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LOUISIANA Agriculture

Assuring Our Future Through Scientific Research and Education

Preventing herbicide drift can be tricky

New ways to improve your rice yields

Keeping both weeds and insects out of cotton

LSU AgCenter
Research & Extension

Top LSU AgCenter awards for 2008 go to 20 faculty, staff

Twenty faculty and staff received the top awards for 2008 at the LSU AgCenter Annual Conference Dec. 15-16 in Baton Rouge.

Kayanush Aryana, associate professor in the School of Animal Sciences, received the Rogers Excellence in Research Award for his research with functional foods. His studies involve developing dairy products with nutrition and health enhancements that would benefit consumers.

Chris Clark, professor in the Department of Plant Pathology & Crop Physiology, received the Doyle Chambers Research Award for his research with sweet potatoes. Clark's development of virus-tested sweet potato foundation seed, has helped keep the Louisiana sweet potato industry alive and thriving. His research on sweet potato diseases plays an integral role in developing sweet potato varieties that make up the bulk of the sweet potatoes grown in the United States.

Stuart Gauthier, county agent in Vermilion Parish, received the Floyd S. Edmiston Extension Award for his outstanding contributions to agriculture following hurricanes Rita in 2005 and Ike in 2008.

Don Reed, a wildlife and forestry specialist, who conducts research at the Bob R. Jones Idlewild Research Station near Clinton, received the Excellence in Extension Award. Reed was recognized for working with landowners in improving their property for wildlife enhancement.

Three extension agents received the Denver T. and Ferne Loupe Extension Team Award for their community garden program in Shreveport, which offers citizens an opportunity to consume fresh vegetables, learn about nutrition and take pride in the improved looks of their neighborhoods. The team includes Vicky Chesser and Grace Peterson, family and nutrition program agents, and Denyse Cummins, horticulture agent.

Eleven scientists involved with research on resistant starch won the Tipton Team Research Award. Resistant starch has the potential to reduce body fat, improve glucose tolerance and prevent cancer. The team includes Kayanush Aryana, associate professor, School of Animal Sciences; Chang-Ho Chung, assistant professor, and Donal Day, professor, Audubon Sugar Institute; Marlene Janes, Joan King and Jack Losso, all associate professors, Department of Food Science; Mike Keenan, associate professor, Kathy McCutcheon, research associate, and Richard Tulley, professor, School of Human Ecology; and Don LaBonte and David Picha, both professors, School of Plant, Environmental & Soil Sciences.

The Ganelle Bullock Staff Outstanding Service Award went to Mary Hollingsworth, an administrative coordinator in the Rapides Parish extension office.

The Outstanding Service Award for Associates went to Clark Robertson, research associate in the Department of Plant Pathology & Crop Physiology. ■ **Craig Gautreaux**

Photo by Mark Claesgens

The scientists who work with resistant starch include, left to right, Don LaBonte, Marlene Janes, Kathy McCutcheon, Joan King, John Finley, Mike Keenan, Richard Tulley, David Picha and Kayanush Aryana, standing behind Jack Losso, seated at right. Not pictured are Chang-Ho Chung and Donal Day.

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Assuring Our Future Through Scientific Research and Education

ON THE COVER: Aerial application of herbicides can cause drift problems even on a calm morning, according to LSU AgCenter scientist Eric Webster. See stories on pages 4 and 6. Photo by Steve Linscombe.

Mexican rice borer more dangerous to La. sugarcane than rice

Gene Reagan, LSU AgCenter entomologist, has been studying the Mexican rice borer's spread northward from the Rio Grande Valley for almost 30 years.

Reagan said the insect, which damages rice and sugarcane, has been migrating through Texas at the rate of 15 miles a year. In 2006, it was found in east Texas just one county away from Louisiana, and it was anticipated that it would be found in Louisiana in 2008. Sure enough, two weeks before the end of 2008, borers showed up in two pheromone traps on the Louisiana-Texas line north of Vinton.

The traps have been maintained and checked by personnel from the Louisiana Department of Agriculture and Forestry since 2001.

"It's still about 15-20 miles from any sugarcane fields in Louisiana," he said.

A quarantine preventing Texas cane from entering Louisiana remains in effect, he said, as a means of slowing the borer's spread. But the spread is likely to continue, and that has Reagan worried. "I think we've got some major problems down the road."

Reagan first saw what the pest can do in 1980. He traveled to the Rio Grande Valley in Texas and was astonished at the damage to sugarcane.

"I saw many fields that were totally destroyed," he said.

But Texas cane producers have learned to cope with the problem by developing resistant varieties, and by using irrigation to lessen drought stress.

The insect is inclined to lay its eggs on dying leaves on the lower part of the sugarcane plant, he said, and it prefers drought-stressed cane plants, he said.

"I anticipate the Mexican Rice borer will be more of a problem in sugarcane than in rice," Reagan said.

An economics study conducted last year by the LSU AgCenter and Texas A&M projected a $45 million loss of revenue for Louisiana rice farmers once the entire state is infested.

Mexican rice borers are not obvious pests in rice until the crop is in the boot stage. But by the time it is found within rice plants, he said, the population jumps rapidly.

(*Continued on page 25*)

Herbicide drift can occur in calm weather

Herbicide drift often occurs when it is least expected – during a still, calm morning, according to Eric Webster, LSU AgCenter weed specialist.

Webster said just because it seems like no wind is present at ground level doesn't mean that condition exists a few feet above ground.

"The worst times are when the wind is zero to 2 miles an hour," Webster said. "That's when you get those inversion layers built up."

A field surrounded by tall vegetation increases the variation of wind direction, he said.

Using a ground sprayer is a good way to avoid drift problems, he said, although it still is not a guarantee.

Farmers can contaminate their own fields with unintended applications of herbicides if tanks are not properly cleaned, Webster said. "It's always a good idea to triple rinse after spraying."

Using research plots, Webster and his staff are studying the effects of drift from the herbicides Roundup and Newpath at different concentrations.

Webster is developing a Web site to show symptoms of drift from different herbicides and a pamphlet to help diagnose problems. He said both resources will be ready for the 2009 growing season.

Webster said examining a field for suspected herbicide drift requires a broad view of the affected area. "The best thing you can do is stand back and take a look at the situation."

He said many of the signs of herbicide damage mimic symptoms of nutrient deficiencies because a plant hit with herbicide stops growing.

Browned leaves on nearby trees can offer clues as to the direction the drift traveled, he said.

Herbicide drift can travel as far away as a mile on a still morning, Webster said. Last year, he said, drift from an airplane became evident on rice 150 yards away, but the highest concentration was a mile away.

Newpath drift often results in rice heads failing to emerge from the plant sheath, rotting inside the plant, he said, while the heads in a rice plant contaminated with Roundup often emerge but are sterile.

Roundup is evident on rice with twisted leaves, short internodes and heads shriveled and malformed, he said. In some instances the head locks up in the leaf sheath.

Newpath on young rice will result in green and yellow striations on the leaves, and growth of the main stem stops.

Liberty Link soybeans, which can withstand the herbicide Ignite, will be grown commercially for the first time this year. Webster said Ignite is a contact herbicide that doesn't move through a plant system, so he does not expect it will cause as many problems as glyphosate, which is the ingredient in Roundup. Some crops, such as rice, can survive Ignite, although yield might be decreased by 10-15 percent.

Webster said rice damaged at the two- to three-leaf stage can overcome herbi-

Photo by Bruce Schultz

M.O. Way, far left, Texas A&M entomologist, and Gene Reagan, second from left, LSU AgCenter entomologist, explain the differences between the sugarcane borer and Mexican rice borer to students and farmers during a field day near Ganado, Texas.

cide injury. "The worst thing is to flood a field," he said.

Allowing a field to approach drought conditions can promote root growth that will enable plants to recover, he said.

When Webster is called to a suspected drift case, he is more interested in the what-did-it than the whodunit. He examines a field to find out what chemical, if any, has caused a problem, but he is not involved in investigations.

"I'm not there to point fingers or accuse anyone of doing wrong," he said. "I'm there to give the producer some options."

Complaints aimed at enforcement should be directed to the Louisiana Department of Agriculture and Forestry. ■ **Bruce Schultz**

Ethanol from sugarcane could fuel agriculture

Researchers at the LSU AgCenter's Audubon Sugar Institute in St. Gabriel, La., are combining their knowledge of sugarcane processing with chemical engineering to develop a synergy between sugar production and ethanol. Some of the same process technology industry uses for producing ethanol from corn can be used to produce it from many other raw materials, including sugarcane and similar plants.

"The knowledge base is here," said Donal Day, a researcher at the Audubon Sugar Institute.

Ethanol, which can replace a portion of the gasoline consumers pump into their cars, is produced by fermenting sugars. In the United States, these sugars typically come from corn starch. Ethanol from corn is made by treating the cornstarch with enzymes to create sugar. Then the sugar is fermented with a yeast to produce ethanol – an alcohol.

"It's just like making beer," Day said.

But AgCenter researchers are looking at nonfood sources of sugar as alternatives. Some of these sources include cellulosic materials, such as a plant called energy cane, sweet sorghum, a grass called miscanthus and bagasse – the fibrous portion of a sugarcane stalk that remains after the juice is squeezed out. To make ethanol from cellulose, the plant fibers first have to be treated so enzymes can reach the main sugar structures in cellulose.

Various forms of cellulose contain several types of sugars, particularly glucose and xylose. Giovanna DeQueiroz, a researcher at the Audubon Sugar Institute, is looking for ways to treat various cellulosic materials to extract the sugars that can be turned into ethanol and other valuable chemicals.

"Developing enzymes is an important step in coming up with an economical process for producing ethanol from cellulose," DeQueiroz said. "We have many ways to make ethanol from cellulosic crops, but we have to be concerned with costs and environmental considerations. We convert feedstocks into sugars, primarily glucose but also xylose. We pre-treat the fibers to open the structure so enzymes can get to the cellulose and release these sugars. Our goal is to identify and optimize the process so it can be used with various cellulosic materials."

The LSU AgCenter has patents on the technology DeQueiroz is working with, but the process still needs to be refined.

"Xylose is difficult to work with because we can't get high yields of ethanol," she said.

Conversion from cellulose to sugars and then to ethanol depends not only on the pretreatment technology but also on the enzymes – bacteria or yeasts – and microorganisms that can transform the material from one compound to another. But researchers say one of the challenges is to find the right organisms that will work on both glucose and xylose simultaneously.

"Most of these bugs prefer only one sugar," Day said. "If one converts glucose, it doesn't particularly like xylose."

Many other plant materials can be turned into ethanol, but the technology needs to be economical to be practical. "The process of producing ethanol from cellulose is not inexpensive," Day said.

Researchers from the LSU AgCenter's Sugar Research Station and from the U.S. Department of Agriculture's research station in Houma have developed several varieties of energy cane that can be used as feedstock for producing ethanol. This cousin of sugarcane yields more biomass – the total mass of the plant – but less sugar than sugarcane. Still, it offers a longer growing season because it can withstand colder temperatures.

"Energy cane could be grown farther north in Louisiana than sugarcane is now," Day said.

LSU AgCenter researchers looking for other plants to fill out the growing seasons are evaluating sweet sorghum and miscanthus. Other Audubon Sugar Institute researchers are working to develop economical methods for producing cellulosic ethanol because it could be a boon to Louisiana agriculture.

Louisiana sugar mills operate only three to four months a year, and they have much of the machinery that would be necessary for gathering, crushing and milling plants that are similar to sugarcane and could be converted into ethanol, researchers said. The systems for harvesting and delivering sugarcane and related plant materials systems also are in place.

"They only need to add chemical and bioreactors and distilleries to complete the process," DeQueiroz said. "And the energy to operate the process would come from the same source as sugarcane processing – burning biomass to run the boilers already in place."

To be efficient, an ethanol plant has to work year-round, whether it's an existing sugar mill or a new biomass plant. Many feedstocks such as sugarcane, sweet sorghum and similar plants deteriorate over time, so they can't be stockpiled for too long for ethanol production.

"We need a way to assure continuous delivery," Day said. "We can start with sugarcane in the fall, then move to energy cane later in the winter, then change to sweet sorghum and finally to miscanthus as the year goes on. If there's money in converting cellulose into ethanol, it will come." ■ **Rick Bogren**

Soybean industry honors Boethel

David Boethel, vice chancellor of the LSU AgCenter, received the Distinguished Service Award at the Tri-State Soybean Forum held in January in Oak Grove.

A professor of entomology since 1983, Boethel began his career with the LSU AgCenter in 1974 at the Pecan Research and Extension Station in Shreveport.

Photo by John Wozniak

Boethel received his doctorate in entomology from Oklahoma State University and his bachelor's and master's degrees from Texas A & M University. He was named the outstanding alumnus in the OSU Department of Entomology in 1992.

