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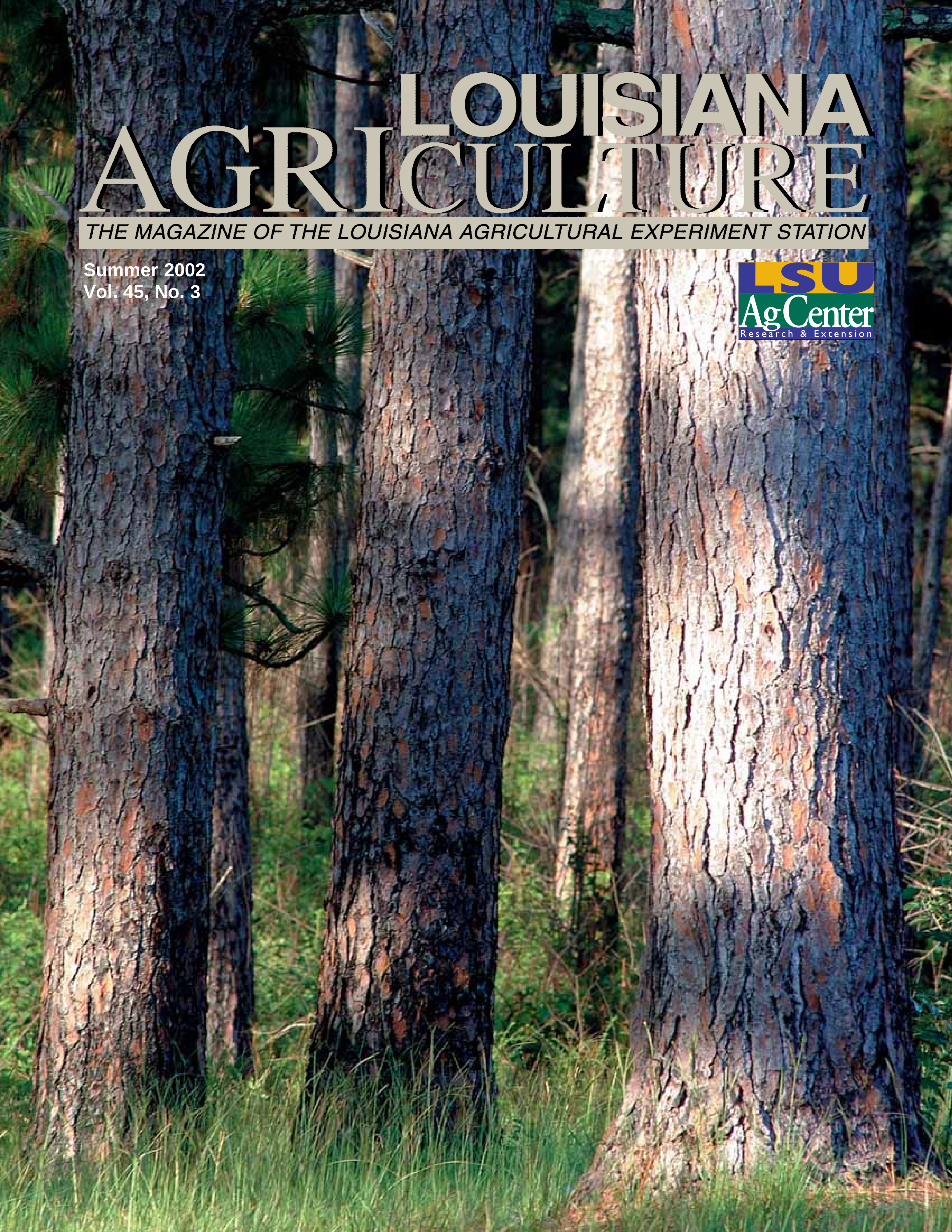

Reception Honors LSU AgCenter Faculty Inventors

Twenty-three LSU AgCenter inventors who have received patents were honored at a Patent Club recognition reception at the Lod Cook Conference Center on the LSU campus in June.

LSU AgCenter administrators used the occasion, the first of its kind, to commend the 23 faculty members who developed innovative solutions to chronic problems facing Louisiana agriculture. Chancellor William Richardson stressed the importance of recognizing faculty members who produce patentable works.

"One of the AgCenter's great strengths," Richardson said, "is its focus on applied research. This focus has fostered long-standing beneficial relationships with multiple industry partners and has led to the development of groundbreaking inventions in agriculture and biotechnology. The entire state benefits from the commercialization of technologies developed by LSU AgCenter researchers and patented by the University."

William H. Brown, vice chancellor and director of the Louisiana Agricultural Experiment Station, and Paula Jacobi, Experiment Station assistant director responsible for AgCenter Intellectual Property Management, distributed plaques to inventors who received new patents in 2001. All patent recipients were formally inducted into the LSU AgCenter Patent Club.

"We believe it is important for the community to know that our researchers collaborate effectively with industry to develop new technologies that can improve quality of life in Louisiana and throughout the world. All too often, people forget that scientific advances usually take form from the ideas of one person," Jacobi said.

The Patent Club, created to showcase the achievements of inventors who develop exciting and promising new innovations, is expected to grow in membership yearly. ■ **Jane Honeycutt**

Photo by Mark Claesgens

Researchers honored included: (seated, from left) Gregg Henderson, Entomology; Gerard Berggren, Central Stations; Lee Southern, Animal Science; John Chandler, Dairy Science; and William Hansel, Veterinary Science. Standing, from left are Michael Saska, Audubon Sugar Institute; Timothy Page, Livestock Show Office; James Farr, Food Science; William Todd, Veterinary Science; Sam Rollason, Information Technology; Ronald Thune, Veterinary Science; Don Groth, Rice Research Station; James Ottea, Entomology; Daniel Satterlee, Animal Science; Fred Enright, Veterinary Science; Roger Laine, Biological Sciences; and Richard Cooper, Veterinary Science. Not pictured are Richard Corstvet, Veterinary Science; Dearl Sanders, Idlewild Research Station; Timothy Croughan, Rice Research Station; Donal Day and Willem Kampen, both of Audubon Sugar Institute; and Kenneth McMillin, Animal Science.

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ON THE COVER

These are longleaf pine trees in a forest near Alexandria, La. See story on page 4. Photo by John Wozniak.

Longleaf Seedling Production: Some Problems and Their Solutions

John P. Jones, Xiaoan Sun, Lori Eckhardt, Ann Weber, Nolan Hess, Jim Barnett and John McGilvary

Photo by John P. Jones

Many of the forests that once grew longleaf pine are now growing loblolly, which is showing signs of decline. The loblolly pine in the center of this Alabama forest shows signs of disease.

Research in forest pathology is shaped by the need to consider the consequences of a crop that must be managed from 20 to 100 years. If the desired end product of a forested area is wilderness, then dead and hollow trees may be considered part of the natural process and desirable for providing shelter for wildlife. On the other hand, if the desired end product is high quality lumber, then disease prevention is critical. Effective forestry management requires long-range goals.

Currently, the South is establishing its "fourth" forest. The first was the forest present when the first European settlers arrived, which was essentially harvested by the early 1900s. The second was harvested from about 1930 to the 1960s. The third forest is now being harvested. The fourth will supply the wood and fiber needs well into the 21st century or early 22nd century. Net annual timber growth has, however, begun to decline, and it has become crucial to understand factors that reduce both stand establishment and long-term growth and development in the forest. Forest diseases are a major factor in all phases of forest establishment and development.

The South's third forest is approaching 30 to 40 years old and consists largely of loblolly pine in areas that originally grew shortleaf or longleaf pine. This has become a problem because loblolly pine in many of these areas goes into a serious decline beginning at this age. Until recently, the U.S. Forest Service was able to sell off timber before decline became a serious problem, but policy changes now require that much national forest timber should go to 100-year rotations to maximize habitat diversity. This presents researchers with short-term and long-term problems. In the short term, researchers must find the cause of the decline and figure out what, if anything, can be done to alleviate it (see page 6). In the long term, researchers must look into what can be done to prevent decline from reoccurring 40 years from now if the

John P. Jones, Professor, Department of Plant Pathology and Crop Physiology, LSU AgCenter, Baton Rouge, La.; Xiaoan Sun, former graduate student and now with the Florida Department of Agriculture & Consumer Services, Gainesville, Fla.; Lori Eckhardt and Ann Weber, graduate students; Nolan Hess, Jim Barnett and John McGilvary, all with the U.S. Forest Service.

problematical stands are cut and replanted. The approach being taken to prevention is to consider regenerating to other species, particularly longleaf pine. However, longleaf pine is difficult to regenerate.

Whole Forest System

A forest pathological problem should be considered only in the context of the whole forest system, which includes everything from seedling production to the end product. LSU AgCenter scientists are working on problems related to seed production, seedling production, outplanting survival, diseases of mature forests and wood products. Each project relates to the rest in a scientific and intellectual ecology. All of these projects are important to understanding the biology of the forest and for making policy decisions. The decline of loblolly has led to an intensified research interest in regenerating longleaf pine in those areas in which it comprised the first forest.

Most forest regeneration in the South today is accomplished by outplanting seedlings raised in forest tree nurseries (bare root seedlings). Seedlings are lifted by the millions during the winter and held in cold storage until planted. This storage period can last several weeks, which is not problematical for loblolly pine but results in severe mortality in longleaf pine. Loblolly pine, for example, will have 98 percent survival even after being stored for six weeks, while longleaf survival drops to 46 percent after only one week.

This was a problem that needed to be resolved so that longleaf pine could be raised and planted in sufficient numbers to meet the potential need. We investigated the possibility that this problem was caused by a fungal pathogen. Stored seedlings exhibit few symptoms but had poor survival after planting. Our suspicion was that a root pathogen was involved, so we conducted isolation and inoculation studies of seedlings in storage. We found that a particular group of water molds were present in increasingly high numbers as the seedlings were held in storage.

