LOUISIANA AGRICULTURE

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Forewarned is fore-armed for Asian soybean rust

If the LSU AgCenter were like *Time* and had a "person of the year," that individual would be Ray Schneider for 2004.

Schneider, a plant pathology researcher, discovered the presence of a soybean disease new to this country at the perfect time, so the agricultural industry could gear up to prevent potentially catastrophic losses.

The disease, spread by wind-borne spores, is Asian soybean rust. It has been in Asia for a century and had recently spread to Africa. In 2000, it was found for the first time in the Western Hemisphere in Brazil. Schneider's discovery on Nov. 6, 2004, was the first in North America.

Asian soybean rust is feared by farmers because it is extremely difficult to detect in early stages. The symptoms start on the bottom leaves, hidden from view. When not found early, the disease has been known to destroy entire fields because it can spread like wildfire.

If Schneider had not unexpectedly come across the disease when he did, after the 2004 harvest, then the rust could have severely damaged the 2005 crop.

Schneider, who had been trained just a few months earlier on Asian soybean rust detection, saw the suspicious leaves in a production field on the LSU AgCenter's Ben Hur Research Farm. He had been giving a tour to a visiting Illinois farmer.

But Schneider is not the only hero in this story. Many people contributed to this remarkable call-to-arms. Most notably is Clayton Hollier, extension plant pathologist and the southern region's principal investigator for the pest detection network.

When Schneider returned to his laboratory from the field on that fateful day, he called Hollier. This was on a Saturday evening. Hollier met him at the lab and helped prepare samples to send to a national laboratory in Beltsville, Md., where the DNA could be officially confirmed as Asian soybean rust and not one of several look-alikes.

Fortuitously, Hollier and colleagues had just two weeks before finished a response and action plan in case Asian soybean rust was found in Louisiana.

"We knew it was coming. But we didn't think it would be here for maybe another couple of years," Hollier said.

Hollier and David Boethel, vice chancellor for research, followed the plan and notified key people, including the Louisiana Department of Agriculture and Forestry and the U.S. Department of Agriculture Animal Plant Health Inspection Service (APHIS). Then, everyone anxiously awaited the lab test results, which takes several days.

"It was like waiting for a baby to be born," Schneider said.

Finally, early on a Wednesday morning (Nov. 10, 2004), APHIS top officials in Washington, D.C., said yes it's rust, called a press conference to alert the world, and dispatched a team to Baton Rouge to figure out the next step.

The group included an agent with the Federal Bureau of Investigation. Because of its destructive nature, Asian soybean rust is on a list of substances that could be spread purposely by bioterrorists.

And this was the main objective of the team – to find out how the rust got here. The LSU AgCenter's plan provided the group with a framework for working through the dilemma in a systematic, scientific manner. Though the scientists believed the August hurricanes spread it, they had to prove that. They dispersed in groups to look for evidence within a 100-mile radius of Baton Rouge.

Suspicious samples were sent to Beltsville, and early the next week, rust was confirmed in several locations that did indeed match the path of the hurricane winds.

Because of the timely discovery, American soybean farmers are on alert to comb their fields for any symptoms of the disease and make sure they have enough fungicide available to fight it, if found. They also can factor in the cost of those fungicides, which are among the most expensive farm inputs, should they need them.

Forewarned is fore-armed. And that's what America's farmers are – thanks to Ray Schneider and the LSU AgCenter. ■ **Linda Foster Benedict**

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ON THE COVER: *As part of the effort to find out how widespread Asian soybean rust was in Louisiana, Ray Schneider and other scientists hunted for the disease in a 100-mile radius of Baton Rouge on Thursday, Nov. 11, 2004. Schneider is the LSU AgCenter plant pathologist who discovered the disease several days earlier and touched off an international flurry of activity. His discovery was the first in North America. The disease had been spreading around the world from its origins in China. This photo was taken in a soybean field in St. James Parish by Mark Claesgens.*

What's New?

Photo by Mark Claesgens

Charles Looney, second from right, has established a new graduate assistantship in animal sciences at the LSU AgCenter. The first recipient is Casey Ballard from Atlanta, Texas, center. Looney received a Ph.D. in animal sciences from LSU under the direction of Robert Godke, at right. Ken Koonce, left, is the dean of the College of Agriculture, and Paul Humes is the head of the Department of Animal Sciences

Looney funds animal sciences assistantship

Charles R. Looney, president and founder of OvaGenix of Bryan, Texas, has established a graduate assistantship in the Department of Animal Sciences. The first recipient is Casey Ballard from Atlanta, Texas, who began his program of study fall semester 2004.

Looney received his Ph.D. from LSU in 1983 in reproductive physiology, a program established by Robert Godke, his major professor.

"The best opportunity for success is right here," Looney said of the LSU AgCenter's Embryo Biotechnology Laboratory, which is part of the Reproductive Biology Center near St. Gabriel, La., where Ballard will conduct his research. "This is one of the leading scientific centers in the world."

The two-year assistantship will lead to a master's degree and includes the cost of research support and supplies, said Richard Denniston, the center's director. Ballard, who is a graduate of Texas A&M University, will concentrate his studies on the use of cryopreservation in Brahman breeding. Cryopreservation, a process of subjecting live tissue to extremely low temperatures, is used in the cattle industry as a way to preserve embryos.

"We have limited success in trying to cryopreserve the embryos from Brahman cattle," Denniston said. "We need to find out why. Cattle breeders are much more successful with Angus, for example."

Cryopreservation in animal breeding is extremely important, Denniston said, because of new restrictions on transporting cattle across state lines and international borders.

"The threat of BSE has changed the rules," Denniston said. BSE stands for bovine spongiform encephalopathy, also known as mad cow disease. A few instances of this disease in recent years have had devastating effects on the cattle industry.

Brahman and Brahman-influenced cattle make up 60 percent of the cattle population in the world, Denniston said.

OvaGenix, which began operation in 1999, is a biotechnical company specializing in cattle breeding.

■ **Linda Foster Benedict**

'Golden' rice could help reduce malnutrition

LSU AgCenter researchers are assisting a humanitarian group with a genetically engineered product known as "golden" rice that could help reduce malnutrition. The rice was grown in tests at the Rice Research Station in Crowley, La., in the summer of 2004 – the first such testing in the world. It has been genetically modified to produce beta-carotene, which humans convert to vitamin A. The distinctive amber hue from beta carotene led to its name.

Vitamin A deficiency causes numerous health problems, including blindness and a weakened immune system.

In 1999, scientists in Europe successfully inserted genes from daffodils and bacteria into rice DNA. Those cause rice to express beta carotene.

In 2001, scientists in Japan inserted the genes into the Cocodrie rice variety, which was developed at the AgCenter in 1998. It has become the most widely used variety of rice grown in the United States.

After evaluation and seed increase in growth chambers and greenhouses, golden rice was brought to the Rice Station to be grown in test plots.

Preliminary results indicate the yield of the genetically modified Cocodrie is comparable to conventional Cocodrie.

"This may not be anything U.S. producers actually grow, but it may be. We don't know what its potential is," said Steve Linscombe, director of the Southwest Region. ■ **Bruce Schultz**

Photo by Bruce Schultz

"Golden" rice, which is fortified with vitamin A, gets its distinctive hue from daffodil genes inserted into its DNA.

What's New?

Top researchers honored

The top research awards presented during the 2004 LSU AgCenter Annual Conference went to Michael Chamberlain, assistant professor in the School of Renewable Natural Resources; Gene Reagan, professor, Department of Entomology; and the corn hybrid test team, led by Steve Moore, professor at the Dean Lee Research Station in Alexandria.

Theresia Lavergne, assistant professor in animal sciences, received the Excellence in Extension Award. Lavergne serves as the state extension poultry specialist. She was instrumental in the development of a broiler litter pasteurization project that has allowed poultry producers to reuse poultry litter – thus reducing the amount of litter being disposed. She also is active with the 4-H program and is the poultry coordinator for the state livestock show.

Chamberlain, a wildlife biologist, received the Rogers Excellence in Research Award, which is made available through contributions from Larry Rogers, former vice chancellor for research. Chamberlain has studied more than 20 species of animals including threatened species such as the Louisiana black bear. He helped develop a relocation plan for the Louisiana black bear, which enjoyed success where other plans had failed. Chamberlain is examining why northern bobwhite quail numbers are diminishing across the South.

Reagan, whose specialty is insect problems in sugarcane, won the Doyle Chambers Research Award, which is presented to a researcher for long-term contributions to science. Much of Reagan's recent work has focused on the Mexican rice borer – a pest already in Texas and expected to make its way to Louisiana. Reagan plays a vital role in the sugarcane variety development team that revolutionized the cane industry with the release of the successful variety LCP 85-384.

The Tipton Team Research Award went to the group that tests corn hybrids for their yield and agronomic performance. In 2004, 92 different hybrids were tested. In addition to Moore, the team includes Mildred Deloach, research associate at the Dean Lee Station; Jim Rabb, professor, and Jose Liscano, research associate, at the Red River Research Station at Bossier City; Rick Mascagni, professor, and Robert Bell, research associate, at the Northeast Research Station at St. Joseph; and Warner Hall, research associate in the Department of Agronomy and Environmental Management.

Sue Hagius, research associate in the Department of Veterinary Science, was selected for the 2004 Outstanding Service Award for Associates.

■ **Linda Foster Benedict**

Photo by Mark Claesgens

Winners of the Tipton Team Award for 2004 are, left to right, Steve Moore, team leader, and Mildred Deloach, research associate, both at the Dean Lee Research Station in Alexandria; Mr. and Mrs. Ken Tipton, the donors (Tipton is a former director of the Louisiana Agricultural Experiment Station); Jim Rabb, professor at the Red River Research Station in Bossier City; Warner Hall, research associate in the Department of Agronomy and Environmental Management; Rick Mascagni, professor, and Robert Bell, research associate, at the Northeast Research Station in St. Joseph; and Jose Liscano, research associate at the Red River Station.

Jack Hamilton endowed chair created

The LSU AgCenter will have a $1 million endowed chair in cotton production as the result of industry donations honoring a man who was a driving force in Louisiana cotton production.