"Dr. Boethel has had a major impact in the soybean industry and its profitability not only in the tri-state area but in the southern United States," said Robert Hutchinson, LSU AgCenter regional director in northeast Louisiana. ■ **Mary Ann Van Osdell**

Herbicide drift

affects Louisiana rice production

Justin B. Hensley, Eric P. Webster, Dustin L. Harrell and Sunny L. Bottoms

In 2007, Louisiana producers planted 605,000 acres into soybeans. Approximately 95 percent of those acres were planted in Roundup Ready varieties, which are resistant to the herbicide glyphosate. That same year, approximately 26 percent of Louisiana's 348,000 rice acres were planted in Clearfield varieties, which are resistant to the herbicides imazethapyr (Newpath) and imazamox (Beyond). In addition, 21 percent of the rice acreage was ratooned – harvested a second time – from the stubble that regrew after initial harvest. These fields of Roundup Ready soybeans and Clearfield rice are often grown adjacent to fields of rice varieties susceptible to the herbicides used in these cropping systems. This creates a great potential for damage to rice from the off-target movement of these herbicides.

In recent years, researchers at the LSU AgCenter Rice Research Station near Crowley have evaluated the effects of simulated herbicide drift into rice fields. Two major objectives of this research are to quantify the potential yield losses caused by herbicide drift in both the primary and ratoon rice crops and to better understand the visual symptoms of injury caused by a particular herbicide.

Two studies evaluated drift of Roundup and Newpath to rice. These two herbicides account for a vast majority of all reported off-target herbicide drift. Two reduced rates of each herbicide were applied at one of four growth stages – one-tiller, panicle differentiation, boot and harvest maturity. The one-tiller treatment was applied to rice when plants were beginning to tiller – or produce sprouts. The panicle differentiation treatment was applied at the onset of reproductive growth when the panicle – or flower cluster – first began developing. The boot treatment was applied to rice in the late reproductive phase of growth immediately prior to panicle emergence. The harvest-maturity application was done when the rice was at approximately 20 percent grain moisture within a week of harvest.

Both herbicides reduced primary crop yield when applied at the one-tiller, panicle differentiation and boot stages (Figures 1 and 2). Ratoon crop yield was reduced by applications at one-tiller and panicle differentiation but was increased at the boot stage. This increase in ratoon crop yield was attributed to excessive tillering that did not produce harvestable seeds in the primary crop but did in the ratoon crop. When the primary and ratoon crop yields are combined to calculate total yield, however, overall yield was reduced compared with the nontreated control. Simulated herbicide drift applied to rice at harvest maturity had no effect on the primary or ratoon crops.

Justin B. Hensley, Research Associate, and Eric P. Webster, Professor, School of Plant, Environmental & Soil Sciences, Baton Rouge, La.; Dustin L. Harrell, Assistant Professor, Rice Research Station, Crowley, La.; Sunny L. Bottoms, Research Associate, School of Plant, Environmental & Soil Sciences, LSU AgCenter, Baton Rouge, La.

Figure 1. Effects of Roundup drift on total crop rough rice yield.

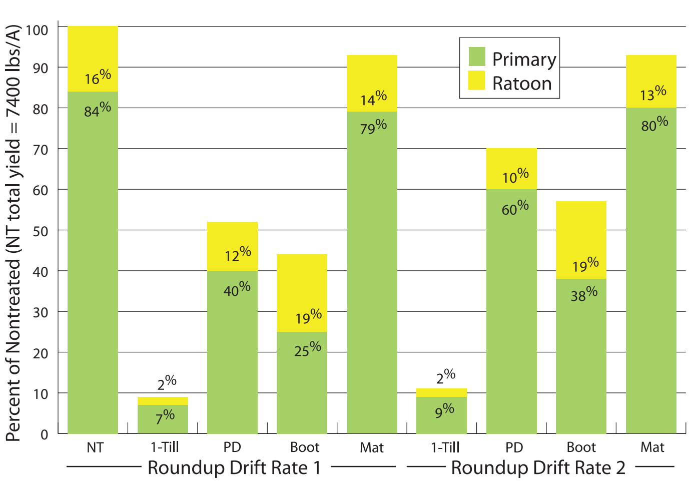
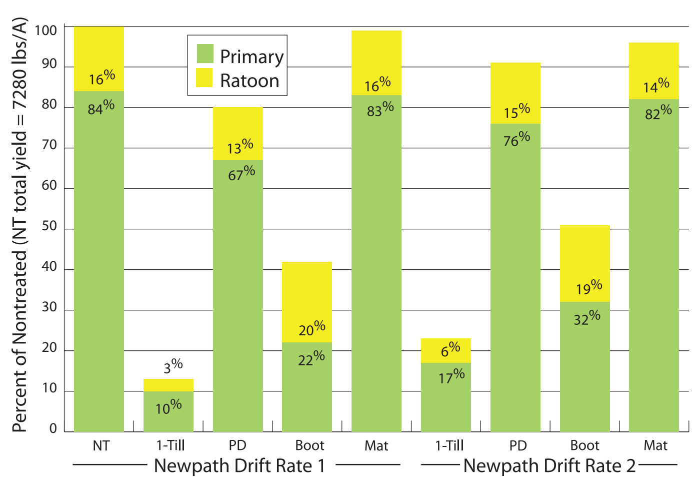


Figure 2. Effects of Newpath drift on total crop rough rice yield.



When using visual symptoms to evaluate the possibility of drift in a field, it is important to look at the big picture before trying to associate the symptoms with a particular herbicide. In the case of drift, distinguishable patterns usually occur, and many other factors must be considered to differentiate herbicide drift from injury caused by disease or insects. One factor to look for is if damage is more severe on one side of the field than the other. Another factor is if the vegetation at the field edge and in buffer areas between the injured field and an adjacent field has symptoms indicating herbicide drift. Basically, if drift has occurred, the herbicide has to have come from an application to a target field and will usually leave a noticeable path as it moves off target. These patterns are often observed on a side of the field associated with the predominant wind direction. Levees often can be used to determine the direction of drift. In many cases, symptoms will occur only on one side of the levee.

Note the lack of vegetation on the left side and top of the levee. The vegetation was killed by drift of the herbicide Newpath with the predominant wind traveling from left to right in this picture.

Excessive tillering at the upper nodes of the plant is often observed with Roundup drift.

If a pattern can be established and the factors evaluated indicate the presence of herbicide drift, then the symptoms can be associated with a particular herbicide. The two most common herbicides involved in drift in Louisiana are Roundup and Newpath. Research has shown that it is easier to distinguish drift of Newpath from Roundup when it occurs to rice in the vegetative growth stages (from emergence through tillering). Both herbicides will cause the newly emerging leaf to be tightly rolled and yellowing. In the case of Roundup drift, often the tips of older leaves will have a “burned” appearance. Some symptoms specific to Newpath drift are yellowing of the new leaf being restricted to the leaf area between the veins. If plants recover, they often will tiller along a single plane, developing a flat-fan appearance. Plants affected by Newpath also will have leaf lesions similar in appearance to the lesions from leaf blast disease. These symptoms do not occur on plants affected by Roundup drift.

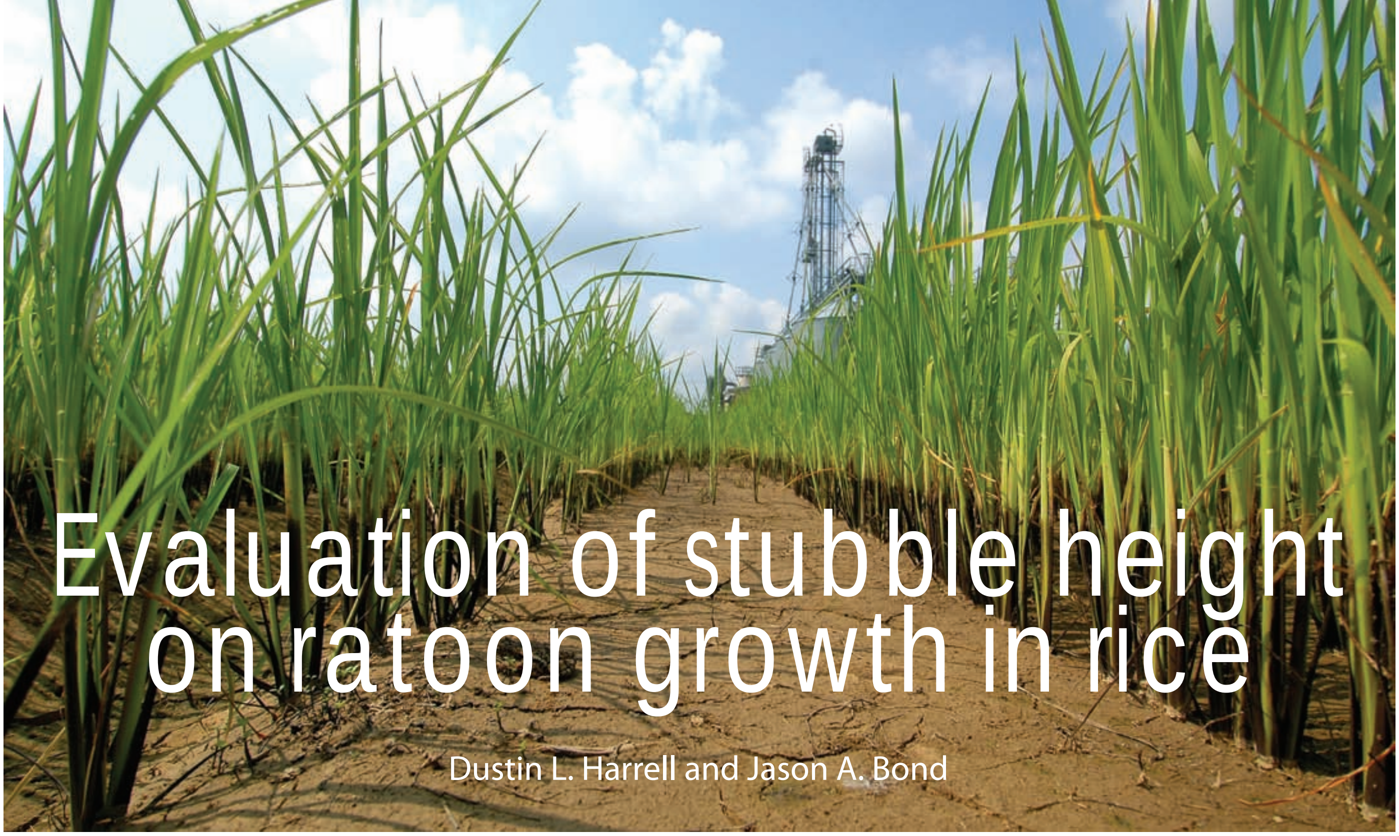
For drift occurring during the reproductive growth stages of rice (from panicle differentiation to boot stage), the symptoms from both herbicides are very similar. It is common to see a shortened or distorted flag leaf (the first leaf below the panicle) and malformed and blanked or unfilled grains on the panicle. For drift occurring during the boot stage, symptoms are excessive tillering from the upper nodes of the plant and failure of the panicle to fully emerge from the boot or sometimes not to emerge at all. This lack of panicle emergence is more commonly observed from Newpath drift compared with drift from Roundup. In severe cases, it can cause death of the flag leaf.

Determining if herbicide drift has occurred is not an exact science. No single factor can lead one to determine if herbicide drift has occurred; it is more of a combination of several factors determined from observation. The main point about herbicide drift on rice is that is can be detrimental if it occurs at any time during the growing season, so applicators should be aware of adjacent crops, wind direction and wind speed when applying herbicides near susceptible rice fields. ■

Photos by Justin Hensley

Leaf lesion symptom of Newpath drift; lesions are similar in appearance to lesions from leaf blast disease.

Symptoms typical of Roundup drift on rice during the reproductive stages often cause a malformed flag leaf and kernels and cause the panicle to not fully appear.