Use of Fungicides

This finding led to an attempt to increase seedling survival through application of fungicides to control these water mold fungi, and we were successful. Common nursery practice includes coating the bare roots of seedlings with a koalinite clay slurry. We found that including either benlate at high levels, or metalaxyl at 10 ppm in the slurry, reduced water mold levels to trace amounts, even after six weeks of storage, and increased survival rates for the longleaf seedlings to approximately 95 percent. Untreated check seedlings had survival rates of about 15 percent after only one to two weeks of storage.

We also noted that high levels of the fungal genus *Trichoderma* correlated at statistically significant levels with increased survival of outplanted seedlings. A project was initiated to explore the possibilities of using nonchemical biological control methods to enhance outplanting survival. We found that several species of this fungus would, if applied in precisely defined ways, result in high seedling survival rates. We have not pursued biological control because chemical control is more effective, less expensive and simpler to use. The procedural groundwork has, however, been established in case the chemical option is removed.

There has also been an increasing emphasis on containerized seedling production for longleaf, which avoids many of the problems associated with bare root production. Containerized seedling production uses seedling trays consisting of individual cells about 6 inches long and about 1.5 inches in diameter, tapered at the bottom with a small opening for water flow. A longleaf seed is placed in each cell and can be outplanted a few months later. Containerized seedlings can be produced under controlled conditions at any time of year. They are also much easier to handle and outplant successfully than are bare root seedlings.

Photo by John P. Jones

Tim Haley, a U.S. Forest Service entomologist, collects insects that feed on tree roots. Researchers then examine the pathogens growing on the insects.

Disease Problem

Increased production of containerized seedlings to meet demand, however, revealed a serious disease problem. Seedlings that looked relatively healthy during the growing season would suddenly die or sometimes continue to look usable until pulled from the container. The roots would be so deteriorated that attempting to pull the seedling revealed essentially no root system left, just a handful of green needles unconnected to a root. Containerized seedlings are grown under such highly optimal conditions that even a highly reduced root system can support enough shoot development to maintain needles. It is also possible that this disease accelerates its effect as root growth becomes limited by the confines of the container late in the growing season. Isolations from the roots resulted in almost pure cultures of *Fusarium circinatum*, the pitch canker fungus. It was found that the fungus was present in the seed coat at planting.

We have conducted preliminary tests in which we immersed longleaf seed in hot water for two minutes at 140 degrees F, followed by immersion in cold water. This effectively reduced population levels of the pitch canker fungus to trace levels and resulted in high levels of plantable seedlings.

We have also tested the fungicide benlate as a seed treatment as well as soaking the seed for 30 minutes in a 30 percent hydrogen peroxide solution. Benlate, however, will become unavailable for use in the near future, and hydrogen peroxide at that rate can be explosive and is dangerous to use. This work will be repeated and extended to determine what combinations of time and temperature for hot water treatment will produce acceptable results and to develop procedures for scaling up to operational levels.

The studies briefly outlined here address a wide range of problems, each of which involves some essential aspect of a forest management system. No phase of forest establishment, development and maintenance can be ignored if optimal usage of the forest resource is to be achieved. ■

Photo by John P. Jones

This is a forest in Alabama where LSU AgCenter researchers conduct studies on the loblolly pine. The problems with these forests in Alabama may happen in Louisiana if preventive measures are not taken.

Scientists Study Loblolly Pine Decline

A decline in loblolly pine, first reported in Bogalusa, La., in 1966, helped trigger a long-term study at the LSU AgCenter. At first, it was suspected that it was the same disease as littleleaf disease of shortleaf pine, which was attributed to site factors and *Phyphthora cinnamomi*, a water mold. However, other studies led us to suspect *Leptographium* species might also be involved. We implemented a study to determine the respective roles of *P. cinnamomi*, *Leptographium* species, root attacking insects and various site factors. Preliminary data indicate that *P. cinnamomi* do not significantly correlate with decline symptoms, but *Leptographium* species correlate with symptoms and are probably the major pathogens involved. We have also found that *Leptographium* can routinely be isolated from many of the beetles and weevils that occur on pine roots and the soil around the roots. Our data indicate that loblolly decline results from an imbalance in the complex interrelationships involving insects, pathogenic fungi and the pine itself. We are now analyzing soil samples for physical and chemical characteristics that may affect the course of the decline. We are also conducting various inoculation experiments to confirm the ability of insects to vector *Leptographium* and to confirm that it is pathogenic to loblolly pine. The information developed from this research will help policy makers with the decisions that will determine the nature of southern forests for the next 100 years. ■

John P. Jones, Professor, Department of Plant Pathology and Crop Physiology, LSU AgCenter, Baton Rouge, La.

Growing Greenhouse Tomatoes Can Be Profitable

Debbie Otwell has learned tomatoes can be as profitable as they are tasty.

Otwell grows about 2,000 tomato plants, which produce about 35,000 pounds per year, in her three greenhouses near Dubach, La. She got the idea after visiting the LSU AgCenter's Red River Research Station in Bossier City.

"I originally started growing perennials in the greenhouses," Otwell said. "But I wasn't making much money, because at that time no one knew what perennials were. I saw tomatoes being grown in greenhouses at the Red River station, and I fell in love with the idea of growing my own tomatoes."

Otwell, who has been growing tomatoes for more than five years, said she didn't realize how much work it would be. While Otwell's husband, Ricky, helps out sometimes, she says she does most of the work herself.

"A lot of days I stay in my greenhouses working from daylight to dark," she said. "But that's what you have to do if you have greenhouses. As long as there's light, you have to work.

Otwell has about $50,000 invested in the three greenhouses. And as more people are finding out about her tomatoes, business is picking up, Otwell said.

"I make deliveries to stores and stands in Monroe, West Monroe, Bastrop, Natchitoches and wherever else people call me from," Otwell said. "People just really seem to love the tomatoes after they taste them.

Sue Mitchell of Arcadia became a fan of the tomatoes after she ate some at her church.

"One of the ladies at our church came here and bought some tomatoes," Mitchell said. "Everyone loved them and asked her where she got them. She told us, and here I am."

Greenhouse tomato project

H.Y. Hanna of the LSU AgCenter started a greenhouse tomato project at the Red River station in 1996. Hanna said he believes this is the future for the tomato industry.

"The tomatoes are grown in a controlled environment," Hanna said. "Problems with diseases and insects aren't as big as they are for field tomatoes. Another advantage is greenhouse tomatoes can be grown year-round. And it can be profitable. One greenhouse, with 700 plants, can generate $15,000 to $20,000 per year."

The cost of producing each tomato plant in a greenhouse is about $15 per year, Hanna said. Half that cost is labor and 25 percent is energy, he said, adding that growers can save money by adopting a do-it-yourself approach and using a heating system he developed.

Heating greenhouses can be expensive, Hanna said. Greenhouse tomatoes are normally heated by hot air blown directly into plants' surroundings from oil or gas furnaces, he said. They also can be heated by circulating hot water through the interior of the greenhouse in pipes that release the heat to the plants' environment. But heating greenhouses by using forced air is more popular among growers because of simplicity and ease of maintenance of such a system, Hanna said.

Photo by A. Denise Coolman

Debbie Otwell of Dubach, La., has learned that growing greenhouse tomatoes can be profitable. She got the idea from the greenhouse production at the LSU AgCenter's Red River Research Station in Bossier City.

Traditionally, furnaces that generate heated air are suspended as high as 10 feet above the greenhouse ground level to keep the heaters out of the workplace and to blow the heated air above the plant tops. In top-heated greenhouses, there can be temperature differences of up to 15 degrees F from the top to the bottom of plants, because warm air is lighter and stays at the top.

"More heat has to be generated to ensure adequate warming at the plant level," Hanna said. "Even with more heat generated, root-zone temperatures remain less than optimum for improving plant growth and yield."

Photo by Mark Claesgens

H.Y. Hanna conducts research on greenhouse tomatoes at the Red River Research Station. He works with tomato producers to help them increase their profits.

Tomato plant response to warm root-zone temperature has been well documented, according to the researcher, who said studies have shown that the ideal root-zone temperature is 70-75 degrees F.

Root Temperature Critical

To achieve optimum plant growth, root temperature is more critical than leaf temperature, Hanna stresses, adding with root-zone temperature at the optimum level, growers can lower air temperature around the plant a few degrees to reduce energy consumption without reducing plant growth and yield.

Because an optimum root temperature allows for maximum production, some researchers suggest using a separate heating system of circulating hot water in pipes located under the growing bags to heat the growing medium. But operating two heating systems – one to heat the air around the plant canopy and another to heat the growing medium around the roots – is too complicated and more expensive than small greenhouse tomato growers can afford, Hanna said.

To solve the problem, he modified the heat distribution channels so that one system could heat the growing medium, the pipes carrying the nutrient solution and the air around plants.

The changes include using a floor heater connected to an 18-inch duct for heat transfer. The duct has five equally spaced 8-inch openings for releasing warm air into five perforated poly tubes. Each poly tube is laid over a feeding pipe carrying the nutrient solution to the plants and is placed snugly between double rows of tomato growth bags.

Greenhouse tomato growers also save money because they don't have to buy a lot of chemicals to spray their plants for pests and diseases, Hanna said. This savings also is passed on to the consumer.

"It is a fact that greenhouse tomatoes can be produced with little or no chemical spray," Hanna said. "However, saving money by reducing spray is not the issue. The issue is producing a more desired fruit in the greenhouse. Greenhouse tomatoes can be produced with little or no pesticide use."

$20,000 Greenhouses

Growers also can save money by building their own greenhouses, Hanna said. The cost for a contracted greenhouse is about $20,000.

"But if growers build their own houses, they can save about 66 percent of this cost," he said. "If you can use simple tools, you can build a greenhouse."

Among the supplies and equipment needed in greenhouses are fans, heaters, pumps and cooling pads, he said.

