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Rice Station Spurs State's Economy

Nearly all of the rice grown in Louisiana was developed at the LSU AgCenter's Rice Research Station in Crowley. The world's first herbicide-resistant rice, which helps Louisiana producers fight the weeds that historically have plagued their rice, was discovered here. Rice production contributed nearly $324 million to the state's economy in 2004.

The LSU AgCenter Rice Research Station, founded in 1909, has a long history of conducting research and developing new rice varieties that benefit the rice industry in Louisiana as well as other states. Rice farmers in Arkansas, Texas, Mississippi and Missouri rely heavily on rice varieties developed at the station.

"The Rice Research Station is among the premier research organizations in the world devoted to rice," said David Boethel, LSU AgCenter vice chancellor for research. "It has an international reputation excelling in all phases of rice culture – breeding and variety development, pest management, fertilization and physiology."

Funding for research includes a major share from Louisiana rice farmers themselves. They voluntarily pay a check-off fee of 5 cents per hundredweight, which goes into a fund distributed through the Louisiana Rice Research Board. Established in 1972, this board has provided more than $30 million to aid LSU AgCenter research.

"We would not be in the rice business today had it not been for the hard work at the rice station," said John Denison, rice farmer from Iowa, La., and founding member of the Rice Research Board. "The 1990s and the early 21st Century have been dominated by the rice breeding and rice farming technology developed at the station."

The two most important technologies in recent years of rice farming, herbicide-resistant varieties of Clearfield and Liberty Link, were developed at the station.

Clearfield was used on almost 25 percent of rice acreage in Louisiana during the 2004 growing year. Liberty Link has yet to be released.

Herbicide resistance allows farmers to spray for weeds without harming the rice. The No. 1 weed problem for rice growers is red rice, a close relative of commercial rice. Because of Clearfield, farmers can now plant in fields that have historically been riddled with red rice, and they can grow the rice more efficiently.

Farmers Rely on Rice Station

Jeffrey Sylvester said Rice Research Station's breeding program is the station's most significant asset for his farming operation in St. Landry Parish where he grows rice with his brothers.

"They're always experimenting with things so we don't have to try it in the fields.

(Continued on page 27)

Photo by Bruce Schultz

The Rice Research Station participated in a study of "golden" rice, which is the rice fortified with Vitamin A to help with nutrition deficiencies in countries where rice is a primary food staple.

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ON THE COVER:
Bruce Schultz, area communications specialist headquartered in Crowley, took this photo of maturing rice on the Zaunbrecher Brothers farm in northern Acadia Parish. Read the latest research on planting dates on page 6.

Sea oats studied as coast 'preservers'

HOLLY BEACH – Hundreds of sea oat plants bent in the breeze on a sandy beach as LSU AgCenter researchers walked among them, looking for plants with potential to help stem erosion on Louisiana's Gulf Coast.

"What we have is about 1,000 plants, each of which is genetically different," said Steve Harrison, an LSU AgCenter plant breeder, as he stood on the beach about seven miles west of here.

"What we're doing here is comparing the survival, spread, vigor, seed production and aesthetic attributes of each of these plants and trying to narrow down the thousand to a list of maybe a hundred that warrant additional study," he said.

The sea oats at Holly Beach came from seeds collected along the Gulf Coast from Texas to Florida and from the Atlantic Coast from Florida northward, according to Mike Materne, an LSU AgCenter coastal wetlands plant specialist.

Federal and state agencies and park systems helped collect the seeds along the Gulf. North Carolina State University plant breeder Paul Murphy and county agent David Nash contributed seeds collected along the Atlantic Coast.

The seeds then were planted in a greenhouse on the LSU campus in Baton Rouge, and the plants were transplanted at Holly Beach and Biloxi Beach, Miss., in 2004. Researchers at North Carolina State University made similar plantings at Wrightsville Beach, N.C.

"Because each plant was produced from seeds, every plant is potentially genetically different," Materne said.

It's the genetic variation that the researchers are looking for.

"Not a lot is known about sea oats in terms of genetics," Harrison said.

The Louisiana and North Carolina researchers are collaborating to identify plants that will grow best, hold sand and keep it from blowing away.

In the fall of 2004, the researchers began evaluating the plants at Holly Beach, and they made a second selection in July. They dug up parts of the selected plants, which will be divided and planted in greenhouses to produce plants for further testing. ■ **Rick Bogren**

Farm Bureau gives $4,000 to Master Farmer Program

The LSU AgCenter's Master Farmer Program received a $4,000 check from the Louisiana Farm Bureau during the bureau's annual conference in July 2005. Farm Bureau President Ronnie Anderson made the presentation to Carrie Mendoza, coordinator. He said the program "is one of the most important out there for farmers. Its success will depend on producer involvement and we want to make sure as many farmers as possible have access to the program." The Master Farmer Program was established four years ago as a way to help farmers learn to reduce runoff into Louisiana's waterways and improve water quality. To become a Master Farmer, participants must successfully complete the program's three phases—training, visiting a model farm and developing a conservation plan. For more information about the program contact Mendoza at (225) 578-2906, or cmendoza@agcenter.lsu.edu. ■ **Linda Foster Benedict**

Photo by Mark Claesgens

Steve Harrison evaluates sea oat plants on Holly Beach as part of coastal preservation efforts.

Turning alligator waste into 'gold'

Louisiana produces about a million pounds of alligator waste – primarily carcasses – each year.

If Jack Losso has his way, that waste will be turned into a usable product that could add millions of dollars to the Louisiana economy.

Losso, an LSU AgCenter food science researcher, and his research team have developed a way to extract collagen from alligator carcasses into a form suitable for the cosmetic, food and pharmaceutical industries.

The cosmetic industry uses collagen in manufacturing personal care products, and the food industry uses collagen as a source for gelatin as well as for clarifying alcoholic beverages and other uses.

In addition, successful medical and pharmaceutical applications of commercially available collagen include the treatment of hypertension, urinary incontinence and pain associated with osteoarthritis and inhibition of cancer spread in the body.

Collagen has a variety of uses in biomedical applications.

"First is tissue engineering – creating artificial skin for grafts for burn victims and other applications," Losso said. "Second is wound healing – companies are interested in putting collagen in bandages. It also can be used in emergency rooms for stopping bleeding."

Most commercial collagen now comes from cattle and swine, but Losso said "mad cow disease" in England and Canada has made collagen users "anxious and looking for other sources."

Marine collagen offers an alternative

What's New?

to collagen from cattle or swine. Shark collagen has long been used as an alternative, particularly for medical uses, including wound coverings, artificial skin, artificial bone, artificial cartilage, artificial tendons and surgical sutures.

Commercial collagen also comes from other fish.

"We started with removing collagen from fish skins – black drum and sheepshead – about two years ago and have a patent pending on the technique we developed," Losso said.

"We've extracted collagen from the alligator cartilage and compared it with collagen from shark cartilage," Losso said. "There is a striking similarity, biochemically speaking.

"What we produce is almost 100 percent pure," Losso said. "The next step is FDA certification."

Losso's team includes fisheries and coastal issues agent Mark Schexnayder, aquaculture agent Mark Shirley and two other Food Science Department faculty members Michael Moody and Jon Bell, as well as Ralph Portier from the LSU Department of Environmental Studies. ■ **Rick Bogren**

Vandeveer lauded as teacher, researcher

Lonnie R. Vandeveer, a professor in the Department of Agricultural Economics and Agribusiness and a frequent contributor to *Louisiana Agriculture*, died on May 5, 2005, from a heart attack. He was 55 and a native of Coyle, Okla. A U.S. Army Vietnam veteran, he received his B.S. ('72), M.S ('76) and Ph.D. ('79) degrees from Oklahoma State University. He began his academic career with LSU in 1979. His research and teaching programs were in agricultural finance and rural land markets. During his career, Vandeveer received numerous awards for his teaching and research activities. He was recognized by the LSU chapter of Gamma Sigma Delta for meritorious teaching efforts. The National Association of Colleges and Teachers of Agriculture awarded him the Teaching Award of Merit. Vandeveer also won several awards for his student advising activities. These included the Outstanding College of Agriculture Award by the World Association of Agricultural Councils and the Outstanding Academic Adviser Award from LSU. He won several awards for the Southern Agricultural Economics Association and the American Agricultural Economics Association for posters developed from his research program. The LSU chapter of Gamma Sigma Delta recognized his research work with the Research Award of Merit. He was named the Warner L. Bruner Professor in 1999. ■ **Kenneth W. Paxton**

Lonnie R. Vandeveer (1949-2005)

Photo by Mark Claesgens

Kenneth Gravois, resident coordinator and sugarcane breeder, explains the differences in new sugarcane varieties at the Sugar Research Station's 2005 field day on July 20.

New sugarcane varieties take pressure off 384

LSU AgCenter sugarcane researchers showcased new varieties at the sugarcane field day held July 20 at the Sugar Research Station at St. Gabriel.

The three varieties – HOCP96-540, L97-128 and HO95-988 – all have good yield potential and attractive characteristics, but the real interest stems from getting some of the sugarcane acreage away from the state's dominant variety LCP89-384. That variety made up 91 percent of the Louisiana sugarcane crop last year.

"That's not a good situation," said Kenneth Gravois, station coordinator. "That's a situation that puts all of our eggs in one basket."

The 384 variety has been around for 12 years. While it's been a good variety that growers are comfortable with, they are concerned by the amount of rust disease showing up in their fields.

"384 was resistant to rust, but Mother Nature is dynamic. She will not lay over and play dead," warned Gravois.

The expert said he suspects either the rust organism mutated or the characteristic was "selected out" of the variety over the years.

"Each year since 2000 we've seen increasing levels of rust, and that is alarming to Louisiana sugarcane growers," Gravois said.

Rust is a foliar disease of sugarcane and will reduce the plants' height and ultimately the yields.

Researchers also showcased two varieties for release in 2006. The two varieties have good yield potential, and one has the added benefit of insect resistance.

"It's one of the first varieties in a number of years with resistance to the sugarcane borer," Gravois said. ■ **Tobie Blanchard**

PLANTING DATE CRITICAL for Maximum Rice Yield, Milling Quality

Xueyan Sha and Steven D. Linscombe

These young rice plants are in Vermilion Parish. Photo by Bruce Schultz

About three quarters of Louisiana rice is grown in the southwestern region of the state. In recent years, ratooning (a second harvest from the same planting) has become a common practice for many rice growers in this region. Ratooning allows Louisiana rice growers to compete with rice growers in other states where the environment is more favorable for rice growing.

Because of the environmental limitations that restrict the time when rice stands can be successfully established or panicles can flower and fill grain optimally, rice in Southwest Louisiana is planted between late February and early July. Recommended planting dates for this region range from March 15 to April 20. To have a successful ratoon crop, rice must be planted before mid-April. Rice planted before the window of optimum dates usually has slow germination and emergence, poor stand establishment, increased production costs, and reduced grain production. Planting rice after the optimum dates can result in higher pest incidence and shorter day length (less photosynthesis) during grain filling, resulting in low yields. Because the current planting date recommendations are based on studies with relatively older varieties, there is a possibility that the pattern of response to planting date of recent or future releases may be different.

Milling quality, especially head rice yield (percentage of whole milled kernels), is equally as important as grain yield. Milling yield determines the unit ($/100 pounds) economic value of the crop. Research conducted in other states suggests that planting dates might also affect rice milling quality.