Evaluation of stubble height on ratoon growth in rice

Dustin L. Harrell and Jason A. Bond

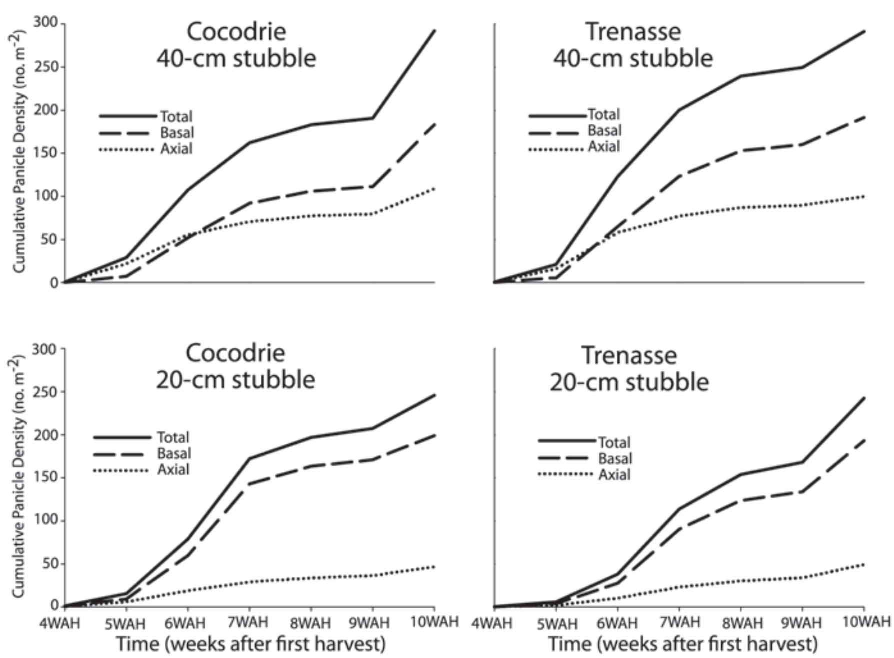
Photo by Bruce Schultz

The growing season in southwest Louisiana is long enough to produce two rice crops. The second rice crop is known by several names including stubble and ratoon. The ratoon crop develops by regenerating tillers from buds on the stubble left behind after the first crop harvest. The costs associated with growing the ratoon crop are minimal compared with the first crop. Generally, these costs include nitrogen (N) fertilizer, irrigation, harvesting and grain drying. Additional inputs such as herbicides, insecticides and fungicides, which are used in the first crop, are not used in the ratoon crop.

In general, a rice farmer can expect to see ratoon yields of approximately one-third of that realized in the first rice crop. Although ratoon yields are much less than that of the first crop, there is a definite economical advantage of growing the ratoon crop in southwest Louisiana. Because of the importance of the ratoon crop, several research studies have been implemented over the past few years to help improve ratoon productivity. These studies have focused on identifying proper fertilizer nutrient timing and rates, as well as identifying stubble manipulation practices that may have the potential to increase ratoon yields.

Several stubble manipulation practices have the potential to increase ratoon rice yields. One such practice includes lowering the first crop harvest height to around 20 centimeters tall, which would be about half the typical height of 40 centimeters. Other practices include harvesting at the traditional harvest height followed by either flail-mowing or rolling the remaining stubble. Harvesting with a lower combine platform height, however, is the only stubble manipulation practice that could be implemented without purchasing additional equipment or without substantially increasing fuel costs associated with running equipment over the field a second time.

Figure 1. Cumulative ratoon panicle density on a weekly basis beginning 4 weeks after harvest (4 WAH) and ending 10 WAH for Cocodrie and Trenasse when initial stubble is either 20 or 40 cm tall. Total, basal and axial panicle points of origin are differentiated by a solid, dashed and dotted line, respectively.



Dustin L. Harrell, Assistant Professor, Rice Research Station, Crowley, La., and Jason A. Bond, Assistant Professor, Delta Research and Extension Center, Mississippi State University, Stoneville, Miss., and formerly with the LSU AgCenter.

Table 1. Plant height and yield results for the main and ratoon crop during 2006 and 2007.

		Ratoon crop			
		Mature plant height		Yield	
		2006	2007	2006	2007
		(centimeters)		*(lb/acre)*	
Cocodrie	20-cm	64	73	1287	3349
	40-cm	66	74	1279	2974
Trenasse	20-cm	71	74	2099	3245
	40-cm	67	73	1940	3056

Ratoon stubble height trial

A two-year trial was initiated in 2006 to evaluate the effects of ratoon stubble height on ratoon rice growth, development and yield. The trials were conducted at the LSU AgCenter's Rice Research Station South Farm in Crowley on a Crowley silt loam. Cocodrie and Trenasse rice varieties were used in the trials. The first rice crop was harvested with a small plot combine with the cutter bar adjusted to leave either a stubble height of 20 or 40 centimeters. After the main crop harvest, panicles in a flagged 3-meter linear section were tagged on a weekly basis as they emerged beginning at three weeks after harvest (3 WAH) and concluding 10 WAH.

Prior to whole plot ratoon harvest with the combine, the 3-meter sections were hand-harvested and panicle origins were determined to be either axial or basal. Basal panicles were defined as those panicles that developed from nodes at or below the soil surface and included any nodes less than 2 centimeters above the soil surface that had roots extending into the soil. Axial nodes were defined as those that originated above the soil surface and did not have any roots extending into the soil.

Ratoon yield results

In 2006, ratoon rice grain yield was not improved when the ratoon stubble was reduced to 20 centimeters. This can be explained partially by the narrow brown leaf spot (NBSP) outbreak experienced in 2006, which limited the yield potential of the ratoon crop. A fungicide was not applied in the trial in an effort to mimic the minimal chemical strategy used in commercial agriculture. In 2007, ratoon yields were not limited by disease, and both Cocodrie and Trenasse grain yields were improved when the initial stubble height was 20 centimeters (Table 1) compared with the traditional 40-centimeter stubble.

Ratoon heading and point of origin results

Differences in panicle point of origin on a cumulative weekly basis were observed for both rice varieties and initial stubble height in 2007 (Figure 1). Briefly, when the main-crop stubble was 20 centimeters, basal and axial panicle points of origin were similar 5 WAH for both varieties. A higher density of ratoon panicles originated from basal nodes at 6 WAH and beyond.

In contrast, when the main-crop stubble was 40 centimeters, approximately 75 percent of the emerged panicles originated from axial nodes at 5 WAH for both varieties. Densities of panicles emerging from basal and axial nodes were nearly identical 6 WAH. After 6 WAH, greater panicle density was observed from basal nodes. Therefore, the delay in maturity often associated with shorter main-crop stubble heights can be explained partially by the minimal exertion of panicles from tillers originating from axial nodes, which is more prevalent from the taller ratoon stubble associated with traditional harvest heights that leave 40-centimeter stubble.

Conclusions

In southwest Louisiana, rice ratooning is important because the total rice yield per area can be increased with minimal additional agricultural inputs. Data from this study suggest that harvesting the main crop at a lower-than-normal height, resulting in stubble of approximately 20 centimeters, will alter panicle point of origin in Cocodrie and Trenasse and, in some years, may increase ratoon yields.

The 2007 yield advantage of the 20-centimeter main-crop stubble height was associated with heavier panicles from tillers originating on basal nodes (data not shown). During years when a low ratoon yield potential exists, lowering the main-crop harvest height most likely will not improve ratoon yields. In all years, genetics, stubble health, availability of soil nutrients and water, and weather during ratooning precedes harvest height as the most limiting factor for ratoon yield potential. Producers need to evaluate ratoon potential before implementing a lower-than-traditional harvest height or applying post-harvest flail-mowing, which can increase production costs. ■

Acknowledgments
This research was funded in part by the Louisiana Rice Research Board. Special thanks to Richard Dunand, now retired, and research associates James Leonards, Ron Regan and Russell Dilly for their contributions to this research.

Photo by Dustin Harrell

Research associates James Leonards, left, and Russell Dilly determine panicle point of origin and week of emergence from hand-harvested ratoon panicles.

Pre-flood Nitrogen Applications in Rice

Theory Behind Practice

Dustin L. Harrell

One of the most important practices in drill-seeded, delayed-flood rice production is the timely application of the pre-flood nitrogen fertilizer. To minimize nitrogen losses in rice production, the accepted practice is always to apply nitrogen fertilizer onto a dry soil and then flood the field as soon as possible. If producers have trouble flooding their fields in a timely manner, they can use a slow release nitrogen fertilizer or apply a urease inhibitor to urea fertilizer.

To understand how nitrogen can be lost from a rice field, one must recognize that nitrogen management in rice is much more difficult than in upland crops, such as soybeans or corn. The principal reason is that rice fields remain flooded for extended periods of time creating an anaerobic – without oxygen – soil condition. Over time after flooding, the soil will form two distinct layers, a thin oxidized (with oxygen) soil layer directly below the flood water and an anaerobic soil layer. A thin oxidized soil layer also exists around the proximity of the rice roots because some oxygen being taken in by the rice plant, via its hollow stem, is lost from the roots to the soil.

Nitrogen exists in many forms in the soil and can change from one form to another depending on the presence, or lack of, either oxygen or water, the form of nitrogen fertilizer used, and the placement of the fertilizer. Rice-available forms of nitrogen include both the nitrate (NO_3^-) and ammonium (NH_4^+) forms.

Urea is the most common granular nitrogen fertilizer used in Louisiana rice production. When a granular nitrogen fertilizer like urea is applied to a dry rice field, and the field is flooded immediately, the water from the flood incorporates much of the fertilizer into the anaerobic soil layer. See Figure 1. The urea [$(NH_2)_2CO$] fertilizer is quickly hydrolyzed in the presence of water and the urease enzyme to the ammonium (NH_4^+) ion as illustrated in Equation 1:

$$[(NH_2)_2CO] + H^+ + 2H_2O \leftrightarrow 2NH_4^+ + HCO_3$$

Most of the nitrogen is located in the anaerobic soil layer in the NH_4^+ form and can be taken up by the rice roots. The NH_4^+ remains fairly stable in the anaerobic soil layer.

If urea is applied and the field is not flooded for several days, there will be enough moisture from the soil and the atmosphere to begin hydrolysis of the urea fertilizer to the NH_4^+ form. This time, however, the NH_4^+ is in the oxidized soil layer, and another reaction will follow the first reaction, which will change the ammonium (NH_4^+) to nitrite (NO_2^-) and then to nitrate (NO_3^-). This process is called nitrification and can be seen in Equations 2 and 3.

$$NH_4^+ + 1\tfrac{1}{2}O_2 \rightarrow NO_2^- + 2H^+ + H_2O$$

$$NO_2^- + \tfrac{1}{2}O_2 \rightarrow NO_3^-$$

Nitrate can be taken up by rice, but because it is a negatively charged ion, it is not held strongly by the clay particles and is, therefore, prone to diffusion to the deeper, anaerobic soil layer. Once NO_3^- reaches the anaerobic layer, it is transformed by anaerobic bacteria in a series of reactions that produces nitric oxide (NO), nitrous oxide (N_2O) and dinitrogen (N_2) gases. All of these gases can be lost to the atmosphere by volatilization. This series of transformations is called denitrification as illustrated in Equation 4:

$$2NO_3^- \rightarrow 2NO_2^- \rightarrow 2NO \rightarrow N_2O \rightarrow N_2$$

What happens if a situation arises during a rice growing season that would warrant draining of a rice field? Ex-

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Dustin L. Harrell, Assistant Professor, Rice Research Station, Crowley, La.

Illustration by Bryan Briggs

amples of this untimely draining would include draining to help alleviate rice water weevil pressure, straighthead, zinc deficiency or some other disorder. A flood could also be lost accidently by a break in the levee. In a situation like this, the NH_4^+ that was stable in the anaerobic soil layer under the flood now becomes susceptible to nitrification as the soil oxidizes and is transformed to NO_3^- (Equations 2 and 3). Although the NO_3^- can still be used by the rice plant, the real problem occurs when the rice field is re-flooded. The soil environment again becomes anaerobic and denitrification (Equation 4) begins transforming NO_3^- to gaseous forms, which are eventually lost to the environment. This is why more urea fertilizer should be applied prior to re-flooding in rice.

The reason the soil needs to be dry when applying fertilizer can be explained in Equation 5:

$$NH_4^+ + OH^- \leftrightarrow H_2O + NH_3\uparrow$$

In this equation the dissolved ammonium (NH_4^+) ion and ammonia gas (NH_3) are in equilibrium because the equation arrow points in both directions. When soil is moist, however, this forces the reaction to the right side of the equation because the soil is continuously drying. Thus, more ammonia gas (NH_3) is produced, which can be lost to the atmosphere by volatilization and depletion of NH_4^+. We can also see from this equation that a high soil pH (a large concentration of OH^- ions in soil solution) can also force the reaction to the right resulting in volatilization losses.

If producers are unable to flood their fields in a timely manner, they can use a special form of nitrogen fertilizer stabilized with a urease inhibitor, which can slow the hydrolysis processes before appreciable nitrogen can be lost. A urease inhibitor is just that; it is a chemical that can be coated on urea fertilizer that inhibits the urease enzyme and, thus, slows the hydrolysis of urea to the NH_4^+ form (Equation 1). Agrotain is a commercially available urease inhibitor that can be applied on urea at the local fertilizer dealer. Past studies at the Rice Research Station have shown that producers can gain about five days before flooding when using Agrotain-coated urea before they see a decline in rice grain yields.