Once a greenhouse has been built and growers are ready to plant their tomatoes, they will need to get some type of medium to put the plants in. Hanna suggests using perlite, a processed volcanic mineral widely used as a propagating and growing medium for many horticultural crops, including tomatoes. The initial rock found in nature is crushed into small pieces and heated to 2000 degrees F. The trace of moisture trapped inside the small pieces evaporates and puffs the granules just like popcorn.

"Perlite is a lightweight mineral, easy to handle, pathogen-free and will never decompose," Hanna said. "Growers have to replace it every year or two to minimize the risk of crop failure because of salt and pathogen buildup. So the expense to dispose of the old material and replace it with new perlite shipped from distant markets can be significant."

Hanna has developed a procedure to clean, sterilize and recycle perlite.

Following the tomato harvest and removal of all vegetation from the greenhouse, perlite is sifted to remove tomato roots and restore its original loose structure. For better handling of the medium and to minimize labor input, researchers built a simple movable hopper equipped with a wire mesh screen for sifting the perlite to isolate and remove tomato roots. The hopper is built on wheels and can be rolled between the tomato rows in the greenhouse.

"Perlite mixed with old tomato roots is poured out of the grow bag onto the hopper screen and shaken well," Hanna said. "The loose, root-free perlite is collected in a receiving bag at the bottom. It is then treated with hot water at temperatures reaching 200 degrees F using a hot water pressure washer to leach out excess salt and kill pathogens and insects."

This procedure can be repeated once a year after harvest, he said. ■ **A. Denise Coolman**

Figure 1. A movable hopper with a wire mesh screen is used for sifting the perlite.

Recycling Perlite

for More Profit in Greenhouse Tomatoes

Perlite is a processed volcanic mineral widely used as a propagating and growing medium for many horticultural crops, including tomatoes. The initial rock found in nature is crushed to small pieces and heated to 2000 degrees F. The trace of moisture trapped inside the small pieces evaporates and puffs the granules just like popcorn. Perlite is a lightweight mineral, easy to handle, pathogen-free and will never decompose. Growers have to replace it every year or two to minimize the risk of crop failure because of salt and pathogen buildup. The expense to dispose of the old material and replace it with new perlite shipped from distant markets can be significant.

LSU AgCenter researchers have developed a procedure to clean, sterilize and recycle perlite. Following the tomato harvest and removal of all vegetation from the greenhouse, perlite is sifted to remove tomato roots and restore its original loose structure. For better handling of the medium and to minimize labor input, researchers built a simple movable hopper (Figure 1) equipped with a wire mesh screen for sifting the perlite to isolate and remove tomato roots. The hopper is built on wheels and can be rolled between the tomato rows in the greenhouse.

Perlite mixed with old tomato roots is poured out of the grow bag onto the hopper screen and shaken well. The loose, root-free perlite is collected in a receiving bag at the bottom. It is then treated with hot water (Figure 2) at temperatures reaching 200 degrees F using a hot water pressure washer to leach out excess salt and kill pathogens and insects. Each bag is drenched with one to two gallons of hot water in a couple of minutes. Measuring temperature in a random sample of the hot water treated bags revealed that perlite temperature ranged from 170 degrees F to190 degrees F and remained hot for several hours after treatment. This procedure can be repeated once a year after harvest.

New versus recycled

Researchers tested recycled and new perlite media for growing greenhouse tomatoes over the last three years and found no significant differences in tomato yield. The cost to sift and disinfect the perlite in a 30-by-96 foot greenhouse was estimated at about $250. That figure is based on approximately 30 hours to do the job at $5 to $6 per hour plus the hot water pressure washer rental at around $60. Replacing the old perlite once a year to avoid crop failure would require the same amount of labor to dispose of the old medium and re-bag the new perlite at a purchase price of about $515 for the same size greenhouse.

Recycled perlite benefits

Fungus gnats, a major problem in the greenhouses at the Red River Research Station, disappeared completely after the regular use of hot water. We believe that hot water treatment reduced thrips, white flies, spider mites and a disease that strikes greenhouse tomatoes called botrytis. Pest control with hot water can lead to less pesticide use, lower production costs and a product more desirable for some consumers looking for pesticide-free products.

Another benefit is not having to use household bleach as a disinfectant for the growing medium. Chlorine bleach can cause eye and skin irritation. Also, it can damage tomato plants severely if not leached out completely from the growing medium.

Traditionally, tomato seedlings are raised in growing trays for five weeks before transplanting into the permanent grow bags. Because the hot water-treated medium is pathogen free, and salts are leached out, it is possible to skip this step and plant the new germinated seedlings (10 days old) directly into the permanent grow bags. This practice can lead to healthier and more productive tomato plants as long as the perlite temperature remains between 60 degrees F and 80 degrees F to minimize seedling loss. ■

Photos by H.Y. Hanna

Figure 2. The perlite is treated with hot water.

H.Y. Hanna, Professor, and Douglas T. Smith, Maintenance Repair Master, Red River Research Station, Bossier City, La.

Modifying Greenhouse Heating Systems
to Reduce Energy Costs and Produce More Tomatoes

Heating greenhouses during cold weather is the second highest cost of greenhouse tomato production after labor. Greenhouse tomatoes are normally heated by hot air blown directly into plant surroundings from oil or gas furnaces. They also can be heated by circulating hot water through the interior of the greenhouse in pipes that release the heat to the plant environment. Heating greenhouses by using forced air is more popular among growers because of system simplicity and ease of maintenance.

Photos by H.Y. Hanna

Figure 1. Traditionally, furnaces are suspended as high as 10 feet above the greenhouse ground level.

Traditionally, furnaces that generate heated air are suspended as high as 10 feet above the greenhouse ground level (Figure 1) to keep the heaters out of the workplace and blow the heated air above the plant tops. In top-heated greenhouses, there can be temperature differences of up to 15 degrees F from the top to the bottom of plants, because warm air is lighter and stays at the top. More heat has to be generated to ensure adequate warming at the plant level. Even with more heat generated, root-zone temperature remains less than optimum for improving plant growth and yield.

Tomato plant response to warm root-zone temperature has been well documented. Research has shown that the ideal root-zone temperature is between 70 and 75 degrees F. To achieve optimum plant growth, root temperature is more critical than leaf temperature. With root-zone temperature at the optimum level, growers can lower air temperature around the plant canopy a few degrees to reduce energy consumption without reducing plant growth and yield. Because an optimum root temperature allows for maximum production, some researchers suggest using a separate heating system of circulating hot water in pipes located under the growing bags to heat the growing medium. Operating two heat systems to heat the air around the plant canopy and the growing medium around the roots is too complicated and more expensive than small greenhouse tomato growers can afford.

At the LSU AgCenter's Red River Research Station, researchers modified the heat distribution channels so that one system could heat the growing medium, the pipes carrying the nutrient solution and the air around plants. The changes include using a floor heater connected to an 18-inch duct for heat transfer (Figure 2). The duct has five equally spaced 8-inch openings for releasing warm air into five perforated poly tubes (Figure 3). Each poly tube is laid over a feeding pipe carrying the nutrient solution to the plants and snugged in between double rows of tomato bags (Figure 4).

Heat transfer by direct contact between the poly tubes and the growing bags is effective in heating the growing medium and plant roots. The warm air released from the poly tube orifices at the base of the growing bags heats both the growing medium and the roots. The same warm air rises through the plant canopy and heats the plant from the bottom up. Placing the poly tubes over the feeding pipes heats the fertilizer solution before it is released to the roots. The warm root environment further increases nutrient temperature that is absorbed by the roots and circulates the vegetative part of the plant, leading to more active plant growth. Moisture on the lower leaves evaporates faster, and dry leaves are less likely to be infected with disease.

To compare the new bottom-heat system with the traditional top-heat system, studies were conducted between January 1 and March 31 in 2001 and 2002. Two greenhouses were used, one with the modified system and one with the traditional system. In both years, the bottom heat, supplied by a diesel-fired heater, raised the night temperature of the root medium to an average of slightly higher than 73 degrees F, which is within the ideal zone. Top heat, supplied by gas-fired heaters and delivered

Figure 2. One modification is to use a floor heater connected to an 18-inch duct for heat transfer.

Photos by H.Y. Hanna

Figure 3. Warm air is piped through perforated poly tubes.

by blowing heated air above plant tops, raised the night temperature of the root medium to an average of just under 66 degrees F both years. There also were differences in the air temperature surrounding the plant base, the air temperature at the plant center (4 feet above greenhouse ground) and the temperature of the nutrient solution. (Table 1)

The modified heating system saved 27.1 percent in fuel costs over the traditional system in 2001 and 29.8 percent in 2002. The yield in 2001 was 7.5 percent higher for the new system, and, in 2002, was 6.8 percent higher than in the traditional top-heated system. ■

H.Y. Hanna, Professor, and K.D. Henderson, Maintenance Repair Master, Red River Research Station, Bossier City, La.

Table 1. Effects of bottom- and top-heated systems on temperatures of the root medium, plant surroundings and nutrient solution in two years

	Average temperatures (degrees F)	
	Bottom-heated system	**Top-heated system**
Root medium		
2001	73.8	65.9
2002	73.4	65.6
Plant base		
2001	70.9	68.9
2002	71.3	67.0
Plant center		
2001	71.5	70.2
2002	71.5	71.6
Nutrient solution		
2001	69.1	68.0
2002	69.3	67.0

Figure 4. Each poly tube is laid over a feeding pipe carrying the nutrient solution to the plants and snugged between double rows of tomato bags.

Update: Search Finds No Conclusive Evidence of Ivory-billed Woodpecker

Researchers at Cornell University's Ornithology Lab in Ithaca, New York, recently finished analyzing audio recordings and have determined that there is no conclusive evidence of the ivory-billed woodpecker's existence in Louisiana. The last documented sighting of the bird was in Tensas Parish in 1942.