Studies have been conducted continuously at the LSU AgCenter Rice Research Station at Crowley during the past decade to evaluate the effects of planting dates on main crop yield, ratoon yield, milling quality, and agronomic performance of major rice varieties and experimental lines. Information generated from these studies is important not only in evaluating the stability of rice genotypes under the various environmental conditions posed by different times of planting but also in determining the optimum planting dates for different rice varieties.

Field data were obtained from experiments conducted from 2001-2004 at the Rice Research Station. Each year, between 12 and 15 rice varieties and advanced breeding lines were tested. Tests were planted every two weeks from late February to early July. All tests were no-till water-seeded at a seeding rate of 150 pounds per acre. At maturity, a small sample was hand-harvested from each plot for milling yield determination. For tests seeded on or before April 15, plots were fertilized and flooded approximately 4 to 6 days after harvest of the main crop to evaluate ratoon crop potential.

A broad range of genotypes were evaluated, including conventional long-, medium- and short-grain varieties, Clearfield (herbicide-tolerant) varieties, and hybrids. Rice genotypes in this study were new releases by the rice research stations in Louisiana, Texas and Arkansas, and experimental lines from Louisiana, as well as hybrids developed by RiceTec, which is a Texas-based private company and

Xueyan Sha, Assistant Professor, and Steve D. Linscombe, Professor, Rice Research Station, Crowley, La.

the only program that develops and commercializes rice hybrids in the United States. Entries were grouped into conventional long-grain, conventional Clearfield, conventional medium/short-grain, and hybrids:

- Long-grain: Cypress, Cocodrie, Cheniere, Trenasse, Saber, Ahrent, Wells, Francis, LA2051, LL184, and LL355
- Clearfield: CL121, CL131, CL141, CL161, and CL029
- Medium/Short-grain: Bengal, Earl, Jupiter, Pirogue, LA2028, LL001, and LL401
- Hybrids: XL8, XL710, and CLXL8

For the main crop overall, rice seeded in mid-April produced the highest grain yield (Figure 1). Grain yield increased as planting date was moved forward from February to mid-April then declined gradually with planting through early and mid-May. However, grain yield declined dramatically when seeded after mid-May.

Differences in response to planting date were noted between genotypes (Figure 1). Conventional long-grain and Clearfield types generally followed the trends noted above. Conventional long-grain and Clearfield types responded somewhat differently to planting date than medium-grain types. Medium-grain types were generally lower yielding when planted between the end of February and the middle of April and were generally higher yielding when planted after the middle of April. Medium-grain types had relatively constant yields when planted between the middle of April and the middle of May. Long-grain types showed a general decline in yield during this same period. Hybrids had the highest yield, regardless of planting date. Peak yields were associated with planting around the first of May, which was about two weeks later than the optimum planting date for peak yields with the conventional long- and medium-grain types.

Yearly environment affected the response of yield to planting date (Figure 2). In 2001, grain yield increased continuously as planting date advanced from the end of February through the middle of March, peaked with planting around the first of April, and declined continuously at each subsequent planting date. In 2002-2004, the patterns were relatively similar. In each year, grain yield was relatively constant with planting from the end of February through the first of April, peaking with planting around the middle of April, and declining with later plantings.

Overall, high milling (head rice) yield of main crop rice was associated with early planting, and milling yield gradually declined at later planting dates (Figure 3). Milling yield was uniquely low for two planting dates, the first of May and June. The trend was consistent for conventional long-grain and Clearfield types. Milling yields of medium-grain types were only dramatically reduced at the early June planting date. In contrast, hybrids exhibited no consistent effect of planting date on milling yield.

Ratoon crop production was evaluated following harvest of main crop rice planted from the end of February to the middle of April (Figure 4). Averaged across all genotypes, the main crop planted in the middle of March produced the highest ratoon yields, and ratoon yields declined continuously when the main crop was planted around the first and middle of April. The pattern of total crop yield (main plus ratoon yields) followed main crop yields for the planting dates from the end of February to the middle of April. Yields were relatively constant for the first three planting dates and increased

Figure 1. Effect of planting date on main crop grain yield of different types of rice, Crowley, LA, 2001-04.

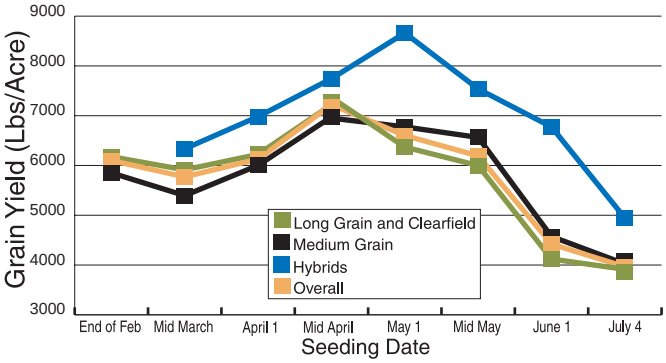


Figure 2. Effect of year and planting date on grain yield of selected rice cultivars and advanced breeding lines, Crowley, LA.

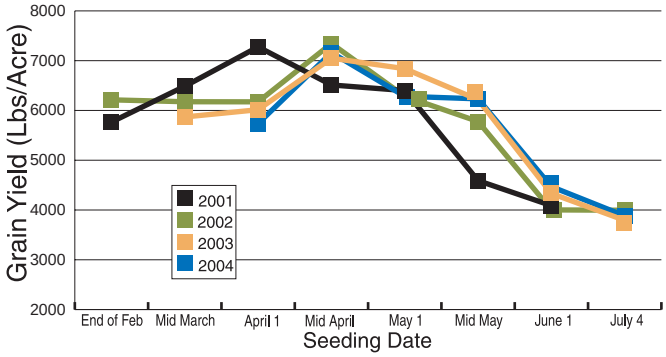


Photo by Bruce Schultz

Steve Linscombe, rice breeder, plants a test plot of rice on February 28, 2005.

when the main crop was planted in the middle of April. Main crop yields (6,000 to 7,000 pounds per acre) had a greater effect on total crop yields because they were higher than ratoon crop yields (1700 to 2200 pounds per acre).

Figure 3. Effect of planting date on head rice milling yield, Crowley, LA, 2001-04.

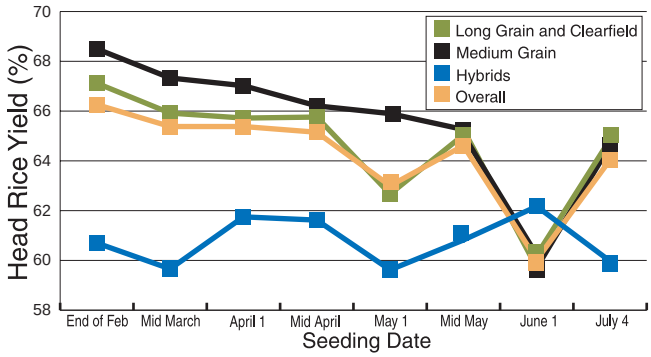
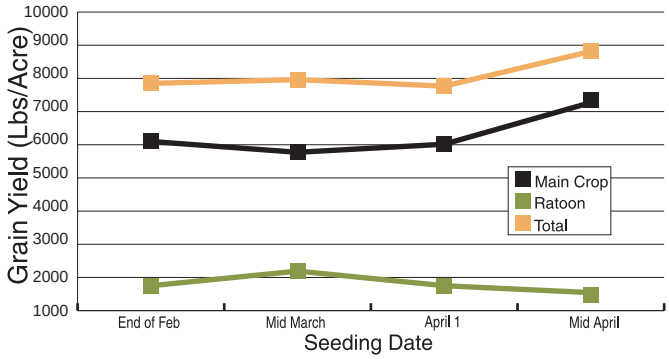


Figure 4. Effect of early planting dates on the grain yield of main, ratoon, and total (main plus ratoon) crop, Crowley, LA, 2001-2004.



Other agronomic characteristics were also affected by planting date. Seedling stands of the February planting were significantly poorer than of later planting dates, except for the July planting. The early season effects of planting date may be attributed to the low air and soil temperatures that occur during February that can cause slow germination and growth, and lead to increased seedling disease. The poor stand associated with the July planting date may have resulted from high water temperature following flood establishment. Because of steadily increasing soil and air temperature from February through July, the time between planting and seedling emergence decreases as planting date advances. The average number of days from planting to seedling emergence for rice planted in February was 19 days compared with 5 days for rice planted in July. For all genotypes, maturity (days between seedling emergence and 50% heading) was shortened as planting advanced from the end of February to the first of July. The average maturity was 90 days for rice planted in February and 70 days for rice planted around the first of June. For rice planted in July, a slight increase in maturity (74 days) was noted.

In summary, the optimum planting date for conventional rice types (long-, medium-, and short-grain and Clearfield varieties and experimental lines) was the middle of April. Hybrids performed best when planted around the first of May and consistently had higher yields than conventional rice types. Environment is a key factor and optimum planting dates can change yearly. Rice planted before the optimum date usually had a poor seedling stand but better milling quality and higher ratoon yields.

Rice planted after May 15 will suffer substantial losses of both grain and milling yields. When seeded between April 15 and May 15, long-grain and Clearfield rice types may have acceptable grain yield but may expect a significant head rice yield reduction, while such a reduction is much less for medium-grain rice types.

Milling yield of hybrids was erratic and did not appear to be affected in a consistent manner by planting date. Milling yield of hybrids was lower than milling yield in conventional rice types. Yield potential, as well as milling yield, as affected by planting date, is valuable to our rice growers because they often make decisions on which crop or variety to plant while considering commodity prices, production cost, and environmental conditions. These decisions are frequently considered in case of replanting or late planting when adverse weather conditions or crawfish production prevent rice establishment during the optimum seeding period. ■

Acknowledgment: *This research was partially supported by the Louisiana Rice Research Board.*

Photo by Bruce Schultz

Rice seeds begin to sprout a few days after water-seeding.

Reducing the Potential for Herbicide-resistant Red Rice

Richard T. Dunand, R. Russell Dilly, Eric P. Webster, Christopher T. Leon and Wei Zhang

Photo by Bruce Schultz

Rice matures in test plots at the LSU AgCenter's Rice Research Station in Crowley.

Red rice, a noxious weed in rice, costs rice producers millions of dollars each year. Red rice is physiologically similar to rice. Consequently, rice and red rice are susceptible to the same herbicides, so controlling red with herbicides in rice fields is difficult.

Imazethapyr (Newpath) is one herbicide normally injurious and commonly fatal to both rice and red rice. A group of rice varieties has been modified through mutation and standard breeding practice to be resistant to the herbicide imazethapyr. The creation of imazethapyr-resistant rice has led to a rice production system that for the first time allows early-season herbicidal control of red rice in rice fields. The imazethapyr-resistant rice is called Clearfield rice.

The importance of Clearfield rice and use of imazethapyr in rice production in Louisiana is evident by the fact that more than 20 percent (100,000+ acres) of the acreage in 2004 was planted to CL161, a Clearfield rice variety. But as with all weed control programs, there is seldom 100 percent weed control. In weed control in general, survival of a few weeds is not a major problem. However, when the weed and crop cross-pollinate, the situation changes. Cross-pollination is a major concern. LSU AgCenter researchers have shown that rice and red rice can cross-pollinate with the potential for moving the herbicide-resistant trait into red rice through pollen exchange. Therefore, red rice that escapes control during seedling-stage applications of imazethapyr threatens the sustainability of the herbicide-resistant technology through cross-pollination (outcrossing) between red rice and Clearfield rice.