All nitrogen recommendations in rice are variety-dependent and are updated and published yearly by the LSU AgCenter in *Rice Varieties and Management Tips*. This publication is available online at www.lsuagcenter.com or at any LSU AgCenter parish extension office. All nitrogen recommendations are based on yearly variety-by-nitrogen trials conducted at the Rice Research Station and at producer sites across Louisiana. A minimum of three years of data is needed before an official nitrogen recommendation is made on a newly released variety. To facilitate this, many potential varieties actually begin to be tested before their official release. Much of this type of research is funded by the Louisiana Rice Research Board.

Producers must be vigilant with nitrogen fertilizer applications. Unfortunately, even under the best management practices, not all of the applied nitrogen fertilizers will be taken up by the rice plant; some will eventually be lost. This loss, however, can be minimized with the proper fertilizer source, placement and water management. ■

Figure 1. Urea fertilizer transformations which can occur in oxidized and reduced soil layers.

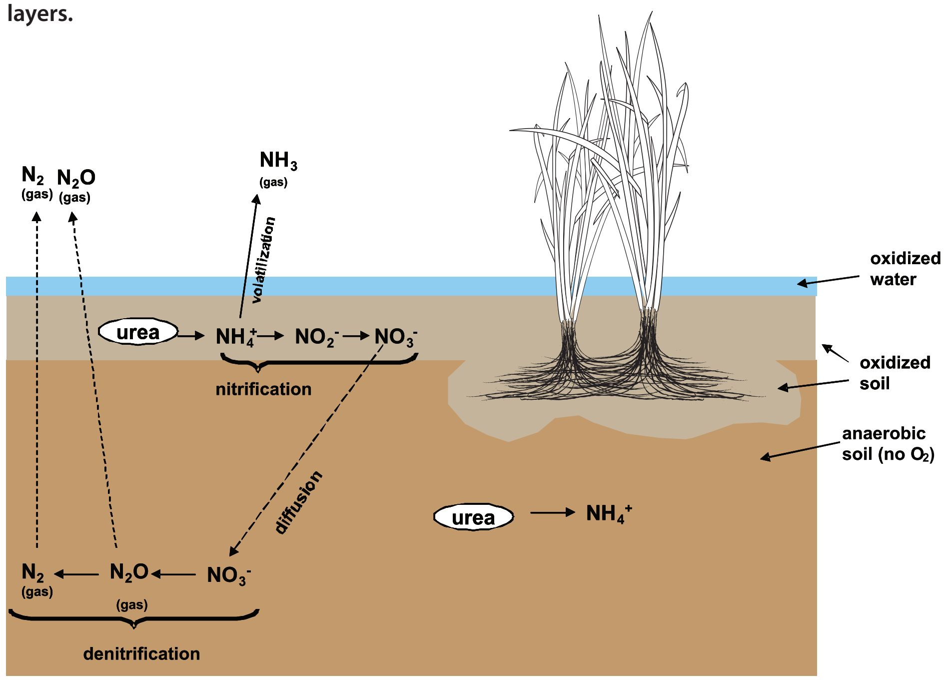
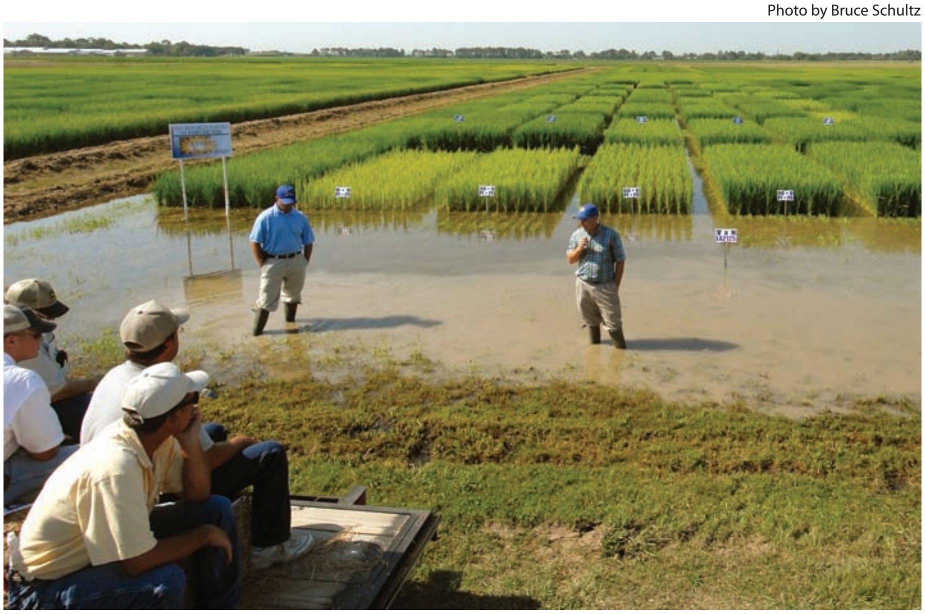


Photo by Bruce Schultz



Tim Walker, left, and Dustin Harrell, discuss the importance of proper rate and timing of fertilizer N applications in rice production at the 2008 Rice Research Station Field Day in Crowley, La.

Creeping Rivergrass
Another Menace to Rice

Creeping rivergrass is an aquatic perennial grass that affects approximately 10,000 acres of rice in Acadian, Vermilion and Jefferson Davis parishes in south Louisiana. It had only been observed in Plaquemines Parish before 1993. Locally, it is also known as perennial barnyardgrass and waterbermuda. It is a native of Central and South America and is known to invade and choke out other native plant stands in seasonally wet and tropical wetlands. It has been found surviving in water up to 15 feet deep in the Amazon floodplains, where most other native species cannot survive. Creeping rivergrass is efficient at assimilating nutrients from water and soil and has been documented to grow 10 inches in a day.

The ability of creeping rivergrass to use nitrogen and other nutrients efficiently allows it to produce large amounts of dry matter, up to 44 tons per acre. Because of its extraordinary dry matter production, it has been used as a forage in ponded pastures in the Pacific Islands, Brazil and Australia. Unfortunately, after a commercialized variety was released in Australia for ponded pastures, creeping rivergrass quickly became a problem and was deemed a potential invasive species.

Creeping rivergrass has the potential to become a big problem for south Louisiana. The sub-tropical climate in south Louisiana supplies adequate rainfall and a long growing season for the tropical grass, and the mild winters allow the grass to survive year-round. A rice-crawfish rotation production system provides an excellent environment for creeping rivergrass. Many rice fields in this system are drained only for rice harvest and then re-flooded for crawfish production. Therefore, some fields remain flooded 11 months per year. Even if the field is not used for crawfish production, the large amounts of rainfall are enough to sustain the grass. To complicate matters, creeping rivergrass cannot be controlled with herbicides alone.

Because little research has been conducted on creeping rivergrass in rice production, a study was initiated in 2006 to gain a better understanding of growth habit, competition with rice and possible control methods using both cultural and chemical practices. Creeping rivergrass mainly reproduces vegetatively from nodes on the stems (Figure 1) or nodes on the crown (Figure 2). It is believed to be spread mainly through irrigation ditches, canals and contaminated equipment (Figure 3). It produces a seedhead (Figure 4), but preliminary studies found that average seed production was less than one seed per head and that seed viability was 70 percent to 80 percent. The results from these studies indicate that integrated pest management is the best approach to managing this weed.

Plant early

The first step in this integrated approach is adjusting planting date. Vegetative germination is reduced at temperatures below 70 degrees. In fact, germination is reduced from 50 percent to 90 percent at temperatures in the low 50s to the mid 60s. In south Louisiana approximately 50 percent of the rice is planted by the first week of April, during which time the average daily temperature is in the mid to upper 60s. Fields infested with creeping rivergrass should be planted earlier to take advantage of reduced germination during lower temperatures. An earlier planting date will allow rice to gain a competitive advantage over creeping rivergrass.

Adjust seeding rate

The next step involves rice seeding rate and establishment of a uniform stand. Research indicates that employ-

Sunny L. Bottoms, Research Associate; Eric P. Webster, Professor; and Justin B. Hensley, Research Associate, School of Plant, Environmental & Soil Sciences, LSU AgCenter, Baton Rouge, La.

Figure 1. Creeping rivergrass stem node.

Figure 2. Creeping rivergrass crown node.

Figure 3. Equipment contaminated.

in Louisiana

Sunny L. Bottoms, Eric P. Webster and Justin B. Hensley

ing the higher end of the recommended rice seeding rates can reduce growth of creeping rivergrass. With higher seeding rates the growth rate and dry matter accumulation can be reduced approximately 50 percent. If creeping rivergrass dry matter is reduced, the total number of nodes is decreased, which can effectively reduce future populations of creeping rivergrass because it reproduces mainly vegetatively. Drill-seeding of rice, which is sowing on dry land with drill-seeding equipment, ensures a more uniform stand than water-seeding rice, which is the aerial seeding of rice into flooded fields. Some rice producers in south Louisiana, however, must water-seed to prevent other pest problems in rice.

In biology studies conducted near Crowley, La., creeping rivergrass displayed aggressive growth habits, growing up to 7 inches per day with no competition from rice. In these studies 4-inch, single-node creeping rivergrass segments were planted in rice at a density of 1 plant per square yard, along with rice planting rates ranging from zero to 100 pounds per acre. See Table 1.

Control weeds

Herbicides can play an important role in the management of creeping rivergrass. Employing the herbicide glyphosate and planting Clearfield rice, which is a herbicide-resistant rice, can help reduce creeping rivergrass. Two applications of Newpath, imazethapyr, followed by Clincher, cyhalofop, can control creeping rivergrass 75 percent to 90 percent in an integrated weed management system, according to LSU AgCenter research.

Although the use of a preemergence herbicide has little effect on controlling creeping rivergrass, it helps ensure rice a clean seedbed. This allows the rice to gain a competitive advantage over creeping rivergrass by reducing other weeds that may impede early rice growth.

Table 1. Effect of rice density on creeping rivergrass growth and node production. All measurement data were obtained immediately before rice harvest.

Rice seeding rate	Average growth rate	Fresh weight	Node production
lb/A	inches/day	lb/A	nodes/ A (x1000)
0	7	1,530	779
20	5	1,190	695
40	4	690	492
60	4	660	468
80	4	540	416
100	4	540	436

Break production cycle

Maybe the most important strategy for managing creeping rivergrass is to break the production cycle. In nearly every case, creeping rivergrass infestations occur in a rice-crawfish rotation. If a field has a creeping rivergrass infestation, the best management strategy is to take that field out of the current production system for at least a year and preferably two. During this fallow period, the field should be tilled repeatedly. Creeping rivergrass does not respond well to dry weather conditions. Tillage during the fallow period cuts the stems into smaller segments, which reduces the amount of nutrient reserves during the vegetative germination process and allows for dessication of the plant segment. Previous research has shown that burial of plant segments to a depth of 2 inches can also reduce creeping rivergrass emergence.

An integrated approach is the most effective management strategy for controlling creeping rivergrass. This weed has shown the ability to invade areas similar to those found in south Louisiana. Care should be taken to keep creeping rivergrass isolated in the rice-growing areas of south Louisiana to prevent this weed from expanding into the state's valuable swamps and marshes as it has done in the Amazon flood basin. ■

Figure 4. Creeping rivergrass seedhead.

Pure stand after many herbicide applications.

Photos by Sunny L. Bottoms

Scientists explore *silica and rice growth*

Gary Breitenbeck and Joseph Kraska

Photo by Gary Breitenbeck

Floodwater, especially when supplied by wells, is a significant source of soluble silicon. Draining fields results in a loss of dissolved silicon.

Silicon, a common element in our daily lives, generally exists in nature as silicon dioxide – or silica. Silicon is a major constituent of glass, ceramics and computer chips. Next to oxygen, silicon is the earth's most abundant element and is found in sand, silt and clays – the mineral constituents of soils. The solubility of silicon in water varies greatly among its various forms. A coffee mug, for example, is mostly silica, but we don't think of it as soluble. Clays in soil are slightly more soluble, and ground water often contains more than 100 parts per million of silicon.

Most plants take up dissolved silica. The silica content of many plants is less than 1 percent of their dry weight, but some species take up large quantities. Such plants are called silica accumulators, where silica can represent 10 percent or more of their dry weight. Silica accumulators include rice, sugarcane, wheat and many other grasses as well as broadleaf plants such as cucumbers. Unlike nitrogen and phosphorus, silica is not essential for a plant's metabolic function and growth. Even silica accumulators can complete their life cycle when denied silica in their rooting medium. These plants, however, typically grow more vigorously when supplied with silica.