Audio recordings made in January and February during an official 30-day search undertaken in the lower Pearl River basin in southeastern Louisiana revealed no evidence of the ivory-billed woodpecker. This area was chosen because of a reported sighting in 1999 by an LSU forestry student and because the area exhibited suitable habitat for the bird. Researchers had hoped one of the audio recordings had captured the distinct tapping sound made by the bird. Further analysis determined that the sounds were probably gunshots and not the bird.

According to Vernon Wright of the LSU AgCenter's School of Renewable Natural Resources, the findings do not mean the bird is extinct. Wright says further searches are being discussed in other places such as the Cat Island area in West Feliciana Parish, the Atchafalaya Basin and along the Sabine River south of Toledo Bend. These searches would not begin until late fall.

Wright is trying to secure use of the Cornell Lab's Acoustic Recording Units (ARUs) for these searches. If the woodpecker is in a search area, the ARUs could record its call or the tapping sound made by the ivory-billed when it removes bark from a tree. The birds are more vocal during the mating season and are more likely to be captured by the ARUs. Wright says the birds' mating season usually begins in November. ■ **Craig Gautreaux**

Cotton Yields Unaffected by Boll Dangle

Patrick D. Colyer, Boyd Padgett, William D. Caldwell and Philip R. Vernon

Photos by Patrick D. Colyer

Figure 1. Affected boll "dangling" from the stem.

In the past few years there has been a resurgence of a boll rot often referred to as boll dangle, Phomopsis boll rot, atypical boll shed or vascular cavitation. This boll rot has been present at low levels for many years but has become more severe in the past eight years. Researchers described a similar boll rot on cotton in Louisiana in 1963, which they attributed to the fungus Phomopsis. Although Phomopsis is frequently isolated from infected bolls, its role in the etiology of the disease is uncertain.

Boll dangle is characterized by the death of small (thumbnail size) bolls that remain attached to the plant, often suspended by a strand of bark below the node, hence the name (Figure 1). A lesion often forms around the base of the peduncle of the boll and may extend several inches down the stem (Figure 2). This boll rot is different from typical boll rot because it is not restricted to the denser lower canopy of the plant and affects mainly young bolls. The disease is most evident in late July or August. The epidemiology and full impact of this condition on cotton development and yield are not fully understood.

Testing Varieties

Tests were conducted to document the incidence of boll dangle on cotton varieties entered in the statewide cotton variety tests from 1997 to 1999. Over the three-year period, 81 early-maturing and 107 medium-maturing varieties were evaluated in the trials conducted at the Dean Lee, Macon Ridge, Northeast and Red River research stations. Boll dangle incidence (number of affected bolls per plant) was measured by counting the number and position of symptomatic bolls on 30 plants of each variety (10 plants per replicate) in late July or early August of each season.

Incidence of boll dangle was highest in the medium-maturing varieties at all locations. Across all varieties, boll dangle incidence was highest each year at Macon Ridge and Northeast. Nearly every variety was

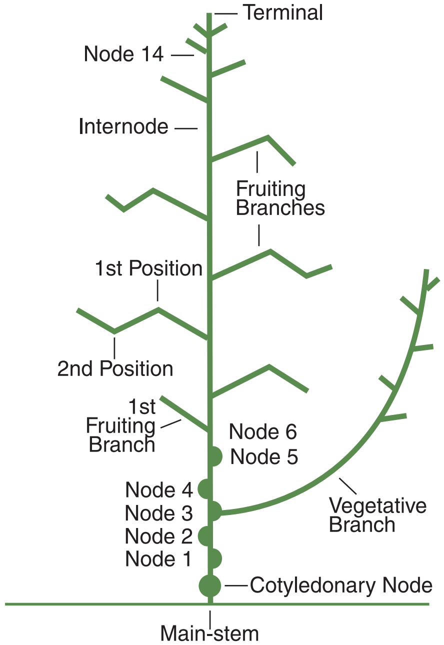
Patrick D. Colyer, Professor, Red River Research Station, Bossier City, La.; Boyd Padgett, Associate Professor, Northeast Research Station, Winnsboro, La.; William D. Caldwell, Professor, and Philip R. Vernon, Research Associate, Red River Research Station, Bossier City, La.

susceptible to boll dangle, but the number of affected bolls rarely exceeded two per plant. Each year in each test, 70 percent of the affected bolls were located in the first position (Figure 3). Severity of boll dangle was generally greater on plants with heavy boll loads.

Because the varieties in the test changed annually, it was impossible to evaluate all varieties across all three years. In the early-maturing varieties, Suregrow 501 had the highest incidence of boll dangle all three years. Other varieties heavily affected in the early test were Phytogen PS355, Deltapine 5415 and Stoneville 474. In the medium-maturity test, Suregrow 248 had the highest incidence of boll dangle in 1997 and 1998. Other varieties with a high incidence of boll dangle in the medium test were ACSI EXP0805, HCR9310, Deltapine 90B, Deltapine 9775, Deltapine 5690RR and Deltapine 675.

Figure 2. Cankers form at the base of the peduncle of affected bolls.

Figure 3. Cotton Plant Structure



Cotton Development, Yield

In 1999 and 2000, additional studies assessed the effect of boll dangle on cotton development and yield. Researchers identified four fields that exhibited a high incidence of boll dangle. Three were on the Macon Ridge Research Station and one was in Madison Parish. In 1999, the fields monitored were planted in NuCOTN 33B (Macon Ridge) and Deltapine 90RR (Madison Parish), and in 2000, Maxxa (Macon Ridge) and Phytogen 355 (Macon Ridge). In mid-July, 50 pairs of plants in each field were marked for future reference by securing plastic tags around the main stem. Each pair consisted of a plant with boll dangle symptoms and a plant without symptoms. Paired plants were adjacent or in close proximity within the same row. The tagging date, the condition of the plant (affected or not affected) and the pair number (1-50) were recorded on each tag.

At tagging, the number of harvestable bolls (24 days old or older) and boll dangle severity (number of affected bolls per plant) were assessed. The location of each affected boll was identified by node number and fruiting position. Boll dangle severity was reassessed every seven to 14 days until harvest. During mid-September, plants were chemically defoliated when 60 percent of the bolls were open. After defoliation, each plant was hand picked, and seedcotton from vegetative, first, second and all other boll positions was recorded. (Figure 3)

In 1999, initial boll dangle incidence was similar in both fields, but, by the end of the season, incidence was highest in Deltapine 90RR (4.64 affected bolls per plant) (Table 1). Most of the affected bolls (69 percent for NuCotn 33B and 56 percent for Deltapine 90RR) were at first position sites. Affected plants produced more harvestable bolls and seedcotton than non-affected plants in both varieties. Most seedcotton per plant for affected and healthy plants was produced from first and second position bolls, followed by vegetative bolls.

Table 1. Number of affected bolls per plant in four cotton varieties in tests conducted in 1999 and 2000

Year / Variety	Evaluation Period 1	2	3
1999			
NUCOTN 33B	2.08	2.24	2.62
DP90RR	2.24	4.28	4.64
2000			
Phytogen 355	2.78	3.38	3.38
Maxxa	1.98	2.10	2.10

Results on cotton development and yield from 2000 were similar to those in 1999. Phytogen 355 had more infected bolls than Maxxa (Table 1). Most affected bolls in both varieties were located at first position sites (54 percent for Phytogen 355 and 72 percent for Maxxa), followed by second position sites. The number of harvestable bolls was similar for affected and non-affected plants in Phytogen 355 and Maxxa. Seedcotton yields did not differ among affected and non-affected plants of Maxxa; however, the affected plants of Phytogen 355 produced more seedcotton than did non-affected plants.

Results from these two studies indicate that even though the incidence of boll dangle has been increasing, the disease did not affect cotton development or yield adversely. In statewide variety trials, the incidence of boll dangle rarely exceeded two bolls per plant. In monitored fields with infestations with select varieties, more harvestable bolls were produced on affected plants in both varieties evaluated in 1999 and did not differ among affected or non-affected plants in 2000.■

Cotton Harvest Management in Louisiana

Donnie K. Miller, Alexander M. "Sandy" Stewart, Ralph D. Bagwell and John W. Barnett

Preparing for cotton harvest involves some of the most important management decisions producers face. Applying chemical harvest aids before harvest can increase harvester efficiency, reduce leaf and trash content in harvested lint, facilitate dew drying, straighten lodged plants, retard boll rot, maintain or improve fiber quality and stimulate boll opening. In addition, using harvest aids with desiccating activity on weed species (causing leaves to dry out) can increase harvest efficiency.

Application Timing

A frequent question about harvest preparation is "When do I defoliate?" Harvest aid application decisions are based primarily on crop maturity as well as crop and weather conditions and harvesting schedule. Premature defoliation can reduce efficacy and yield. Delayed defoliation can cause loss of lint quality from weathering, high micronaire (measure of fiber thickness) values and, in some cases, reduced efficacy because of lower temperatures. Several methods for timing defoliation have been proposed. Each has merits and limitations. Unfortunately, there is no one-size-fits-all recommendation for cotton defoliation.

Open Boll Percentage

The most widely used method is based on percentage of opened bolls in a field, with 60 percent a common recommendation. In many situations, unopened bolls are mature enough to withstand negative effects and will open before harvest. This method, however, has limitations. Research in Louisiana has shown that, depending on fruit distribution on the plant, maximum yield can be obtained when defoliation occurs before 60 percent are open. Additionally, in cases where a large fruiting "gap" (no bolls present at fruiting sites) occurs and a large percentage of bolls are less mature and set in the uppermost region of the plant, optimum defoliation timing may occur later than 70 percent open. Research evaluating optimum defoliation in Louisiana and other states has shown maximum yield can be achieved with application ranging from 42 percent to 81 percent open, depending on crop maturity and fruit distribution.