In anticipation of outcrossing, BASF Corporation, rice seed dealers and representatives of the LSU AgCenter conducted a series of meetings to introduce a stewardship program and teach rice growers how to minimize outcrossing and limit the survival of herbicide-tolerant red rice that occurs because of outcrossing. As part of this effort, AgCenter scientists are conducting research to determine if compounds with plant growth regulator activity can limit reproductive growth in red rice.

Test Plot Study

In addition to herbicidal activity, imazethapyr has been shown to act as a plant growth regulator in several turfgrass species, where it suppresses growth and imparts lodging resistance to prevent plants from falling over in seed production fields. Evaluations in rice at the LSU AgCenter Rice Research Station in 2002 showed that similar results can occur in red rice. An area naturally infested with red rice was drill-planted with CL121, the first Clearfield variety released to farmers. Standard, labeled, early-season applications of imazethapyr provided more than 95 percent red rice control through direct herbicidal activity. Some red rice plants survived, providing a natural situation for evaluating the plant growth regulator effects of late-season applications of imazethapyr.

At midseason around the panicle differentiation (PD) stage of growth of red rice (when the panicle or flower is about 1/8-inch long inside the main stem approximately 70 days after planting) and later at heading, imazethapyr at a rate of 4 fluid ounces of Newpath per acre was applied in a foliar spray. Following these applications, rice and red rice (no longer seedling stage) exhibited no harmful symptoms.

At harvest, it was noted that the CL121 was unaffected by either time of application of imazethapyr. On the other hand, red rice plants treated at PD had arrested growth. Yield and milling yield of CL121 were similar between the treated and control plots. Red rice plants were short and produced no panicles in the treated plots. The application of imazethapyr at heading had minimal

Richard T. Dunand, Professor, and R. Russell Dilly, Research Associate, LSU AgCenter Rice Research Station, Crowley, La.; Eric P. Webster, Professor, Christopher T. Leon, Research Associate, and Wei Zhang, Postdoctoral Researcher, Department of Agronomy and Environmental Management, LSU AgCenter, Baton Rouge, La.

effects on red rice seed production. The main consequences were malformed seeds and some sterility.

With higher levels of herbicide resistance available in the newer CL161, the CLXL8 hybrid and the most recently released Clearfield variety CL131, the effects of late-season applications of imazethapyr for its plant growth regulator effects on red rice should show no ill effects on Clearfield varieties and hybrids. Evaluations of CL161 and CL131 are being conducted.

From this research, it can be concluded that the potential to selectively arrest reproductive development in red rice without affecting Clearfield rice can be done with imazethapyr, minimizing the potential for outcrossing between Clearfield rice and any red rice plants that survive the early-seasonal applications of imazethapyr.

Stewardship Support

Minimizing the transfer of imazethapyr resistance from Clearfield rice to red rice requires a concerted effort. Conventional practices associated with land management, seed source, seeding method, water management and rotational crops as provided in a stewardship program will continue to play a major role in minimizing the amount of red rice in rice fields. A stewardship program will reduce the amount of red rice pressure placed on the newly developed imazethapyr-resistant technology and will serve to control the survival of any resultant herbicide-resistant red rice.

For red rice that does survive the new imazethapyr-resistant technology within a given rice cropping season, midseason applications of imazethapyr and similar growth-suppressing compounds may eliminate or interrupt reproductive development in red rice without affecting imazethapyr-resistant rice.

Used together in a planned and integrated manner, all of the measures outlined in a stewardship program, in addition to the use of growth suppressants, can reduce the opportunity for the transfer of imazethapyr resistance to red rice and lengthen the period for the usefulness of the technology. At present, imazethapyr is not labeled for late-season application and at the standard rate of 4 fluid ounces per acre is restricted to applications no later than 45 days before harvest.

Because of this restriction, there are no recommendations for the use of plant growth regulators at this time. This research project was conducted to determine the potential of the plant growth regulator technology. ■

Efforts Must Be Made To Minimize Outcrossing in Clearfield Rice

Steven D. Linscombe

The Clearfield system of using herbicide-resistant rice offers for the first time the ability to selectively eliminate the weed red rice from a production rice field with the use of an herbicide. However, one major problem with the technology is the chance of outcrossing. Since red rice and rice are closely related, they can actually cross-pollinate each other. This means pollen from a rice plant can pollinate a red rice plant or vice versa. One potential outcome of this cross-pollination would be a resulting offspring plant with weedy (red rice) characteristics that is also resistant to NewPath and Beyond herbicides.

To maintain the viability of the Clearfield system, it is essential to do everything possible to minimize the potential for outcrossing and to eliminate any plants that might result from an outcross event. Unfortunately, these "outcross" plants will typically possess all the characteristics that make red rice so difficult to control and eradicate (shattering, dormancy, etc.). However, they will be immune to the activity of NewPath and Beyond herbicides.

Several actions will minimize the potential for outcrossing in a Clearfield rice field. Among the most important are these:

1) Always use two (sequential) applications of NewPath. This will better allow for the control of any red rice plants that "escape" the first application.
2) If red rice plants remain after the two NewPath applications, consider using Beyond, which can control larger "escaped" red rice plants.
3) If practical, physically remove any "escaped" red rice plants.
4) NEVER plant Clearfield rice two consecutive growing seasons in the same field.

Remember, seldom does any herbicide system provide 100 percent control of any weed. Therefore, it is probably a good policy to assume that outcrosses have occurred in any fields in which Clearfield rice has been grown. Efforts must be made to eliminate any resulting offspring from these outcrosses. How these fields are handled the season following Clearfield rice production may be the most important factor in maintaining the long-term viability of this technology. Perhaps the best approach is to plant Round-Up Ready soybeans following Clearfield rice. A weedy rice plant resistant to NewPath as the result of an outcross will still be susceptible to all other soybean herbicides that will control red rice. Many Southwest Louisiana producers may be debating the economic viability of soybeans, especially with the looming threat of Asian soybean rust. However, when one factors in the added benefit of maintaining the ability to effectively use Clearfield rice, the economics of soybean production may be seen in a different light. The worst thing one could do in a field the season after Clearfield rice is nothing. This will allow any resulting "outcross" plants to germinate and mature seed which will certainly exasperate the problem.

Clearfield technology is one of the most promising breakthroughs in Louisiana rice production in many years. It is up to all of us to make every effort to sustain the value of this technology for our rice-growing region. ■

Steve Linscombe, Southwest Regional Director and Rice Breeder, Rice Research Station, Crowley, La.

Compatibility of Ricestar with Broadleaf, Sedge Herbicides

Eric P. Webster and Wei Zhang

Ricestar (fenoxyprop), a relatively new selective herbicide, is used for postemergence control of grasses in rice. It provides good to excellent control of major grasses such as barnyardgrass, broadleaf signalgrass and sprangletop. Because Ricestar does not have activity on broadleaf weeds or sedges, it is likely that other herbicides with broadleaf or sedge activity will be needed in a weed control program containing Ricestar.

It would be beneficial to rice producers to apply Ricestar plus a herbicide with broadleaf or sedge activity in a mixture, which would save time and money. Often, however, broadleaf or sedge herbicides in a mixture with herbicides with grass activity, such as Ricestar, may antagonize or reduce the activity of the herbicide on grass weeds. This is a common problem observed with Ricestar when mixed with herbicides with broadleaf or sedge activity including those potential mixture herbicides mentioned on the Ricestar label. Thus, identifying the compatibility of potential tank-mix herbicides with Ricestar is important to rice producers. Such information will help rice producers select herbicides to be tank-mixed with Ricestar for optimum grass and broadleaf weed control.

Two-year Field Study

A field study was conducted (2001 to 2003) at the LSU AgCenter Rice Research Station near Crowley, La., to evaluate the compatibility of five herbicides used in rice, with activity on broadleaf weeds and sedges, with Ricestar for barnyardgrass control. Ricestar was applied at zero, 15, and 17 ounces per acre. The broadleaf or sedge herbicides evaluated were Aim at 1 ounce per acre, Basagran at 1.5 pints per acre, Grandstand at 0.67 pints per acre, Londax at 1 ounce per acre, and Permit at 1 ounce per acre.

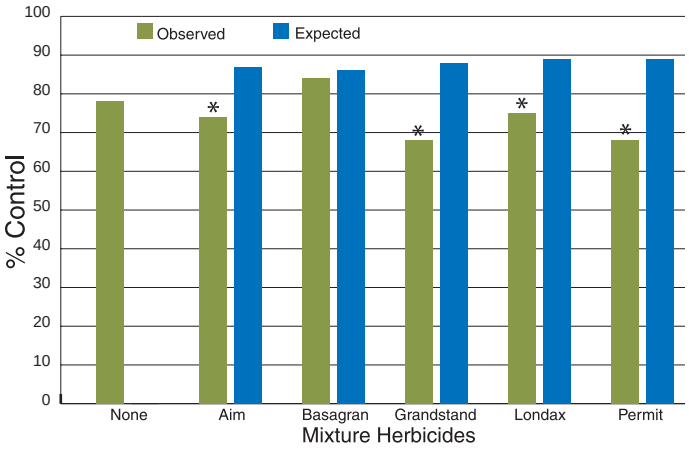
The herbicide mixtures were applied postemergence to three- to four-leaf rice with a backpack sprayer. Barnyardgrass had two to four leaves at the time of herbicide application. Barnyardgrass control was visually estimated, on a scale of zero to 100, at 10, 20 and 30 days after treatment (DAT). If the visually estimated, or observed, control was significantly lower than the expected control, an antagonistic effect occurred. The expected control is determined by a mathematical equation.

Reduced Barnyardgrass Control

Barnyardgrass control with Ricestar at 15 ounces per acre was antagonized by Aim, Londax and Permit at 10 days after treatment (DAT) and by Aim, Grandstand and Permit at 30 DAT. At 20 days after treatment, control of barnyardgrass by Ricestar at 15 ounces per acre was reduced when mixed with Aim, Grandstand, Londax and Permit (Figure 1).

Basagran did not antagonize the activity of Ricestar at 15 ounces per acre on barnyardgrass at any evaluation date. It is generally believed that the antagonistic effect on a grass herbicide by other broadleaf herbicides can be overcome by increasing the rate of the grass herbicide. However, in this study an increase in the Ricestar rate from 15 to 17 ounces per acre did not reduce the antagonistic effect from the mixture herbicides.

Figure 1. Barnyardgrass control with Ricestar at 15 oz/A in tank mixture with broadleaf or sedge herbicides 20 days after treatment. The symbol (*) indicates an antagonistic effect or reduced control of barnyardgrass with Ricestar when tank-mixed with a herbicide with broadleaf or sedge activity.



Compatibility Ranking

The compatibility analysis indicates that among the six herbicides evaluated, Basagran is the most compatible with Ricestar. Barnyardgrass control was 91 percent with Ricestar in combination with Basagran. Londax ranked second in compatibility with Ricestar with 86 percent control of barnyardgrass. Permit and Grandstand had an antagonistic effect on the activity of Ricestar on barnyardgrass.

These results indicate that Basagran and Londax are safe to be used as tank-mix partners with Ricestar for barnyardgrass control. But Grandstand and Permit can potentially antagonize the activity of Ricestar on barnyardgrass. Thus, these herbicides should be used with caution when applied in a mixture with Ricestar. ■

Eric P. Webster, Professor, and Wei Zhang, Postdoctoral Researcher, Department of Agronomy and Environmental Management, LSU AgCenter, Baton Rouge, La.

