric textiles (fabrics) and cordage (yarns or strings) in Louisiana or other states in the Southeast. Yet, during construction of Interstate 55 near Lake Maurepas in South Louisiana in the mid-1970s, fragments of cordage dating

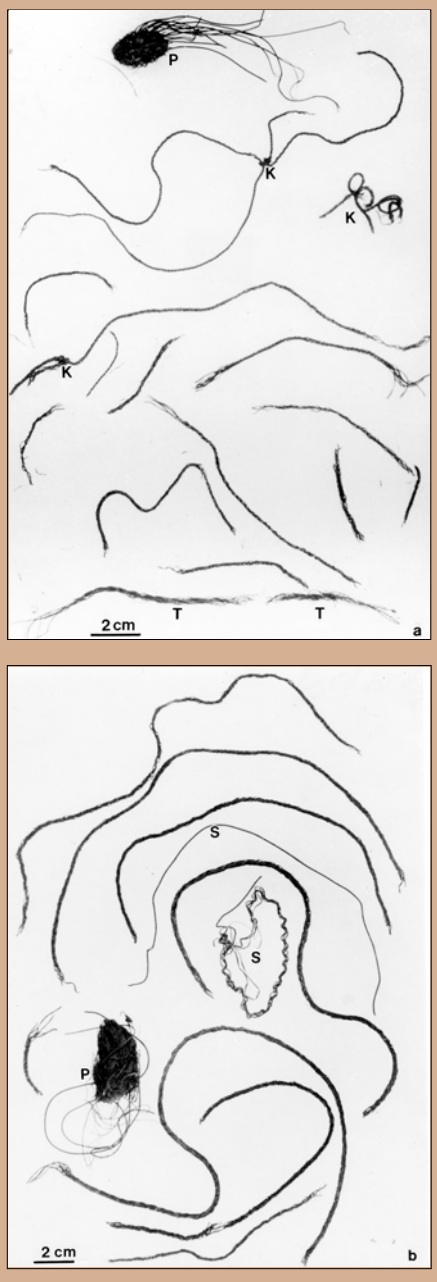

Figure 1. This is a sample of the cordage found from Bayou Jasmine. In addition to the braided cordage, there are different stages of production and features represented: plant parts (P), fiber strands (S), twisted fiber bundles (T) and knots (K).

Prehistoric Cordage
Louisiana's Bayou Jasmine

Jenna Tedrick Kuttruff and Marie Scott Standifer

back 3,000 years were recovered from the soil thrown up on the banks of the bayou when a dragline cut through the Bayou Jasmine site.

These specimens represent an important cultural resource and a rare research opportunity for LSU scientists. Five private collections containing examples of cordage, fibers and plant parts have been studied, and some of these specimens are now in the collections of the Textile and Costume Museum and the Museum of Natural Science, both on the LSU campus in Baton Rouge (Figure 1).

Since the site had been occupied from about 1500 B.C. to A.D. 1400, it was important to get accurate dates for the cordage. The calibrated radiocarbon dates obtained were 1600-1292 B.C. for a cordage specimen and 1110-835 B.C. for a bundle of fibers. These dates place them in the Poverty Point cultural period in the pre-history of Louisiana and make them among the oldest dated organic textile remains in Louisiana and the Southeast.

Technical analysis of 31 cordage specimens revealed that all were braided. The braids were composed of whole and/or split fibers, and the number of strands varied from four to 10 (Figure 2). It appears from our analysis that a consistent, overall diameter of