NACB Method

The node above cracked boll (NACB) method, in contrast to the percent open boll method, focuses on the unopened portion of the crop. (See illustration of cotton plant on page 13.) NACB is determined by locating the uppermost first-position boll that is cracked open with visible lint and counting the number of main-stem nodes to the uppermost harvestable boll. By focusing on the unopened portion, NACB takes into account potential fruiting gaps. Most recommendations call for defoliation at four NACB. Low plant population and skip-row cotton, however, are often safer defoliated at three NACB. Lower plant population usually means a later-maturing crop with a significant portion of yield coming from outer position bolls and bolls set on vegetative branches.

DD60

Another method recently developed in Arkansas recommends defoliation after accumulation of 850 heat units, or DD60s, after cutout (stage when vegetative growth ceases). A DD60 (degree days above 60) is a measure of accumulated heat needed for growth and development using a 60 degree F minimum threshold. The value is determined by adding the daily high and low temperatures, dividing by two and subtracting 60. LSU AgCenter research indicates that under conditions experienced in Louisiana, the appropriate defoliation timing may be higher than 850 heat units (1050 heat units) beyond a cutout of node above white flower four (four main-stem nodes above uppermost first-position white flower). Although this method does focus on the unopened portion of the crop and is supposed to allow enough time and DD60s for full development of all bolls, it requires that a determination of cutout be made. The definition of cutout is a moving target and can be different for every field.

Boll Maturity

Whatever method is used, growers also should inspect unopened bolls for maturity. A boll is considered mature if it is difficult to slice in cross-section

Photo by John Wozniak

Harvest aid application decisions are based primarily on crop maturity as well as crop and weather conditions and harvesting schedule.

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with a knife and seeds have begun to form a brown or black seed coat. Once a dark seed coat has formed, defoliation will not affect yield of those bolls adversely. Cotton bolls need about 40 to 60 days to mature, depending on temperature. Bolls set later in the season will take longer to mature and may never be harvestable. Growers should walk their fields before defoliation and examine only those bolls that can reasonably be expected to mature.

Harvest Aid Considerations

In addition to defoliation, boll opening and weed desiccation, desired effects of harvest aids include inhibition of regrowth of cotton plants and removal of any juvenile growth. Because no one product can accomplish all of these objectives, tank-mix combinations are usually required. Harvest aids exhibit either herbicidal or hormonal activity. Compounds classified as having herbicidal activity injure the plant. This injury changes the hormone balance in the leaf by reducing growth hormone levels and stimulating ethylene production, which leads to leaf abscission (leaf drop). Hormonal harvest aids either deliver ethylene to the plant or stimulate its synthesis. Regardless of the mode of action, thorough coverage of foliage is required for maximum effect. Research has shown that hollow cone nozzles provide superior coverage for harvest aid applications. Research also has shown that harvest aids are affected by environmental conditions. Thus, label precautions must be followed.

Use of defoliants and boll openers for preparing cotton to be harvested is a critical management decision. LSU AgCenter researchers continue to evaluate products and timing strategies to determine the most profitable level of defoliation. A good cotton crop in the field can only be sold once it is harvested and ginned. Proper defoliation is a profitable part of a total cotton management system. ■

Acknowledgment

Donna R. Lee and A. Lawrence Perritt, research associates at the Northeast Research Station; Derek Scroggs, research associate at the Dean Lee Research Station; and Barrett McKnight, extension associate at the Scott Research and Extension Center for their work in the cotton defoliation research and extension programs and the Cotton Foundation for providing funding.

Harvest Aids Available for Harvest Preparation

tribufos (Def, Folex): Def and Folex are phosphate-based compounds that provide good to excellent defoliation over a range of environmental conditions, but minimal regrowth inhibition.

thidiazuron (Dropp, Freefall, Ginstar, Leafless): Dropp and Freefall provide good to excellent defoliation, regrowth inhibition and removal of juvenile growth under warm, humid conditions (higher than 70 degrees F). Activity is reduced or slowed as temperatures drop below 60 degrees F before or after application. Addition of 1 pint per acre crop oil concentrate adjuvant or the insecticide methyl parathion at 0.25 pound active ingredient per acre can increase efficacy under such conditions. Ginstar, a combination of thidiazuron and diuron (active ingredient in the herbicide Direx), provides all the positive attributes of thidiazuron alone and is more active under cooler conditions. It is, however, more likely to cause unwanted desiccation of cotton leaves than thidiazuron alone. Higher rates and tank mixtures increase this potential.

dimethipin (Harvade 5F, Leafless): Harvade 5F provides effective defoliation of mature plants but is a weak inhibitor of regrowth. It can desiccate several weed species including morningglory and prickly sida but exhibits little activity on emerged juvenile growth. Leafless is a combination of dimethipin and thidiazuron. It combines benefits of dimpethipin listed above and good to excellent regrowth inhibition and removal of juvenile growth provided by thidiazuron. Activity of the thidiazuron component is reduced and slowed under cooler conditions (see above). Crop oil concentrate should be added to dimethipin-containing compounds.

ethephon (Ethophon 6, Prep, Super Boll, Cottonquick, Finish): With adequate spray coverage, Prep and Super Boll accelerate the opening of mature bolls, but are not labeled as defoliants. Therefore, they should be tank-mixed with other defoliants. At low rates, ethephon can enhance the activity of other defoliants. Adequate time should be allowed before harvest for optimum boll opening effect. Cottonquick and Finish are combinations of ethephon and a synergist to increase defoliation and speed boll opening faster than ethephon alone. Neither provides adequate suppression of regrowth or removal of juvenile growth.

carfentrazone (Aim): Aim is a newly registered compound that has shown fair to good defoliation activity, but it can increase the likelihood of desiccation. Multiple applications or tank-mixtures with other harvest aids are usually needed to achieve complete defoliation. Aim exhibits excellent activity on emerged juvenile growth but provides minimal regrowth inhibition. Limited research with Aim has shown excellent desiccation activity on weed species including morningglory.

glyphosate (many formulations): Glyphosate provides excellent regrowth inhibition of conventional (non-Roundup Ready) cotton when applied in conjunction with defoliants or ethephon and results in excellent johnsongrass control.

sodium chlorate: Sodium chlorate is most effective in defoliating mature leaves and provides no regrowth inhibition or removal of juvenile growth. At higher rates, it acts as a desiccant, tending to stick to cotton leaves. Sodium chlorate may be the best defoliant choice when temperatures are below 55 degrees F. Application should not be made before cotton has 85 percent or more open bolls. Sodium chlorate should not be tank-mixed with other defoliants for safety reasons.

paraquat (Gramoxone Max): Gramoxone Max at lower rates in addition to conventional defoliants may increase defoliation of juvenile growth and stimulate boll opening. It does not, however, inhibit regrowth. Higher rates may result in cotton leaf desiccation and “freezing” of closed bolls. It may be used as a spot treatment for weed desiccation and should not be applied at weed desiccation rates before cotton is at least 85 percent open. ■

Clearfield rice at the Northeast Research Station near St. Joseph, La.

Photo by Mark Claesgens

Weed Management Systems for Clearfield Rice

Bill J. Williams, Ron Strahan and Eric P. Webster

Advances in weed control technology have played an essential role in the development of the rice industry. Herbicides are critical to obtaining optimum yield and maximum profit. Before the development of selective rice herbicides, weed control involved intensive manual labor. As is the case today, maintaining an adequate flood was important to managing weeds in rice.

Red rice, a close relative of commercial rice, is the No. 1 weed that limits rice production in Louisiana. Since red rice and commercial rice share many of the same physiological properties, herbicides that control red rice can severely injure commercial rice. As a result, the most effective herbicides for controlling red rice have been developed mainly in broadleaf crops such as soybeans and cotton.

Until recently, herbicides that selectively control red rice in commercial rice have not been available. The development of genetic engineering techniques has given plant breeders the tools they need to incorporate into crops genes that convey tolerance to herbicides that normally injure crops severely. Crops developed using genetic engineering techniques are commonly referred to as herbicide-tolerant crops.

Three herbicide-tolerant systems are being developed in rice: Clearfield, Liberty Link and, to a lesser extent, Roundup Ready rice. The Liberty Link system is a transgenic technology and conveys resistance to glufosinate (Liberty). Liberty is a broad spectrum, non-selective, postemergence herbicide with no soil or residual activity. Clearfield rice is not a transgenic technology because it was developed through mutation and not gene transfer. It is tolerant of a family of herbicides known as the imidazolinones. Scepter and Pursuit are two of the most familiar imidazolinone herbicides. Roundup Ready rice is a transgenic technology that conveys resistance to glyphosate (Roundup). Monsanto, the company that owns Roundup Ready technology, is not currently focusing on the development of Roundup Ready rice.

Clearfield rice was registered in 2001 and fully released by BASF in 2002. Clearfield rice represents the first available herbicide technology that selectively removes red rice from commercial rice. Between 5 percent and 10 percent of Louisiana's rice acreage was planted in Clearfield varieties in 2002. While Clearfield rice will be an excellent tool for managing red rice, it should not be viewed as a stand-alone herbicide program in most field situations.

Clearfield Research Review

Red Rice Control. So far, Newpath (imazethapyr) is the only imidazolinone herbicide registered for use in the Clearfield system. Single applications of Newpath have not maximized weed control or rice yield in most research trials. Trials that evaluated Newpath activity on red rice and other annual

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grasses have clearly demonstrated that two applications are required for acceptable weed control. The most consistent weed control has been observed when at least 4 ounces per acre of Newpath was applied to soil and followed by at least 4 ounces per acre of Newpath applied at the 3- to 5-leaf rice stage. All postemergence applications of Newpath should be applied with a surfactant. Producers should follow label recommendations when tank mixing with other herbicides. Note that the second Newpath application should be made at or before red rice reaches the 3- to 4-leaf stage. The soil application can be made before planting or immediately after planting.