EXPORT OPPORTUNITY

More Louisiana Sweet Potatoes to the U.K.

On average, Americans eat 5 pounds of sweet potatoes per year.

Photo by John Wozniak

David H. Picha and Roger A. Hinson

Most of the sweet potatoes produced in Louisiana are marketed within the continental United States. However, domestic per capita consumption of sweet potatoes has remained mostly stagnant during the past several decades, hovering around 5 pounds per person per year. A market development within the past several years has been the significant increase in fresh sweet potato import volume by the United Kingdom (U.K.). Total import volume nearly tripled from 8.5 million pounds in 1997 to slightly more than 25 million pounds in 2002. Exports of U.S. sweet potatoes to the U.K. increased from 3.1 million pounds in 1997 to 13.1 million pounds in 2002, constituting slightly more than half of total U.K. import volume for 2002. This is the fastest-growing market destination for U.S. sweet potatoes. Fresh sweet potatoes from North Carolina, Louisiana, California and Mississippi are being exported to the U.K. British supermarket buyers and importers forecast this market growth trend will continue. Louisiana grower and shippers have an excellent opportunity to benefit from this market opportunity and increase their export volume.

Personal discussions with produce managers from leading British retail supermarket chains indicated the sweet potato led all other fresh vegetables in market growth percentage during 2004. Orange-flesh sweet potatoes are now stocked year-round in all the U.K. stores of the top six British retail supermarket chains, which represent slightly more than a 75 percent market share of the British retail food market sector.

This is a dramatic contrast from only three years ago (2002), when few retail stores routinely stocked orange-flesh sweet potatoes. Though demand is year-round, consumption is higher during the cooler winter months. Sweet potatoes are widely consumed during the major winter holidays and festivals celebrated by the ethnic communities. The catering market segment – restaurants, institutions and food-service establishments – also is experiencing market growth in their value-added sweet potato products. Orange-flesh sweet potatoes are the preferred type in this market segment.

Better Diet for Brits

Factors which have contributed to the increased consumption of exotic fresh produce items like sweet potatoes are the desire for a nutritious diet, greater affluence and a willingness to try new products. This has led to a new class of consumer with more sophisticated tastes and requirements.

Research in the LSU AgCenter is focusing on postharvest care and packaging technologies to improve market life and arrival quality of Louisiana sweet potatoes. Value-added products being tested include minimally processed fresh-cut items for the institutional and food service trade and individually shrink-wrapped microwavable roots for the supermarket retail trade. Appropriate product handling techniques and packaging specific to the British market must be used to increase market penetration.

David H. Picha, Professor, Department of Horticulture, LSU AgCenter, Baton Rouge, La.; Roger A. Hinson, Professor, Department of Agricultural Economics & Agribusiness, LSU AgCenter, Baton Rouge, La.

Fresh sweet potatoes are susceptible to weight loss, deterioration and decay during all stages of transport and market distribution. These undesirable quality changes must be kept to a minimum to avoid a discounted market price or load rejection upon arrival in the U.K. British retailers typically impose tight quality control specifications for sweet potatoes. Damage from all sources (such as bruising, skinning, insect damage and disease) must not exceed a 2 percent gross defect tolerance level. Export-quality roots should be carefully selected to include only firm, well-shaped sweet potatoes with bright, clean skins. Strict control over sizing during grading is necessary to assure root uniformity within a carton, which is an important criterion of the British importers.

EUREPGAP Approval

All British retail supermarkets obtain their sweet potatoes through importers rather than purchasing directly from a grower or exporter. However, individual supermarket chains dictate their grade standards and quality requirements to which importers must adhere. In addition, sweet potato suppliers must be certified to sell to any of the principal British retailers. This is an industry-based scheme of good agricultural practices and compliance criteria in the areas of food safety, product traceability, environmental protection, and occupational health, safety and welfare. Grower and shippers receive EUREPGAP approval through an independent verification body approved by EUREPGAP. Started in 1997 as an initiative of retailers belonging to the Euro-Retailer Produce Working Group (EUREP), the organization is a partnership of agricultural producers and their retail customers to develop standards and procedures for the global certification of Good Agricultural Practices (GAP).

Several distinct differences exist between American and British retailers in market presentation and packaging used for sweet potatoes. American retailers typically present fresh sweet potatoes to the consumer in the form of bulk displays, while British retailers offer both bulk and bagged displays of sweet potatoes. The size of the individual roots in the bulk display typically ranges between 12 ounces to 16 ounces and is larger than the roots in the consumer bags. Retailers offer store-labeled bagged roots in 500-gram (1.1-pound), 750-gram (1.7-pound) or 1 kilogram (2.2-pound) perforated polyethylene bags. Individual root size within the consumer bags generally ranges between 5 ounces to 7 ounces and is equivalent to a U.S. #2 (canner) size root. This is significant because it gives the Louisiana grower and shipper the opportunity to sell canner-sized roots to the British fresh market at substantially higher prices compared to the domestic processing market.

Another difference between American and British markets is in the shipping carton. The standard carton used in the American market is 40-pound, while the U.K. importers strongly prefer a 6-kilogram (13.2-pound) carton. The smaller 6-kilogram carton has been the standard in Britain for some years and conforms to the retailers desire to display bulk sweet potatoes in a shelf-ready carton. This avoids expensive re-packing of the sweet potatoes from the larger 40-pound carton into the smaller 6-kilogram carton and reduces product handling and potential bruising. It is in the best interests of the Louisiana exporter to comply with the importers' desire to receive the product in the preferred shipping carton for their market, rather than assume the larger American style carton is satisfactory. Since other countries also export sweet potatoes to the U.K. and pack in 6-kilogram cartons, it is important for Louisiana exporters to be competitive and use the style of shipping carton desired in the destination market. Stronger cartons (preferably 6-kilogram size) with high impact color graphics will result in improved root protection during transit and distribution and give the importer a better impression of Louisiana product.

Israel Competes for Market

Next to the United States, the principal suppliers of sweet potatoes to the U.K. are Israel, South Africa and Egypt. The sweet potato industry in each of these countries is expanding, with the lucrative U.K. market their principal target destination. Minor supplying countries include Brazil, China, Jamaica, Uganda, Peru and New Zealand. The only European production, albeit limited, is in Spain, Portugal and Italy. Sweet potatoes are not grown in the U.K.

LSU AgCenter researchers also are studying the market opportunities and retailer preferences for Louisiana sweet potatoes in continental Europe. Significant growth potential exists in France, Germany, the Netherlands, Belgium and Scandinavia. Sweet potato import volume in these markets is just beginning to increase. In continental Europe, the sweet potato is allocated only limited shelf space in separate exotic sections of retail produce departments.

To sustain the Louisiana sweet potato industry, it is important to develop new market opportunities for fresh and value-added products. The British and European export markets are key examples of the possibilities awaiting the grower and shipper who can provide consistent supplies of high quality products tailored to these expanding market destinations. ■

Photo by John Wozniak

To sustain the Louisiana sweet portato industry, it is important to develop new market opportunities for fresh and value-added products.

Cotton Yield Loss from Premature Defoliation

Jonathan D. Siebert, B. Rogers Leonard, Alexander M. Stewart and Karla D. Emfinger

Cotton is a perennial plant capable of recovering from many stresses during Louisiana's long growing season, including insect damage. However, as plants near maturity, their capacity to recover from stresses is reduced. Management of late-season defoliating insects in Mid-South and Southeastern cotton-producing states has changed dramatically with the introduction of genetically engineered, insect-resistant cottons (Bt cotton) with a foreign gene from *Bacillus thuringiensis* (Bt), the use of target-selective insecticides and boll weevil eradication programs. These technologies have reduced the number of broad spectrum insecticide applications used in integrated pest management programs for cotton.

The occurrence of damaging caterpillar levels during the post-bloom period of cotton development remains a problem both in conventional and Bt (Bollgard) cotton. Their damage appears as holes in leaf tissue or entire leaves missing in the crop canopy. Premature defoliation delays overall crop maturity, makes the timing of harvest-aid application (chemical defoliators) difficult and ultimately reduces cotton yield and lint quality.

LSU AgCenter entomologists have previously evaluated the effect of simulated insect defoliation on cotton plants to determine the amount of injury that the crop could tolerate at physiological "cutout" without significant yield loss. Cutout, in practical terms, defines the end of the effective fruiting period. Bolls produced after cutout may not have enough time to mature before harvest and contribute to yield. Cutout, in fact, is a moving target, but it typically is defined as the plant stage when flowering occurs on a fruiting branch five main-stem nodes below the terminal leaf (NAWF5). In these studies, cutout was defined as NAWF5, and harvest-aid applications were based on developmental stages designated by accumulated heat units (HU) beyond cutout. Cotton growth and development are closely related to HU accumulation, using 60 degrees F as the base temperature for cotton growth. Heat units are calculated by subtracting 60 from the sum of the daily high and low temperatures divided by 2.

Establishing Defoliation Thresholds

In the first study, plots of cotton plants were defoliated at four levels based on plant height. These treatments were applied when the cotton crop accumulated 350 HU beyond cutout. Considerable data have shown that harvestable bolls are not susceptible to insect injury after those bolls have accumulated 350 HU; however, no such information is available to support yield tolerances to defoliation by leaf-feeding insects.

Treatments corresponded to no defoliation, removal of all leaves from the lower one-third of plants (33 percent), removal of all leaves from the lower two-thirds of plants (66 percent) and nearly complete defoliation (> 99 percent).

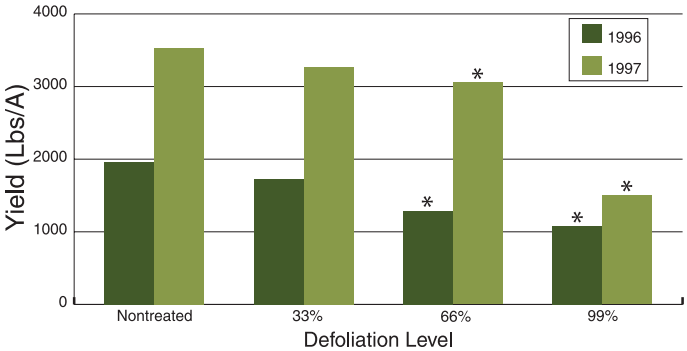
Results indicated that as defoliation levels increased from 33 percent to nearly complete defoliation, cotton yield consistently declined. Cotton yields of plots defoliated at 66 percent or greater were significantly lower than non-defoliated plots (Figure 1). These studies established the threshold of simulated insect defoliation at 66 percent, which is the point where yield is significantly reduced at 350 HU beyond cutout.

Jonathan D. Siebert, Research Assistant, Department of Agronomy and Environmental Management, LSU AgCenter, Baton Rouge, La.; B. Rogers Leonard, Professor, Macon Ridge Research Station, Winnsboro, La.; Alexander M. Stewart, Assistant Professor, Dean Lee Research Station, Alexandria, La.; Karla D. Emfinger, Research Associate, Macon Ridge Research Station.

Photo by John Chaney

Jonathan Siebert talks with Rapides Parish farmer Henry Vanderlick during a field day at the Dean Lee Research Station in Alexandria.

Figure 1. Effect of simulated insect defoliation level applied at NAWF5+350 HU on seedcotton yield. Seedcotton yield significantly lower (*) than nontreated, within each year.



