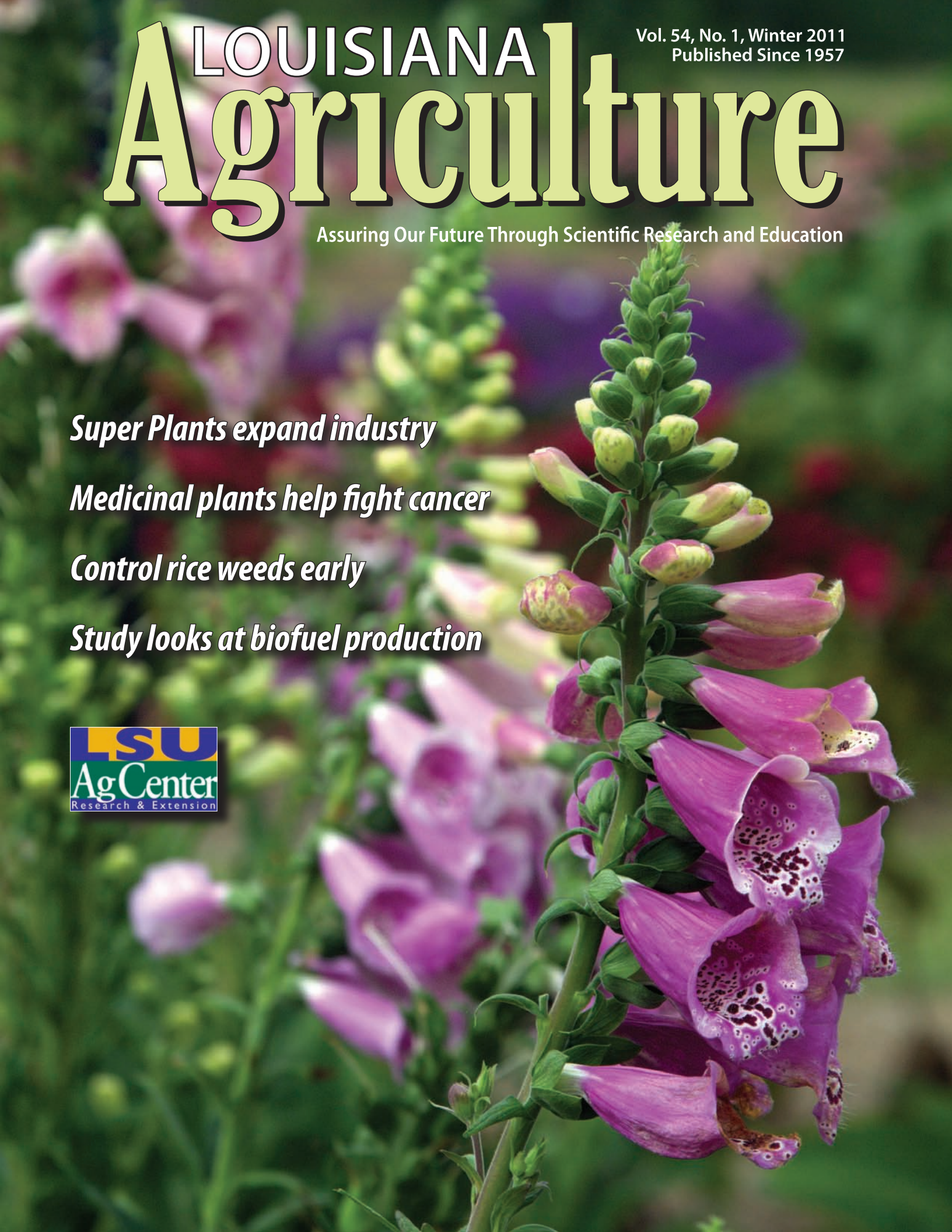
Vol. 54, No. 1, Winter 2011
Published Since 1957

LOUISIANA Agriculture

Assuring Our Future Through Scientific Research and Education



Super Plants expand industry

Medicinal plants help fight cancer

Control rice weeds early

Study looks at biofuel production

LSU AgCenter Research & Extension

David Boethel leaves a legacy

David Boethel's last day of work at the LSU AgCenter was Jan. 7, 2011. He retired as the Vice Chancellor for Research and Director of the Louisiana Agricultural Experiment Station, a post he held for the last six years of his 36-year career with the AgCenter.