The Jack Hamilton Chair in Cotton Production will be a memorial to Hamilton of East Carroll Parish, an innovator and major player in the cotton industry, until his death in 2001.

Donations totaling more than $600,000 qualify the chair for state matching funds in the amount of $400,000 through the Louisiana State Board of Regents.

Hamilton's activities included serving as an organizer and president of the Louisiana Cotton Producers Association and as president and chairman of the board of the National Cotton Council of America. A native of Mississippi, Hamilton was an LSU graduate and lived in Lake Providence for many years.

The person named to the Hamilton Chair must have demonstrated excellence in cotton production research and must have a research program showing potential to provide significant contributions to improving the productivity, profitability and environmental friendliness of the Louisiana cotton industry. This person will be named later in the year.

■ **Tom Merrill**

Tiny rice pest discovered

Boris Castro, LSU AgCenter entomologist, has discovered a new pest of rice – a tiny fly.

And Howard Cormier, LSU AgCenter county agent in Vermilion Parish, said the insect's damage was devastating on two fields he inspected last year.

Castro said the pest has so far been referred to as the rice whorl maggot because of its similarity to a fly in Asia that afflicts rice fields there. But he said a taxonomist at the Smithsonian Institution has concluded this fly probably is a new, unidentified species.

Castro said research this year will include spraying different insecticides, which are already labeled for other rice pests, on test plots where the insect is found. ■ **Bruce Schultz**

Slowing Down the Mexican Rice Borer

The Mexican rice borer has been the major economic pest in Texas sugarcane since it became established in 1980, quickly surpassing that same year the sugarcane borer in economic importance. Even though the insect has not yet been found in Louisiana, scientists from both states and from the U.S. Department of Agriculture are working together to conduct research on the areawide population dynamics of the Mexican rice borer and to develop cultural and production practices to slow down its spread.

New discovery of Mexican rice borer moths in the main Texas rice area, 2000-2004.

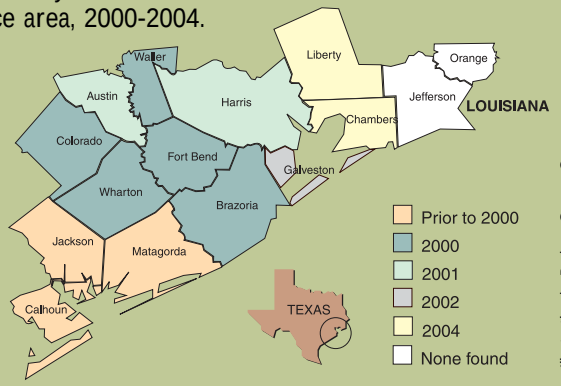


Illustration by Barbara Groves Corns

T. Eugene Reagan, Francis P.F. Reay-Jones, Ben Legendre, M.O. Way and José Amador

LSU AgCenter scientists have joined forces with Texas A&M University scientists to address Mexican rice borer problems in sugarcane and rice. The first mission was to monitor Mexican rice borer movement through the Texas Rice Belt and cooperate with state regulatory agencies to protect the Louisiana sugarcane and rice crops from invasion by the new pest.

The Mexican rice borer is a devastating pest of sugarcane and a serious pest of rice that cannot be controlled (at least in sugarcane) with insecticide sprays. Basic life cycle biology of the Mexican rice borer has been studied mainly on sugarcane, which has suffered from severe infestations in Texas. The majority of female moths lay eggs (oviposit) on dried sugarcane leaves on the lower part of the plant, where they are relatively protected from predation and parasitism. The spherical, cream-colored eggs are laid in groups of 5 to 100. Young larvae quickly migrate from the oviposition site to bore into green and moist parts of the plant suitable for feeding. Toward the end of development, the larvae have tunneled in the stalk both vertically and horizontally.

Pupation takes place in tunnels after mature larvae have constructed an emergence window covered by one or two layers of plant tissue. This is a relatively protected environment compared to the sugarcane borer, which produces a hollow cavity and is therefore more accessible to parasites and predators. It is also another reason why insecticide applications are less effective in Mexican rice borer control.

The insect is active throughout the growing season in the Lower Rio Grande Valley of Texas, where many of the larvae continue to feed, develop and complete all phases of the life cycle (including oviposition) through the winter months not only in sugarcane, but in many of its alternate hosts as well.

Host Preference

One way of developing a crop resistant to the Mexican rice borer is to select a variety less attractive for egg laying (oviposition). To supplement field research at Ganado and Eagle

Table 1. Oviposition preference estimates of the Mexican rice borer from greenhouse experiments, Weslaco, Texas, 2003-2004.

Crop	Variety	Stage	Stress (sugarcane only)	Oviposition preference estimates[1]
Sugarcane	LCP 85-384	5 internodes	Nondrought-stressed	0.533
			Drought-stressed	1.000
		11 internodes	Nondrought-stressed	0.851
			Drought-stressed	0.803
	HoCP 85-845	5 internodes	Nondrought-stressed	0.324
			Drought-stressed	0.682
		11 internodes	Nondrought-stressed	0.338
			Drought-stressed	0.805
Rice	Cocodrie	Tillering 3-4 leaves		0
		Tillering 6-7 leaves		0.121
		Boot		0.250
		Heading		0.487
	XL8	Tillering 3-4 leaves		0
		Tillering 6-7 leaves		0.607
		Boot		0.362
		Heading		0.561

[1]Standardized oviposition preference estimates ranging from 1.000 (most attractive treatment) to 0.000 (least attractive treatment) based on number of eggs laid per plant adjusted for across experiment variability. Mean number of eggs laid on the most attractive stage was 521, and zero for least attractive. Thirty pairs of moths were released per cage, four treatments (stages and condition of crop) per cage.

T. Eugene Reagan, Austin C. Thompson Endowed Professor, and Francis P.F. Reay-Jones, graduate research assistant, Department of Entomology, LSU AgCenter, Baton Rouge, La.; Ben Legendre, professor and sugarcane specialist, LSU AgCenter St. Gabriel Research Station, St. Gabriel, La.; M.O. Way, associate professor and rice specialist, Texas A&M University Agricultural Research and Extension Center, Beaumont, Texas; and José Amador, professor and director, Texas A&M University Agricultural Research and Extension Center, Weslaco, Texas.

Photo by Gene Reagan

Split sugarcane stalk with Mexican rice borer frass-packed tunnels.

Lake, greenhouse studies were conducted at the Weslaco Center involving different stages of sugarcane and rice. Two sugarcane varieties, LCP 85-384 and HoCP 85-845, under different water stress conditions, and two rice varieties, Cocodrie and the rice hybrid XL8, were selected.

Data in Table 1 are based on studies in which different developmental stages of sugarcane and rice were exposed to ovipositing moths. Sugarcane was more attractive than rice, and LCP 85-384, which represents 90 percent of Louisiana sugarcane acreage, was the most attractive variety. On sugarcane, the moths laid eggs only on brown leaves or brown tips of leaves. Drought-stressed sugarcane was more attractive because of increased numbers of dry leaves.

Rice generally was less attractive than sugarcane with no oviposition on the 3-4 leaf tillering stage. However, contrary to sugarcane, oviposition on rice did not occur exclusively on dry leaves, with a major portion of egg masses laid on green leaves or inserted behind leaf sheaths. Changes in chemical physiology associated with plant stage and variety were more important in explaining ovipositional preference differences in rice. Field studies are showing that modifying rice planting dates may help to avoid critical periods when yield loss from stem borers is most severe.

Variety Resistance

Criteria for field assessment of resistance to the Mexican rice borer in sugarcane include percentage bored internodes and adult emergence holes, the latter used to determine the relative impact each variety has on the potential areawide buildup or reduction of adult Mexican rice borer populations.

Table 2. Mexican rice borer injury and adult moth production in Louisiana sugarcane varieties grown at Ganado, Texas, 2002.

Variety	% bored internodes	Adult moth emergence/acre
LCP 85-384	67	45,447
HoCP 96-540	62	42,749
HoCP 91-555	58	66,841
HoCP 85-845	47	25,372
NCo 310	36	21,481
CP 70-321	28	15,846

As shown in Table 2 from an experiment at Ganado, Texas, variety CP 70-321 was the most resistant. LCP 85-384 was the most susceptible, substantially more susceptible than NCo 310, traditionally the most susceptible variety grown in the Lower Rio Grande Valley of Texas. It is encouraging to note that there is biological resistance to this pest. However, the domestic sugarcane breeding programs have not yet taken full advantage of this germplasm in developing high yielding varieties resistant to the Mexican rice borer.

Stem borer host plant resistance studies conducted in rice each of the last several years have included both commercially produced and experimental varieties with insecticide treated (two applications of Karate Z) and untreated plots in a four replication experiment. Using number of whiteheads (borer killed panicles) and yield, Priscilla was consistently the most susceptible, followed by Cocodrie, Jefferson and Cypress. In addition to Cheniere, the

Photo by Francis Reay-Jones

Female Mexican rice borer moth on a rice plant in the greenhouse at Weslaco, Texas.

Photo by Gene Reagan

Mexican rice borer pheromone trap at a rice field at Jacko Garrett's farm in Brazoria County, Texas.

Monitoring of Pheromone Traps and Regulatory Actions

Tad Hardy, T. Eugene Reagan and M.O. Way

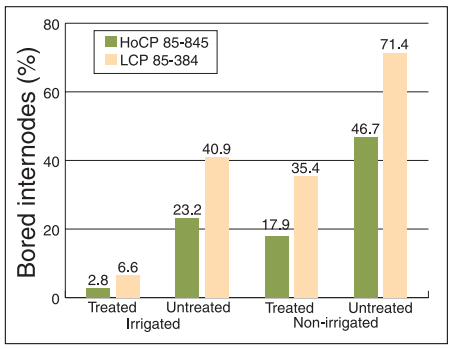
During the winter of 1999, the Louisiana Department of Agriculture and Forestry (LDAF) entered into a compliance agreement with the Texas Department of Agriculture (TDA) concerning a pheromone trapping protocol that would allow sugarcane produced in Southeast Texas to be transported to mills in Louisiana for processing. The compliance agreement specifies that any Mexican rice borer found in Southeast Texas would automatically initiate a 1-mile radius quarantine on sugarcane around any trap capture or larval discovery location.