Timing Crop Termination Strategies

A second study at the Dean Lee and Macon Ridge Research Stations during 2003 and 2004 used the 66-percent threshold to evaluate the effect of insect defoliation timing on cotton yield and quality. Varieties planted at Macon Ridge were Delta and Pine Land Delta Pearl and Stoneville ST 5599 BR and at Dean Lee were Delta and Pine Land DP 451 BG/RR and Stoneville ST 4892 BR. Manual defoliation (simulated insect injury that resulted in removal of all leaves from the lower two-thirds of the plant canopy) and chemical defoliation treatments (the application of harvest-aids) were applied at 450, 550, 650, 750 and 850 accumulated HU beyond cutout. A standard chemical defoliation treatment applied at 1,050 HU beyond cutout was also included for comparison. Percent open harvestable bolls and nodes above cracked boll (NACB) were recorded at each application. NACB refers to the number of mainstem nodes between the uppermost open first position boll and the last harvestable boll.

There was no significant reduction in yield when simulated insect defoliation occurred after 550 or more HU were accumulated beyond cutout. Lint yield, averaged across four experiments, was only 82 percent of the standard treatment (chemical defoliation at 1,050 HU beyond cutout) when simulated insect defoliation occurred at 450 HU beyond cutout (Figure 2). Chemical defoliation at 450, 550 and 650 HU beyond cutout reduced lint yield 38 percent, 37 percent and 15 percent, respectively, below that of the standard treatment (Figure 3). Simulated insect defoliation did not affect fiber properties. Chemical defoliation of plants that accumulated 550 or fewer HU beyond cutout significantly lowered fiber micronaire (a measure of fineness determined by resistance of air flow through a specified weight of fibers under a specific degree of compression) but did not affect fiber strength, length, elongation or uniformity.

Terminating insecticide management strategies for late-season defoliating insects may begin at 550 HU beyond cutout, which usually corresponds to approximately 10 percent open bolls or NACB 7. Chemical defoliation should not be initiated until plant development exceeds 750 HU beyond cutout, approximately 40 percent open bolls or NACB 5.6. Maximum lint yields were obtained with chemical defoliation once the crop had accumulated 1,050 HU beyond cutout, 80 percent open bolls or NACB 2.9.

Low levels (less than 33 percent after cutout) of late-season insect-induced defoliation may be beneficial in reducing the incidence of boll rot pathogens by increasing air movement and light penetration within the cotton canopy. Minor levels of defoliation in the lower crop canopy can occur without significantly reducing yield; however, insect management strategies must be applied to prevent excessive defoliation levels from progressing up the mainstem.

Other research has documented lower fiber micronaire associated with premature harvest-aid application compared to proper application timing. These data also support current AgCenter harvest-aid recommendations for cotton defoliation. Maximum lint yields and optimum fiber quality can be obtained with harvest-aid application at 42 percent to 81 percent open bolls and NACB of 3 to 4 depending on variety, boll distribution and environmental conditions in Louisiana. ■

Photos by Brandi W. Garber

Manual leaf removal for simulated insect defoliation treatments.

Plots after simulated insect defoliation with manual removal of lower 66 percent of cotton canopy.

Figure 2. Effect of simulated insect defoliation timing on lint yield. Lint yield significantly lower (*) than standard chemical defoliation (956 Lbs/A).

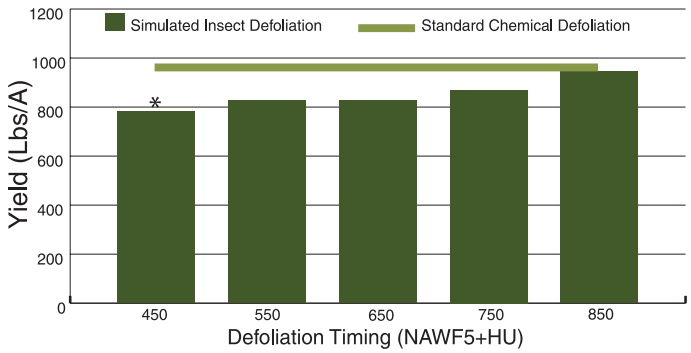


Figure 3. Effect of harvest-aid application timing on lint yield. Lint yield significantly lower (*) than standard chemical defoliation (956 Lbs/A).

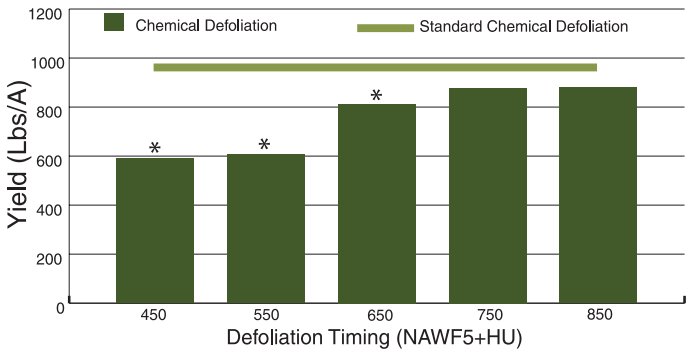


Photo by Qinglin Wu

Using Engineered Composites from Rice Straw As WOOD ALTERNATIVES

Qinglin Wu

The United States produces about10 million tons of rice annually, with about 1.4 million tons in Louisiana. With an approximately equal rice-to-straw weight ratio, an equivalent amount of dry rice straw is produced per year. Rice straw consists of more than 60 percent lignocellulosic fibers. In current rice farming practice, most straw is left in the field to decompose after rice harvesting. Thus, the use of the straw fiber resources for value-added applications is so far limited. Transforming the straw fiber resources into high quality panel products provides a prospective solution to the straw disposal problem. Straw-based composites offer potential as materials for sub-floors, cabinets, shelving and building products. Technical information on strength and dimensional stability of the product is critical for such an application.

LSU AgCenter researchers conducted studies to develop technical data for manufacturing straw-based particleboard. The objectives were 1) to evaluate straw strength properties in comparison with wood, and 2) to investigate effects of panel density, resin content and wax level on dimensional stability and mechanical properties of the straw particleboard.

Qinglin Wu, Professor, School of Renewable Natural Resources, LSU AgCenter, Baton Rouge, La.

Straw Collection, Preparation

Green straw (with the top portion removed during rice harvesting) was hand-harvested from an experimental rice field at the Rice Research Station at Crowley. The collected straws were 51 to 66 centimeters long, and 2.2 to 4.8 millimeters in diameter with a wall thickness of 0.23 to 0.68 millimeters. Moisture content of the straw was approximately 200 percent. The straw was transported to the Engineering Composite Laboratory at the Louisiana Forest Products Development Center at the LSU AgCenter in Baton Rouge in large plastic bags.

Testing Straw Property

More than 200 long straw stems were selected from the collected straws for preparing samples for tensile strength testing. They were first dried to about 30 percent moisture content. The straw samples (without containing node portion) were taken from three locations along each straw stem (bottom, middle, and top). The samples were cleaned with water at room temperature and subsequently conditioned for two weeks to a moisture content of about 7 percent. Tensile specimens were prepared by notching the middle portion of each sample to ensure the breakage from there. Tensile tests were conducted using an INSTRON universal testing machine at room temperature. Similar wood samples from southern pine lumber were also tested for comparison.

Producing Straw Panel

The rest of the straw stock was dried and hammermilled to pass an 8-millimeter screen. The processed straw particles were re-dried to 2 percent to 3 percent moisture content before panel manufacture. During panel manufacturing, dry straw particles were blended with various levels of polymeric Methylene Diphenyl diisocyanate (pMDI) resin and wax emulsion with a laboratory blending system. The mats were then manually formed and hot-pressed into solid panels with target density levels. All boards were conditioned at 68 degrees F and 65 percent relative humidity for two weeks before cutting test samples. Tests including basic mechanical and physical properties were conducted according to the American Society for Testing and Materials Standard. Test results were analyzed and compared with the corresponding values of wood-based particleboards specified by the American National Standard Institute (ANSI 208.1).

Straw Properties

Rice straw has a tensile strength four times higher than southern pine wood. Thus, the high tensile strength properties of the straw can be used to improve strength properties of particleboard. Sampling locations from a straw stem had significant influences on the tensile properties of rice straw. Generally, middle nodes of rice straw had the highest average tensile strength, which

was followed by the bottom and top parts.

Straw Panel Properties

Panel density and resin level played a significant role in controlling mechanical performances of straw particleboard. For panels with densities higher than 0.70 g/cm^3, bending modulus of elasticity, modulus of rupture and internal bond strength met the minimum values specified in the ANSI 208.1 standard for the corresponding wood particleboard. Thus, these products can compete directly with wood particleboard in terms of their strength properties in the market place. In general, bending strength of the straw particleboard was higher than its corresponding tensile strength. This was due to the density profile across sample thickness formed during hot-pressing of the panel, which helps increase the bending properties. There was no significant influence of wax on mechanical properties of the particleboard.

Dimensional stability of straw particleboard was also strongly affected by density and resin content. The dimensional instability of the particleboard under water was significantly improved by wax sizing. High-density boards had relatively low short-term (24 to 48 hours) linear expansion and thickness swelling values, but these boards had higher deformation potentials. By increasing resin and wax content (wax sizing), both linear expansion and thickness swell were reduced. In general, linear expansion met the specifications for the corresponding wood-based particleboards in ANSI 208.1. Thickness swelling was also in the range of values specified in the standard.

This study shows that it is technically possible to make rice straw particleboard with pMDI resin as a bonding agent and wax as a dimensional stabilizer. The particleboard developed had mechanical properties that well exceeded the standard requirement for wood particleboards. Panel dimensional stability properties were also in the range of the values for wood particleboards. The study demonstrated an effective way of transforming rice straw into high quality industrial panel products, providing a prospective solution for value-added straw use. Further development of the technology includes bonding the straw with formaldehyde-based resins at reduced cost.

Successful commercialization of straw-based panel products depends on development of a cost-effective manufacturing process on a commercial scale and establishment of a market base for the products. With increasing wood fiber costs and environmental pressure for using agricultural residues, the industry is developing manufacturing facilities for using valuable straw fibers. Current technology includes straw particleboard, whole-straw-based build-ing blocks, and extruded plastic composites reinforced with straw fibers. ■

Researchers to study forest certification

LSU AgCenter, Mississippi State share $102,000 grant

LSU AgCenter and Mississippi State University researchers are starting a project to measure how well nonindustrial private forest landowners understand certification programs.

"We want to know about their awareness, understanding and perceptions of certification," said Richard Vlosky, director of the Louisiana Forest Products Development Center in the LSU AgCenter.

Vlosky and the other researchers, Michael Dunn, an economist with the LSU AgCenter, and Glenn Hughes, an extension professor of forestry at Mississippi State University, also will identify the current and potential future certification systems and products acceptable to major home retail centers.

The results of the survey will provide the background needed for developing a Web site and handbook, Vlosky said.

The researchers also expect to conduct at least six landowner meetings in each state to present information on the choices they may have.

The two-year project will survey the 500 largest home centers in the United States as well as 1,300 private landowners in each state to determine knowledge and willingness to participate in certification.

Large companies buy timber from small private owners, and if their customers want certified wood products, the manufacturer must buy from certified landowners.

The researcher said certification requires that the forest landowner establish sustainable management practices, and not all certifying agencies have the same requirements.

Vlosky said private nonindustrial landowners often are confused about certification programs they're asked to participate in. "This has implications for landowners," he said.

Louisiana has about 144,000 private, nonindustrial forest landowners. They own most of the forest land in the state, Vlosky said.