For improved weed control, soil applications made before planting may be incorporated. If weeds are present at planting, the first Newpath application should be tank mixed with glyphosate or paraquat and applied before rice emergence. When Newpath is applied at the proper timing and adequate soil moisture is maintained by periodic flushing, the herbicide provides excellent red rice control.

Newpath has demonstrated good annual grass activity when applied alone, but more consistent barnyardgrass control has been observed with tank mixtures of Newpath plus Prowl or Facet applied before rice and weeds emerge. Newpath plus Prowl or Command has been the most consistent combination for controlling sprangletop. Newpath combinations with Facet, propanil and Arrosolo also improve the control of emerged grasses. These recommended programs should provide excellent control of annual grasses.

Newpath does not control several important broadleaf weeds such as hemp sesbania and jointvetch. Acceptable broadleaf weed control has been achieved by tank mixing Newpath with several postemergence herbicides such as Arrosolo, Stam, Facet, Basagran, Permit, Blazer, Storm or Grandstand. Tank mixing Newpath with recommended herbicides for improved weed control does not appear to affect red rice control negatively.

Water Management. Water management is critical to the success of Clearfield rice technology. After the soil application, a flush or rainfall is necessary within 48 hours to activate the herbicide. For maximum benefit from the soil application, good moisture should be maintained, and soils should not be allowed to become dry. Timely flushing will be a key component to successful control of red rice and other weeds in Clearfield rice. Permanent floods need to be established as soon as possible after the postemergence application. Research has shown that allowing soil to become excessively dry or delaying floods drastically reduces the success of Newpath programs.

Clearfield rice is labeled for dry-seeded production systems. Research indicates that Newpath can be equally effective in both broadcast and drill-seeded rice. Rice tolerance to Newpath applications in broadcast and drill-seeded rice has been evaluated extensively. Currently available varieties, CL-121 and CL-141, are sensitive to postemergence Newpath applications when applied before the 3-leaf stage of development. Research indicates that new CFX varieties available commercially in 2003 will be much more tolerant to Newpath than CL-121 or CL-141.

Outcrossing Issue. Because of similar biological and physiological properties common to red rice and Clearfield rice, there is a potential for outcrossing. If red rice is allowed to flower at the same time or in close proximity to flowering Clearfield varieties, the gene for Newpath tolerance can be transferred to red rice. Outcrossing seriously compromises the longevity of the Clearfield system. Therefore, it is extremely important that producers take the necessary steps to prevent outcrossing. It is essential that producers do not reduce Newpath rates and make a soil and postemergence application to prevent red rice escapes. It is equally important for producers to rotate Clearfield rice with other crops and use herbicides with alternative modes of action, such as Roundup Ready soybeans.

Soybeans are tolerant of Newpath and may be grown anytime after a Newpath application. Rotation to other non-Clearfield crops may result in severe injury if the plant-back intervals listed on the label are not followed. For example, corn (non-Clearfield), cotton and rice (non-Clearfield) should not be planted within 8.5, 18 and 18 months of Newpath applications, respectively. Continued use of Clearfield rice without rotation, however, will place tremendous selection pressure on red rice and certainly lead to a Clearfield red rice.

Clearfield Rice Success

Clearfield rice is not a "silver bullet." Clearfield systems do give producers the opportunity to selectively control red rice in commercial rice. Two applications of Newpath at 4 ounces per acre are required to control weeds in the Clearfield system. The first Newpath application should be made at or near planting followed by a second application before permanent flood. The closer the second application is made to permanent flood, the better the control will be; however, when weeds escape the first application, the second Newpath application needs to be made before the 3- to 4-leaf stage of red rice and other annual grasses.

One important result of the Clearfield system is that water-seeding and muddy water practices will not be required to control red rice. This means less use of water and less release of sediment-filled water into the environment. Producers will now be able to employ more agronomically and environmentally desirable seeding methods. ■

TABLE 1. Characteristics of the Clearfield rice system

Labeled herbicides	Newpath plus those registered for conventional rice
Herbicide program	Newpath (4 oz/A) applied to the soil followed by Newpath (4 oz/A) at the 3- to 5-leaf rice stage. It is critical that both applications be made, even if weeds are not present. Rates should not be reduced. Lower rates have resulted in consistently poor weed control.
Seeding systems	Dry-seeded (drill or broadcast dry-seeded).
Weeds controlled	Most annual grasses and some broadleaf weeds. Tank mixes for improved broadleaf weed control will be required. Amazon sprangletop control is improved when tank mixed with Prowl or Command. Newpath does not consistently control annual grasses with more than 3 leaves.
Water management	A flush or rain to activate Newpath within 48 hours of the soil applied application is required. Adequate soil moisture must be maintained following soil application. Permanent floods should be established as soon as possible after the postemergence application.

Evaluation of Nitrogen Rates for Corn in a Cotton-Corn Rotation

Rick Mascagni, Donald Boquet, Alphonse Coco and Steve Hague

Management of fertilizer nitrogen (N) is one of the most important components in producing maximum yield and profits in corn and cotton. Corn is inherently inefficient in fertilizer N uptake, typically using less than half of that applied. Cotton, on the other hand, has extremely high fertilizer uptake efficiency. When the two crops are grown in rotation, fertilizer not used by one crop may affect the optimal fertilizer rate for the next. The weather is probably the one factor that most affects yield potential and plant N use. During growing seasons with adequate rainfall and moderate temperatures, N uptake increases and maximum yields are produced. But, when growing conditions are less than ideal, yields are lower and N not removed by the crop is left in the field.

A cotton-corn rotation study was initiated in 1996 on Commerce silt loam at the Northeast Research Station near St. Joseph and on irrigated Gigger silt loam at the Macon Ridge Research Station near Winnsboro to evaluate fertilizer N rates and N carried over from year to year. Two blocks, corn and cotton, were planted adjacent to each other each year, and crops were switched in alternating years to maintain a cotton/corn rotation. Nitrogen rates were 0, 150, 200 and 250 pounds N per acre for corn and 0, 25, 50, 75, 100 and 125 pounds N per acre for cotton. Nitrogen fertilizer, ammonium nitrate, was broadcast each year. In the corn test, four corn N rates were superimposed over the previous year's six cotton N rates. Similarly, each cotton N rate was superimposed over the previous year's four corn N rates. Effects of carry-over N were determined from response of the current year's crop.

Optimal N rate for corn yield was 150 pounds per acre in four of five years at St. Joseph and all five years at Winnsboro. Averaged across five years, there was little difference in yields among fertilizer N rates of 150 to 250 pounds per acre (Figures 1 and 2). Responses to N rate in this study are consistent with previous research and with current recommendations. With application of optimal fertilizer N, average yields for the five-year test were 151 bushels per acre at St. Joseph and 146 bushels per acre at Winnsboro.

Carry-over N from cotton had little effect on corn yield (Figures 1 and 2) and, in fact, increased yield of the following corn crop only when no fertilizer N was applied to the corn. When no fertilizer N was applied to corn, yield increases from residual cotton N were about 16 bushels per acre at both St. Joseph and Winnsboro. When fertilizer N was applied, there were no yield responses to residual cotton fertilizer N, even at St. Joseph in 1998, the only time when attainment of maximum yield production required more than 150 pounds per acre of N. These results illustrate that corn would respond to residual N when fertilizer N was insufficient for plant needs; however, in this study, the lowest fertilizer N rate of 150 pounds per acre was usually adequate for maximum yield.

The number of N rates (main plots) for corn had to be limited in the experiment to four because of land availability. Previous research had established that the optimal N rate on silt loam soil was 150 pounds per acre for corn and 75 pounds per acre for cotton. Corn is not as sensitive as cotton to overfertilization, and corn producers usually apply more than 150 pounds N per acre to ensure maximum yields. Thus, in this study, we chose to evaluate N rates for corn of 150 pounds per acre and higher that are commonly used rather than lower rates that are unlikely to be used.

This study substantiates that the optimal N rate for corn production on both Commerce silt loam and Gigger silt loam is about 150 pounds per acre. Results also demonstrate that cotton N rates of 75 to 100 pounds per acre are not likely to affect the quantity of fertilizer N required by the following corn crop. The average corn yield in these tests was 150 bushels per acre. Cotton lint yields were excellent during this study, ranging from 1,100 to 1,400 pounds per acre at St. Joseph and 1,100 to 1,300 pounds per acre at Winnsboro. Fields with yield potential exceeding those in this study may require higher N rates for maximum yield. Residual N effects on corn may be greater when cotton yields are reduced by poor growing conditions, which may result in higher residual N levels. ■

Acknowledgment

The authors thank Cotton Incorporated and the Louisiana Cotton Support Committee for funding for this research.

Figure 1. Corn yield response to fertilizer on Commerce silt loam at St. Joseph, five-year average

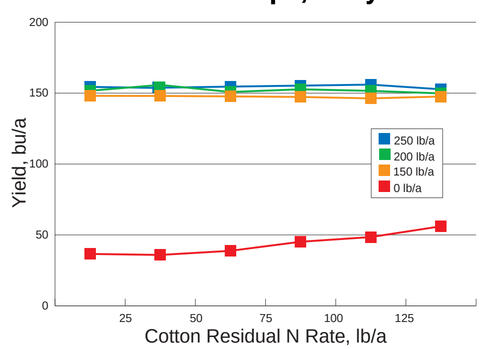
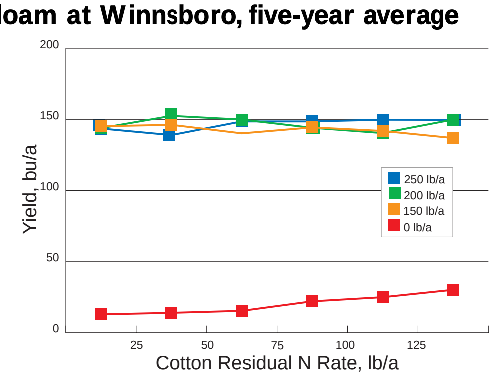


Figure 2. Corn yield response to fertilizer on Gigger silt loam at Winnsboro, five-year average



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Researchers Begin Long-term Project To Make Use of NASA Images

Using computers to translate remote images of crop fields into prescriptions for irrigating, fertilizing and controlling pests is the next technological advance in farming—as soon as researchers can figure out how to do it economically.