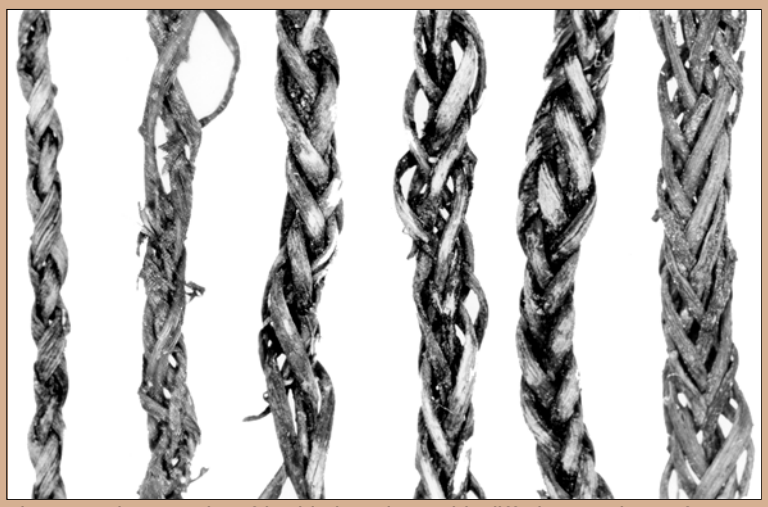

Figure 2. Photographs of braided cordage with differing numbers of strands, from left to right: 4-, 5-, 6-, 7-, 8- and 10-strand braids.

approximately 0.06 inches (a little less than the thickness of a nickel) was an important requirement for the end uses of the cordage. The starting end of a braid (Figure 3), along with knots (Figure 1) and splices, provide evidence of some of the techniques used in braid construction. The people who made this cordage were able to braid minute strands into a tight and strong end product.

A botanical analysis revealed that all of the cordage had been made from roots and that the anatomy of the roots matched that found in monocotyledonous plants (plants like corn or grass). The

Photos by Jenna Tedrick Kuttruff

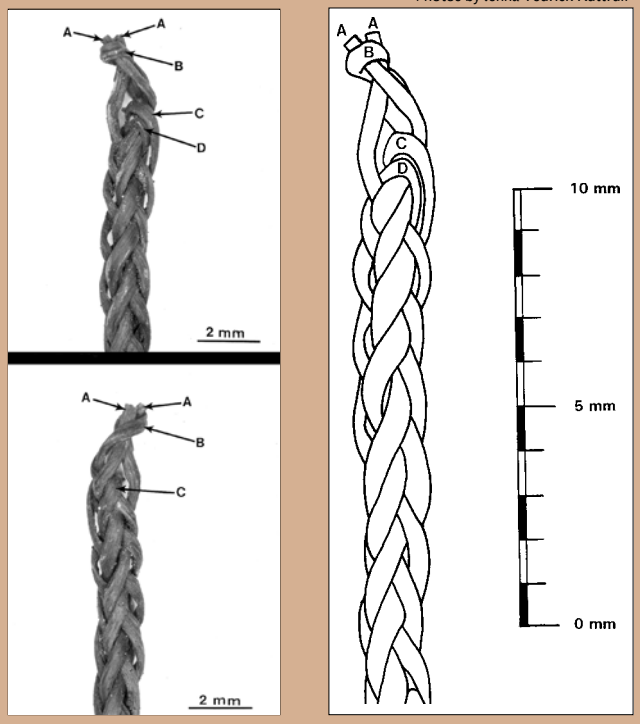

Figure 3. Photographs and drawing of the starting end of 8-strand braid: A indicates the cut fiber ends that may have originally formed a loop; B, C and D indicate additional fiber strands added to create the 8-strand braid.

source plant is thought to have been a local grass or sedge, which previously had not been reported as a prehistoric fiber plant. Efforts are being made to identify this important fiber source.

The collections also revealed information about activity at the site and possible end uses of the cordage. Contained in the collections were all of the components needed for cordage production: source plant parts, individual fibers, loosely arranged fiber strands and braids. Such a grouping of artifacts indicates that cordage was produced on the site. In addition, the cordage was recovered along with other artifacts and animal remains related to fishing. Although such cordage can be used in a variety of ways, it is likely that one use for the prehistoric braided cordage from Bayou Jasmine was as a fishing line. Through these studies, knowledge of previously unknown 3,000-year-old prehistoric cordage production in Louisiana has been gained. ■