While scientists don't completely understand the role of silica in plants, it is well-known that adequate silica can cause stronger, more upright stems and leaves that capture sunlight more efficiently and, thereby, increase yield. The principal roles of silica appear to

Gary Breitenbeck, Professor, and Joseph Kraska, Graduate Research Associate, School of Plant, Environmental & Soil Sciences, LSU AgCenter, Baton Rouge, La.

be largely protective. Ample evidence indicates adequate silica reduces susceptibility of silica accumulators to insects and disease (biotic stresses) and to drought, metal toxicities and salt (abiotic stresses).

In many parts of the world, silica fertilizers are applied to ensure adequate uptake to protect crops. For example, many of the ancient rice paddies of Asia receive routine applications of silica to compensate for removal rates. Organic soils and extremely weathered soils of the tropics containing low amounts of silicate clays also respond to silica fertilization. Similarly, crops grown on sandy soils may also respond favorably to silica fertilization.

While silica is a principal constituent of quartz sands, this form of silica is highly insoluble and unavailable for plant uptake. Conventional wisdom has maintained that silica fertilization is not necessary for soils containing appreciable amounts of silica-rich clays, such as the alluvial soils that comprise much of Louisiana's agricultural land.

LSU AgCenter researchers were first drawn to the possibility that silica deficiency may occur in Louisiana while pursuing the mysterious "localized decline" syndrome that affects isolated rice fields in southwest Louisiana. Toxic accumulations of iron and aluminum are symptoms of this disorder and are the probable cause of the crop's decline. The cause of this increased uptake of toxic metals, however, remains unclear.

Because several scientific reports have linked iron toxicity with a deficiency in silica, the AgCenter researchers conducted a survey to determine silica levels in affected crops. A value of 5 percent silica is an accepted standard for silica sufficiency in rice. When rice plants begin to spread by tillering – sending out shoots – those that display symptoms of localized decline contain an average of 3.2 percent silica – not an extremely low value, but possibly deficient.

For a source of silica to conduct greenhouse trials, the researchers obtained rice hull ash from a co-generation utility in the Lake Charles area that burns rice hulls to generate electricity. They also found out that a local cooperative had conducted an informal study, applying three rates of rice hull ash to a rice field south of Iowa, La., three years earlier. The exact application rates were unknown, and crop responses had not been measured. AgCenter researchers collected samples from those fields prior to harvest in the third season after ash was applied. The differences were astounding. Rice hull ash had not only increased silica uptake by as much as 111 percent but resulted in taller, stiffer plants with larger stems. Moreover, seed head (panicle) weights of maturing rice were 77 percent greater in areas receiving the highest rate of hull ash than in areas receiving no hull ash. These findings and those of the initial AgCenter survey indicated further investigation was merited.

Table 1. Silicon content ranges for rice plants and water.

	Average	Minimum	Maximum
Y-Leaf (% Si)	3.1%	1.0%	5.2%
Panicle (% Si)	2.6%	1.6%	5.6%
Straw (% Si)	5.4%	2.2%	8.1%
Flood water (Si ppm)	10.1 ppm	2.0 ppm	26.7 ppm
Pore water (Si ppm)	9.8 ppm	0.7 ppm	22.7 ppm
pH	6.3	4.1	7.4

In 2007, AgCenter researchers and extension agents sampled rice fields representative of each rice-growing area in Louisiana. Young plants were collected at mid-tiller, and straw and seed heads were collected immediately before harvest. Soil and floodwater samples also were collected. Water was extracted from the soil pores in flooded soils as an additional index of silica availability in each of the 126 fields sampled. The silica content was measured in all tissue and water samples.

The principal findings of this survey are shown in Table 1. The most striking finding is that young rice contained less that 5 percent silica in more than 90 percent of the field samples. While a 5 percent level has not been confirmed deficient in Louisiana, a wealth of evidence from other rice-growing regions indicates that young rice containing less than 3 percent silica is severely deficient with increased susceptibility to disease, insects and other stresses. By maturity, the silica accumulated in straw and seed heads in many of the fields had increased, often above the 5 percent level – sometimes in rice severely deficient early in the season.

Silica deficiency is most severe early in the season. The cause of this deficiency is less clear but may be related to the discharge of irrigation and rainwater laden with the most soluble forms of soil silica. On one farm, the reuse of warm, silica-rich irrigation water from a nearby crawfish pond substantially reduced the symptoms of localized decline in a field severely affected by this disorder for several seasons. While it is tempting to attribute this to greater silica availability, the specific cause for this response is uncertain because no clear relationships were evident between silica concentrations in flood or soil pore water and silica accumulation in rice plants at most locations. The influence of pH was the only significant relationship between silica uptake and the various soil properties measured. As a rule, silica uptake tended to increase as pH increased.

Sufficient evidence is not yet available to recommend silica fertilization for Louisiana, but the relationship between silica and pH suggests that perhaps slag should be substituted for limestone when "liming" fields used for silica-accumulating crops. Slag is a byproduct of metal smelting and is the most common form of silica fertilizer worldwide. Slag is produced when ground limestone is added to heated ores. Calcium combines with the silicates in these ores, causing the pure metals to sink to the bottom of the cauldron and calcium silicate slag to rise to the surface. The slag is then skimmed and finely ground for use as a silica fertilizer. When applied to soils, slag increases pH and available calcium in addition to supplying a fairly soluble form of silica. Depending on the ore, slag can supply a number of micronutrients as well. The price of slag is somewhat greater than that of agricultural lime because of higher shipping and processing costs. Even so, slag merits consideration as a lime alternative, especially in rice-soybean rotations where rice may benefit from greater silica availability and the soybean crop from elevated pH and added calcium.

LSU AgCenter researchers have evaluated a number of methods for assessing silica availability using the diverse soil samples collected in the 2007 survey. Unfortunately, none of these tests proved reliable, and research to identify a suitable soil test continues. The most reliable means of assessing silica status is tissue testing of the plant. Initially, this too proved problematic because the methods most commonly used proved highly variable and unreliable. Since then AgCenter researchers have developed a rapid, precise and inexpensive method for measuring silica accumulation in plants. That method was used for the analyses presented here and possibly will be available soon through the LSU AgCenter's Soil and Plant Analysis laboratory. ■

Management Strategies for Roundup Ready Flex Cotton

Photo by John Chaney

Donnie K. Miller, David C. Blouin, Robert G. Downer, Ralph Bagwell, Eugene Burris, Ernest L. Clawson, B. Rogers Leonard and Alexander M. "Sandy" Stewart

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Predicted trends in the early 1990s indicated weed control would shift to genetically altered plants with high levels of tolerance to key herbicides. These predictions proved valid, and the vast majority of Louisiana cotton acreage today is devoted to glyphosate-resistant technology. Because the first commercially available glyphosate-resistant cotton did not allow over-the-top application of glyphosate beyond the four-leaf stage because of negative effects on growth and yield, a second generation of glyphosate-resistant cotton, Roundup Ready Flex cotton, was developed. This second generation glyphosate-resistant cotton allows topical applications of glyphosate throughout most of the season with no adverse effects.

Because glyphosate controls emerged weeds only and does not prevent emergence of new weed flushes, multiple applications are needed to maintain weed-free conditions season-long. Producers often include herbicides such as metolachlor (various formulations) or pyrithiobac (Staple LX), which have soil activity and prevent future weed emergence, with glyphosate applications over-the-top of cotton to extend weed control and perhaps reduce the amount of herbicide applications needed per season. These materials also offer a different mode of action than glyphosate, which may delay or prevent weed resistance to glyphosate.

Another possible herbicide that has the potential for this use and is being considered for such labeling is pendamethalin (Prowl H_2O). Previous research at the LSU AgCenter shows good weed control and Roundup Ready Flex cotton tolerance to over-the-top co-application of glyphosate and Prowl H_2O.

Cotton insect control and crop management often require multiple chemical applications throughout the growing season. Insecticide and plant growth regulator applications often coincide with applications of glyphosate. Producers may be able to combine pest and crop management strategies by co-applying glyphosate with Prowl H_2O and insecticides or glyphosate with insecticides and plant growth regulators.

Such co-applications may result in fewer in-season applications and lower production costs, provided a negative response is not observed on crop safety. Therefore, research was conducted at the LSU AgCenter Northeast Research Station to evaluate tolerance of Roundup Ready Flex cotton to glyphosate (Roundup Weathermax) or glyphosate plus Prowl H_2O alone or co-applied with nine insecticides.

Additional studies investigated the impact of glyphosate applied alone or plus mepiquat chloride (Mepex Gin Out), a plant growth regulator, with 20 different insecticides on second generation glyphosate-resistant cotton at two different cotton growth stages.

Glyphosate/Prowl H_2O/Insecticide Co-application Research

Roundup Weathermax alone or plus Prowl H_2O was applied to Roundup Ready Flex cotton at the four- to five-leaf growth stage with or without the following insecticide treatments: Orthene, Trimax, Centric, Karate Z, Vydate C-LV, Dimethoate, Bidrin, Baythroid and Mustang Max.

At seven and 14 days after treatment in the first year of the experiment (2006), injury in the form of leaf vein chlorosis (yellowing) and leaf curling ranged from 13 percent to 23 percent for herbicide/insecticide co-applications and Roundup Weathermax plus Prowl H_2O alone, with no differences noted among these treatments. Injury from these treatments was different, however, from that observed with Roundup Weathermax applied alone, which resulted in no visual injury.

In 2007, visual injury was similar for all treatments and no greater than 4 percent. Visual crop injury did not result in height reduction at both seven and 21 days after treatment in both years of the experiment. In addition, differences in seedcotton yields were not noted among the treatments evaluated, indicating that early-season cotton injury did not result in yield reduction.

Glyphosate/PGR/Insecticide Co-application Research

Roundup Weathermax alone or co-applied with the plant growth regulator Mepex Gin Out was applied to Roundup Ready Flex cotton at the pinhead square or first bloom growth stage with the following insecticide treatments: no insecticide, Orthene, Trimax, Centric, Capture, Karate Z, Vydate, Curacron, Intruder, Dimethoate, Diamond, Bidrin, Baythroid, Prolex, Mustang Max, Steward, Lannate, Larvin, Tracer, Denim or Battery.

At seven days after treatment, co-application of insecticides Lannate or Curacron resulted in 5 percent and 9 percent injury, respectively. These were the only insecticide co-applications that resulted in greater injury compared with Roundup Weathermax or Roundup Weathermax + Mepex Gin Out alone. At 14 days after treatment, Lannate was the only insecticide co-application to result in injury greater than Roundup Weathermax or Roundup Weathermax + Mepex Gin Out alone. Injury for this treatment, however, was only 2 percent.

At seven and 28 days after treatment, addition of Mepex Gin Out resulted in a slight cotton height reduction. This result was not unexpected because the compound is a plant growth regulator used to manage the cotton crop by modifying the plant in many beneficial ways, including reducing height. Seed-cotton yield or percent first harvest (measure of cotton maturity) results did not differ among treatments, indicating that cotton injury and differences in height were not manifested in yield reductions or maturity delays.

These data indicate that producers may be able to combine multiple pest and crop management strategies to reduce application costs with minimal effect on the crop. Negative effects of co-applications evaluated in this study to Roundup Ready Flex cotton actively growing at the four- to five-leaf growth stage were limited to minor transient visual leaf vein chlorosis burn that lasted no longer than 21 days and did not result in reductions in crop height or yield.

Producers are cautioned to make insecticide co-applications only as dictated by insect threshold levels. Initiating unnecessary insecticide treatments may result in decreased populations of non-target insect pests. In addition, co-applications evaluated in this research applied to cotton in earlier growth stages, especially under less than optimal environmental conditions or to cotton under stress, may increase injury potential and result in greater injury than observed in this research.

Most insecticide applications are recommended for use with spray nozzles that produce fine droplets to maximize spray coverage. Caution must be exercised that use of such application technologies with glyphosate does not result in drift to nontarget plants. Product labels should always be consulted for allowable co-applications. ■

Leonard named to Louisiana Agriculture Hall of Fame

B. Rogers Leonard, the Jack Hamilton Chair of Cotton Production at the LSU AgCenter's Macon Ridge Research Station, has been chosen for the Louisiana Agriculture Hall of Fame. The announcement was made at the Louisiana Agricultural Consultants Association annual meeting in February in Alexandria, La.

Leonard has a B.S. in agronomy, and an M.S. and Ph.D. in entomology, all from LSU. He was recently named the LSU AgCenter's cotton specialist.