On Sept. 2 and 20, and again on Oct. 2, 2004, Mexican rice borer moths were observed in two research project traps (a total of six moths) near Winnie in Chambers County, Texas.

Until the recent find, monitoring conducted by the TDA near Southeast Texas sugarcane during the summer and fall employed 10 to 24 pheromone traps annually (since 1999). The LDAF program conducted in Western Louisiana and adjacent to sugar mills processing Texas sugarcane initiated their annual study with 12 pheromone traps in 1999, increasing to 22 traps in 2003 and 40 traps in 2004. Traps are deployed adjacent to both sugarcane and rice fields and sugar mills. They are maintained in the field until harvest or processing is complete.

Bucket traps with a male pheromone attractant lure suspended above the bucket funnel are used in the program. Traps are hung from metal posts and checked several times each month. ■

Figure 1. Percentage of bored internodes of sugarcane from irrigation/variety/insecticide study on November 1, 2003, at Ganado, Texas.



hybrid varieties XL8, CLXL8, XP723 and CL161 were the most resistant.

Multiple Tactic Management Studies

A two-year field study also assessed the role that irrigation, when used in combination with variety selection and insecticide application, plays on the effective management of the Mexican rice borer. To achieve the degree of insecticidal control shown in Figure 1, seven applications of Confirm (tebufenozide) were sprayed every two weeks (June to mid August). In this four replication test, the untreated (nonirrigated) LCP 85-384 had greater than 70 percent bored internodes, compared to nearly 40 percent under the heavy insecticide pressure.

Irrigation reduced injury levels in both varieties, which can be explained by the decreased attractiveness for oviposition on nonstressed sugarcane. Injury in both resistant and susceptible varieties still exceeded 20 percent and 40 percent bored internodes, respectively, in untreated, irrigated plots. As shown in Figure 1, only when all management tactics were used was injury suppressed below 10 percent (LCP 85-384) and 5 percent (HoCP 85-845).

Summary

Studies in the Mexican rice borer program collectively have emphasized the value of employing multiple tactics used in combination to manage insect pest infestations. If the crop plants can be made less attractive to the pest through resistant varieties or healthier management, the use of insecticides, when they work, can be more efficient. Another factor which enhances the permanency of an integrated pest management program (IPM) is the importance of achieving a balance among the use of diverse control tactics. If an overemphasis on any tactic (especially insecticides) can be reduced, the selection pressure on the pest population is also reduced, enhancing the permanency of the IPM system. This often includes biological control to conserve and enhance predators and parasites maintaining lower pest populations.

For Louisiana, the anticipated problems with the Mexican rice borer will continue to demand a team approach with areawide perspectives both in sugarcane and rice. We want to develop and implement practices that not only protect the host crops, but also reduce pest populations. ■

Photo by Ben Legendre

Gene Reagan, second from right, and Louisiana extension agents Rick Louque, left, Assumption Parish, and Jimmy Flanagan, St. Mary and Iberia parishes, observe Mexican rice borer moths caught in a pheromone trap next to a sugarcane field in Chambers County, Texas (Sept. 20, 2004). Because of the urgency of the problems with the Mexican rice borer (all work had to be conducted in Texas where the pest occurs), site visit field days for sugarcane and rice consultants and county extension agents were at a field study location near Ganado, Texas, during September of each of the past three years.

Acknowledgments

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Economics of the Mexican Rice Borer

Francis P.F. Reay-Jones, Dale K. Pollet and Ben Legendre

The Mexican rice borer was first detected in the Lower Rio Grande Valley of Texas in 1980. The insect caused yield reductions in sugarcane of up to 50 percent before the end of that year and now represents more than 95 percent of the sugarcane stalk borer population in the valley.

Surveys in commercial sugarcane fields during the early 1980s showed an average of 62 percent bored internodes because of Mexican rice borer damage, and some fields were not harvested because yield reductions were greater than expected returns. Following the first year of discovery, management efforts resulted in a gradual reduction in damage to an average of 26 percent bored internodes by the end of the decade. Since then, the averages are around 20 percent.

For nearly two decades, Texas A&M scientists focused on biological control, importing exotic parasites for mass release. Estimates of the effects of borer damage on revenue, based on a 20 percent level of bored internodes, were determined to be $233 per acre when considering the producer's loss, and as much as $478 per acre when considering the effect on all involved parties (producer and mill).

In rice, yield losses in certain replicated experiments conducted in the Texas Rice Belt have exceeded 50 percent, with especially severe damage in the ratoon crop. This insect, referred to locally as the "nightmare that we don't want in Louisiana," may become real anyway; thus, our efforts are focused on doing all things possible to delay this reality. ■

NONI TREE

Potential cancer preventative, therapy

Zhijun Liu, Conrad Hornick and Eugene Woltering

Current technologies for the prevention and treatment of cancer are far from being effective at safe, non-toxic doses. Standard chemotherapeutic drugs are all designed to be toxic, harming cancerous and healthy tissues to varying degrees. Targeted therapies such as angiogenic inhibitors directed toward specific receptors or growth-factor pathways offer great hope in managing cancer. Angiogenesis is the process by which new blood vessels grow. All adult angiogenic processes are caused by disease with the exception of a few physiological processes like menses and placental formation. Tumors cannot grow beyond the size of 0.08 inch without first inducing new blood vessel formation. Inhibiting angiogenesis can thus prevent cancer from developing beyond the simple limits of diffusion for oxygen and nutrients.

Scientists at the LSU Health Sciences Center discovered that noni (a tree) fruit juice can inhibit angiogenesis in their human tissue-based Human Placental Vein Angiogenesis Model (HPVAM). Noni juice completely blocked the angiogenic response in this test at 10 percent by volume but was only partially active at a lower concentration. This discovery is certainly exciting since noni fruit is a commonly used dietary item, which minimizes safety concerns.

Noni (*Morinda citrifolia*) is a Polynesian folk medicine and enjoys a safe and long history of human use. Bark, stem, leaves, roots and fruits have been traditionally used as folk remedies to treat diseases such as hypertension, diabetes and cancer, and are additionally used today for boosting one's immune system. Noni trees are widely cultivated in many parts of Polynesia and Hawaii.

Noni juice has potential as a perfect cancer preventative for long-term use, despite its unpleasant taste. However, turning this discovery into a practical cancer therapy presents two major obstacles, both typical in the use of botanical extracts for healthcare and therapeutics. First, botanical extracts are either not standardized or standardized without reference to the active ingredients. This has been a key flaw in the quality control of botanical extracts. Manufacturing without knowledge of what is responsible for anti-cancer activities in the noni juice extract risks the loss of the key ingredients in the

Photo by Mark Claesgens

Dr. Zhijun Liu with a noni tree in an LSU AgCenter greenhouse. The noni tree, which is also called Indian Mulberry, has a long history as a source of herbal remedies in the tropical areas of the South Pacific.

Zhijun Liu, Associate Professor, School of Renewable Natural Resources, LSU AgCenter, Baton Rouge, La.; Conrad Hornick, Professor, Department of Physiology, LSU Health Sciences Center, New Orleans, La.; Eugene Woltering, James D. Rives Professor, Department of Surgery, the Stanley S. Scott Cancer Center, the Neurosciences Center of Excellence, and the Veterans Administration Medical Center, LSU Health Sciences Center, New Orleans, La.

Photo by Zhijun Liu

Each noni fruit displays a cluster of small, white, five-petal flowers.

process and results in inconsistent clinical anti-cancer effects. The commercial availability of multiple brands further complicates things for potential users of this product. To be effective, the active ingredients must be concentrated enough to achieve a therapeutic effect. Extrapolating from current anti-angiogenic studies, if we assume a therapeutic dose of one quart a day, this translates into 180 capsules (500-milligram) a day of freeze-dried, powdered noni juice. A dose of 180 capsules a day is not a practical therapy for cancer.

To overcome these obstacles, a series of experiments was conducted at the LSU AgCenter and the LSU Health Sciences Center. First, we attempted to characterize the active fractions of noni juice. Fractionation of noni juice was performed with column chromatography under the direction of HPVAM tests. Initial fractionation found that one of four fractions (F4) was active. This active fraction was subjected to a second round of fractionation. That subfractionation resulted in the active sub-fraction S100. S100 was subjected to additional fractionation, and two sub-sub-fractions were found to contain active ingredients. Chemical fingerprinting of these fractions gave us a template of key ingredients that must be present in noni products to create an antiangiogenic effect.

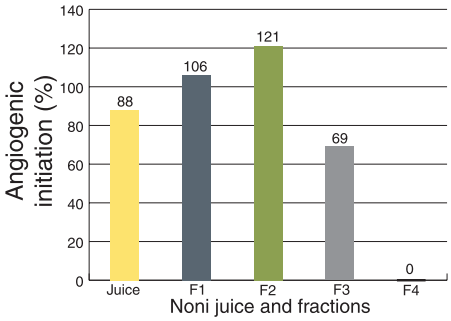
Currently, isolation and purification of these active compounds are being performed. The isolated and purified compounds will be structurally described by using nuclear magnetic resonance and mass spectrometry at the LSU Chemistry Department's facilities in Baton Rouge. Once the active compounds are known, they will be used as chemical markers to standardize the extract.

The use of the fractionation processes revealed that 1) noni juice contains more than one active compound responsible for the observed antiangiogenic activity and 2) the active ingredients are in very low concentrations. Clearly, we need to develop a commercially viable processing method that can retain and raise all the active ingredients to therapeutic concentrations.

As the first step in this process, we developed a simple, single-step method to derive a highly concentrated noni extract called Super Noni. Super Noni represents 3 percent by weight of native, freeze-dried noni juice. At a 0.1 percent solution, the Super Noni extract completely inhibited human angiogenesis (Figure 1), whereas 10 percent by volume of native, freeze-dried and reconstituted noni juice was required to produce the same antiangiogenic effect. This increased potency of 100-fold is due to the removal of 97 percent of the inactive ingredients in the noni juice, yielding a net 33-fold increase in the concentration of active ingredients. This disproportionate increase in potency may have occurred because some substances that nullify the effects of angiogenesis may have been removed during processing or possibly as a result of a synergistic effect among the active ingredients in the Super Noni extract.