The $102,000 research project is funded by a grant from the Southern Region Sustainable Agricultural Research and Education Program and combines research and extension activities of both institutions to identify the potential for providing certified forest products in Louisiana and Mississippi. ■ **Rick Bogren**

Order extras of wildlife and fisheries issue

We have extra copies of the Louisiana Agriculture issue that featured our research and extension programs in wildlife and fisheries (Spring 2002). The issue includes articles about the Louisiana black bear, invasive aquatic plants, wetlands, coastal restoration, waterfowl, eagles, alligators, the pallid sturgeon, hunting lease enterprises, and more. Please contact Linda Foster Benedict, the editor, at (225) 578-2263, or lbenedict@agcenter.lsu.edu. ■

Photo by John Wozniak

Educators have reported that school gardens can be used to teach across the curriculum and that concepts and skills from virtually every subject can be learned through a school garden.

Gardens Grow Student Achievement

Horticulture Enriches School Curriculum

Carl E. Motsenbocker and Leanna L. Smith

School gardens are used as outdoor classrooms around the United States to supplement the curriculum. Educators have reported that school gardens can be used to teach across the curriculum and that concepts and skills from virtually every subject can be learned through a school garden. For example:

- Native species that were used by early settlers or native inhabitants and their role in daily life can be explored for social studies.
- The outdoor classroom is a tangible place to apply math concepts such as measuring perimeter, circumference and ratios of plants and trees, and growth rates can be charted.
- The outdoor classroom can also be an inspiration for language arts such as for writing stories, poetry and journals, for reading and for sketching, painting and making creative rubbings.
- A school garden can provide hands-on learning and stimulate discussions about many aspects of the natural world such as food chains, balanced ecosystems, diversity, change, communities and interrelationships and enhance classroom science classes.

In many cases, gardens can provide a link between concepts learned in the classroom and real-life applications. The use of gardens to provide hands-on science activities is not a new concept, but little research has been conducted to quantify the effects of gardens and their potential benefits.

Gardens have been used in schools in the United States since the late 1890s and early 1900s. Research to quantify the effects of school gardens, however, is relatively new. Educators have written many articles using observations and anecdotes to relate the qualitative effects of school gardens on students, but few research studies have been conducted. The studies have examined the wide range of effects such as environmental attitude, nutrition knowledge, social interaction, interpersonal skills and science achievement.

A horticulture-based, hands-on science curriculum that included small garden plots was introduced into public elementary schools in East Baton Rouge Parish as a pilot study. Three inner-city schools with both experimental and control fifth grade classes were selected. The Junior Master Gardener (JMG) Handbook Level 1 was the curriculum chosen for classroom integration. This program targets grades 3 to 5 and was chosen because of its thoroughness and stimulating activities. Only the first four chapters out of the eight in the teacher/leader guide were used in this study in the fall semester. Selected activities, usually 15 to 20 minutes each, were implemented in a 14-week period.

Garden activities were included in addition to the hands-on science activities. These were not specified in the JMG program but were supplemental to the formal lessons. The gardening space was standardized with each school having three 4-foot by 10-foot garden beds for the students as their outdoor classroom area. Students planted herbs such as mint, rosemary, parsley and basil as well as cool-season vegetables such as broccoli, radish, lettuce, carrots and potatoes. The teachers and students were responsible for making sure the gardens were properly watered and fertilized.

The program was introduced as an informal science

Carl E. Motsenbocker, Professor, and Leanna L. Smith, former graduate student, Department of Horticulture, LSU AgCenter, Baton Rouge, La.

education program taught by volunteers from an LSU service-learning horticulture science education class and Louisiana Master Gardeners. The volunteers went into the schools for two hours each week during regular school days to lead the lessons and work with students in the gardens. The first hour and a half was used for JMG program activities, and the last half hour was used for garden time.

During the semester approximately four hours were spent on 10 activities from the first chapter (Plant Growth and Development), slightly less than three hours were spent on six activities from the second chapter (Soils and Water), approximately three hours were spent on seven activities from the third chapter (Ecology and Environmental Horticulture), and approximately two and a half hours were spent on five activities from the fourth chapter (Insects and Diseases).

Most of the volunteers had never taught children before and were guided in leading the lessons. The schools varied in the total number of volunteers assigned due to differing class sizes. The presence of the volunteers, however, allowed the classes to be divided into small groups of four to six students each. The presence of the adult volunteers for supervision also allowed for greater management of the students in the garden.

Science achievement tests of 40 questions developed at Texas A&M University specifically for the JMG program were given before the program started and after the students participated in the gardening activities to determine whether or not the activities helped improve achievement scores. In addition, a control class at each school in the same grade was also tested.

Students who participated in the program had higher science achievement test scores at the end of the semester compared to the beginning. In comparison, there were no differences in pre- and post-test scores of the control classes. The chapters that were most effective in influencing the fifth-grade students were chapter 1 (Plant Growth and Development, the chapter that most time was spent on) and chapter 4 (Insects and Disease). There were, however, no differences in test scores between the program participants and the control classes. The outcome of the gardening project was not affected by gender, indicating both girls and boys equally benefited from the program. Several variables such as the degree of integration of the program into regular school activities and the interests of the teachers may have affected the outcome of the study. The results show, however, that once-weekly use of gardens and hands-on classroom activities help improve science achievement test scores.

In the future, the formal organization and support of school gardening may be realized in many states, including Louisiana. Until then, more research into the benefits and effects of gardening is needed in order to justify the efforts in school gardening projects.

Individuals who are interested in supporting school gardening projects in Louisiana have several ways to get involved. Teachers can incorporate school gardening in their curriculums. Many programs, such as the JMG program, can be used in the classroom. In addition, the LSU AgCenter has 4-H programs that develop and support gardening clubs in schools. Gardeners may get involved by becoming Master Gardener volunteers. Most parishes in Louisiana have an active Louisiana Master Gardener program. In other states, the JMG and similar programs also are administered through the Master Gardener program.

Parents and other interested persons, especially those who are active gardeners, can become involved and volunteer to support hands-on gardening projects at neighborhood schools. Local businesses, such as garden centers, and civic organizations often support educational programs in neighborhood schools. Only by working together will Louisiana school children have the opportunity to benefit from hands-on science programs like the JMG program. ■

Photo by John Wozniak

Volunteers from the LSU service-learning horticulture science education class help with school garden projects.

Photo by Carl Motsenbocker

These students press flowers for cards.

Influence of Soil Type on Wheat's Response to Sulfur Fertilization

Rick Mascagni, Steve Harrison, Boyd Padgett and Bubba Bell

Adequate and timely fertilization is an important component of small grain cropping systems. Much research has been conducted on the macronutrients nitrogen (N), phosphorus (P) and potassium (K); however, less information is available on the need for the secondary nutrient sulfur (S). Sulfur deficiencies have increased because of decreased organic matter levels in the soil, less sulfur contamination in commercial fertilizers and less sulfur released into the atmosphere by industry. A cool-season crop such as wheat is more sensitive to sulfur deficiencies because of slower organic matter breakdown rates.

Deep, sandy Mississippi River alluvial soils are likely candidates for sulfur deficiencies because they have relatively low organic matter levels and, more importantly, low sulfur-adsorbing properties, which increase sulfur loss through leaching. Research indicates that the response to sulfur depends to a large extent on the depth of coarse-textured sandy soils, with yield responses increasing as the depth of sand increases.

Loessial silt loams of the Macon Ridge have shallow rooting depths and extremely low organic matter levels, which also make them susceptible to sulfur deficiencies. Information is needed on the influence of soil type

Rick Mascagni, Professor, LSU AgCenter Northeast Research Station, St. Joseph, La.; Steve Harrison, Professor, Department of Agronomy and Environmental Management, LSU AgCenter, Baton Rouge, La.; Boyd Padgett, Associate Professor, LSU AgCenter Macon Ridge Research Station, Winnsboro, La.; Bubba Bell, Research Associate, LSU AgCenter Northeast Research Station.

Photo by Bruce Schultz

Ripe heads of wheat await harvest.

on wheat's response to sulfur fertilization on Louisiana alluvial and upland soils. Other cultural practices such as variety selection and timing of sulfur fertilization may also affect responses to sulfur fertilization.

Field experiments were conducted in the 2001-2002, 2002-2003 and 2003-2004 growing seasons at the Macon Ridge Research Station near Winnsboro and at the Northeast Research Station near St. Joseph to determine the influence of sulfur fertilizer rate and time of application on yield performance of wheat varieties. At St. Joseph, experiments were conducted on Commerce sandy loam and Sharkey clay in 2002 and Commerce very fine sandy loam in 2003 and 2004. At Winnsboro, experiments were conducted on a Gigger silt loam each year.

Three wheat varieties, AGS 2000, USG 3209 and Pioneer/26R61 were evaluated. Sulfur, as ammonium sulfate, was applied at rates of 5, 10 and 20 pounds S per acre with spring N fertilizer. Additionally, the 20 pounds S per acre rate was applied in the fall to evaluate the effect of fall versus spring application. Spring N as ammonium nitrate was applied at 80 to 90 pounds N per acre in late February or early March. Nitrogen was adjusted for each treatment such that total N was equivalent in all the plots. At the Commerce very fine sandy loam site in 2002, only spring sulfur rates were evaluated for the wheat variety AGS 2000.

Wheat was planted in late October to mid-November at approximately 90 pounds seed per acre. Measurements included grain yield, yield components (heads per acre, kernel weight and kernels per head) and soil chemical analyses. Soil samples were collected after harvest from check plots at depths of 0 to 6, 6 to 12 and 12 to 18 inches.

At St. Joseph, soil sulfur levels were low on the sandy Commerce soil each year, with levels less than 5 ppm in 2002 and 2003 and less than 8 ppm in 2004. Sulfur level decreased with soil depth. On the Sharkey clay at St. Joseph, soil S increased from 13.6 to 21.8 ppm as sampling depth increased. At Winnsboro, sulfur increased with depth each year, averaging 8.6 ppm S per acre at the 0-to-6-inch depth, 29.8 ppm S per acre at the 6-to-12-inch depth and 39.6 ppm S per acre at the 12-to-18-inch depth.

According to AgCenter recommendations, soil sulfur is considered low at 8 ppm. Like nitrogen, sulfur is mobile in the soil, and soil test levels may vary depending on soil moisture conditions. This is particularly important in sandy soils. On heavier-textured soils, S is less mobile, and soil test levels tend to remain more stable over time.

Yields were increased by the application of S only in one of the seven experiments. On the Commerce very fine sandy loam at St. Joseph in 2002, applied S increased yields from 42.5 to 59.8 bushels per acre. Averaged across rates, S increased yields by approximately 30 percent and increased heads per acre by 28 percent; optimal yield occurred at 10 pounds S per acre. Response occurred on a soil that was very sandy down to 18 inches; the organic-matter level decreased from 0.6 percent in the top six inches to 0.2 percent at the 12-to-18-inch depth.

The lack of S responses on the other alluvial soils may have been due to a combination of higher organic matter levels and more clay at deeper levels, while on the Macon Ridge the lack of response was probably due to an accumulation of soil S as depth increased. Studies are continuing to better define soil conditions and other factors such as weather and previous crops that may affect the response of wheat to sulfur fertility. ■

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

Small-grains breeding program produces results

In 20 years, the LSU AgCenter's small grain breeding program has grown from nothing to being the source of the most widely planted wheat variety in Louisiana.

"Breeding is a long-term process," said LSU AgCenter plant breeder Steve Harrison. "It takes 12 to 14 years from crossing to growers being able to harvest a variety derived from that cross."