Boethel came to Louisiana right after earning his Ph.D. in entomology from Oklahoma State University in 1974. He took on the responsibilities of the pecan insect integrated pest management research at the Pecan Research and Extension Station in Shreveport.

"He was an outstanding scientist – and he still is. His first love is research. His research contributed to saving thousands of dollars for pecan growers in Louisiana and across the South," said Jere McBride, who was director of the Pecan Station at the time and felt lucky to land this talented new Ph.D.

In 1980, Dr. Boethel transferred to the Department of Entomology at LSU in Baton Rouge, where for 17 years he conducted research on soybean integrated pest management and taught biological control of insect pests. In 1997, he was promoted to assistant director in the experiment station and then associate vice chancellor and associate director in 2001. He was selected vice chancellor and director in 2004.

In 2009, a 10-university group that collaborated on integrated pest management (IPM) in soybeans, led by Boethel, was awarded the National Excellence in Multistate Research Award from the Association of Public and Land-Grant Universities. The IPM movement seeks to reduce the use of pesticides in crop production.

"This group of scientists, working under the direction of Dr. Boethel, potentially restored the profitability of soybean production in the United States, saving producers an estimated $1.3 billion," said David Wright, director of research for the North Central Soybean Research Program, based in Ankeny, Iowa.

As an experiment station administrator, Boethel promoted projects in management and control of mosquitoes, fire ants and termites. He was the driving force behind the establishment of the Louisiana Biofuels and Bioprocessing Institute at the LSU AgCenter.

Boethel has been the wind beneath the wings of the LSU AgCenter's intellectual property office. The AgCenter is the most successful of all the LSU System entities at producing patents, licensing agreements and start-up companies. A consultant called the AgCenter the "crown jewel" of the LSU System intellectual property effort. The return of royalty income based on direct research expenditure, nearly 5 percent, is among the highest in the country.

Boethel was the perfect leader of the AgCenter's research effort in these past few years. He put into place policies and procedures that propel scientific discovery well into the next few decades – despite the budget cuts to higher education that a handful of Louisiana's short-sighted politicians appear prepared to do.

We wish him the best in his retirement. ■ **Linda Foster Benedict**

Photo by Linda Foster Benedict

His colleagues surprised him at his retirement party on Dec. 3, 2010, with an enlarged check for the amount they had raised to establish the David Boethel Student Scholarship fund. The check says $36,675, but by the time of the party, the group had received more than $40,000 from donors. Left to right, Kenneth Koonce, dean of the LSU College of Agriculture; Boethel; B. Rogers Leonard, entomology professor; Tim Schowalter, head of the Department of Entomology; and Mike Salassi, agricultural economist.

LOUISIANA Agriculture

Louisiana Agriculture is published quarterly by the Louisiana Agricultural Experiment Station. Subscriptions are free. You may also subscribe to a Web version of the magazine, which is available at www.LSUAgCenter.com. Please go to the "Louisiana Agriculture Magazine" site if you would like to receive an e-mail notification when a new issue is online. For more information or to subscribe, please contact:
Linda Foster Benedict, Editor
Louisiana Agriculture
P.O. Box 25100
Baton Rouge, LA 70894-5100
tel (225) 578-2263
fax (225) 578-4524
lbenedict@agcenter.lsu.edu

LSU AgCenter Research & Extension

www.LSUAgCenter.com

LOUISIANA
Agriculture

Vol. 54, No. 1, Winter 2011
Published Since 1957

Assuring Our Future Through Scientific Research and Education

ON THE COVER: This is the Camelot Rose in the Camelot series foxgloves, which have been designated as Louisiana Super Plants. Read more about Super Plants on page 19. The Camelot series includes three other colors – Camelot Lavendar, Camelot Cream and Camelot White. These foxgloves are bred to be especially strong and vigorous and are somewhat more heat tolerant than past foxgloves, allowing them to bloom well into late May or early June. Especially notable is an improvement in the flower spikes. The flowers are larger and the spikes taller than previously grown varieties. The bell-shaped flowers of foxgloves are arranged around a strong, tall stem that grows from the center of the plant. Typically, the flowers tend to hang down, and you cannot see into the beautifully spotted throats. The flowers of Camelot foxgloves, however, are held more horizontally. This is a tremendous improvement in the ornamental qualities of this foxglove and a big reason they were made a Louisiana Super Plant. (Photo by Igor Kamalov)

Caffey honored with new rice variety

Friends, family and former co-workers of Rouse Caffey gathered Feb. 10 at the Rice Research Station in Crowley to celebrate the naming of a new rice variety in his honor. The first work on the Caffey variety, a medium-grain rice, started in 1999, said Steve Linscombe, LSU AgCenter regional director.