Assuming a therapeutic dose of one quart a day (equivalent to 3.17 ounces of freeze-dried noni juice powder), one would require 180 capsules (500 milligrams) a day of the noni juice but only six capsules (about 0.2 ounces) of Super Noni extract a day. Thus, the Super Noni product is extremely practical for clinical use. An antiangiogenic extract may not be therapeutically effective if underdosed, and this underdosing is most likely to be caused by low levels of the active ingredients in the extract. Yet large doses (for example, 180 capsules a day) are not feasible. The exact therapeutic dosing regimen will have to be determined in human clinical Phase I trials, but it is obvious that this refined noni extract offers a great advantage in designing clinically effective yet practical dosing regimens for cancer therapy and prevention trials.

Figure 1. Angiogenic initiation (%) affected by exposure to noni juice and its fractions after 14 days of co-culture in a human tissue based angiogenesis tests. Noni juice showed 12 percent inhibition to human angiogenesis at 0.1 percent, whereas fraction F4 displayed a total inhibition. Fractions F1 and F2 appeared to be proangiogenic–stimulating angiogenesis.



The Super Noni concept makes commercial sense and presents a viable commercial opportunity for product development in the area of medical foods and nutraceuticals.

The collaborative work of these researchers presents convincing scientific evidence and a botanical prototype product for treatment and prevention of re-occurrence of tumors, malignant or benign, that rely on angiogenesis to grow and spread. A method is being developed in tissue culture settings to propagate noni plants. Since noni is a tropical plant, cultivation of this plant will have to be limited to greenhouses in Louisiana. ■

Photo by Mark Claesgens

Noni Maui is one of several brands of noni juice that are produced and distributed throughout the world as a natural tonic.

What Homebuilders Think of Southern Yellow Pine Lumber

Michael A. Dunn, Richard P. Vlosky and Todd F. Shupe

Photo by Rich Vlosky

Southern yellow pine has for many years provided the homebuilding industry with abundant, cost-competitive wood products. Recent research indicates that softwood lumber, including southern yellow pine, continues to lose market share in the U.S. residential construction industry and that builders remain concerned about softwood lumber quality and price.

Southern yellow pine (SYP) has for many years provided the homebuilding industry with abundant, cost-competitive wood products. Recent research indicates that softwood lumber, including SYP, continues to lose market share in the U.S. residential construction industry to substitute products such as concrete, steel and plastic and that builders remain concerned about softwood lumber quality and price. Further, some studies have reported that different user groups perceive that lumber quality in general has decreased in recent years.

To ascertain homebuilders' perceptions of SYP lumber quality, a questionnaire was sent to the largest 500 homebuilders in the United States as measured by sales in 2000. Of the 500 homebuilders sent surveys, 198 responses (40 percent) were received and used in the study. Respondents were relatively well-dispersed throughout the United States (Figure 1). The highest region of response came from the southern region (39 percent) and the lowest region of response was the northeast region (14 percent).

Homebuilders responding to the survey perceive that the quality of southern yellow pine (SYP) lumber has changed over the past 50 years. Nearly half (48 percent) stated that they believe SYP quality has declined. Another 15 percent stated that quality has stayed the same, while 9 percent stated that quality has improved. Twenty-six percent responded that they did not know or were unsure.

Those that responded that SYP quality had declined over the past 50 years were further asked their opinions on why the quality had declined. Sixty-eight respondents stated that SYP warps in service, while another 47 stated that SYP trees are grown too fast. Thirty-five stated that it is kiln-dried too rapidly, and 34 stated that SYP has too many knots.

Respondents were asked to rank criteria used in building new houses based on their perceptions of the importance of various items to homebuyers (Figure 2). Respondents ranked each criterion on a scale of 1 to 5, with 1 signifying "not important at all" and 5 signifying "very important." Respondents ranked all of the seven criteria above the midpoint (3.0) in level of importance. Of the 182 responses, housing cost (4.5), resale value (4.4) and energy efficiency (4.2) were cited as most important. Resistance to flooding (3.2), followed by absence of chemicals (3.5), wind damage resistance (3.7) and insect damage resistance (3.9) were cited as relatively less important.

Respondents were asked to rank on a scale of 1 ("not at all") to 5 ("significantly") growing conditions that might influence wood quality. The factors were soil, rainfall, proximity to municipal landfills, growth rate, tree straightness and

Figure 1. The responses used in the study were relatively well dispersed throughout the United States.

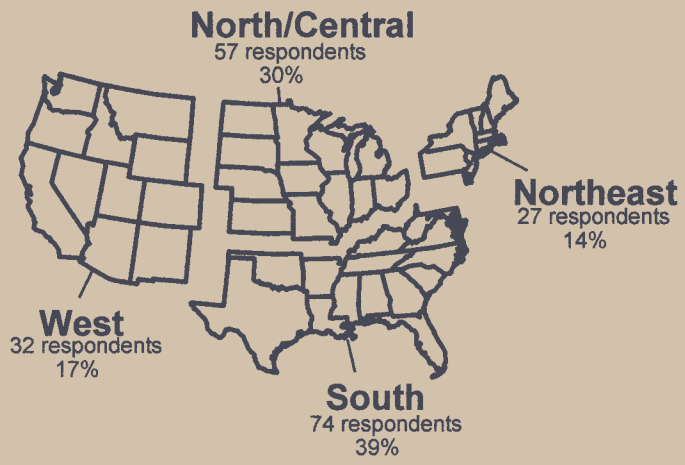
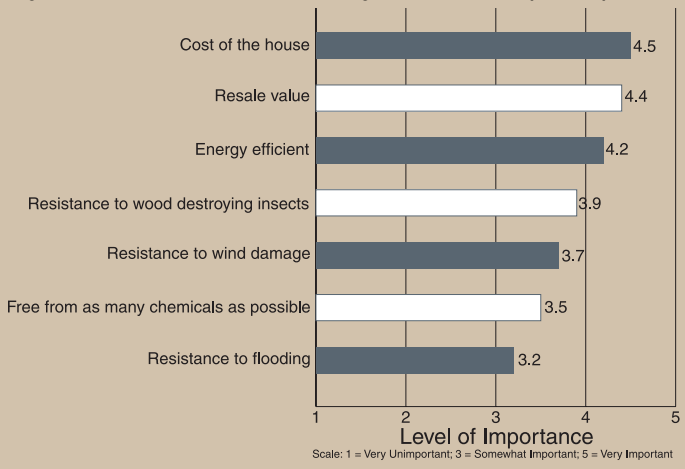


Figure 2. Criteria used in building a new house (n=182)



Michael A. Dunn, associate professor, Department of Agricultural Economics and Agribusiness; Richard P. Vlosky, professor; and Todd F. Shupe, associate professor, School of Renewable Natural Resources, LSU AgCenter, Baton Rouge, La.

Photo by Rich Vlosky

More survey respondents said they use Southern yellow pine for structural components in the construction of a new house than for any other reason. Other popular applications included decks, landscaping timbers, outdoor structures and interior walls.

geographic location. The most important criterion was tree straightness (4.2) followed by rainfall (4.1), rate of growth (3.9), soil (3.7) and geographic location (3.6).

In a related question, 72 percent of respondents stated that wide rings negatively affect lumber quality either somewhat or significantly, while 10 percent thought they had no effect. Another 18 percent did not know whether or not wide rings negatively affect lumber quality. Also, 74 percent of respondents felt that rate of tree growth affects lumber quality, while 10 percent said it did not, and 16 percent did not know.

Respondents were also asked to rate the importance of species selection in specifying projects. Fully 64 percent of respondents replied that species selection was either somewhat important or very important. Twelve percent replied that this criterion was either somewhat unimportant or extremely unimportant.

More than half of the respondents had a somewhat positive (40 percent) or extremely positive (13 percent) perception of SYP. Eight percent of respondents expressed a somewhat negative (6 percent) or extremely negative (2 percent) perception of SYP. Twenty-eight percent of respondents rated SYP as either somewhat superior (21 percent) or extremely superior (7 percent) to other species of lumber, while 15 percent rated SYP as somewhat inferior (11 percent) or extremely inferior (4 percent) to other species of lumber.

Respondents were further asked their willingness to build a house using SYP. Eighty-three percent responded that they would be willing to use SYP in housing construction while 17 percent said they would not. Of the 17 percent that responded negatively, 35 percent stated that it is a poor building material, 24 percent stated that its long-term performance is unknown, 20 percent stated cost and 20 percent stated warp as deterrents.

Respondents indicated a variety of applications where they use SYP (Figure 3). More respondents use SYP for structural components in the construction of a new house than for any other reason. Multiple responses were possible for this survey question. Other popular applications of SYP included decks, landscaping timbers, outdoor structures and interior walls.

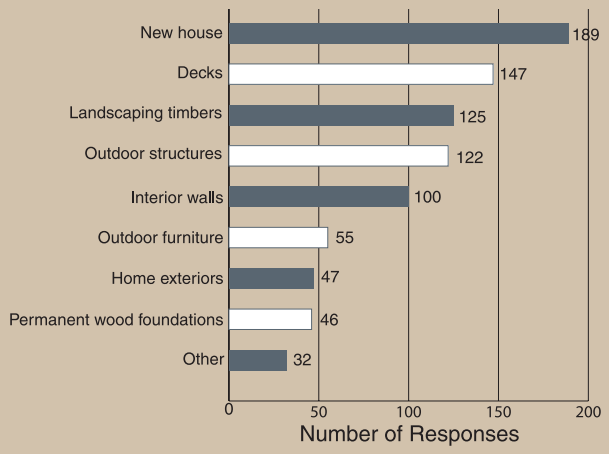
Results indicate that homebuilders perceive that homebuyers are most influenced by economic factors associated with construction. In all regions of the country, respondents list cost of the house, resale value and energy efficiency as key factors. Other factors that might be perceived by some to be more important in particular regions (for example, resistance to termite damage in the South or resistance to wind damage in the north central region) were not given significant importance to replace traditional economic factors as top priorities. This indicates that homebuilders are still guided by traditional cost factors in determining the makeup of the constructed unit.