And that's where Roger Leonard and Ralph Bagwell, scientists at the LSU AgCenter, come in.

Earlier this year they received one of the largest grants ever awarded AgCenter researchers, $1.26 million from the National Aeronautics and Space Administration. That's right, NASA, the same folks that put men on the moon. In addition to space exploration, NASA controls sophisticated satellite imaging technology, and they want more people to take advantage of it.

Leonard and Bagwell, both headquartered at the LSU AgCenter's Macon Ridge Research Station in Winnsboro, are leading a team that in the next four years, and probably beyond that, will help bring more practicality to this technology so more farmers can use it.

"No one else is doing this kind of research. We're going to develop an economic benefit that will help farmers adopt this technology," Leonard said.

Though the money comes from NASA, the project is administered jointly by the U.S. Department of Agriculture through its Initiative for Future Agriculture and Food Systems.

Start with cotton

Leonard and Bagwell are starting with cotton, but what they learn will have implications for all row crops.

"Cotton is an expensive crop to produce. If we can reduce the inputs, that will be a dramatic savings to the farmer," Bagwell said. "That's the advantage of this precision farming technology."

The project is multi-faceted and excruciatingly complex, but the three main goals are these:

- To learn to interpret the remote images by studying how they correlate with what's happening in the field.
- To develop prescriptions for field inputs, including irrigation—not only how much but when to apply.
- To make this technology user-friendly.

One of the first hurdles is learning how to read NASA's satellite images.

Summer for learning

"This is the summer for learning software," Leonard said.

They have already started conducting experiments. In May, they flew a plane over a field to see if it could apply water in the same computer-prescribed pattern at 110 miles per hour as on-ground equipment had done earlier at 10 to 12 miles per hour. They used water for testing instead of fertilizer or defoliant.

"We're still analyzing the data. But it appears to have a level of accuracy that has field practicality," Leonard said. "Use of planes can be a more efficient means of application."

Edwards Barham of Barham Bros. Flying, Rayville, is the cooperating pilot and provider of aircraft for this project. A big part of the research is figuring how to program the computers that operate the application equipment in the plane. Assisting with this are Dale Magoun from University of Louisiana-Monroe, head of the computer science department, and Randy Price from agricultural engineering and Bob Downer from statistics, both from the LSU AgCenter.

In addition, Leonard has hired two graduate students, Srinivas Vinnakota and Daniel Culli, from the LSU Department of Geography for the summer to help with developing and refining the software.

The AgCenter scientists eventually will also use Barham's planes to record images and use these in addition to the satellite images provided by NASA.

Divulge plant growth

A basic premise of the project is correlating biological knowledge with these remote images. The images can divulge what's happening with plant growth, for example.

Knowing exactly the plant growth patterns in a field may reveal where insects are, since they can be attracted to highly vegetative plants. If scientists can look at images and know precisely where insects are, then they can determine exactly where to spray insecticides.

"Insects are not randomly spread through a field. They're only in certain spots. They tend to clump. If farmers can pinpoint those spots and add chemicals to only those spots, it will save them money and the environment. This will reduce insecticide and defoliant costs in cotton," Bagwell said.

Most of the research will be conducted on Jay Hardwick's farm near Newellton. Both Hardwick and his consultant Howard Anderson are part of the research team.

Irrigation timing

Steve Hague, an agronomist at the LSU AgCenter's Northeast Research Station in St. Joseph, is an expert in irrigation, and he will lead the effort to determine use of this technology to help with the timing of irrigation. The remote-sensed images also reveal soil moisture levels, which is critical to knowing when to irrigate.

Ken Paxton, an LSU AgCenter ag economist, will analyze the data for costs and benefits to the producers.

"This is among the largest, single grants we've ever received for research and a tremendous tribute to our scientists who conceptualized this," said Dr. Bill Brown, vice chancellor and research director.

The use of remote-sensed images taken from airplanes and satellites will help create precise prescriptions for use of chemicals in fields, thus dramatically cutting down on their use. This will ultimately save farmers money, improve profit margins and have tremendous benefits for the environment.

This is the promise. Two LSU AgCenter researchers and the team they have assembled are taking the first steps toward a giant leap for agriculture. ■ **Linda Foster Benedict**

Developing Termite-resistant Structural Wood-based Panels for Home Construction

Qinglin Wu, Jong N. Lee, Sunyoung Lee, W. Ramsay Smith and Bryan Strickland

Formosan subterranean termites pose a growing threat to all structural wood materials in residential construction. The species is one of the most aggressive and voracious insects in the world.

Chemical treatments of wood with chromated copper arsenate and borate have been effective against the termites. Structural lumber and plywood can be successfully pressure-treated with these chemicals, and both are widely used in Louisiana. Structural composite panels, such as oriented strandboard (OSB), however, cannot be pressure-treated in the same manner with these chemicals because of swelling. OSB is made of wood flakes glued with a thermal-setting resin. It is widely used as sheathing, flooring and I-joist materials in home construction, replacing plywood. Thus, alternative techniques for protecting OSB against termites must be developed.

LSU AgCenter researchers conducted a study to measure the effects of incorporating borate powder into wood flakes during the blending process on the performance characteristics of OSB. The objectives of the project were to study the effects of wood species, borate type (calcium borate or zinc borate) and borate content on panel strength, swelling, water leaching and termite resistance. This information is highly desired for developing durable structural panels for residential construction using southern wood species.

Table 1. Results of laboratory no-choice termite tests for zinc-borate modified OSB from southern pine and mixed hardwoods

Wood Species	Zinc Borate BAE [1] (%)	Sample Density (g/cm³)	Visual Damage Rating [2] (1-10)	Wood Weight Loss (%)	Termite Mortality (%)
Mixed Hardwood	0	0.74	2.96	16.48	17.50
	0.97	0.69	8.54	4.58	34.95
	1.75	0.59	8.52	4.17	40.05
	3.00	0.71	9.54	3.08	37.95
Southern Pine	0	0.74	2.36	21.02	19.50
	1.03	0.72	9.80	2.70	32.45
	1.77	0.70	8.86	3.84	32.25
	3.02	0.67	9.18	3.51	37.00

[1] Actual boric acid equivalent (BAE) values of termite test samples.
[2] 1 = most amount of damage; 10 = least amount of damage.

Qinglin Wu, Associate Professor; Jong N. Lee, Research Associate; Sunyoung Lee, Graduate Student; and W. Ramsay Smith, Program Leader, Louisiana Forest Products Laboratory, and Professor, School of Renewable Natural Resources, LSU AgCenter, Baton Rouge, La.; and Bryan Strickland, Technical Service Representative, Dynea Inc., Winnfield, La.

Flake mats with resin- and borate-coated southern pine flakes ready to be hot-pressed.

A comparison of damaged (top) and undamaged test samples.

Panel Manufacturing and Testing

Fresh-cut lumber boards from eight southern species were obtained from a local sawmill in southern Louisiana. The boards were cross-cut into 6-inch-long blocks along the grain. These blocks were flaked with a laboratory flaker to produce 3-inch-long by 0.025-inch-thick flakes. The flakes were dried to 2 percent to 3 percent moisture content using a steam-heated dryer and were screened to eliminate small wood particles.

The OSB panels were then produced by blending the dry wood flakes with liquid phenol formaldehyde resin, wax and borate powder (zinc or calcium borate), forming them into loosely packed mats and then putting them through a hot press.

Samples were taken from each panel to test the borate content. The result was expressed as boric acid equivalent (BAE) (Table 1). Tests were conducted to determine each panel's stiffness and strength, internal bond strength, thickness swelling, water leachability and termite resistance. In addition, creep tests were conducted. Creep measures how much deformation or movement wood will experience under long-term loading. For example, a beam inside a house under a heavy load (the roof) will tend to bend in the middle of the span. Creep measures how much bending will occur as a function of time. The creep data were fitted to a mathematical model, which was then used to predict the creep performance over 30 years.

Photos by Qinglin Wu

An oriented strandboard sample (southern pine) in a test bottle with Formosan subterranean termites tunneling through the sample.

Mechanical, Physical Properties

Panel stiffness and strength, which measure resistance to a bending load, were affected little by borate up to the 3.5 percent BAE level. Wood species and borate type had an insignificant influence on both properties.

The effect of borate on internal bond (IB) strength, which measures glue-bond efficiency, varied with borate type and wood species. Zinc borate showed fewer negative effects on the IB values, compared with calcium borate for both mixed hardwood and southern pine OSB. Both types of borate, however, had acceptable IB values (based on the industry standard).

Thickness swelling from 24-hour water soaking generally increased with borate content in the panel for both zinc and calcium borate OSB. Zinc borate-modified OSB had less thickness swelling than calcium borate OSB at a comparable BAE level. Borate particle size had a significant influence on the swelling properties. Calcium borate with large particle size caused significant thickness swelling at high BAE levels, but reducing the particle size of the chemical helped bring the thickness swelling to a stable and acceptable level.

A certain amount of borate leached out under the water-soaking condition. The use of borate with a smaller particle size helped reduce sample thickness swelling and leaching rate. Boron fixation with other chemical agents may be necessary for borate-modified OSB under the extreme water exposure conditions. Protection of the panel from direct water exposure can help reduce this problem.