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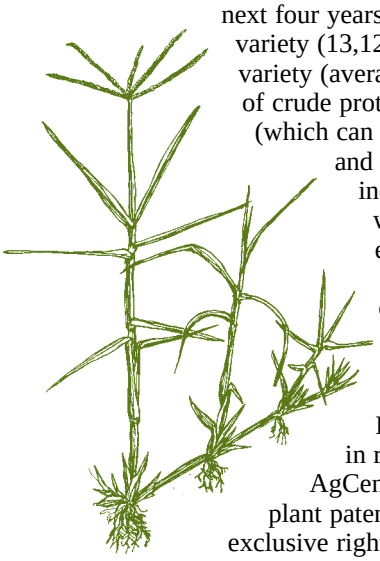
Forage Research Contributes to Patent for 'Little Phillip'

W. D. Pitman

Hay producers Clyde Sneed and Larry Herrington discovered a unique variety of bermudagrass in a hay field in Sabine Parish. Clyde Sneed originally noticed a small area of grass differing distinctly from the surrounding Alicia bermudagrass in 1991. The area covered by this grass increased during the following years, and Sneed and Herrington noted its superior performance during each hay harvest.

Sneed and Herrington provided planting material of this unique bermudagrass for establishment of plots in a bermudagrass variety test planted at the Rosepine Research Station in 1997. During the following four years, data were collected to compare the plant growth characteristics, forage production and forage quality of this new grass with the varieties being planted commercially in the area. Forage production from five harvests per year for the next four years resulted in substantially higher yields by the new variety (13,120 pounds per acre per year) than by any other variety (average of 8,340 pounds per acre). Laboratory analyses of crude protein, *in vitro* digestibility, neutral detergent fiber (which can be used as an indicator of potential animal intake) and acid detergent fiber (which indicates the indigestible plant cell wall fraction) for this grass were similar to those of the superior variety for each characteristic.



The forage data along with plant botanical characteristics were used to develop a plant patent application. The patent was granted in 2003. The discoverers, Sneed and Herrington, designated that the official assignee of the plant patent be LSU's Board of Supervisors. They made this designation in recognition of the contributions of the LSU AgCenter in developing the grass and processing the plant patent application. While Sneed and Herrington retain exclusive rights to market planting material of the grass, a portion of the proceeds from their sales has been assigned to the LSU AgCenter to support continuing research programs.

The patent of rights to this grass is expected to help extend the commercial life of the variety and increase the benefits Louisiana farmers will receive from the research. Previously, the success of publicly developed bermudagrass cultivars released in Louisiana in the 1980s was rather short-lived, largely because no one owned rights to the materials and had a commitment to maintain their commercial availability.

Sneed named this variety of bermudagrass "Little Phillip No. 1" for his grandson, Phillip. Currently available research results indicate that Little Phillip No. 1 is the superior bermudagrass variety for intensively managed forage production on Coastal Plain upland soils in West Louisiana. Preliminary evaluations also indicate that Little Phillip No. 1 is well adapted to a variety of other soil types in Louisiana and the lower Gulf Coast region.

More information about the planting material may be obtained by contacting the LSU AgCenter's Rosepine Research Station at (318) 463-7708. ■

W. D. Pitman, Professor, Rosepine Research Station, Rosepine, La.

Louisiana Farmer Discovers Bermudagrass

Louisiana forage producers can plant a new variety of bermudagrass that has proved to outproduce traditional varieties in Coastal Plain soils, said W.D. "Buddy" Pitman, LSU AgCenter researcher at the Rosepine Research Station.

The new variety is named Little Phillip after the grandson of one of its discoverers, Clyde Sneed of Florien, La., who first observed the plant growing in his Alicia bermudagrass field in 1991.

"It was darker green and had larger leaves," said Sneed. He showed it to his friend, Larry Herrington, another hay producer in the area.

"We continued to watch the plant grow and take over approximately a quarter acre until 1996," said Herrington. "Then, when we thought we had something special, I called our county agent."

LSU AgCenter Agent Paul Morris in Sabine Parish looked at the grass and called Pitman, who then planted the cuttings in research plots on the Rosepine Research Station, which is near Rosepine, La., and compared the plants with the other leading bermudagrass varieties – Jiggs, Tifton-85 and Russell.