The majority of homebuilders participating in the survey view SYP favorably. Further, a large majority state they are willing to use SYP in the construction of houses. However, there are indications they perceive the quality of SYP products to be declining. As long as SYP remains price competitive with its substitute products and homebuilders perceive it to be a quality product, it will likely maintain a strong market share.

On the other hand, producers of SYP lumber can likely improve market share for their product if they can develop appropriate marketing strategies that tout their product's performance and price. It is possible that a niche market could be established for dense, slow-grown SYP lumber; however, it is more likely that fast-grown SYP lumber is here to stay.

The industry could be well-served by developing innovative marketing strategies that emphasize how lumber grading rules ensure structural integrity and design reliability for the builder or other end-user. The key is consumer education. When lumber consumers are better educated regarding lumber grade rules, the effects of moisture on basic wood properties, and when and how to select and use preservative-treated lumber, their understanding of lumber's uses and benefits could lead to an even more positive perception of the product. ■

Figure 3. Applications where Southern yellow pine was used by respondents (multiple responses possible).



Helping Honduras' Forest Products Industry Recover from Hurricane Mitch

Photo by Rich Vlosky

Sparse forest cover between Tegucigalpa, the capital of Honduras, and San Pedro Sula, the second largest city in the country. A principal port and the major industrial and commercial city of Honduras, San Pedro Sula was significantly damaged by Hurricane Mitch in 1998.

Michael A. Dunn and Richard P. Vlosky

Because of the significant impact of Hurricane Mitch in October 1998 on the entire agricultural sector in Honduras, representatives of the LSU AgCenter contacted Honduran President Carlos Flores to offer assistance to and collaboration with the Ministry of Agriculture and Livestock.

In February 1999, the LSU AgCenter was invited to send a team of faculty for assessment purposes. In addition, the LSU AgCenter joined the Louisiana/Honduras Alliance, which was formed in April 1999. This alliance was a comprehensive economic development partnership that brought together the resources of Louisiana State University, Tulane University, Loyola University, the University of New Orleans, and the Honduran public and private sectors in a united effort to rebuild Honduras.

The forest-sector project, primarily a technical transfer effort, focused on areas including forest products utilization and processing, economic and rural development, marketing and business development, and value-added wood processing. To accomplish this, the LSU AgCenter assembled a team of specialists to work with counterparts in Honduras in each of these areas. The primary objective of the forest-sector project was to empower people from many stakeholder groups to better utilize forests in a productive and sustainable manner that would contribute to local economic development.

In May 2001, the LSU AgCenter forest-sector team began working with the Fundacion para la Inversion y Desarrollo de Exportaciones (FIDE) to help craft a set of strategic recommendations for forest sector investment and development. FIDE is a private, nonprofit institution created in 1984 to promote investment in Honduras and encourage development in the export sector. The foundation also works closely with the government to create and advocate legislation aimed at improving the Honduran business climate. Today, FIDE's mission is to promote sustainable development in Honduras by strengthening investment and exports through constant improvement of the country's international competitiveness.

The first step was to review forest industry documents generated by FIDE over the past five years. These documents were generally consulting studies that examined different aspects of strategic and investment opportunities in the Honduran forest industry. The recommendations and major conclusions contained in each document were translated into English and compiled into a comprehensive list, which was further categorized by major area or issue and then narrowed to 25 priorities.

The next step was to conduct a multi-stakeholder prioritization exercise facilitated by the LSU AgCenter team. The top 25 recommendations submitted by FIDE were the starting point.

Michael A. Dunn, associate professor, Department of Agricultural Economics and Agribusiness, and Richard P. Vlosky, professor, School of Renewable Natural Resources, LSU AgCenter, Baton Rouge, La.

However, participants at the meeting had the opportunity to add to the list. This process had two components. First, the group prioritized the recommendations and, second, ranked them as to probability of being accomplished ("doability"). (Figure 1)

The top-ranked recommendation was to conduct market research that could help to identify market opportunities for Honduran wood products producers. Second-ranked was the need to develop a comprehensive national marketing strategy and implementation plan.

The third highest ranked item was the need for government involvement in forming the foundation for industry development at the national level. This was followed by the recommendation to form a national forest-sector development council that would have representation from all key stakeholder groups including industry, government, academia, nongovernmental organizations (NGOs), and international consulting support.

Beyond identifying priorities for forest sector development, it was also critical to identify which recommendations were feasible and had a high probability of successful implementation. There was general agreement between what was a priority and what was do-able. The recommendation with the widest gap was "identification of market opportunities," where implementation potential exceeded priority (although this was first-ranked for both). On the other hand, there was a perception that "marketing strategy development" was more easily implemented than its ranking in the prioritization exercise.

When people participate in the recommendation prioritization session, they are most likely to express their concerns as problems. The first step for action planning then is to convert problems into goals.

The next step in the strategic planning support process for the Honduran forest sector will be to break the overall goal into smaller objectives that are reasonably achievable and measurable. Structured planning procedures should produce working plans for addressing issues by goals, objectives, action steps, resources, timeframes and contacts. These working plans should become the foundation of a forest-sector strategy for the next three to five years. They are also the foundation for cross-agency collaboration.

Regardless of the underlying motivation (rural development, adding value, employment enhancement), the recommendation prioritization process is but the first step in a planning framework that can help develop sustainable strategies. For success to be achieved, many stakeholders – including local development organizations, industry members, academic institutions and state and local economic development agencies – must be involved to move from baseline analysis to program implementation.

The ultimate ambition of this project is that the information generated in this first step in forest-sector development planning will be used by legislators and other policy makers in Honduras to provide resources to develop programs that will further forest industry stability and sustainable growth. Whether or not the Hondurans take this next step is up to them. To move forward, they must maintain the momentum developed in this first stage so that they can move their forest-based economy forward in a sustainable manner. ■

Figure 1. Priority versus do-able forest sector development recommendations (number=number of responses).

Photo by Mark Claesgens

Carlos Robert Flores, formerly the president of Honduras (center), meets with Louisiana delegation from public and private institutions following a signing ceremony June 7, 1999, in Tegucigalpa, Honduras. The institutions had pledged to assist the country in recovery efforts following Hurricane Mitch, the worst hurricane to hit the country in 200 years, killing 10,000 people. Representing the LSU AgCenter was Leo Guedry, second from the right. He is the former vice chancellor, now retired. The AgCenter was an early volunteer to propose recovery projects in agriculture, agribusiness and natural resources.

Effects of Defoliation on Field Corn Seedlings

Rhett H. Gable, B. Roger Leonard, Donald R. Cook and Karla T. Emfinger

Photo by Rhett Gable

Seedling corn is susceptible to injury from frost, hail, herbicides and insects. LSU AgCenter researchers simulated defoliation at various growth stages to find out how corn plants would recover.

Several physical, chemical and biological factors can influence corn seedling development and reduce maximum yield potential. Adverse weather conditions, such as frost and hail, can destroy the shoot portions of corn seedlings depending on the time of seeding and growth stage of the plant. Improper herbicide selection or drift from adjacent fields can damage or kill corn seedlings and lower yields. Foliage injury from insect pests can range from minimal leaf injury to complete destruction of the above-ground portion of seedlings.

In Louisiana, producers have adopted practices that reduce the emphasis on tillage and rely heavily on pre-plant burndown herbicide applications to establish clean seedbeds. The shift to these conservation tillage systems has allowed several insect pests to become more consistent problems. The black cutworm and the variegated cutworm are significant pests of field corn and a common problem in no-till fields. Cutworms damage plants by severing the plant stem near the soil line. Another caterpillar pest, the true armyworm, feeds on corn seedlings, completely defoliating the leaf tissue and occasionally feeding on the stems.

Insect injury to the shoot tissue of corn seedlings can result in abnormal plant development, seedling death or a barren stalk. Seedling defoliation also can delay crop maturity and decrease grain yield. During early spring in Louisiana, the field environment is usually not conducive to optimal plant development; therefore, corn plants usually have difficulty compensating for this type of injury and recovering to produce optimal yields.

During 1999 to 2002, studies were conducted at the LSU AgCenter's Macon Ridge Research Station to determine the effect on grain yield of foliage injury to field corn seedlings. To simulate seedling injury caused by caterpillar pests, corn seedlings were defoliated with a gas-powered weed trimmer. Plants were severed within one inch of the soil surface at selected growth stages, ranging from first leaf (V1) through fifth leaf (V5). Each treatment was only applied one time, and the injured plants were allowed to recover for the duration of the growing season. These studies were conducted in several environments (conventional and conservation tillage systems) using multiple varieties of field corn. The test areas were managed in accordance with practices recommended by the LSU AgCenter to optimize crop development and manage pests. Each plot was mechanically harvested to determine treatment effects on grain yield. All defoliation treatments were compared to non-defoliated control plots.

During the four-year test period, seed yields from plants defoliated at growth stage V1 and V2 were not significantly different from yields of the nondefoliated plants. However, significant yield losses were observed when plants were defoliated at the V3 through the V5 growth stages. In 1999, only plants defoliated at the V5 growth stage had significantly lower yields than the nondefoliated plants. In subsequent years, defoliation of the plants at the V3 to V5 growth stages significantly reduced yield compared to the nondefoliated plants. During the testing period, yield losses ranged from 16.7 to 67.3 bushels per acre in defoliated plots compared to the nondefoliated plots.

Early-season defoliation will decrease plant populations when the apical meristem (the growing point in which the leaves and eventually the tassel are initiated) is above the soil line compared to plants with the meristematic tissue below the soil line. Seedling defoliation can kill the primary stalk and cause the plant to produce a secondary stalk (sucker), which

Rhett H. Gable, research associate, and B. Roger Leonard, professor, Macon Ridge Research Station, Winnsboro, La.; Donald R. Cook, research associate, Department of Entomology, LSU AgCenter, Baton Rouge, La.; and Karla T. Emfinger, research associate, Macon Ridge Research Station, Winnsboro, La.

Photos by Rhett Gable

The split stem of two corn seedlings shows the growing point at the V3 (left) and V5 growth stages. Defoliation or stalk injury can kill a corn plant when the growing point is injured.