"This is probably the variety I'm most proud of," Linscombe said. "We get to honor someone who has made an important impact on the rice industry and LSU."

The variety went through 11 generations before it was approved, and its parents can be traced back to other medium-grain varieties such as Bengal, Mercury and Rico 1.

Caffey was the Rice Research Station director from 1962 until 1970, and he later became chancellor of the LSU AgCenter, a post he retired from in 1997. ■ **Bruce Schultz**

New guidelines say less salt

The 2010 Dietary Guidelines, released in January 2011 by the U.S. Department of Agriculture and the Department of Health and Human Services, are the first to address the U.S. problem of too many overweight or obese adults, according to LSU AgCenter nutritionist Beth Reames.

The goal of the new guidelines is to help people maintain a calorie balance over time to achieve and sustain a healthy weight. The guidelines also steer people away from food containing high amounts of saturated fats, sodium and refined grains.

A significant change in the guidelines is a reduction in salt intake for half the population – including African-Americans, people 50 or older, and those with diabetes, hypertension or chronic kidney disease. This population should consume no more than 1,500 milligrams of sodium – a little more than a half teaspoon a day.

For those not included in the restricted groups, the guidelines continue to advocate only 2,300 milligrams of sodium a day. Americans typically consume twice that amount, Reames said.

She said the best way to not exceed sodium recommendations is to eat fresh fruits and vegetables and limit foods with hidden sodium such as breads, pasta and processed foods.

"The old guidelines gave vague suggestions to eat more fruits and vegetables. The new guidelines urge people to make half their plates fruits and vegetables," she said.

■ **Tobie Blanchard**

Nature tourism project gets $115,000

The LSU AgCenter has received a $115,000 grant from the Walton Family Foundation to help make the northeast Louisiana parishes bordering the Mississippi River a better nature tourism destination, said Dora Ann Hatch, LSU AgCenter agritourism coordinator, who will serve as project leader.

The funds will be used to form an advisory committee, which will evaluate the region's cultural, natural and heritage resources, Hatch said. The information will be used to produce brochures and a website. The goal is to create employment opportunities based on nature tourism, agritourism, cultural heritage tourism and wildlife-related activities such as hunting, fishing, bird watching, outdoor photography, canoeing, kayaking and hiking, Hatch said.

■ **Mary Ann Van Osdell**

Russin named interim vice chancellor, director

John Russin has been appointed the interim vice chancellor for the LSU AgCenter and the interim director of the Louisiana Agricultural Experiment Station. He replaces David Boethel who retired in January 2011. Russin had been the associate vice chancellor and associate director, a position he was named to in 2008.

Russin first came to the AgCenter in 1984 as a postdoctoral researcher in the Department of Entomology, having completed his Ph.D. in plant pathology at the University of Kentucky-Lexington. In 1989, he joined Crop Genetics International in Hanover, Md., as a plant pathologist.

In 1991, he moved back to Baton Rouge as an assistant professor in the Department of Plant Pathology & Crop Physiology, where he remained until 1998, having been promoted to associate professor. He then went to Southern Illinois University in Carbondale as an associate professor. He was promoted to professor, then chairman of the Department of Plant, Soils and Agricultural Systems. He became associate dean for research in the College of Agricultural Sciences in 2004.

In addition to many academic honors, he has served as science adviser for the Illinois Council on Food and Agricultural Research. He helped establish the Illinois Soybean Center, a public/private partnership to promote research and education, and the Afghanistan Water, Agriculture and Technology Transfer program to aid in the re-establishment of agriculture infrastructure in that country.

One of Russin's most recent achievements since returning to the AgCenter is the establishment of the Louisiana Biofuels and Bioprocessing Institute. This institute brings together research related to this industry and promotes collaboration and increased funding for more research and extension programming. The institute was initially approved by the Louisiana Board of Regents in 2010 and given a five-year extension in January 2011. The Regents provide no funding.

■ **Linda Foster Benedict**

Weeds top agenda at cotton, rice meeting

Farmers from across the Midsouth, along with researchers from the LSU AgCenter and several other universities, met Feb. 1-2, 2011, to share techniques and ideas at the National Conservation Cotton and Rice Conference.