"Dr. Leonard's insect pest management research has had a major positive impact on the profitability and environmental sustainability of row crop production across the southern United States," said Robert Hutchison, director of the LSU AgCenter's Northeast Region. "It is a tremendous compliment to Roger's research and outreach programs to be recognized in this way by the private crop consultants of our state." ■ **Bruce Schultz**

WEIGHING LYSIMETERS

WEIGHING LYSIMETERS
WEIGHING LYSIMETERS

Ernest L. Clawson and Sean Hribal

Photo by Ernest L. Clawson

Lysimeters planted to cotton, Northeast Research Station.

Irrigation is an important part of many crop production systems in northeast Louisiana. The amount of irrigation a crop requires is affected by the rate at which that crop uses water. Crop water use is known as the evapotranspiration (ET) of the crop and includes both water lost by the soil and water used by the plants.

Predicting crop ET is difficult because it is affected by crop species and by crop growth stage. In addition, it is influenced by weather conditions, which suggest ET values measured in a given year are likely to differ from the values for the same crop in a different year.

To overcome this challenge, irrigation researchers often focus on the relationship between crop ET at a given growth stage and contemporaneous weather conditions. ET measurements are expressed as a percentage of a reference ET, calculated from weather parameters such as solar radiation and wind speed. Once they are determined, these percentages (known as crop coefficients) can be used to estimate ET values in future

Ernest L. Clawson, Assistant Professor, and Sean Hribal, Graduate Assistant, Northeast Research Station, St. Joseph, La.

measure crop water use

years. This is done by calculating reference ET from a nearby weather station, which accounts for current weather influences, and multiplying it by the crop coefficient.

One of the best methods for measuring ET over short intervals is the weighing lysimeter. This instrument consists of a container filled with soil and resting on a scale with its upper surface at ground level. The container allows water losses only through the soil or through the crop planted in the lysimeter. Changes in the container mass, therefore, represent the actual ET of the crop planted in it.

Paired weighing lysimeters were installed at the Northeast Research Station, St. Joseph, La., in 2005. Each includes an inner tank filled with soil and resting on four load cells within an outer tank. The load cells record the inner tank's mass. A data logger records the mass once per second and stores the data as five-minute averages. Differences in inner tank mass from midnight to midnight represent the daily ET of the crop.

The design of the lysimeters includes a sufficient rooting depth for field crops (approximately 4.5 feet), and both tanks are braced for structural stability. The inner tank is aligned within the outer tank so the two do not touch at any point. A flexible rubberized fabric seals the gap between the two tanks at the soil surface to keep out rainwater. Unwanted water can be pumped from the outer tank through an access pipe. Accumulated drainage water from the inner tank can be pumped through a standpipe connected to a perforated pipe drain at the bottom of the tank. The inner tank is one crop row wide.

A calibration performed in spring 2007 demonstrated that the lysimeters have linear responses to changes in mass. In addition, each change in mass was measured to within the equivalent of a 0.008-inch depth of water – a very small percentage of the total ET expected for a 24-hour period. Thus, the precision of the lysimeters is sufficient to measure daily crop ET.

In practice, an irrigated area is maintained around the lysimeters to ensure they are in an environment similar to large-scale irrigated agriculture. This helps to promote representative measurements of the crop ET. Because tractor tires and tillage implements cannot pass over them, many operations on the lysimeters are performed by hand. Growth stages and other important crop parameters are measured regularly. The inner tanks are pumped to avoid excessive accumulations of water in them. A weather station under construction nearby will record the data needed to calculate reference ETs. Like the lysimeters, the weather station will be surrounded by a large irrigated area.

Future research will focus on developing crop coefficients for irrigated cotton and other crops. ■

Scientist develops way to recycle used motor oil containers

As more than 3 billion quart-size, high-density polyethylene motor oil containers head for U.S. landfills each year, LSU AgCenter researchers are looking for ways to keep them out.

Each year, U.S. motorists use about 150,000 tons of HDPE containers, leaving the insides coated with residual motor oil, said Qinglin Wu, a researcher in the LSU AgCenter School of Renewable Natural Resources.

Wu and his research team have been combining recycled plastics with such fibers as rice straw, wood and bagasse – the fibers remaining after the juice is squeezed out of sugarcane to – create engineered products that can be used in a variety of construction projects.

While many used plastic containers can be recycled, containers contaminated with motor oil pose special problems, Wu said. Most recycling programs cannot accept emptied motor oil bottles.

"Currently, to recycle used plastic containers with residual petroleum products, the containers usually must be cleaned first to remove the petroleum residue," Wu said.

While developers have created techniques to separate plastic and oil, these methods are often too expensive and too energy intensive to implement on a production scale, he said. Using solvents to wash away the oil creates different waste products difficult to dispose of.

Recycling partially cleaned oil containers for new oil bottle manufacturing has been one of the primary targets for the recovered HDPE plastic, Wu said. However, the blow molding process used for manufacturing the bottles requires temperatures high enough to cause significant thermal degradation of the residual oil. And the bottles end up having a strong oily odor, which limits their marketability.

Wu's process combines the recycled, oil-contaminated plastics with natural fibers that absorb the oil and an agent to bond the fibers into the plastic.

The result is an engineered product that can be used in place of wood in many applications, Wu said. He cautioned, however, that the new product has to be used outdoors because residual oil still represents 5 to 6 percent of the plastic component. Because it doesn't require any extreme measures to clean the plastic, the process produces little waste.

"This process provides a way to deal with recycled plastics," Wu said. "And the oil bonded into the product won't escape. Louisiana produces many natural fiber products and has a lot of polymers from chemical processing plants. This product will bring these two industries together."

Wu said the process has drawn interest from oil producers, including BP, which has provided funds to perfect the process.

■ **Rick Bogren**

Development of a mycoplasma mastitis control program in Louisiana

Photos by John Wozniak

William E. Owens

Mycoplasma mastitis is a unique form of mastitis, which is an inflammation of a cow's udder. Mycoplasma species differ from the majority of bacteria that cause mastitis by having unique growth requirements and physical characteristics that make them difficult to detect and treat once detected. Mycoplasma mastitis infections do not respond to antibiotic therapy using antibiotics currently available, so no effective therapy exists. In addition, growing these organisms in the laboratory requires specialized media and atmospheric conditions. These difficulties often delay diagnostic efforts and management response to this type of mastitis, magnifying the impact an outbreak has on a dairy herd.

The highly contagious nature of these infections and the difficulties in diagnosis and therapy contribute to catastrophic herd outbreaks, resulting in severe economic loss. In addition, mycoplasma species can cause several other diseases, including pinkeye, meningitis, ear infections, abscesses, pneumonia, joint infections and vaginal infections. Outbreaks of these conditions also may be associated with mycoplasma mastitis outbreaks.

Classic signs of mycoplasma mastitis include:

- Increased incidence of cases resistant to therapy.
- Clinical cases that involve multiple quarters of a cow's udder at the same time.
- Rapid drop in milk production.
- Cows with systemic symptoms such as fever and being off feed.
- In some cases, the outbreak may be associated with increased arthritis and pneumonia in both adult animals and calves.
- Nonclinical cases with increased inflammation counts and normal-appearing milk.

In 2002, the National Animal Health Monitoring System (NAHMS) Dairy Study assessed the prevalence of mycoplasma in bulk-tank milk from 21 states across the United States. Results indicated that 7.9 percent of dairy farms tested positive for mycoplasma from a single bulk-tank sampling using standard culture methods. Sixteen of the 21 states tested had at least one dairy with a positive mycoplasma bulk-tank culture.

History of the Louisiana Outbreak

Mycoplasma mastitis was first detected in Louisiana in September 2002. The positive dairy farm was suffering a severe outbreak of clinical mastitis. Culture for mycoplasma was done as a last resort after routine culture techniques failed to identify a cause. As a result of this initial outbreak and because of the potential for serious economic loss associated with this type of mastitis, all the dairy farms in the state were screened for mycoplasma mastitis by bulk-tank culture. This screening identified an additional 12 dairies (2.8 percent) as having mycoplasma in bulk-tank milk. Cows

Mastitis is a disease that cannot be eradicated, but it can be controlled. The LSU AgCenter works closely with the Louisiana dairy industry to help them be as profitable as possible.

William E. Owens, Professor, Hill Farm Research Station, Homer, La.

with confirmed cases of mycoplasma mastitis were isolated from five of these herds.

The statewide bulk-tank results prompted a rapid and unique response from several diverse groups to address the problem. Research scientists and extension specialists from the LSU AgCenter led meetings with dairy producers, dairy fieldmen, the Louisiana Department of Health and Hospitals and the Louisiana Department of Agriculture and Forestry (LDAF). These meetings were held to teach the participants about this type of mastitis and to discuss possible courses of action to deal with it. These meetings led to a program to combat this threat.

Louisiana dairy producers agreed to pay $15 a month to help defray the cost of this program, which consisted of a schedule of monthly bulk-tank cultures from each dairy farm in Louisiana. Bulk-tank samples were collected by milk haulers and transported within 48 hours by LDAF personnel to the Mastitis Research Laboratory at the LSU AgCenter's Hill Farm Research Station at Homer. Once delivered to the laboratory, samples were immediately cultured for mycoplasma and routine mastitis pathogens typically found by such culture. These routine organisms include *Staph. aureus*, *Strep. agalactiae*, *Streptococcus* species (environmental streptococci), coliforms (primarily *E. coli* and *Klebsiella* species) and other pathogens.

When a suspected mycoplasma herd was identified, a confirmatory bulk-tank

Mastitis in dairy cattle

Cathleen C. Williams

Mastitis is one of the most common and most expensive diseases of dairy cattle throughout most of the world. One-third of all dairy cows are estimated to have mastitis. In terms of economic losses, mastitis costs dairy producers approximately $200 per cow per year. Nearly 70 percent of this loss is a result of reduced milk production, with the remainder coming from replacement costs, discarded milk, treatment and veterinary expenses.

It is doubtful that any dairy herd, regardless of size or management system, is free of this disease. It is often the end result of the interaction of several factors, which could include humans, cows, environment, microorganisms and management. So, what exactly is mastitis?

Mastitis is defined as an inflammatory reaction in the mammary gland. The inflammation in the udder tissue may be the result of bacterial, chemical, thermal or mechanical injury. Mastitis may be infectious – meaning it is caused by microbial organisms – or non-infectious as a result of physical injury to the udder. The inflammation occurs to destroy the irritant, repair the damaged tissue and return the udder to normal function.

While mastitis can be non-infectious, it is usually an infectious disease. An infection occurs when microorganisms enter the mammary gland through the teat end. Most cases of mastitis are caused by bacteria, but other types of microorganisms – including yeasts, mycoplasmas and even algae – occasionally cause intramammary infections. The majority of infections are caused by a few types of bacteria.

An important concept in understanding mastitis is that these common pathogens fall into two major categories: (1) contagious bacteria that are spread from an infected quarter of the udder to other quarters and cows, and (2) environmental bacteria that are commonly present in the cow's environment and may reach the teat end from that source. This distinction is of practical importance because different control measures are needed for the different groups of microorganisms.

Mastitis infections may be clinical or subclinical. Clinical mastitis is characterized by visible abnormalities in the udder or in the milk. This form of mastitis can vary in severity, depending on the type of microorganism causing the infection. Subclinical mastitis, on the other hand, is far more subtle and cannot be detected by visual observation. It can be identified by conducting tests to detect the presence of microorganisms or the products of inflammation such as somatic cells.

Somatic cells are normal constituents of milk and only indicate a problem when numbers become excessive. Somatic cells are composed of leukocytes (75 percent) and epithelial cells (25 percent). Leukocytes (white blood cells) increase in milk in response to infection or injury while an increase in epithelial cells is the result of infection or injury. The number of somatic cells reflects the severity of mastitis.

Subclinical mastitis is 15 to 40 times more prevalent than clinical mastitis. It usually precedes clinical mastitis, is of long duration, is difficult to detect, reduces milk production, adversely affects milk quality and constitutes a reservoir of microorganisms that lead to infection of other cows in the herd. Information to assess the prevalence of subclinical mastitis may be provided by somatic cell counts of the bulk tank milk and of individual cows.

Although mastitis is a very prevalent disease in the dairy industry, it is important to note that milk is a safe, wholesome and nutritious product. Pasteurization destroys the organisms that cause mastitis, so there is no threat to human health. The dairy industry is one of the most highly regulated food industries. All milk is carefully tested for bacteria and antibiotics to ensure the safety of our food supply.