These corn plants had recovered 18 days after nearly complete defoliation. This study was conducted at the LSU AgCenter's Macon Ridge Research Station in Winnsboro.

usually produces less yield compared to nondamaged plants. Defoliation also may delay crop maturity because of the time required for the plant to compensate for foliage loss.

Early-season seedling defoliation can make replant decisions difficult. Producers typically underestimate the resilience of corn plants after they undergo early-season injury. The studies reported here indicated that plants defoliated at the V1 and V2 growth stage should recover and produce normal yields following nearly complete defoliation before the apical meristem emerges above the soil line. Regardless of the factors causing the injury (frost, hail, herbicides, insects), early-season seedling injury will not always result in a significant yield loss. Corn seedlings will often recover if environmental conditions are favorable. ■

Find corn information at the LSU AgCenter

Each year LSU AgCenter scientists test commercial corn hybrids. Results are compiled and made available every October as a publication and online. The title is "Corn Hybrids for Grain." #2827

Other publications to assist in growing corn are:

- "Aflatoxin Production in Corn by Aspergillus flavus Relative to Inoculatin, Planting Date, and Harvest Moisture in Louisiana" #RR-102
- "Corn Fertilization in Louisiana" #2684
- "Managing Corn and Grain Sorghum Insect Pests" #2284
- "Louisiana's Suggested Chemical Weed Control Guide" #1565 (online only)

These publications are all online free of charge. Hard copies may be obtained at your local parish extension office or by ordering online at www.lsuagcenter.com.

You can also subscribe to the "Louisiana Soybean & Feed Grain Review" free of charge by contacting David Lanclos at the Dean Lee Research Station in Alexandria at (318) 473-6530 or dlanclos@agcenter.lsu.edu.

For Web users, go to www.lsuagcenter.com/grains/corn. The site includes information on demonstrations and variety trials.

Planting Patterns for Different Grain Sorghum Hybrids

Rick Mascagni and Robert Bell

Research has found a consistent sorghum yield response to row widths narrower than 40 inches, particularly on alluvial soils. On Macon Ridge soils, narrow rows tend to yield better than wider rows in years with adequate rainfall, while wider rows are superior to narrow row widths in rain-deficient years. For rows less than 30 inches, crops are generally planted on flat seedbeds, which preclude the use of furrow-irrigation. Raised beds are necessary for furrow irrigation and important for drainage, particularly on heavy clay soils. Multiple rows planted on 40-inch-wide raised beds maintain cultural advantages of raised beds and permit furrow irrigation. Cultural practices such as hybrid selection and seeding rate may interact with row spacing. The objective of this research was to evaluate the influence of row configuration (multiple rows per bed) and seeding rate on yield performance of three grain sorghum hybrids, differing in maturity.

Field experiments were conducted in 2002 and 2003 on Gigger silt loam at the Macon Ridge Research Station at Winnsboro to evaluate the influence of row configuration and seeding rate on yield performance of three hybrids, differing in maturity. Row configurations included single, twin and triple rows on 40-inch-wide raised beds. Single rows were centered on 40-inch-wide beds. Twin rows were approximately 20 inches apart and triple rows were approximately 10 inches apart centered on 40-inch-wide beds.

Hybrids evaluated were the very-early maturing Asgrow Reward, early-maturing Dekalb DK36E, and medium/late-maturing Dekalb DK52. Grain sorghum was planted on April 29, 2002, and April 23, 2003, at seeding rates equivalent to 6, 8, and 10 seeds per foot on single row; 3, 4, and 5 seeds per foot on twin rows; and 2, 2.7, and 3.4 seeds per foot on triple rows. All recommended cultural practices of the LSU AgCenter were followed, including the use of seed treated with the insecticide Gaucho.

Sorghum yields were affected by row configuration in one of two years of this study. In 2003, yields were increased an average of 14 percent by both twin and triple rows. Yields were similar between twin and triple rows. Yield response to multiple rows was primarily due to increased head size. Head size, number of kernels/head, was increased approximately 24 percent by both twin and triple rows. Hybrids responded similarly to multiple rows, regardless of maturity. Optimal seeding rate was the equivalent of 8 to 10 seeds per foot for single row, 4 to 5 seeds per foot for twin row, and about 3 seeds per foot for triple row.

This study indicates that planting multiple rows on raised beds may be beneficial in some years. Wide rows may have more of an advantage in dry years, while narrower rows generally produce higher yields with adequate soil moisture. When rainfall is adequate or irrigation available, cultural practices such as narrow row spacing may be required for maximum yield. As row spacing narrows, distance between plants increases allowing for better utilization of soil moisture and light. This strategy of planting multiple rows on raised beds provides the benefits of narrow rows as well as the ability to furrow irrigate. More information is needed to fully evaluate the advantages of planting multiple rows on raised beds, particularly under irrigated conditions. ■

***Acknowledgment**: Louisiana Soybean and Grain Research and Promotion Board*

Rick Mascagni, professor, and Robert Bell, research associate, Northeast Research Station, St. Joseph, La.

Photo by Mark Claesgens

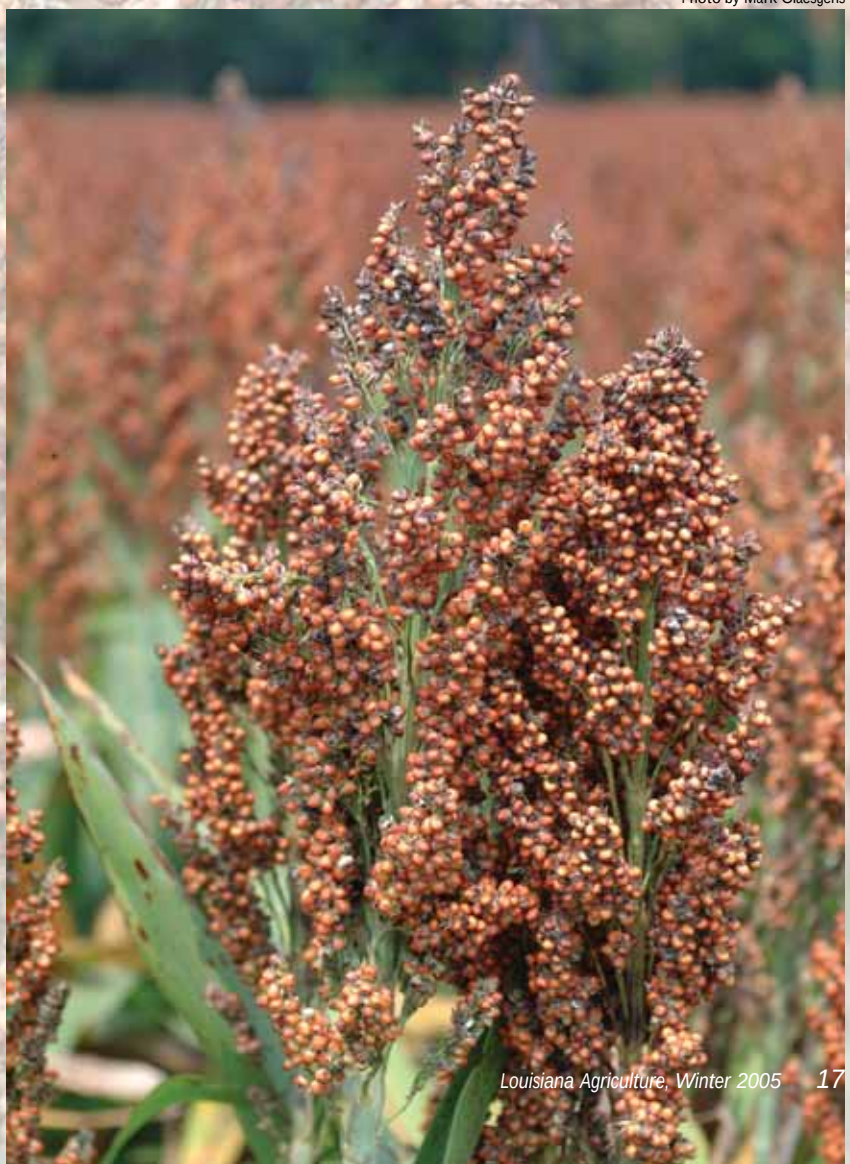


Photo by John Wozniak

Salvias have been one of the most common bedding plants used in landscaping. There are nearly 1,000 species of salvia. The annual salvia provides a wide range of flower colors.

Screening Bedding Plants for Heat Stress Tolerance

Seenivasan Natarajan and Jeff S. Kuehny

Bedding plants are widely used in landscaping or in containers. Two-thirds of the value of U.S. floriculture production in 2002 consisted of bedding plants. Salvias have been one of the most common bedding plants used in landscaping and as a pot plant. The genus *Salvia* is one of the largest of all plant genera – approaching 1,000 species – and these plants are grouped into either annuals or perennials. *Salvia splendens*, or annual salvia, is the most common species used in floriculture, with many series providing a wide range of flower colors. Two popular series (breeding selections which include a variety of flower colors) of salvia are Vista and Sizzler.

Though many bedding plants have been labeled heat-tolerant, such as salvias, they perform poorly in the heat of Louisiana and southern Gulf states. While some of these series or hybrids are heat-tolerant, many lack most of the characteristics that aid a plant in its ability to withstand high temperatures. Despite the continued increase in popularity of herbaceous plants, the lack of available scientific data on the effects of heat stress on these plants and well-defined screening techniques for selecting heat-tolerant lines represent a major obstacle for cultivation and breeding.

Heat Tolerance of Salvias

We selected the red variety of each of Vista and Sizzler series of salvia to characterize their heat tolerance levels by studying their morphological (or structural) and physiological (or functional) responses under various higher-than-optimal temperature conditions. We conducted several experiments to determine the duration and extent of high temperature that most affected the Vista and Sizzler series of salvia.

For the first experiment, 3-week-old seedlings were subjected to several short-duration (3-hour), high-temperature treatments (86, 95, 104 and 113 degrees F) every three days, with 77 degrees F being the control or optimal temperature for growth. These treatments were applied until flowering. Exposure to 113 degrees F proved lethal to both series. Short-duration high temperatures of 86, 95 and 104 degrees F caused significant morphological changes in both series by the conclusion of the experiment. Vista had shortened internodes (the portion of stem between successive leaves), thicker stems, reduced plant height, no visual symptoms of marginal leaf scorching and acceptable overall marketable quality (Figure 1). These morphological characteristics are similar to those that have

Seenivasan Natarajan, research assistant, and Jeff S. Kuehny, associate professor, Department of Horticulture, LSU AgCenter, Baton Rouge, La.

been observed in other heat-tolerant plants. The morphological characteristics of Sizzler were just opposite of Vista and proved to be less high-temperature tolerant.