Much of the 14th annual conference concentrated on herbicide-resistant weeds. LSU AgCenter researchers confirmed the presence of herbicide-resistant pigweed in two north Louisiana parishes recently. Last year, resistant pigweed and johnsongrass were confirmed in Louisiana.

LSU AgCenter weed scientist Daniel Stephenson was among the 54 researchers to present results of their work. Stephenson advised farmers to use herbicides with varying modes of action, and that means

glyphosate with 2,4-D or dicamba and not relying on glyphosate alone.

"We're going to have to go back to using residual herbicides," Stephenson said. Residual herbicides should also be used for burndown applications, and farmers would be prudent to consider returning to tillage along with more frequent crop rotations.

Tall waterhemp in some areas of Louisiana is suspected of being herbicide-resistant, he said.

University of Arkansas weed scientist Ken Smith said herbicide-resistant pigweed is a major problem for commercial agricultural production. "It is much worse than I ever anticipated."

He said one pigweed plant can produce 1.8 million seeds.

More than three dozen farmers gave presentations on their operations and the various conservation practices they use. Herbicide-resistant weeds often were included in their discussions.

Steve Stevens from southeast Arkansas said he uses Liberty Link cotton as an alternative to Roundup Ready crops. He said a yield drag was noticeable in the first few years, but it has become less of a problem. He said Ignite herbicide seems to be weaker on some grasses, and it is less effective during a drought, even more so than Roundup.

LSU AgCenter soybean specialist Ron Levy said Liberty Link soybeans are a good option for farmers facing herbicide resistance. "Ignite herbicide controls a broad spectrum of weeds including most glyphosate resistant weeds," he said. "The rate for Ignite is 36 ounces for a single application or two 22-ounce applications."

■ **Bruce Schultz**

Sugar Cane League honors Legendre

Ben Legendre, professor and head of the LSU AgCenter Audubon Sugar Institute at St. Gabriel, has received the 2010-2011 President's Award from the American Sugar Cane League.

The award has been presented each year since 1995 to a person who has done outstanding work in the sugarcane industry. Legendre received a plaque from Greg Nolan, the outgoing president, at the 88th annual meeting of the American Sugar Cane League on Feb. 8 in Lafayette.

"Legendre has more than 40 years of research and extension experience in state and federal organizations in the genetic improvement of sugarcane," Nolan said.

Legendre's honors include being named to the Louisiana Agriculture Hall of Fame Award in 2010 and as an LSU College of Agriculture Outstanding Alumni of the Year in 1998. ■ **Johnny Morgan**

Temple Grandin urges better animal management

She rarely cracked a smile during her hour-long presentation, but internationally renowned animal scientist Temple Grandin cracked up the audience many times with her wry observations on the food industry.

Grandin, whose life story was made into an Emmy Award-winning movie that aired on HBO in 2010, was one of the guest speakers during a day-long workshop on livestock management, sponsored by the LSU School of Veterinary Medicine and the LSU AgCenter on Jan. 26.

Grandin's overarching concern for the welfare of animals, even as they go to slaughter, changed the way livestock facilities are designed and managed. She attributes her success partly to her autistic condition. In addition to being a spokeswoman for the humane treatment of animals, she uses her celebrity to call for better understanding of autism.

"I'm a very visual person," said Grandin, who is an animal science professor at Colorado State University. "I see details. And that's what animals see, details. They think in pictures."

As Grandin has studied livestock animal behavior over the past 35 years, she has on occasion put herself physically in their place – down in the chutes, for example – to determine what could be done to make the animals less fearful.

The bottom line is that animals produce more and better meat and higher-quality food products if they're treated well, she said.

She sees no problem in being a proponent of both animal welfare and the eating of animals and their products.

"Vegans have to realize that they need animal manure to make plants grow," she said.

Dressed in her signature cowboy shirt, she told the audience of agriculture students and faculty the basics of good animal management. The No. 1 rule for the animal handler is to remain calm and not yell at animals or physically abuse them in any way. With strategic use of lights and barriers, she designs facilities that get rid of distractions for animals and abrupt changes in lighting that cause them to get nervous.

She sees nothing wrong with the use of large feedlots or confinement facilities as long as the animals have enough space to move and lie down, do not get overheated and can have privacy for such acts as hens' laying eggs.

"What does a hen need? A secluded area to lay her eggs," Grandin said.