Mastitis is a disease which cannot be eradicated, but it can be controlled. Herd managers must be concerned with both clinical and subclinical mastitis. An effective mastitis control program is an important component of dairy management. Research at the LSU AgCenter has produced a relatively simple set of practical technologies producers can use to prevent most occurrences of mastitis. With sound mastitis management procedures, economic losses from this prevalent and complex disease may be reduced and allow dairy producers to maximize profit from their labor and investments. ■

Cathleen C. Williams, Gerald A. Simmons Professor of Dairy Science and Associate Professor, School of Animal Sciences, LSU AgCenter, Baton Rouge, La.

sample was collected as soon as possible from the suspect dairy and cultured to confirm the presence of mycoplasma. If confirmatory tests proved positive, efforts were made to help the dairy producer identify infected cows. In many cases, composite samples of the entire herd were collected and shipped to the Mastitis Research Laboratory where samples from each cow were cultured.

LSU AgCenter research and extension personnel worked in conjunction with dairy fieldmen, veterinarians and dairy producers to devise management strategies to eliminate mycoplasma mastitis from the affected herd. In addition, LDAF established regulations to reduce the possibility of cows from infected herds being sold to uninfected herds. Once a herd was confirmed positive for mycoplasma mastitis, cows from that herd were restricted to sale for slaughter only. Six consecutive negative monthly bulk milk samples were required to remove a herd from this restriction and allow the sale of cows for dairy use.

Results of the Louisiana Mycoplasma Program

Monthly bulk milk analyses revealed mycoplasma in at least one bulk tank for 12 of the 20 months tested. The greatest number of mycoplasma-positive dairies occurred in the first three months of the program, with sporadic outbreaks occurring randomly thereafter. Twenty-four bulk milk samples were positive for mycoplasma during the monthly sampling phase of the program. Of the 24 mycoplasma-positive samples, four were repeat positive dairies, so a total of 20 dairies tested positive for mycoplasma during the period. Fourteen dairies were confirmed positive by repeat sampling. Seven of those 14 dairies submitted samples from individual cows for culture. A

Dairy success requires team

Cathleen C. Williams and Gary M. Hay

Mastitis – an infection and inflammation of a cow's udder – is one of the most common and costly diseases in the dairy industry. Therefore, mastitis control should be a continuous process in all dairy herds. An effective control program should be a team effort and involve cooperation among veterinarians, extension specialists, milk plant field representatives and dairy producers. The LSU AgCenter plays a major role in mastitis control, with many key individuals working as part of the team. Several services available to our dairy producers aid in the detection, diagnosis, treatment and prevention of mastitis.

The LSU AgCenter has two programs dairy producers may use in assessing the mastitis situation in their herds.

The Dairy Herd Improvement Association (DHIA) is housed at the Dairy Improvement Center on the Baton Rouge campus. Through DHIA, dairy producers work with the field services supervisor and their local DHIA field technicians to collect milk samples and production information from each cow in their herds. The samples are analyzed at the DHIA lab in Baton Rouge for somatic cell counts (SCC) and milk components. Somatic cell counts are extremely useful in assessing the mastitis status of the herd because they are an indirect indication of mammary infections.

The primary advantage of DHIA somatic cell counts is to identify individual cows that may have mastitis infections. This information helps producers become aware of mastitis problems in their herds. DHIA somatic cell counts are used to identify management practices that may be contributing to mastitis problems in a dairy herd. Cows with high somatic cell counts can be further examined to determine if they need to be treated for an infection.

Cell counts alone, however, normally are not used to determine whether individual cows need to be treated for mastitis. The DHIA somatic cell count program at the Louisiana DHIA lab on campus can be a highly effective component of a mastitis control program in a dairy herd. The DHIA program helps dairy farmers produce a safe, nutritious, high-quality product for human consumption by helping dairy farmers control mastitis in their herds.

Another valuable service in mastitis control available through the LSU AgCenter is the Mastitis Research Laboratory at the Hill Farm Research Station in Homer, La. This laboratory offers bacterial culture analysis of milk from potentially infected cows. Technicians there are able to determine whether a cow is infected and positively identify the type of infectious organism. Producers can then work with their extension specialist and their veterinarian to determine which treatment method is best for their herds.

In herds with high bulk tank somatic cell counts, the problem is usually a high prevalence of subclinical mastitis. In these herds, a reliable diagnosis of the herd problem can be made by culturing milk from a representative sample of cows selected on the basis of increased DHIA somatic cell counts.

Through the LSU AgCenter's dairy extension specialists, county agents, the state extension veterinarian, DHIA laboratory and the Hill Farm mastitis lab, Louisiana dairy producers have access to a sound program in mastitis detection, diagnosis and control. These individuals work together as a team to ensure the state's dairy producers receive the assistance they need to achieve their goals in dairy production and management. ■

Cathleen C. Williams, Gerald A. Simmons Professor of Dairy Science and Associate Professor, and Gary M. Hay, Professor, School of Animal Sciences, LSU AgCenter, Baton Rouge, La.

total of 1,025 cow samples were evaluated, and cows positive for mycoplasma were isolated from four dairies. All dairies confirmed positive for mycoplasma and placed on restricted status were subsequently cleared of mycoplasma status, and restrictions were removed by virtue of six negative bulk-tank samples.

Figure 1 shows the distribution of all mastitis pathogens present in bulk-tank milk during the program. *Staphylococcus aureus* was the most frequently isolated major pathogen, with 51 percent of the tanks testing positive for this pathogen. *Staph. aureus* and environmental streptococci were present together in 21 percent of the samples.

In 2006, the program shifted to a quarterly rather than monthly sampling schedule. A total of 545 bulk-tank samples were collected in 2006, and three (0.5 percent) tested positive for mycoplasma.

Results indicate that mycoplasma mastitis is present and an ongoing problem for Louisiana dairy producers. While the total number of dairy farms testing positive in any month did not exceed 2 percent, the total of 14 dairies confirmed positive for mycoplasma during the course of the program represents approximately 5 percent of the dairies in the state. This compares favorably to the 6.6 percent of positive dairies reported for the South in the 2002 NAHMS survey. It is noteworthy that after the initial catastrophic outbreak in one dairy, no other dairy suffered similar losses.

Early detection because of the monthly monitoring program allowed for quicker intervention and allowed dairy producers to cull cows and eliminate infections before they sustained major losses. Also, the publicity generated by first meeting to discuss the problem and then involving dairy producers in planning the program helped heighten awareness of this type of mastitis. The heightened awareness helped producers, veterinarians and dairy fieldmen be more aware of proper management procedures to control and prevent this type of mastitis. The 2006 quarterly culture results indicate this program has substantially reduced mycoplasma mastitis in Louisiana to 0.5 percent from an initial incidence of approximately 2.8 percent.

In addition to the mycoplasma culture information generated by this program, dairy producers also benefited greatly from bulk-tank information on other types of mastitis pathogens. Each dairy bulk-tank sample was cultured, and the types and amounts of various mastitis pathogens were recorded. Extension agents and dairy specialists provided this information to dairy producers. This appears to be the only statewide program that provides producers with continuing mastitis results on both mycoplasma and other more routine mastitis pathogens. Such monthly information helps producers monitor their overall mastitis situation and make management changes to control emerging problems before they have a major impact. Louisiana is currently continuing the quarterly phase of the monitoring program. The restrictions established by LDAF will continue to remain in effect, and cows from dairies with mycoplasma will not be sold other than for slaughter.

This program can serve as a model for similar control programs in other states. ■

Figure 1. Percentage of Mastitis Pathogens Isolated Monthly from Bulk Tank Milk.

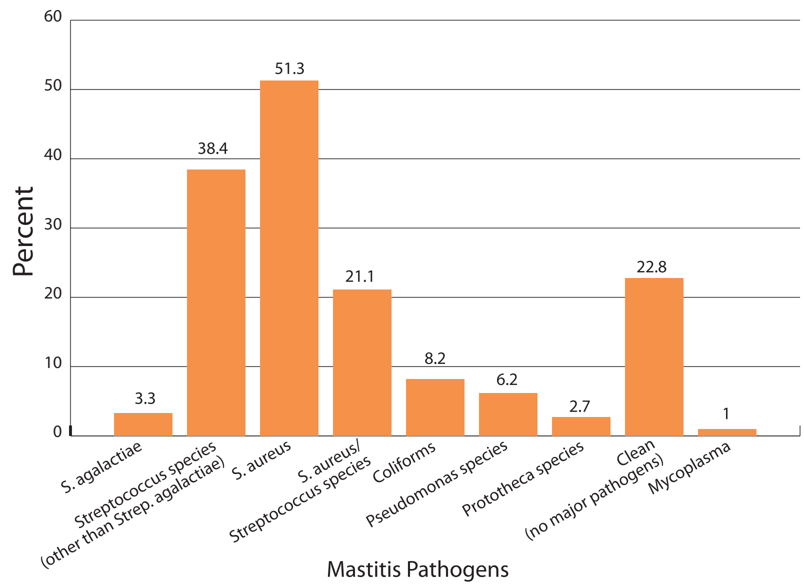

Photo by Mary Ann Van Osdell

William E. Owens, who conducts research at the LSU AgCenter's Mastitis Research Laboratory in Homer, helped prevent mycoplasma mastitis from becoming a problem for Louisiana dairy producers.

Louisiana milk producers' refundable tax credits

Wayne M. Gauthier and J. Matthew Fannin

Over the past few decades, the economics of American agriculture has created a structure in which the number of farmers has declined. The output of the remaining farmers has grown, and areas of production have shifted. This situation characterized the Louisiana dairy industry until 1978, when total Louisiana milk production peaked at 1.1 billion pounds. Since then, both the total number of dairy farmers and the amount of milk produced have declined annually. The negative implications of these declines on the economic well-being of rural communities throughout Louisiana led the state legislature to pass Act 461 in the 2007 legislative session. This act created the Louisiana Dairy Refundable Tax Credit Program (LDRTCP).

The refundable tax credit is applied against a dairy producer's state income tax, and any excess of credit over taxes due is rebated to the producer. Act 461 specifies economic criteria to be used in calculating the refundable tax credits. The credits can be awarded only when current tax-year uniform milk prices are less than a calculated announced production price (APP). The APP reflects the three-year moving average cost of importing milk into Louisiana adjusted for the milk prices Louisiana dairy producers receive plus their cost of production. An individual dairy farmer can receive up to $30,000 in tax credits if both the number of qualifying fiscal quarters and the production levels are met subject to an annual cap of $2.5 million on total program cost.

Table1. Summary Distribution of 2007 Louisiana Dairy Refundable Tax Credits.

Production Ranges (lbs.)	Refundable Tax Credit $	No. of La. Dairy Producers	Total Refundable Tax Credits $	Total Refundable Tax Credits %	(%) Distribution Producers	(%) Distribution Milk
> 3,000,001	15,000	21	315,000	25.05	10.14	30.71
2,500,001-3,000,000	12,500	11	137,500	10.93	5.31	10.26
2,000,001-2,500,000	10,000	14	140,000	11.13	6.76	11.18
1,500,001-2,000,000	7,500	34	255,000	20.28	16.43	20.11
1,000,001-1,500,000	5,000	37	185,000	14.71	17.87	14.07
1-1,000,000	2,500	90	225,000	17.89	43.48	13.67
TOTAL(S)		**207**	**1,257,500**	**100.00**	**100.00**	**100.00**

Implementing the tax credit requires the cooperation of the Southeast Federal Milk Market Order (SEFMMO) office in Atlanta, Ga., Louisiana's dairy farmers, and four state agencies. At the state level, the LSU AgCenter's Department of Agricultural Economics and Agribusiness works jointly with the Louisiana departments of Agriculture and Forestry, Health and Hospitals and Revenue to implement the program. AgCenter economists compile and organize data from the state's dairy farmers, the SEFMMO office and the other state agencies and use the data to calculate the refundable tax credit for each farmer.

Act 461 seeks to increase Louisiana's milk production by providing dairy

New law helps dairy industry

The Louisiana Legislature created the Dairy Producers' Refundable Tax Credit Program in 2007. It provides a dollar-for-dollar reduction against the dairy producers' state income taxes. The total tax credit is capped at $2.5 million per year and $30,000 per individual dairy producer.

Louisiana dairy producers are eligible for the tax credit, which ranges from $5,000 to $30,000, based on a formula that includes milk production, milk prices, and transportation and production costs. Eligibility for the credit is assessed monthly and paid for each quarter in a year that the U.S. Department of Agriculture's uniform price drops below the announced production price.

Total production is based on the Louisiana calendar-year milk production within the Federal Milk Market Order System plus additional production not included in the system. The production price for each month is calculated by the LSU AgCenter Department of Agricultural Economics and Agribusiness using a complex formula specified by state law. ■ **Rick Bogren**

Wayne M. Gauthier, Associate Professor, and J. Matthew Fannin, Assistant Professor, Department of Agricultural Economics and Agribusiness, LSU AgCenter, Baton Rouge, La.

farmers with an incentive to increase production. For example, suppose a Louisiana dairy producer milks 125 cows a day with an average annual milk production of 15,000 pounds per cow. The total annual production would be 1,875,000 pounds of milk. Based on Table 1, this producer would have received a refundable tax credit of $7,500 in 2007. But if this farmer had had nine more cows each producing 15,000 pounds of milk or had the production from the existing herd increased by 125,001pounds, the farmer would have received a $10,000 tax credit.