A major effect of high-temperature stress is cellular membrane modification, causing what is termed a "leaky membrane." This is expressed as an increased permeability for ions and electrolytes, which can be readily measured by the outflow of electrolytes. Hence, membrane damage under heat stress can be determined by measuring membrane leakage of affected leaf tissue in an aqueous solution. We performed electrolyte leakage tests on leaf tissue of Vista and Sizzler to quantify the percentage of membrane damage. Vista had significantly lower membrane damage than Sizzler.

Heat Shock Proteins

Another signature physiological response of all living organisms to heat stress is decreased synthesis of normal proteins accompanied by an accelerated increase of a new set of proteins known as heat shock proteins (HSPs). Heat shock proteins are produced when plants are exposed to temperatures at least 5 to 10 degrees F above their optimal growing conditions. One unique feature of heat-tolerant plants is the abundance of HSPs during heat stress. They can be measured by their molecular weight using what is called a western blot analysis.

Vista and Sizzler plants were subjected to the same temperature treatments a second time, and plant protein was extracted to determine the expression of HSPs. As temperature increased, the levels of these proteins increased. The intensities of these bands were significantly higher at 95 and 104 degrees F in Vista than in Sizzler. This provided another indication of the ability of Vista to tolerate higher temperatures than Sizzler.

Finally, stomata (or pores) in plant leaves control the amount of water vapor exiting the leaf in the transpiration stream and the amount of carbon dioxide entering the leaf for photosynthesis. Stomatal conductance is defined as the measure of the amount of opening of the stomata. Studies with many agronomic crops prove that high-temperature-tolerant plants have higher stomatal conductance and transpiration rates. In Vista and Sizzler, both parameters increased as temperature increased up to 95 degrees F and decreased at 104 degrees F. Vista, however, had significantly higher stomatal conductance and transpiration rates.

The results from this research indicate that these types of experiments can be employed for screening bedding plants for heat tolerance and in breeding plants with heat-tolerant traits. Based on the morphological traits, varieties with shorter internodes and thicker and erect leaves with short petioles (leaf stalks) are better survivors in extreme temperature conditions. Electrolyte leakage tests also can be easily performed for screening heat-tolerant plants. Furthermore, other physiological characteristics such as over-expression of heat shock proteins and higher stomatal conductance and transpiration rates are also associated with heat tolerance. Hence, selection of bedding plants for heat tolerance should not only rely on field trials but also include an amalgamation of morphological and physiological characteristics that truly and more reliably define the ability of a plant to withstand high temperatures. ■

Figure 1. These plants show the effect of periodic short duration exposure to various high temperature treatments on growth and development of the annual salvias, Vista Red, at top, and Sizzler, at bottom. The temperatures from left to right in degrees F are 77, 86, 95 and 104. Vista Red is more heat-tolerant with no scorching on the leaves, even at 104 degrees F.

Photos by Seenivasan Natarajan

Reducing Listeria monocytogenes
on roast beef with acidified sodium chlorite

Marlene E. Janes and Richelle L. Beverly

Listeria monocytogenes is a bacterium that can cause illness when consumers eat refrigerated, ready-to-eat foods contaminated with this microorganism. Eating foods contaminated with *L. monocytogenes* normally causes flu-like symptoms in healthy adults. This disease is more serious for elderly adults and adults with compromised immune systems and can cause meningitis. In pregnant women, the disease may cause spontaneous abortions or stillborn babies.

From July 1998 to January 1999, four U.S. companies recalled ready-to-eat meats after *L. monocytogenes* was found in their products. Two major recalls involved 30 million pounds each. According to the Centers for Disease Control, tainted meat traced to a Michigan plant was responsible for 16 deaths, six miscarriages and 100 illnesses. As a result of this outbreak, the U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS) addressed the problem of *L. monocytogenes* contamination in a directive published in the Federal Register in 2001. It requires new performance standards for producing ready-to-eat meat products.

By September 2003, FSIS introduced a final rule, which requires the ready-to-eat food industry to impose a post-lethality treatment and growth inhibitor for *Listeria monocytogenes* or employ sanitation measures for controlling *L. monocytogenes* in the processing environment. To help Louisiana meat processors meet this new requirement, LSU AgCenter researchers have been investigating acidified sodium chlorite as a possible means for controlling *Listeria monocytogenes* on ready-to-eat meat products.

Marlene E. Janes, assistant professor, and Richelle L. Beverly, postdoctoral researcher, Department of Food Science, LSU AgCenter, Baton Rouge, La.

One of the main concerns of the food industry is that *L. monocytogenes* can grow at refrigerator temperatures. Contamination of ready-to-eat products with *L. monocytogenes* after cooking is a serious threat that many food processors are trying to combat. *Listeria monocytogenes* has been found in the environment of ready-to-eat processing plants and could be a source for contamination of these products.

From February through October 2004, 13 U.S. companies had to recall 460,317 pounds of ready-to-eat meat products as a result of routine FSIS microbiological testing that found *L. monocytogenes* in their products. These recalls clearly indicate the need for new control measures to help meat processors in the continuing battle against *L. monocytogenes* contamination, and we are working with a Louisiana-based company to develop new ways to combat this pathogen in their products.

Our research has evaluated various concentrations of acidified sodium chlorite (sodium chlorite treated with citric acid) to find out how much is needed to effectively reduce *Listeria monocytogenes* counts on samples of ready-to-eat roast beef at refrigerator temperatures. Acidified sodium chlorite is available commercially and has been approved for use as a wash for controlling bacteria on the surface of chicken. FSIS has also approved acidified sodium chlorite for use on ready-to-eat meat products, but no research is available proving how effective it is against *L. monocytogenes.* The FSIS rule states that ready-to-eat food companies have to show their antimicrobial treatments are effective against *L. monocytogenes*. Because *Listeria* is present in the environment, federal regulations require the effectiveness of a treatment be demonstrated by reducing the size of a bacteria colony on cooked roast beef within given parameters.

In laboratory tests, we inoculated cooked roast beef samples with *L. monocytogenes,* then treated them with acidified sodium chlorite. The purpose was to demonstrate the effectiveness of acidified sodium chlorite in controlling *L. monocytogenes.* At day 1, we found that compared with nontreated control samples, all the treated samples showed significantly decreased bacterial counts because of the rapid destructive action of acidified sodium chlorite. The study also showed acidified sodium chlorite was effective in inhibiting the growth of *L. monocytogenes* on the surface of cooked roast beef stored at refrigerator temperatures.

On day 7, the initial innoculation of 1.17 billion *L. monocytogenes* bacteria per pound was reduced to 146,512 per pound with 1000 ppm acidified sodium chlorite, 3.9 million per pound with 750 ppm or 500 ppm acidified sodium chlorite and 7.7 million per pound with 250 ppm acidified sodium chlorite on surface of the roast beef. These reductions in bacterial counts remained constant until day 28 when the 500, 750 and 1000 ppm acidified sodium chlorite treated roast beef samples had reduced *L. monocytogenes* counts to about 143,337 per pound compared with the controls. Furthermore, acidified sodium chlorite had no effect on the color or taste of the cooked roast beef products. These reductions meet the federal regulations for showing the effectiveness of the treatment in controlling *Listeria*.

The recurring recalls of ready-to-eat meat products due to contamination by *Listeria monocytogenes* demonstrate a clear need to develop additional methods to prevent economic loss and possible deaths from foodborne diseases. Our research has shown that acidified sodium chlorite is effective in preventing the growth of *L. monocytogenes* on the surface of ready-to-eat meat products stored at refrigerated temperatures. Based on these results, a Louisiana-based ready-to-eat meat processing company has already included the use of acidified sodium chlorite as a method to combat *L. monocytogenes* on their ready-to-eat meat products. ■

Pollinating Greenhouse Tomatoes with Vibrators, Blowers

Bees Fail in Small Operations

Hanna Y. Hanna

The flower structure of most commercial tomato cultivars assures self-pollination and virtually eliminates the opportunity for outcrossing. Pollen is shed within the individual flowers during blooming when there is a strong enough vibrating force, such as wind, to shake the plant and the flower. In the absence of naturally occurring wind in the greenhouse, tomato flowers have to be vibrated by some mechanical means, such as electric vibrators, air blowers or bumblebees, to release the pollen.

Hanna Y. Hanna, professor, Red River Research Station, Bossier City, La.

Currently, larger greenhouse tomato producers use laboratory-reared colonies of bumblebees to pollinate the crop. In smaller operations, however, bumblebee pollination is not a good choice. At any given time, opened flowers are too few in number to supply enough pollen for the foraging bees. As a result, bees visit opened flowers repeatedly, destroying the protective anther tube (the pollen-producing parts of the flower) and damaging the pistils (the female reproductive organs).

The majority of greenhouse tomato operations in Louisiana and other southern states are small. Thus, hand-held electric vibrators or air blowers may be the best pollinating tools for these operations. This study was conducted to compare the effectiveness and economics of these tools as pollinators in small greenhouse tomato operations.

Studies were conducted in a 30-foot by 96-foot double polyethylene greenhouse at the LSU AgCenter Red River Research Station in Bossier City. Tomato varieties Caruso and Trust were raised in 15-gallon polyethylene bags filled with ground pine bark. Four tomato plants were planted in each bag in two parallel rows, and 30 plants of each cultivar were grown under the same conditions for testing the effect

Photo by A. Denise Coolman

Research conducted by Hanna Y. Hanna indicates that smaller greenhouse tomato growers should use the hand-held electric vibrators to pollinate their crop for maximum fruit yield, size and profit.