Harrison, who heads the small grain breeding program, came to the AgCenter in 1984 to start the program that has produced three new oat varieties and three new wheat varieties since 1997 with more in the pipeline.

Harrison said the AgCenter breeding program depends on the Louisiana Soybean and Grain Research and Promotion Board for much of its funding. "The varieties that have come out of the program are also generating some royalties that are being reinvested in the breeding program and AgCenter research programs," he said.

The first releases were oat varieties in 1997 – Buck Forage LA604 sold for deer feed plots and Secretariat LA495. A third oat, Plot Spike LA9339, was released in 2003 and is widely used for wildlife food plots. The wheat breeding program released LA422 in 1998, 841 in 2002 and LA9560 in 2004. LA422 and LA841 are marketed by Terral Seed Co. of Lake Providence, and LA9560 will be marketed by marketed by AgSouth Genetics as AGS 2060.

LA841 is the most widely grown wheat variety in Louisiana for 2005, Harrison said.

"It's important to have a Louisiana breeding program because our climate is unique," Harrison said. "We look at high yield, high test weight, good quality, good standability, disease resistance and adapatation to our climate."

The program has about 7,000 yield plots and 50,000 headrows planted for 2005.

The plant breeder said Louisiana wheat faces high disease pressures because of climate. And a new wheat disease, stripe rust, found its way to the Gulf region about six years ago from the Pacific Northwest.

"As much as anything else, we develop wheat varieties resistant to disease pressures we experience," Harrison said.

"We have over a dozen important diseases," he said. He ticks them off – stripe rust, leaf rust, stem rust, two septoria diseases, fusarium, black chaff and "two or three viruses."

Harrison said wheat provides Louisiana farmers with cash flow in spring and early summer. It also contributes to conservation tillage and provides winter cover crops. ■ **Rick Bogren**

Water Pollution and Income What's the Connection?

Krishna P. Paudel, Hector O. Zapata and Dwi Susanto

It is hypothesized that the level of environmental degradation will increase as per capita income increases up to a certain level. Then, the level of degradation will decrease with further growth in income, which would be beneficial to the environment. This relationship between environmental quality and per capita income would thus assume an inverted U shape.

Tangipahoa River

Krishna P. Paudel, Assistant Professor, Hector O. Zapata, Professor, and Dwi Susanto, Graduate Research Assistant, Department of Agricultural Economics and Agribusiness, LSU AgCenter, Baton Rouge, La.

Past research comparing pollution and per capita income has had mixed results. Some researchers found the relationship to be U-shaped; others believed the curve to be downward sloping or even flat. In our study at the LSU AgCenter we used watershed-level data to examine the nature of the pollution-income relationship in Louisiana. This approach is different from other studies, which have used county- or country-level data. We determined water quality based on data for two water pollutants, nitrogen and phosphorus.

To estimate the relationship between income and water pollution, we used data sets that contain observations for each parish over a few years. The general form of the model used to describe the relationship between pollution and income contains pollution as a dependent variable. Population density is used in the model as a proxy for human behavior concerning water pollution. The hypothesis underlying this variable is that more populated parishes are likely to be more concerned about reducing water pollution. Hence, increased population density is expected to lead to lower water pollution.

We used data on nitrogen and phosphorus concentrations in water collected by the Louisiana Department of Environmental Quality from each watershed. The pooled data consisted of observations from 1985 to 1999. Per capita income by parish was obtained from the Bureau of Economic Analysis (BEA). Population density is measured in people per square mile and is calculated by dividing the population in a parish by its corresponding area.

Photo by John Wozniak

Income level ranged from $6,013 (for Madison Parish) to $16,269 (for Jefferson Parish), while the Louisiana average was $10,353. Population density ranged from a minimum of 5 people per square mile (Cameron Parish) to a maximum of 2,572 people per square mile (Orleans Parish).

The average turning point income level for nitrogen was between $11,174 and $12,578. For phosphorus, the average turning point income level was between $8,616 and $9,277. The results strongly suggest that parishes differ in their pollution levels. Coefficients associated with population density variables in both nitrogen and phosphorus were found to have a negative sign consistent with our hypothesis.

We found a negative spillover effect in nitrogen, indicating that if a parish is surrounded by wealthier parishes, then one is less likely to find higher nitrogen pollution in that parish. This finding is not consistent with our hypothesis. In the case of phosphorus, we found the results to be consistent with the hypothesis of spillover effect, which means neighboring, more-affluent parishes increase phosphorus pollution in the parish of interest.

We looked at nitrogen-income and phosphorus-income relationships in three representative parishes. Cameron Parish showed a decreasing trend in nitrogen pollution, while Acadia and East Carroll parishes showed an increasing nitrogen pollution relationship. When analyzed with respect to phosphorus and income relationships, two parishes have seen a decline in phosphorus pollution with a rise in income level. East Carroll Parish, however, has an inverted relationship between income and phosphorus pollution.

The turning point gives a reference as to when pollution began to decline as income increased. This value also gives specific levels of income beyond which growth and development are friendly to the environment. Based on the average value for the nitrogen turning point, we found that Lafayette, Jefferson, St. Charles, Plaquemines, Ascension, Caddo, East Baton Rouge, St. Tammany and Orleans parishes are on the right side of the turning point; hence, water pollution should be declining in these parishes. In 1998, all the parishes had values on the right of the turning point, indicating that water quality has been steadily increasing throughout the region. Turning points are found to be a little lower based on phosphorus. The coefficients are not significant, but if one has to draw conclusions based on this analysis, it can be said that most of the parishes have already passed the turning point. Hence, we should see declining pollution in these parishes in the future.

Using a 14-year series of water pollutant data (nitrogen and phosphorus) for Louisiana, we obtained the relationship between income and pollution. The results showed that the per capita income and the level of nitrogen pollutants followed an inverse U-shape curve. We did not find the evidence of an inverted U-shape relationship between income and phosphorus. Many Louisiana parishes are on the right side of the turning point when evaluating based on the nitrogen pollution. This indicates that many parishes have reduced the nitrogen load in their water bodies in recent years. For those parishes on the left side of the turning point, water pollution control policy should be set in such a way that it increases the total benefit to society. ■

ATTITUDES Toward Treated Wood

Richard P. Vlosky and Todd F. Shupe

Wood is a renewable natural resource typically preservative-treated to ensure structural integrity in many exterior applications. Preservative treatment of wood has a long history. Early settlers to the New World in the 17th century first used wood preservatives to protect homes and other structures.

Today, about 44 percent of the 13 billion board feet of southern yellow pine (SYP) lumber produced is pressure-treated with some type of a preservative system. In the past, chromated copper arsenate (CCA) was used for about 80 percent of SYP treated wood production. In recent years, there has been negative publicity about perceived hazards to human health from exposure to wood treated with CCA. These concerns had to do with direct human contact with arsenic in the preservative as well as concerns about leaching of arsenic into groundwater. To remain a viable industry, an agreement between the treating industry and the Environmental Protection Agency resulted in a voluntary phase-out of CCA-treated wood for residential uses at the end of 2003. Although the EPA has not concluded that CCA-treated wood poses any unreasonable risk to the public or the environment, arsenic is a known human carcinogen, and the agency believes that any reduction in the levels of potential exposure is desirable. Most wood treaters that used CCA have converted to alternative arsenic-free preservatives.

Following are some perceptions and attitudes about treated wood from groups that manufacture, sell or use treated wood or products.

Children's Playground Equipment Buyers

Children have been targeted as an at-risk population to exposure from playing on outdoor playground equipment constructed from treated wood. We examined U.S. children's playground equipment buyer perceptions, attitudes and buying patterns for treated wood. Respondents represented 431 preschools, daycare centers, municipal parks and K-8 schools. Thirty-nine percent of respondents had outdoor play equipment fabricated with treated wood. Thirty-three percent had either a somewhat or very positive perception about treated wood, while 41 percent of respondents fell at the midpoint indicating a neutral position. Twenty-six percent had a negative perception. Of the respondents that had purchased playground equipment fabricated with treated wood, 40 percent were concerned about health risks to children. When put in context of other materials used to fabricate playground equipment that respondents plan to purchase, treated wood ranked a distant fourth after plastic, steel and aluminum.

Playground Equipment Manufacturers

We also conducted a study of all 188 children's playground equipment manufacturers in the United States. Forty-eight percent of respondents fabricated outdoor play equipment with some type of treated wood. Fourteen percent of respondents had an extremely negative perception of treated wood, and an additional 18 percent had a somewhat negative perception. Eighteen percent had a somewhat positive perception and 27 percent had a very positive perception of treated wood.

Minimization of chemicals and health risks were important to respondents when considering the materials they use to manufacture children's playsets. These criteria were closely followed by performance, cost, and years of service. Resistance to wood-destroying insects was highest ranked in the South and ranked seventh overall. Of the respondents that manufactured playground equipment with treated wood, 12 percent were concerned about legal or liability issues. Related concerns were health risks to children, lack of knowledge on long-term effects of human exposure, and replacement costs.

U.S. Home Builders

In this study, we looked at what the top 500 homebuilders in the United States think about treated wood. Homebuilders significantly influence demand for wood products, including treated wood. Only 1 percent of the 116 respondents had an extremely negative perception of treated wood while 38 percent had a somewhat positive perception and 32 percent had an extremely positive perception. Sixty-one percent of respondents felt that treated wood is safe for humans in outdoor applications and safe if handled and disposed of properly. Fifty-one percent said it is safe for builders to use. Further, 42 percent believed it is safe for children's outdoor play equipment, and 38 percent believed treated wood is safe for pets or farm animal exposure. Finally, 55 percent of respondents desired additional information on treated wood.

Homeowners

This research was conducted to better understand U.S. homeowner perceptions about building materials in general with particular emphasis on treated wood products. The results indicated that the 451 homeowner respondents out of 1,500 surveyed had a generally positive opinion of the safety and performance of treated wood. Only 5 percent of respondents had a negative perception of treated wood, 40 percent had a somewhat positive perception and nearly a quarter had a very positive perception. Fifty-two percent had some product at their residence made from treated wood, primarily decks and landscape timbers while 75 percent said that they would be willing to use treated wood. The major reasons of those unwilling to use treated wood were livability and health concerns. Respondents indicated that individual wood products companies are the least trusted to provide consumers with treated wood safety and handling information, and environmental organizations are the most trusted.

Richard P. Vlosky, Professor and Director, and Todd F. Shupe, Associate Professor, Louisiana Forest Products Development Center, School of Renewable Natural Resource, LSU AgCenter, Baton Rouge, La.

Public Understanding

A number of common responses across these four groups indicate that there is a general misunderstanding from respondents about treated wood and the companies that manufacture it:

- 54 percent of playground equipment buyers and 50 percent of homeowners were unsure if some types of treated wood is safer than others.
- 70 percent of playground equipment sellers said they would like more information on treated wood proper use and handling.
- 34 percent of home builders did not understand the process of treating wood.
- 49 percent of homeowners reported no understanding of the basic concept of wood treating.
- 79 percent of homeowners and 33 percent of builders reported that they did not have knowledge of treated wood consumer information sheets (a requirement for retailers to have on display at point-of-sale).
- 60 percent of homeowners and 55 percent of home builders desired additional information on treated wood.