Without this, the hen is extremely uneasy, comparable to the way people would feel if they had to spend the night "in a hotel room without a door in a bad neighborhood." ■ **Linda Foster Benedict**

Photo by Sam Irwin

Temple Grandin expresses her concern for the welfare of animals, even as they are sent to slaughter, during her address to agriculture students and faculty at the LSU AgCenter on Jan. 26.

Medicinal Plants and Cancer

Solubility-enhanced reformulation of paclitaxel, an old drug

Zhijun Liu, Gar Yee Koh, Fang Zhang, Duane Jeansonne, Rhett Stout, Dong Liu and Fred Enright

Paclitaxel, which is isolated from the bark of the Pacific yew, is a chemotherapeutic, intravenous drug produced under the names of Taxol and Abraxane. Taxol has been a frontline chemotherapeutic drug for treating ovarian and breast cancers for about 16 years and continues to be prescribed even after losing patent protection. As a chemotherapeutic drug, Taxol has been used to treat millions of cancer patients despite unsatisfactory response rates and a plethora of side effects.

Taxol's therapeutic potential has been held back by challenges in formulation. This challenge starts at the central issue of poor solubility. Paclitaxel is both fat-soluble and water-insoluble. To address the solubility issue, Taxol's developer, Bristle-Myers Squibb, composed the drug with Cremophor EL, a surfactant purified from castor oil and dehydrated alcohol. The combination of a surfactant and alcohol allows the fat-soluble paclitaxel to be diluted with water for intravenous infusion.

Although Cremophor EL has been an effective surfactant and used for formulating many other drugs, such as the immunosuppressant drug cyclosporine and the anti-retroviral drug ritonavir, it causes hypersensitivity in some patients. To get around the use of Cremophor, Abraxis BioScience Inc. formulates paclitaxel with human albumin to produce Abraxane, an intravenous drug approved by the Food and Drug Administration in 2005. Abraxane has eliminated a large portion of hypersensitivity reactions in humans. Although never reported with Abraxane, the FDA cautions about the remote possibility of disease transmission because of the use of human-derived albumin in the product.

The challenge is how to formulate and deliver paclitaxel to the tumor site in a therapeutic quantity, referred as bioavailability, without causing unwanted side effects. The challenge had been largely unmet until a solubilizing property was discovered in the LSU AgCenter's Medicinal Plant Laboratory research program. During the process of finding bioactive molecules from plants, one of nature's well-guarded secrets in solubilizing water-insoluble compounds was also discovered. One single small molecule called rubusoside, part of a compound responsible for the sweet taste of the leaves of the stevia or Rubus plant, was identified and shown to have remarkable and generally applicable solubilizing properties.

In preliminary experiments with a variety of water-insoluble compounds, rubusoside alone increased solubility from two-fold to about one million-fold for vitamin E and propofol. When it was applied to paclitaxel, rubusoside enhanced solubility by 5,000 times. Paclitaxel was solubilized from basically zero to 1.8 grams per liter of water by the use of rubusoside alone, completely eliminating the need for alcohol, Cremophor EL or albumin (Figure 1). Although the underlying mechanisms of this remarkable solubilization are unknown, preliminary studies suggest the formation of rubusoside-paclitaxel (PTX) nanostructures in water (Figure 2).

The new formulation is referred as NANO-PTX. A NANO-PTX water solution can be freeze-dried to powder and completely reconstituted in water or saline. This compatibility is highly desirable because it will not only increase shelf-life but also provide a variety of dosage options for both liquid and solid forms.

The solubility enhancement achieved for paclitaxel is encouraging, and its medical relevance appears promising. In proof-of-concept experiments, the cytotoxicity (an indicator of killing power) of NANO-PTX was completely maintained. First, NANO-PTX showed it can inhibit the growth of human pancreatic, breast and colon cancer cells. Second, when orally administered to normal mice, NANO-PTX was detected in their plasma, which indicates some levels of oral bioavailability and possible maintenance of structural integrity of paclitaxel in the biological systems. Third, dying cancer cells were observed in tumor-bearing mice orally administered NANO-PTX. This shows some promise of therapeutic bioavailability (Figure 3) via the oral route. Fourth, a good safety profile was demonstrated for rubusoside.