Phillip out-produced the closest variety in the test by more than 3,200 pounds per acre per year in a four-year study. Also, the laboratory digestibility results of Phillip compared similarly to the other varieties in the study.

"Usually we have to spend years of research developing new varieties," said Pitman. "This one just came to us. But additional research is needed at other locations in the state and on different soil types."

At first, the LSU AgCenter recommended planting Phillip bermudagrass only on West Louisiana Coastal Plain soils in only a few parishes. However, as of the fall of 2003, the recommendations for Phillip have been extended to all of Louisiana. This is significant for qualifications for federal conservation programs, Pitman said.

"I have high hopes for Phillip bermudagrass," said Herrington. "And I'm planting more acres." ■ **John Chaney**

Fresh-cut Sweet Potatoes
A Potential Value-added Product for Louisiana

David H. Picha and Elif Erturk

Consumers continue to demand ready-to-eat or ready-to-use forms of fresh fruits and vegetables. Industry sources indicate that around 15 percent of all fresh fruits and vegetables marketed in the United States are minimally processed. This includes products which have been peeled, sliced, diced, shredded or cut in various styles and forms. Among the principal contributors are lettuce, carrots, cabbage, onions, broccoli, potatoes and increasingly, various fruits.

The sweet potato, which is Louisiana's leading horticultural crop, has considerable potential to be prepared and marketed in more-convenient, value-added, fresh forms. Several companies in the state have initiated marketing efforts for minimally processed fresh sweet potato products. Despite increasing popularity, the production of fresh-cut sweet potatoes is limited because of rapid deterioration and minimal shelf life. The roots incur damage during preparation, which increases rates of respiration.

Peeling and cutting the root accelerates the drying of the tissues and allows for potential microbial proliferation. It is imperative to keep the fresh-cut product cool at all times. Under ideal conditions, the fresh-cut sweet potato's 14-day shelf life is considered satisfactory, although the fresh produce industry would prefer a three-week shelf life.

Cutting sweet potatoes into different shapes (slices, cubes or sticks) adds value to the fresh product because it adds convenience for the consumer. The postharvest research program in the LSU AgCenter's Department of Horticulture has evaluated different preparation methods and packaging films on shelf life of fresh-cut sweet potatoes. The objective of the research is to determine appropriate sanitizing treatments and packaging materials for optimizing shelf life while maintaining nutritional quality and avoiding microbial deterioration.

Dipping the cut slices in 200 ppm hypochlorous acid (pH 6.5) for five minutes was the most effective sanitizing treatment for preventing a build-up of microorganisms during a 14-day storage and marketing period.

Actively respiring sweet potato tissue reduces the oxygen (O_2) concentration and increases the carbon dioxide (CO_2) in the package, establishing a modified atmosphere conducive to extending the market life; however, if the storage temperature is too high or the O_2 transmission rate too low, the natural product respiration will consume the in-package O_2 supply and cause the fresh-cut tissues to ferment. This results in off-flavor and adversely affects consumer acceptability.

Research has shown that fermentation in sweet potatoes may begin once the O_2 concentration falls below 1.5 percent. This can be avoided in fresh-cut sweet potato products by using a polyolefin film with an appropriate O_2 transmission rate and maintaining a cold storage environment throughout product handling, distribution and marketing.

Research results indicate that fresh-cut sweet potatoes should be held as close to 36 degrees F as possible, which is considerably lower than the recommended temperature of 55 degrees F for whole sweet potatoes. Temperatures above 40 degrees F should be avoided. The fresh-cut product should be cooled to 36 degrees F before packaging. Modified-atmosphere packaging is not a substitute for refrigeration. Furthermore, fluctuating temperatures should also be avoided because of the likelihood of undesirable moisture condensation on the inside of the package.