The lack of trust in the treating industry to provide information to consumers, builders and others that use treated wood is another issue that was consistent in these studies. For example:

- Only 27 percent of homeowners trust safety claims made by treated wood manufacturers.
- Both playground equipment buyers and sellers said that the most trusted entity to monitor treated wood and provide information is the Centers for Disease Control (CDC) while the second least trusted entity to provide this information are treated wood chemical manufacturers (after attorneys).
- 24 percent of home builders do not trust treated wood manufacturer safety claims.

The lack of understanding about treated wood and the lack of trust in the industry indicate that industry players, including lumber manufacturers, treaters and chemical manufacturers, need to be proactive in educating the general public in an unbiased manner based on science. Ultimately, customer perceptions and behavior will determine the future of the treated wood industry. ■

Keeping Treated Wood Out of Landfills

What to do with decommissioned, preservative-treated wood has become a burning issue. Well, not burning, actually. That's one of the methods that can't be used any longer, according to Todd Shupe, a forest products researcher in the LSU AgCenter's School of Renewable Natural Resources. Shupe has been looking for answers for what to do with the products no longer serviceable.

"Disposal of decommissioned, preservative-treated wood has increasingly become a major concern because the popular disposal options – burning or land filling – are becoming more costly and impractical," Shupe said. "Recycling – both of treated wood and of the preservatives – must be considered."

Finding new uses for these products is important to Louisiana because nearly half of the southern yellow pine grown in the state ends up being treated with either creosote or chromated copper arsenate (CCA) for use in industrial applications ranging from utility poles to highway and bridge guardrails.

Although the wood processing industry has voluntarily withdrawn CCA-treated wood products from use in residential construction, the product is still widely used in industrial applications.

"Preservative-treated wood is often recommended to prevent decay and ensure structural integrity," Shupe said. "Without treatment, exterior wood products are at a disadvantage against other materials, such as steel, concrete, plastic and aluminum."

To keep the products as viable alternatives, users need to have a way to dispose of the used wood.

Shupe's answer includes several types of recycling.

"The chemical method has the most potential for industrial adoption," he said. "It's quick, environmentally safe and benign."

In a process Shupe calls liquefaction, treated wood is ground and liquefied with an organic solvent. "The process uses relatively low temperature, short reaction time and small amounts of organic reagents," he said.

Shupe said the process is economically viable and environmentally friendly.

"This approach has the best opportunity for success," he said. "There's zero discharge, and it produces multiple products."

The results can include the chemicals originally used to treat the wood as well as nontoxic liquefied wood that can be used for resins, molded wood products, foams and plastics.

A second process uses super critical water – water at high temperature under high pressure – to recover the preservatives and detoxify the wood for reuse. Shupe said research has shown that the process can remove creosote from wood and yield a mixture of industrially useful hydrocarbons and other chemical compounds along with toxic-free wood.

In addition to removing chemicals from treated wood, Shupe said, the LSU AgCenter has researched re-using the wood with the preservatives still in it.

Photo by Todd Shupe

Decommissioned utility poles can still be useful. LSU AgCenter researchers have developed a method for cutting used poles lengthwise and salvaging usable segments, which are cut in pie-shaped sections and glued together to create new poles.

"Decommissioned wood products often have residual preservatives that can be reconfigured and reused in industrial applications," Shupe said.

Discarded utility poles can be cut lengthwise and glued together to be used again. And other obsolete or damaged wood products can be flaked and made into structural flakeboard, which research shows maintains acceptable mechanical and physical properties and adequate decay resistance with as much as 50 percent treated material in the panels.

Shupe and his colleagues in the Louisiana Forest Products Development Center are hopeful that they can find funding to develop the Louisiana Center for Treated Wood Recycling at the LSU AgCenter's Calhoun Research Station.

"This would be the only center for recycling treated wood in the United States," Shupe said. ■ **Rick Bogren**

Designer Colors Enhance Watermelon Production

Jose Andino, Carl Motsenbocker and Ramon Arancibia

Plastic mulch has been used in the production of warm-season crops such as watermelon and other horticultural crops to reduce water evaporation, decrease soil compaction and fertilizer leaching, modify soil temperature, control weeds and increase yield. In general, black plastic mulch is recommended in Louisiana for spring and fall vegetable production while white plastic mulch is recommended for the summer growing season.

Black plastic mulch absorbs most if not all light striking it, and the plastic becomes warm and heats the soil underneath the mulch. Warm-season vegetables, such as watermelon, are often responsive to higher soil temperatures produced by black mulch in the spring. White mulch, on the other hand, reflects most of the light and is thus often much cooler than bare soil or black mulch. Black mulch becomes too hot in Louisiana summers, so white mulch is used for warm-season vegetables like melons. Previous field research with black or white plastic mulch indicated higher watermelon yield compared to bare-ground culture.

Colored plastic mulches, which are wavelength selective and/or reflective, are relatively new materials that have advantages similar to black or clear mulch. They let certain wavelengths of light through and absorb or reflect other wavelengths. Colored plastic mulches are made with different dyes and other enhancements to change their basic properties. They have additional benefits related to better management of soil temperature by allowing specific light wavelengths to strike the soil. The altered quantity and quality of reflected light in the plant canopy may influence plant growth and productivity. These mulches also block the spectrum of light required for photosynthesis and therefore limit weed growth underneath.

Silver Mulches Reduce Insects

In addition to changing soil temperature and light reflectance into the plant canopy, colored mulches have been shown to influence pest pressure. Researchers have documented that yellow and blue plastic mulches often attract specific insects. In contrast, silver mulches have been shown to reduce insect pressure because of disorientation of insects around the plastic mulch. The highly light reflective silver mulch has been beneficial in commercial tomato production by reducing pest pressure and pesticide use.

The effects of colored plastic mulches on plant growth and yield have been studied in a number of vegetable crops such as bell pepper, cowpea, muskmelon, tomato and Irish potato. Little research, however, has been conducted to evaluate watermelon crop response to colored plastic mulches in the field. Other researchers have demonstrated that vegetative plant growth can be directly affected by the quality of radiation reflected from particular mulches. The effect of light quality on the growth of young watermelon plants in controlled environments was evaluated previously; watermelon plants responded to light environment changes by partitioning more sugars to vegetative parts and producing plants with longer vines. This effect in watermelon is attributed to the light reflectivity of a particular mulch color – red. Even though the effect of colored plastic mulches on watermelon is temporal until the vines cover the mulch, the hypothesis is that early plant response to the light environment can induce modifications in the plant growth that continue after the vines cover the plastic.

The objective of this research was to determine the effect of different

Photo by Jose Andino

Watermelons are a significant crop in Louisiana's Florida parishes.

Jose Andino, former graduate student, Carl Motsenbocker, Professor, and Ramon Arancibia, former Research Associate, Department of Horticulture, LSU AgCenter, Baton Rouge, La.

reflective and wavelength-selective plastic mulches on insect populations, plant growth and yield of field-grown watermelon. Various colored mulches were compared with black and white mulches and bare ground (no mulch) during the spring growing season for the effect on watermelon production.

Watermelon Tested at Burden

Field experiments were conducted at the Burden Research Center, Baton Rouge, La. Raised beds were established with trickle irrigation tubing, and plastic mulch treatments were installed using a commercial plastic layer machine. Commercial colored mulch materials were used where available, or mulches were painted (blue for two years and yellow for one year) because these particular colors were not available. Containerized transplants of Honeyheart, a yellow-flesh variety commonly called "seedless," and Sangria, a red-flesh seeded variety, were hand-transplanted into the field at four weeks into the two center rows. Crimson Sweet was used on the two outside guard rows and together with Sangria, both common watermelon varieties, served as source of pollen for Honeyheart.

Insect, disease and weed management practices were conducted in accordance with LSU AgCenter recommendations, and standard fertilization procedures – preplant and fertilizing through the irrigation system – were followed. Insect populations were sampled by counting all insects present, and main vine length was measured twice after transplanting. Plots were harvested three times, with harvests one week apart. At harvest, fruits from each plot were counted, measured and weighed individually and then classified as marketable or cull fruit for separate analysis.

Colored mulches affected cucumber beetle populations; the red and yellow plastic mulch plots had among the highest cucumber beetle populations recorded in both varieties while the silver plastic mulches had among the lowest. Our research results are similar to other research that has reported that silver mulch is effective in reducing insect populations, presumably because of enhanced light reflection and disorientation of insects.

Most mulched plots had longer vines than the bare-ground treatment with few differences in vine length among the colored-mulch treatments by four weeks after transplanting. The increased plant growth found with mulch use is presumably because of higher temperatures recorded under the plastic mulch and the enhanced growth response of watermelon, a warm-season crop.

There were no differences among mulch treatments in first and total Honeyheart harvests. Two green wavelength-selective mulches and silver-on-black (nonselective, reflective) mulch had the highest first Sangria harvest and were among the highest total Sangria harvest. Plants in plastic mulch treatments had higher yields as a result of higher fruit numbers per area or fruit per plant. Fruit weight, length and diameter and sweetness for both cultivars were not affected by colored plastic mulch treatments.

Further research is required to investigate the influence of colored mulches on watermelon growth and yield and to determine the specific physiological effects on watermelon plants. ■

Rice Station Spurs State's Economy

(Continued from page 2)

The literature they give us keeps us up-to-date on what's going on."

Kevin Berken, who farms with his brothers in Jefferson Davis Parish, said the Rice Station keeps them up-to-date on fertilizer and chemical applications.

Berken said the station's varieties have boosted yields in the past three decades, from a standard of 25 barrels to more than 40 barrels in a normal year. "And we don't have near the problems we had with red rice 30 years ago."

County agents are on the front lines fighting the battles with farmers, and they rely on the station to help provide information to farmers.

Eddie Eskew, LSU AgCenter county agent in Jefferson Davis Parish, said it's essential that extension agents have the support of good researchers.

Rice farmer Tommy Ellett of Angelina Plantation near Ferriday said he depends on recommendations from the AgCenter on fertilizers, pesticides and variety selections. In addition, Ellett said, Angelina buys foundation seed from the Rice Research Station to grow seed rice.

Ellett said he has confidence in the AgCenter's advice because the information is based on sound research.

"We depend heavily on the non-biased opinion of LSU," he said.

Demonstration plots at Angelina show how new varieties will grow in the Angelina Plantation soil. That's important because the climate, soil and insects differ from what exists at the station, he said.

The verification program under Johnny Saichuk, LSU AgCenter rice specialist, has been a big help at Angelina, Ellett said.

Impact

■ Scientists at the Rice Research Station developed the Clearfield long-grain rice variety. Its herbicide resistance allows farmers to spray fields to kill red rice, an undesired plant that lowers the quality of a crop. Clearfield was planted on approximately 500,000 acres in southern rice-growing states, only two years after it was released for commercial production. A new version, Clearfield 131, was released in 2005 for seed production.

■ Varieties developed at the Rice Research Station dominate the acreage planted in Texas, Arkansas, Mississippi, Missouri and Louisiana. During the past decade, Louisiana varieties were planted in 63 percent of the rice in those states. In 2003, Louisiana varieties were planted on 35 percent of the rice grown in Arkansas, 80 percent of the Mississippi rice acreage, 92 percent of the Texas acreage, 59 percent of Missouri acreage and 97 percent of Louisiana acreage.

■ The Rice Research Station's Foundation Seed program has produced 14.8 million pounds of seed from 36 varieties since it started in 1949. The program uses a dryer system with eight bins, each 21 feet in diameter, and a processing facility built at the station in 1996.

■ Scientists at the station plant a total of approximately 10,000 research plots and more than 100,000 progeny rows in variety development activities. ■ **Bruce Schultz**

Inside:

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