The distribution of tax credits to 207 Louisiana dairy farmers for 2007 is summarized in Table 1. The milk-production ranges and corresponding tax credit levels are in the first two columns. Because of relatively higher milk prices in two of the four quarters in 2007, the state's dairy farmers received only half of the available refundable tax credits as prescribed by law.

The second and fourth columns in Table 1 show the dollar distributions of the 2007 credits both to individual dairy producers and to all 207 Louisiana dairy producers. The last three columns show the percentage distributions of those credits across the ranges of the milk production schedule. For example, 21 of the 207 Louisiana dairy farmers each produced more than three million pounds of milk in 2007. Each producer in that production range was awarded a tax credit of $15,000. The $315,000 they received represented 25.05 percent of the total tax credits of $1,257,500 awarded in 2007.

Those 21 producers accounted for 10.14 percent of Louisiana's 207 dairy farmers and 30.71 percent of 2007 milk production. Similar analyses of the tax credits to individual farmers can be applied to the other five ranges in the production schedule in the first column. At the lowest level of production – between one and one million pounds – 90 dairy producers representing 43.38 percent of Louisiana's producers received 17.89 percent of the tax credits for producing 13.67 percent of the milk in 2007.

Louisiana milk-production contributions to economic activity in 2007 were estimated at $199,355,679. Refundable tax credits issued in 2007 were $1,257,500, which means $0.63 was awarded in refundable tax credits for every $100 of economic activity attributable to milk production.

When economic conditions warrant, the tax program provides a refundable tax credit against the dairy farmers' income tax liability. By so doing, it sustains an existing enterprise that contributes to economic activity in rural Louisiana. Assistance through these programs and other research and extension activities by the LSU AgCenter sustains a viable dairy industry in the state. ■

Mexican rice borer more dangerous to La. sugarcane than rice

(Continued from page 4)

Between growing seasons, the insect is found in high numbers in grasses such as Johnsongrass and vaseygrass. "It was phenomenal to me the numbers we found in the weed areas of the Texas rice-growing region," he said.

Once the insect bores into sugarcane, insecticides don't work well because the cavity created by the borer is filled with chewed plant material, frass, blocking a chemical's entry, he said.

Insecticides work better on the pest in rice, he said, although three applications may be required.

A new seed treatment, Dermacor, appears to control the pest in rice. Originally, Dermacor was developed as a seed treatment for drill-seeded rice against the rice water weevil.

Reagan said Dermacor also has potential to protect sugarcane, and he hopes he can persuade the chemical's maker, DuPont, to pursue labeling for that crop.

Reagan said he has worked to develop a response to the insect before it becomes a pest in Louisiana. "I'm a champion of proactive research," he said.

A natural enemy of the borer, a wasp found in the Rio Grande Valley, will be tested in Louisiana by the U.S. Department of Agriculture.

Reagan's work on the Mexican rice borer has been funded with $1.5 million in competitive grants involving joint efforts with entomologist Mo Way of Texas A&M University.

"Mo and I worked closely together. We've had a really good relationship, and Ted Wilson of Texas A&M has been a big help too," Reagan said.

For several years, Reagan and Way have held a field day near Ganado, Texas, to show how the pest has affected rice and cane in the Lone Star State.

"It's been a good collaboration," Reagan said. Without the TAMU cooperation "we clearly would not have gotten any of those grants."

Reagan said it's unlikely the grants would have been approved for the project if its scope were limited to sugarcane. But adding rice to the grant application made a significant difference, he said. "It's also much more practical because the insect feeds on both crops."

Photo by T. Eugene Reagan

Mexican rice borers have moved into Louisiana.

Way said Reagan approached him about 10 years ago with the prospect of a cooperative research venture.

"We appreciate the cooperation from the LSU AgCenter," Way said. "The funding has allowed us to expand our program to do long-term research."

Way said the Mexican rice borer became a pest in Texas rice in 1988. Yield losses in rice can be as much as 500 to 1,000 pounds per acre, he said.

Way said rice producers in Mississippi, Missouri and Arkansas are watching results of the research.

Research has shown that the pest is more of a problem in late-planted rice, Way said. Some rice-growing regions in Texas are more likely to have problems with the insect. It has been severe south of Houston, but it is becoming a more serious pest in the Beaumont area, according to Way.

Research is under way to determine a threshold for spraying pyrethroids, Way said. The threshold would rely on the number of lesions found on plant stems.

Texas rice farmers have found that pyrethroids for the borers can be tank-mixed with fungicides sprayed at late boot and early heading stages, Way said, and that strategy was developed with help from Don Groth, LSU AgCenter plant pathologist, at the LSU AgCenter's Rice Research Station in Crowley, La. ■ **Bruce Schultz**

GROWING ROSES

a challenge in Louisiana

Folksinger

Photo by John Wozniak

Allen D. Owings and C. Allen Broyles

Growing roses in Louisiana is a challenge for industry professionals and home gardeners. A major problem in production and the landscape enjoyment of roses is disease pressure (primarily blackspot and powdery mildew) brought on by environmental conditions of the region. Heat and humidity have an adverse effect on many of the rose varieties we grow in Louisiana.

Landscape shrub roses have become more popular in the past few years. These roses have established market dominance and are surpassing hybrid tea, floribunda and graniflora varieties in sales. The landscape shrub roses with the largest percentage of the market are the Knock Out varieties.

A major rose evaluation project under way at the LSU AgCenter is evaluating EarthKind and other roses. This project was initiated about 10 years ago by Texas A&M University. One of the initial goals was to locate the best "yellow rose of Texas," but now it includes testing and recommending roses for low-maintenance landscapes. This includes evaluating numerous rose varieties, particularly in the shrub category. Characteristics being considered in these evaluations are low irrigation inputs, minimum pruning requirements, desirable flowering characteristics, minimum insect susceptibility and resistance or low susceptibility to blackspot and other devastating rose diseases.

In the initial evaluation process conducted in Texas, 11 original EarthKind rose varieties – Belinda's Dream, Caldwell Pink, Carefree Beauty (Katy Road Pink), Climbing Pinkie, Else Poulsen, Knock Out, Marie Daly, Mutabilis, Perle d'Or, Sea Foam and The Fairy – were the best performing. In 2006, Spice and Duchesse de Brabant were added, and in 2007, Ducher and Georgetown Tea joined the list.

An additional 20 rose varieties are being studied for possible recommendation for the southern United States, while 31 additional varieties are being evaluated for possible recommendation on a national level. One site for the national EarthKind rose evaluation is Burden Center, an LSU AgCenter research station in Baton Rouge.

Current EarthKind roses include:

Dwarf Shrubs

■ Marie Daly is a rose with semi-double, pink, fragrant flowers. Bloom occurs April through November, and plants generally reach 3-4 feet with an equal spread.

■ The Fairy is a popular rose in Louisiana. It has a double form and light pink flowers with a blooming period from spring through fall. It reaches 3-4 feet with a spread of about 4 feet. Cercospora leaf spot is a disease of this rose in south Louisiana.

Small Shrubs

■ Caldwell Pink has a double-form flower with lilac pink petals. It reaches 4 feet with a 3-foot spread.

■ Perle d'Or is a rose with fragrant, peach-colored flowers. It reaches 5-6 feet with a spread of 3-4 feet. It was named Earth Kind Rose of the Year for 2007.

Medium Shrubs

■ Belinda's Dream is a pink rose with double flowers. This variety was named a Texas Superstar plant in 2002

Allen D. Owings, Professor, Hammond Research Station, Hammond, La., and C. Allen Broyles, Research Associate, Burden Center, Baton Rouge, La.

and is popular among Louisiana rose enthusiasts. It is a shrub rose and reaches 5-6 feet in the landscape.

■ Else Poulson has semi-double flowers with pink petals. It is a floribunda rose and has a mature height of 5 feet with a spread of 4 feet. It does not perform quite as well as other Earth Kind roses in Louisiana.

■ Katy Road Pink is also sold in the nursery trade as Carefree Beauty. It has semi-double, pink flowers. Katy Road Pink reaches 5-6 feet and is a shrub rose.

■ Duchesse de Brabant produces full pink flowers. It is a tea rose and reaches 6 feet with a spread of 4-5 feet.

■ Spice has double flowers with blushy pink petals. It is a China rose with a height of 5 feet and a spread of 4 feet.

■ Georgetown Tea was found in Georgetown, Texas. It has dark salmon-pink flowers that fade to lilac-pink. It is a tea rose and reaches 5-6 feet with a spread of 4 feet.

■ Ducher has pure ivory-white flowers. It is a China rose but smaller-growing than other China roses. Heights of 4-5 feet can be expected with a spread of 3-4 feet.

■ Knock Out is an All-America Rose Selection winner from 2000. It usually is categorized as a small shrub rose with an advertised height of 4 feet. In Louisiana, this variety can easily reach 6-8 feet, if left unpruned. You can maintain Knock Out roses at 4-5 feet with regular pruning. Knock Out has cherry-red, single to semi-double flowers.

Large Shrubs

■ Mutabilis is also called the butterfly rose. Single flowers are yellow-red-orange. It is a China rose and reaches10 feet with a spread of 6-8 feet.

Climbers

■ Climbing Pinkie produces semi-double, fragrant flowers with rose-pink petals. It climbs and reaches 12 feet with a 6-foot spread.

■ Sea Foam has creamy white, double, fragrant flowers. It has a ground cover, rambling-type growth habit or can be trained to climb on a trellis.

Photo by John Wozniak

Chuckles

EarthKind Roses for 2008 and 2009

EarthKind rose varieties have recently been named for 2008 (Madame Antoine Mari and New Dawn) and 2009 (La Marne and Souvenir de St. Anne's). This brings the total number of Texas' EarthKind roses to 19.

The roses are listed below with the following information: year of introduction, rose classification, mature height and width (approximate), blossom color, blossom type, frequency of blooming, fragrance and other characteristics. All can be grown in Louisiana.

■ Madame Antoine Mari – 1901, tea, 6-foot-by-6-foot, pink blend, double, repeat blooming, fragrant, new growth is an attractive maroon color. Earth Kind Rose of the Year for 2008.

■ New Dawn – 1930, large-flowered climber, 15-20-foot-by-10-foot, blush pink, double, blooms primarily in the spring, fragrant, tolerates some light dappled shade.

■ La Marne – 1915, 5-foot-by-4-foot, pink and white blend, single, repeat blooming, not fragrant, few thorns, petal edges are ruffled, not recommended for areas with highly saline irrigation water.

■ Souvenir de St. Anne's – 1950, 3-foot-by-3-foot, light pink, semi-double, repeat blooming, outstanding fragrance, not recommended for areas with highly saline irrigation water. EarthKind Rose of the Year for 2009. ■

Photo by Allen D. Owings

Duchesse de Brabant

Blackspot Observations – National EarthKind Rose Evaluations (2007 and 2008)

Resistant to Slightly Susceptible
Knock Out
Blushing Knock Out
Pink Knock Out
The Fairy
Belinda's Dream
Folksinger*

Slightly to Moderately Susceptible
Seminole Wind
Square Dancer*
Prairie Breeze*
Princess Verona*
Prairie Princess*
Amiga Mia*
April Moon*
Barn Dance*
Nearly Wild
Winter Sunset*
Polonaise*
Earth Song*
Chuckles
Climbing New Dawn
Katy Road Pink (Carefree Beauty)*

Moderately Susceptible
Carefree Wonder
Dublin Bay
Country Dancer*
Flora Dora
Pearlie Mae*
Penelope
Sea Foam
Prairie Harvest*

Highly Susceptible
Quietness*
Summer Wind*

*Denotes a Griffith Buck rose variety. See next page.

About Griffith Buck roses

Photo by John Wozniak

April Moon

Griffith Buck roses are new to most horticulturists in the South. Buck conducted rose breeding at Iowa State University from 1952-1985. His roses were bred for cold hardiness and other factors. Many of these roses are able to bloom in partial shade and shady conditions. He named approximately 90 varieties. The most famous Griffith Buck rose is Carefree Beauty. Introduced in 1977, this rose is also sold under the name Katy Road Pink. April Moon, above, is a Griffith Buck rose.

Horticulture professor Steve George at Texas A&M University-Dallas and Mark Chamblee of Chamblee's Nursery in Tyler, Texas, have located the vast majority of the Griffith Buck rose varieties. The LSU AgCenter is evaluating Griffith Buck rose varieties separate from the EarthKind rose project. See story on page 26.

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