Recycling Perlite to Reduce Greenhouse Tomato Production Costs

Hanna Y. Hanna

Most greenhouse tomato operations in the southern United States are small. These growers have to hold down production costs to compete well in a market dominated by more efficient, larger operations. One way they do this is to reuse the root medium (perlite) for growing the greenhouse tomato plants. However, reusing this medium year after year can lead to serious yield reduction problems. Contaminated perlite can impair the root system and cause weak and less-productive plants. Most large greenhouse tomato operations replace the root media once a year, but the smaller grower cannot afford to do this.

Perlite is volcanic lava widely used as a growing medium for many horticultural crops, including greenhouse tomatoes. Before reusing it, it must be cleaned and disinfected to avoid compaction, salt buildup and pest contamination.

Photo by H.Y. Hanna

This procedure involves using a 24-inch auger mounted on a half-inch electrical drill to bore into the perlite in 5-gallon media bags without moving the bags.

The procedure used with this study is a simplified technique involving less labor – time and energy – than previous techniques. It involves using a 24-inch auger mounted on a half-inch electrical drill to bore into the perlite in 5-gallon media bags without moving the bags. This process is necessary to break the root and perlite clumps, restore a loose structure and aid in washing away some of the built-up salts.

To prevent the perlite from dispersing out of the bag, we used a 5-gallon bottomless bucket placed over the media in the bag, and the drill was operated inside the bucket. The perlite was then cleaned and disinfected with a hot-water pressure washer available locally at rental shops. Each bag was drenched with approximately 3.5 gallons of near-boiling hot water (average temperature 194 degrees F) after replacing the pressure nozzle with a spray nozzle.

Information generated from drilling and disinfecting used perlite in 1,880 5-gallon bags indicated that this technique would cost the grower approximately $162 for 5.9 hours for drilling and 6.52 hours for cleaning and disinfecting the media in a 30-foot by 96-foot greenhouse. Replacing the media would cost the grower $753 - $540 to buy new perlite, $56 to dispose of the used perlite and $157 to fill the bags with the new perlite. These data indicate that the described technique can save the grower approximately 78 percent of the annual replacement cost.

Treating perlite with hot water raised media temperature to above limits necessary to kill harmful pests and reduced media salt to within acceptable range for raising container-grown plants.

Tomato plants raised in the recycled perlite produced yields comparable to those raised in new perlite. Used perlite can be cleaned and disinfected repeatedly because it is not organic and is physically and chemically stable.

Most processing expense is labor-related, and smaller producers can save money by doing the job themselves. Renting a hot water pressure washer and buying an auger and a drill can be the only out-of-pocket expenses to complete the job. Many growers have electric drills, and the $20 auger is a popular tool to plant bulbs in flower beds. ■

Hanna Y. Hanna, Professor, Red River Research Station, Bossier City, La.

of each method of pollination on tomato yield and fruit characteristics.

Tomato plants in the blower-pollinated treatment were vigorously vibrated on Monday, Wednesday and Friday of each week. Vibration took place around noon using an Echo P.B.-1000 air blower. Vibration started at the beginning of blooming and continued for 13 weeks. The blower was held approximately 15 inches from the tomato plant and directed toward the flower clusters as the operator walked between the tomato rows.

Flower clusters in the electric vibrator treatment were vigorously vibrated by touching the flower stalk for about two seconds. Pollination was conducted using a Dutch-made electric vibrator on the same days and time as the blower.

Two additional greenhouses having 640 plants each were pollinated for 13 weeks by the same persons using either tool to determine pollination time. Cost of pollination by either tool was calculated based on a 13-week period at $7 per hour per person.

Tomatoes were harvested from each treatment at the pink stage three times per week for 13 weeks, and plant yield was determined. Mean fruit weight and diameter were also determined on a sample of 10 marketable fruits collected at random around mid-harvest. Seeds were extracted from the sample fruits, and the mean number of seeds per fruit was determined.

Test results indicated vibrator-pollinated plants of each variety produced greater marketable yield than did blower-pollinated plants. Within varieties, marketable yield was greater and yields of culls were lower with vibrator-pollinated plants. Fruit weight and diameter and the number of seeds per fruit were greater in vibrator-pollinated plants. Marketable yield of Trust was greater in the first year, but yield for Caruso excelled in the second year.

The time needed to pollinate 640 plants for 13 weeks was 7.13 person hours using the air blower and 11.75 person hours using the electric vibrator. Labor cost for pollination was $49.92 for the air blower and $82.25 for the vibrator. The yield reduction using the air blower for pollination was not offset by the savings in labor cost.

We conclude that smaller greenhouse tomato growers should use the hand-held electric vibrators to pollinate their crop for maximum fruit yield, size and profit. ■

2005 will be learning year for Asian soybean rust

LSU AgCenter scientists are launching a series of research projects in 2005 to learn what they can about Asian soybean rust and how this potentially devastating disease will develop in Louisiana.

Meanwhile, they are telling farmers to go about their soybean planting as they have in the past, despite this looming threat.

"We don't know when we'll see Asian soybean rust again," said Boyd Padgett, LSU AgCenter plant pathologist. "We don't know how it will react in Louisiana. There's a lot we don't know about this disease."

In early November 2004, LSU AgCenter scientist Ray Schneider unexpectedly found Asian soybean rust in a production field on the Ben Hur Research Farm near the LSU campus. This was the first discovery of the disease in North America.

Asian soybean rust has been around since the early part of the 20th century. However, it had been confined to Asia until recently when it spread to Africa and then on to South America. It was first discovered in the Western Hemisphere in Brazil in 2000.

The rust disease, which is spread by wind-borne spores, is feared because it's hard to detect until it's too late to do anything. The symptoms first appear on the bottom leaves – hidden from view. By the time a farmer might see it, the disease, which has taken hold, has been known to destroy entire fields.

Schneider's discovery prompted an emergency gathering of scientists from all over the country at the LSU AgCenter. They determined that the hurricane winds from August 2004 had carried the spores into the state – and, as it turns out, eight other states in the South.

None was found in the Midwest, the major soybean-producing area in the United States. But by then all the beans up north were harvested, and the weather had turned cold, which kills the disease.

To help with understanding the disease, a group from the LSU AgCenter visited Brazil in mid-February to find out how farmers there have learned to cope. Soybean harvest occurs there in February and March. Despite the presence of the disease, Brazil continues to be the No. 1 producer of soybeans worldwide.

Besides Padgett and Schneider, the delegation includes David Lanclos, extension soybean specialist; Allen Hogan and Keith Normand, county agents; and Matt Baur, entomologist.

"2005 will be a learning year," Lanclos said. "Until we find out something different, we will continue with the same recommendations for growing soybeans in Louisiana."

The researchers will plant various types of soybeans at various times to see which ones might get rust. If the rust shows up, they'll spray different products at different times to see what works best.

Meanwhile, they're telling farmers not to spray with fungicide as a preventative measure, unless rust is confirmed in the state. If rust is found, then they recommend using a fungicide.

They are strongly suggesting Louisiana farmers start scouting for signs of Asian soybean rust as soon as the plants emerge from the ground.

Asian soybean rust likes long periods of leaf wetness and warm conditions (60 degrees F to 80 degrees F), Padgett said.

"Look at the areas in your fields shaded from the morning sun," Padgett advised a group of soybean farmers gathered at the LSU AgCenter's Dean Lee Research Station in January. "Know your other diseases. Start looking as soon as the plant's up.

"We don't know if this will be a minor disease or No. 1," Padgett said. "We may be like Brazil with some years bad and some good."

The main advice Padgett and Lanclos are giving Louisiana farmers is don't change a successful production system.

"Continue doing what has worked in the past," Lanclos said. "Plant the varieties recommended by the LSU AgCenter."

Lanclos said he predicts there will be fewer acres of soybeans grown in 2005 because of the uncertainties. In 2004, about a million acres, the most for any crop, were in soybeans. Farmers in the southwestern area of the state may turn more of those acres into crawfish production. And those in the Northeast may grow more grain sorghum.

Soybeans are grown in Louisiana in 40 to 50 parishes, with the most grown in the Northeast, although the good soil there is saved for cotton.

Development of a rust-resistant variety of soybean is predicted to be at least five years away.

■ **Linda Foster Benedict**

Photo by Mark Claesgens

The rust disease, which is spread by wind-borne spores, is feared because it's hard to detect until it's too late to do anything. The symptoms first appear on the bottom leaves – hidden from view. By the time a farmer might see it, the disease, which has taken hold, has been known to destroy entire fields.

Less revenue from soybeans predicted for 2005

How the Asian soybean rust discovery in Louisiana will affect the agricultural outlook for the state in 2005 is difficult to predict.

"The initial fear has given way to a more wait-and-see attitude," said Kurt Guidry, LSU AgCenter agricultural economist who watches the soybean situation closely. "There are many uncertainties about how this disease will react."

Soybeans are planted on more land in Louisiana than any other crop. In 2004, about a million acres were planted in soybeans, slightly up from the year before. The trend, however, has been downward in numbers of acres over the past 20 years.

Average soybean yields, however, have been going up in Louisiana, although they still remain lower than in the Midwest, where more than half of U.S. soybeans are grown.

The state average in 2004 was slightly above 30 bushels per acre, whereas nationwide the average yield is above 40 bushels per acre. 2004 was a record production year for soybeans in the United States.

With estimated costs for managing rust, Louisiana producers who cannot consistently generate yields higher than 30 bushels per acre are going to find it difficult to generate positive returns, Guidry said.

"Soybean production on marginal land or in areas that historically have lower than 30-bushel yields will be affected most by this disease," Guidry said.

Photo by Mark Claesgens

These three were part of one of four teams that searched for soybean rust throughout a designated area within a 100-mile radius of Baton Rouge on Nov. 11, days after the first discovery of the disease. Left to right are Sonny Viator, resident coordinator of the Iberia Research Station in Jeanerette; Ray Schneider, plant pathologist; and X.B. Yang, plant pathologist from Iowa State University, Ames, who received his Ph.D. from LSU.

Most of the state's soybeans are grown in the northeastern and central regions of the state. They also are grown in the Southwest primarily as a rotation crop with rice.

According to LSU AgCenter figures for value to the state's economy in 2004, soybeans contributed about $241 million whereas sugarcane contributed about $496 million and cotton, about $295 million. These figures include value-added by further processing in the state.

■ **Linda Foster Benedict**

Inside:

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