Polyolefin films with low oxygen transmission rates are not suitable for packaging fresh-cut sweet potatoes, even at cold temperatures. Among the various packaging films tested, two semi-permeable polyolefin films – Cryovac PD961 and PD941 – were identified as the most appropriate and maintained acceptable product shelf life for 14 days at 36 degrees F. The films have different gas transmission characteristics, with the PD961 film being less permeable to O_2 and CO_2.

Excellent quality and shelf-life were obtained from fresh-cut product packaged in PD961 film continuously maintained at 36 degrees F; however, PD961 film is not recommended if the temperature will be above 36 degrees F because of the likelihood of product fermentation. The possibility of exposure to higher temperatures during handling and distribution should be taken into consideration when selecting the film type.

The O_2 concentration inside the PD941 packages was sufficiently high to prevent fermentation at either 36 degrees F or 47 degrees F. This film has a high gas transmission rate; however, the higher weight loss of fresh-cut slices packaged in the PD941 film is a limitation. Fresh-cut sweet potatoes packaged in this film must be stored at a high relative humidity to prevent the cut surface from drying out. The PD941 film is considerably thinner and less durable than the PD961 film.

Film type did not significantly affect sugar or nutrient content of fresh-cut slices; however, storage temperature did influence product composition. During two weeks of storage at 36 degrees F, sweet potato sugar content increased, vitamin A value was maintained, but vitamin C content decreased. Storage of the packages at 47 degrees F resulted in fermentation and ethanol production from the sweet potato slices, particularly those held inside the PD961 film. However, no visible signs of spoilage were observed for slices from either film type. Results of sensory taste panel data indicated the fresh-cut sweet potatoes were acceptable after 14 days at 36 degrees F in either PD961 or PD941 film packages. No browning of the cut surfaces was observed.

Using proper preparation protocol and the right choice of packaging film will help Louisiana sweet potato growers and processors provide a safe and nutritious fresh-cut product for the market. Future research will evaluate new and improved film types and product preparation methods. ■

David H. Picha, Professor, and Elif Erturk, Graduate Research Assistant, Department of Horticulture, LSU AgCenter, Baton Rouge, La.

Turtle Farmers Try To Crack Back Into Domestic Market

Scores of turtles slipped off their feeders and disappeared under the water as Keith Boudreaux approached his turtle pond near Ponchatoula, La.

"We feed them Purina Turtle Chow," Boudreaux says of the estimated 10,000 turtles in the 2-acre pond.

Each of the pond's female turtles will lay a clutch of eight to 10 eggs about three times from April through July. Each morning, the farmer harvests the eggs and incubates them until they hatch in about 60 days.

Photos by Mark Claesgens

Keith Boudreaux displays a tray of recently hatched baby turtles in the incubation room at his turtle farm near Ponchatoula. The baby turtles can live for about five months without being fed because of the energy they've stored from the egg, said Boudreaux, who sells around a million baby turtles each year.

Boudreaux operates one of the 72 turtle farms licensed by Louisiana. Those licenses allow producers to sell baby turtles throughout the world because the state certifies them as salmonella-free. But they can't be sold in the United States.

In the 1960s the U.S. Centers for Disease Control in Atlanta documented that American children were being infected with salmonella, and they estimated that as much as 14 percent of the infections were from pet turtles. As a result in 1975, the U.S. Food and Drug Administration (FDA) banned the U.S. sale and interstate transportation of turtles with shells less than 4 inches across. But Louisiana-certified turtles have found a market internationally.

The certification process, which isn't accepted by the FDA, came as a result of work by Ron Siebeling, a professor of immunology with the LSU AgCenter. Siebeling, who died in September 2002, spent nearly 30 years helping turtle farmers overcome the salmonella problem. He developed a way to treat salmonella in baby turtles, using funding from the state legislature administered by the Louisiana Department of Agriculture and Forestry (LDAF). Now, Louisiana turtle producers use the results of Siebeling's research to treat turtle eggs with disinfectants and antibiotics to kill salmonella in the eggs. When the baby turtles emerge, they are salmonella-free.

"We can't eradicate, but we can decrease the problem by proper hygiene," Boudreaux says.