Termite Tests

Laboratory tests indicated that both zinc and calcium borate used in OSB resisted Formosan subterranean termites well (Table 1). As the borate loading increased, wood sample weight loss decreased and termite death rate increased. At higher borate levels, there was little damage on wood samples. The observed weight loss in these samples was caused by loss of volatile materials in the samples. Wood species showed an insignificant effect. There were strong correlations among visual damage rating, wood sample weight loss and termite death.

Long-term Structural Performance

The creep tests conducted showed that borate-modified OSB can meet the National Design Specifications for wood construction. Further testing of creep behavior of the product under combined mechanical and moisture loading conditions is ongoing.

Summary

The results of this work indicated that termite-resistant structural OSB from southern species can be successfully developed with a right combination of wood species, borate type and content and other processing variables. The study provides comparative properties between zinc and calcium borate modified OSB. This technology will help more OSB producers manufacture chemically modified OSB to meet increasing market demands. ■

Acknowledgments

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Renowned Private Camellia Collection Goes to Burden

What may well be one of the country's largest private camellia collections is on its way to a new home.

More than 450 identified camellia varieties from the private collection of Violet Stone are being propagated from cuttings and will be planted in the Windrush Gardens at the LSU AgCenter's Burden Center in Baton Rouge.

When Stone died in October 2001, she left a Baton Rouge garden brimming with about 500 named varieties and 200 to 300 more unknown or duplicated camellia bushes.

With the help of Violet's daughter, Stella Stone Cooper of Paramus, N.J., and longtime family friend and camellia collector Art Landry of Baton Rouge, staff from the LSU AgCenter's Burden Center identified and collected cuttings from all but about 30 varieties in the Stone collection.

The cuttings—20 from each plant—have been sent to two different nurseries for propagation, according to Pat Hegwood, director of the Burden Center.

When they are returned from the nurseries, some of the plants will be grown in pots for two or three years and then grafted to sturdy rootstock for planting, Hegwood said. The nurseries will get commercial access to the plants derived from the cuttings in exchange for their work in propagation.

When the new plants are ready, they will be planted in a special garden at the Burden Center.

"Some of the varieties are quite rare and valuable," Hegwood said of the collection the Stones had accumulated over more than 50 years. "Ultimately, we'll end up with at least one or two grafted plants of each variety. It will take 10 to 12 years for us to get a fully developed garden from the cuttings."

The 420-acre Burden Center, originally Windrush Plantation, was owned by the Burden family from the mid-1800s until it was donated in parcels to Louisiana State University from 1966 until the early 1990s.

Used for horticultural and agronomic research and as home to the LSU Rural Life Museum, the Burden Center, now surrounded by Baton Rouge, is restricted to being a green area without any buildings except those necessary for the museum or for research, according to the Burden family's directions.

The Burden Center features the Ione Burden Conference Center, the Steele Burden Memorial Orangerie, an All-America Rose Display Garden and acres of research plots along with Windrush Gardens and its plant collection. ■ **Rick Bogren**

Photos by C. Patrick Hegwood Jr.

These are three of the camellias from the Stone collection. Top to bottom: 'Tama No Ura,' one of Mrs. Stone's favorites; Lilye Roseman; and Mister Sam (not completely opened).

Photo by Mark Claesgens

Peggy Cox, research associate and curator of the Windrush Gardens, taking cuttings from the Stone camellia collection.

News Briefs

Poultry Litter Composting Process Looks To Be Money Saver

Once again the magical powers of composting are proving to be productive—this time in North Louisiana broiler houses. An AgCenter team has devised a way to use composting techniques on poultry litter to rid it of dangerous pathogens that can kill new “biddies,” the baby broilers. This will help reduce reliance on expensive chemicals to sanitize the bedding and delay the need to buy new bedding. The AgCenter is conducting this demonstration project with several ConAgra producers. The farmer goes into the emptied house with a tractor-drawn scraper blade and creates rows of the bedding at least 2 feet high. These heaped rows, called “windrows,” contain enough oxygen and moisture to generate heat, which kills the pathogens in seven to 10 days. During this period, the AgCenter scientists are also finding that the heat dries out the bedding enough to vaporize ammonia buildup, which is also harmful to the biddies. The farmer can then go back in, re-spread the bedding and have a broiler house safer for new arrivals. The AgCenter team includes Theresia Lavergne, poultry specialist; Bill Carney, environmental specialist; David Schellinger, research associate; and Matt Stephens, county agent in Union Parish. So far, ConAgra is impressed with the cost savings and is encouraging its producers to use composting techniques.

Macon Ridge Gains New Lab Building

A new 4,000-square-foot pest management research building at the Macon Ridge Research Station at Winnsboro has been completed. It includes offices for research associates, labs and a workroom that can double as a meeting room. The research being conducted there will be that of Roger Leonard, cotton entomologist, and Boyd Padgett, plant pathologist.

Donald E. Franke, professor in the Department of Animal Sciences, has been awarded the Rockefeller Prentice Memorial Award in Animal Breeding and Genetics. “This is the highest award of its kind in the country,” said Paul Humes, department head. “Only one such award is presented each year.” The presentation was made at the annual meeting of the American Society of Animal Science.

Michael Saska, professor at the Audubon Sugar Institute, was awarded the Sugar Industries Technologists Crystal Award. This achievement award is made annually to a technologist from anywhere in the world who has made a significant contribution to advancing the technology of the international sugar industry, according to Peter Rein, head of the Audubon Sugar Institute.

Marybeth Lima, assistant professor in the Department of Biological and Agricultural Engineering, has been awarded the A.W. Farrall Young Educator Award for 2002 by the American Society of Agricultural Engineers.

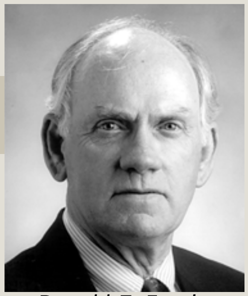
T. Eugene “Gene” Reagan, professor in the Department of Entomology, has been selected to receive an LSU Distinguished Faculty Award for 2002. Only 10 such awards were given this year and only one to a professor in agriculture. This honor indicates a sustained record of excellence in research, teaching and service.

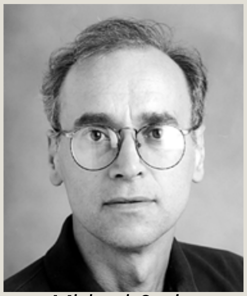
James L. “Jim” Griffin, weed scientist and professor in the Department of Agronomy, has been named the Lee F. Mason LSU Alumni Association Professor in the College of Agriculture. This honor is in recognition of outstanding teaching and includes a supplementary salary stipend of $5,000 annually and a $2,500 academic support budget.

M.C. “Chuck” Rush, professor, and **Abul-Khair Shahjahan**, post-doctoral fellow, from the Department of Plant Pathology and Crop Physiology, and **Donald E. Groth**, professor at the Rice Research Station in Crowley, won the Distinguished Rice Research and Education Team Award at the Rice Technical Working Group meeting in Little Rock, Ark. The award recognized their research identifying a bacterial cause for rice panicle blight, which is a major constraint on rice production in Louisiana and other southern states.

Michael E. McCormick has been named resident coordinator at the Southeast Research Station in Franklinton. He will continue with some of his research work in dairy nutrition and assume some of the administrative duties of James Beatty, the former resident director who retired March 1.

■ **Linda Foster Benedict**


Donald E. Franke


Michael Saska

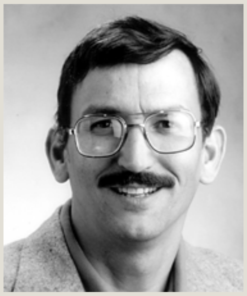

Marybeth Lima


T. Eugene “Gene” Reagan


James L. “Jim” Griffin


M.C. “Chuck” Rush


Donald E. Groth


Michael E. McCormick

New Sweet Potato Adds To Louisiana Mix

The LSU AgCenter has released a new sweet potato named "Bienville," which has resistance to root knot nematodes. It has been in trials as seedling L 94-96 in many locations in the sweet potato production areas of the state for the past few years and was commercially released for planting in May, said Mike Cannon, resident coordinator of the Sweet Potato Research Station at Chase. "It will possibly be a good variety for producers in Morehouse and Ouachita parishes," Cannon said. "It grows well in the fine sandy loam soil there." That's also the type of soil root knot nematodes like. Cannon said because of limited seed availability, fewer than 100 acres have been planted with Bienville this year in Morehouse and Ouachita parishes, which will give producers a chance to see how well it performs. The sweet potato is almost identical to Beauregard. "It's not meant to replace Beauregard, but it fills a niche," Cannon said. "It doesn't sprout as well as Beauregard and may not store as well." Beauregard is a sweet potato variety released by the AgCenter in 1987. It has proved to be one of the most popular varieties ever. ■ **Linda Foster Benedict**

Mike Cannon, coordinator of the LSU AgCenter's Sweet Potato Research Station at Chase, with boxes of seed stock of the new Bienville sweet potato variety.

New Patent May Boost Coastal Fish Farming

The LSU AgCenter has patented a vaccine that could be a shot in the arm for the hybrid striped bass industry to return to the Louisiana coast. Ron Thune of the AgCenter's Department of Veterinary Science developed the vaccine that immunizes fish against photobacteriosis, a disease that all but wiped out the fledgling hybrid striped bass industry on the coast in the 1990s. The disease is caused by a marine bacterium that lives in brackish or salt water but does not affect striped bass grown in fresh water, Thune said. Fish farmers in Louisiana and surrounding states began raising hybrid striped bass in ponds in the 1980s. Because the fish can live in both fresh water and salt water, by 1990 hybrid striped bass spread to the coastal marshes of Louisiana where fish were raised in cages and raceways. The hybrid fish are a cross between striped bass, which are saltwater fish that travel up rivers to spawn in fresh water, and freshwater white bass. "Raising them on the coast did well until the disease arrived," Thune said, adding that hybrid striped bass grow fast and are more profitable than catfish. ■ **Rick Bogren**

Inside:

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