Because of the Siebeling method, Louisiana laws and licenses allow producers to export baby turtles because they're certified salmonella-free . Certification rests with the LDAF, which sends samples of baby turtles to a state-approved laboratory. If the turtles test salmonella-free, the department issues documentation and health certificates that allow them to be shipped to overseas markets. Boudreaux says the market is now primarily Asia, where baby turtles are sold as pets or raised to about 1 pound for meat, shell and medicine.

In 1969, about 75 turtle farms in Louisiana were selling nearly 15 million baby turtles a year. The FDA ban and subsequent loss of the domestic market put many farms out of business as production dropped to about 2 million turtles a year by 1975, and farms dwindled to 21. Now, Louisiana producers annually ship about 12 million to 13 million turtles, says Boudreaux, who ships about 1 million a year.

The Louisiana producers still would like to see the domestic market reopened to turtles as pets, and they're working with researchers at the LSU AgCenter and the LSU School of Veterinary Medicine in their continued quest for FDA approval. Although the state certifies them as salmonella-free, the baby turtles still don't satisfy the federal government.

"The FDA wants something other than antibiotics because of potential bacteria resistance," says Dr. Maxwell Lea, the state veterinarian. He says the federal agency is also concerned about re-infection. That's where the current LSU AgCenter and veterinary researchers come in. They're working with turtle producers to improve the process.

"Instead of chemicals, we're using biological agents to rid turtles of salmonella," says Randy Gayda, a molecular biologist in the AgCenter's Department of Biological Sciences. "We're using specific bacteria viruses we call bacteriophage. Phage means to eat."

Gayda says the bacteriophages attack bacteria, and they're safe for human contact. He's designing what he calls a "cocktail" to kill specific bacteria and knock out about 99.9 percent of salmonella.

"We'll feed the cocktail to turtles and see how long they stay salmonella-free," Gayda says. "Phages naturally occur in the environment. We want to find the ones that work on specific bacteria."

Dr. Mark Mitchell of the LSU School of Veterinary Medicine, who is working with the Louisiana turtle industry, says the FDA has established an absolute-zero tolerance policy in pet turtles – but not in any other animals.

"Currently, nine million reptiles are imported into the United States each year without restrictions or quarantines," says the veterinarian, who specializes in exotic species. "Reptile husbandry and reptile medicine have changed since the 1970s. The markets have changed, too."

Researchers and producers all agree that while pet turtles aren't suitable for small children, they can be ideal pets for city dwellers who want to have pets but aren't in a position to have a cat or dog.

"You can create a human-animal bond with reptiles – pets don't all have to be fuzzy," Mitchell says.

The turtle industry could be an "economic windfall" for Louisiana if the restrictions were lifted, Mitchell says. "This is a legitimate agricultural industry in our state." ■ **Rick Bogren**

Boudreaux uncovers eggs in a turtle nest next to a pond at his turtle farm near Ponchatoula. Female turtles generally lay two or three "clutches" of eight to 10 eggs during the season, which stretches from April through June. Each day, Boudreaux's employees collect and wash the eggs and then put them into an incubation room, where they hatch after 60 days.

Rice Specialist Receives National Honor

A rice specialist with the LSU AgCenter, Johnny Saichuk, has won the prestigious 2003 Rice Industry Award, sponsored by Rice Farming Magazine, Syngenta and the USA Rice Federation.

The award was presented during the 2003 Rice Outlook Conference in December 2003 in Biloxi, Miss. The award honors individuals who make valuable contributions to the U.S. rice industry. The awards committee picked Saichuk for outstanding work bringing extension programs to rice producers in Louisiana and helping deliver the latest in agricultural research to farmers.

Saichuk oversees the LSU AgCenter's rice verification program, an on-going effort in which selected rice fields are monitored and farmers get advice on overcoming problems as they occur. Saichuk works out of the LSU AgCenter's Rice Research Station in Crowley, but spends much of his time on the road, walking rice fields and advising farmers.

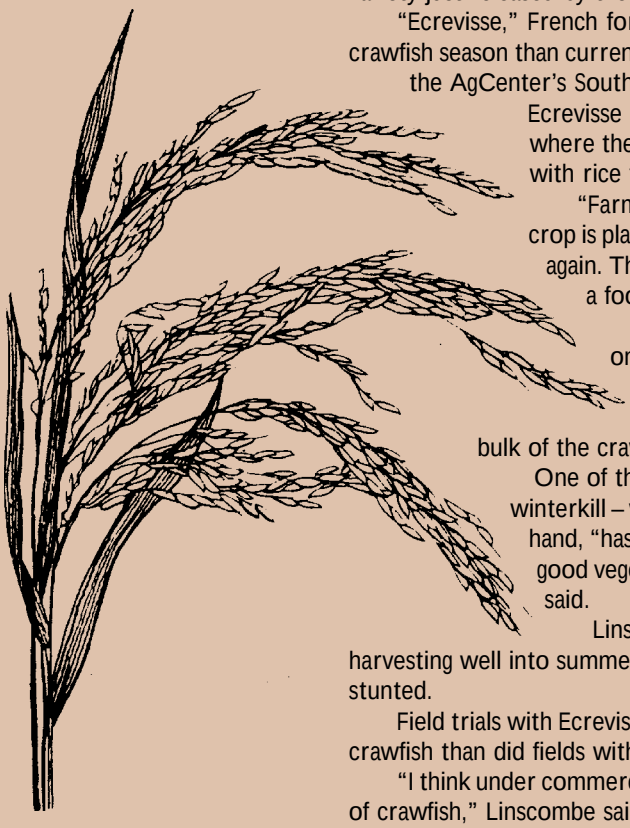
The rice verification program will be starting its seventh year and continues to be popular with rice farmers.

LSU AgCenter County Agent Howard Cormier works side by side with Saichuk in rice fields in Vermilion Parish.

"Johnny is smart enough to make things simple," said Cormier, a 2002 Rice Award winner. "He can converse with the researchers on technical terms, and he has the ability to make things clear for the farmers." ■ **Randy McClain**

Johnny Saichuk

New Rice Variety Developed For Crawfish Farmers



Crawfish farmers will have a way to improve the diets of their crustaceans, thanks to a new rice variety just released by the LSU AgCenter.

"Ecrevisse," French for crawfish, provides more biomass – or vegetation – throughout the crawfish season than current varieties, according to Steve Linscombe, rice breeder and director of the AgCenter's Southwest Region.

Ecrevisse is intended for crawfish farmers who raise crawfish in monoculture – where the ponds are used for raising crawfish only, rather than double-cropped with rice that is first harvested for grain.

"Farmers who double-crop, stock their crawfish in a rice pond after the rice crop is planted," Linscombe said. "After they harvest the rice, they flood the fields again. The stubble and whatever regrowth comes from it provide the basis for a food web that feeds the crawfish."

Though rice is part of the crawfish food chain, crawfish really don't feed on it, explained Ray McClain, aquaculture researcher at the LSU AgCenter Rice Research Station in Crowley. Rather, the decaying green plants provide the food for insects and small water organisms that make up the bulk of the crawfish diet.

One of the drawbacks of rice varieties grown for grain is their susceptibility to winterkill – which means they don't grow back in the spring. Ecrevisse, on the other hand, "has better cold tolerance and can have regrowth in the spring to produce good vegetation that provides the environment where crawfish thrive," McClain said.

Linscombe said farmers who raise crawfish in monoculture often continue harvesting well into summer. But without good vegetation, the crawfish stop growing and remain stunted.

Field trials with Ecrevisse as part of the crawfish's food chain produced more large, high-value crawfish than did fields with common rice plants, McClain said.

"I think under commercial conditions, the use of this variety may actually produce higher yields of crawfish," Linscombe said.

Ecrevisse foundation seed is available from the Rice Station. For more information, contact Larry White, manager of seed programs, at (337) 788-7531. ■ **Rick Bogren**

Inside:

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