Photos by Zhijun Liu

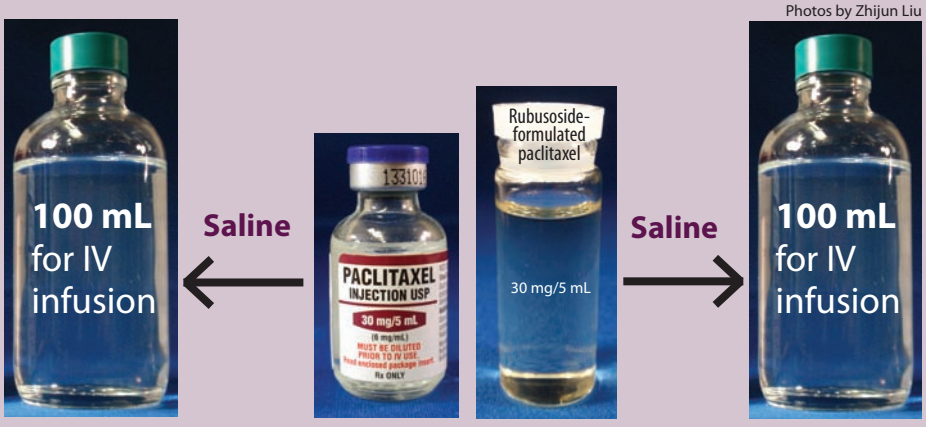


Figure 1. A paclitaxel intravenous drug concentrate (the 30 mg/5 mL) formulated in 528 mg/mL Cremophor (polyoxethylated caster oil) and dehydrated alcohol (49.7% v/v). The nonaqueous drug concentrate is diluted with saline prior to intravenous infusion. The same drug concentrate can be made by the use of 333 mg/mL rubusoside in water free of Cremophor and alcohol, which can be diluted in the same fashion for intravenous infusion as shown in the photo.

Photos by Zhijun Liu

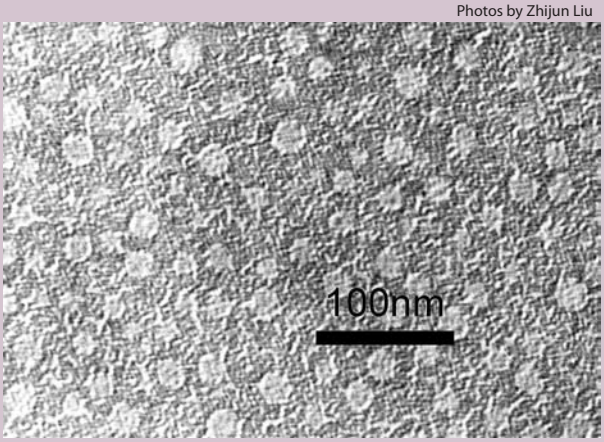


Figure 2. Formation of spherical nano-structures of rubusoside and paclitaxel in water seen under transmission electron microscopy.

As a sweetening agent rubusoside has been consumed for hundreds of years in beverage teas. In fact, based on a two-year study in rats, consuming rubusoside at a daily rate of 0.12 ounce per pound of body weight was found to be at the no-observed-effect level. Consuming it as a sweetener does not require a large amount, but to deliver paclitaxel for treating cancer would require a dose much higher than just to sweeten food and beverages. To gain some insight, a preliminary toxicity study in normal mice found that the animals could tolerate up to 0.65 ounces per pound of body weight, if orally administered, or up to 0.33 ounce per pound of body weight, when intravenously administered, without obvious signs of clinical toxicity. These amounts of rubusoside can deliver more-than-therapeutic amounts of paclitaxel orally or intravenously.

Still, there are more questions than answers. Although research efforts have increased knowledge about rubusoside, developing new knowledge will require a wide spectrum of expertise and financial resources. Because of this demand, the LSU AgCenter's Medicinal Plant Laboratory has taken a new research direction. This includes multiple-disciplinary collaborations with two highly accomplished chemistry professors at LSU to characterize the underlying mechanisms of solubilization and cellular uptake. In another collaborative project, LSU AgCenter scientists have assembled expertise in polymer structure characterization, cell transport and anti-tumor efficacy at the LSU Health Sciences Center and the M.D. Anderson Cancer Center in Houston. A third proposed project will investigate the NANO-PTX in canine cancer patients brought to the LSU School of Veterinary Medicine's companion animal clinic.

The LSU AgCenter has provided small but important seed funds to develop some of the proof-of-concept data. Major funding is needed to move this novel discovery and technology to the forefront of pharmaceutical formulations. The prospect of reformulating an old drug is bright, as the NANO-PTX formulation shows, and reformulation could be applied to other chemotherapeutic agents facing similar problems. Already a new intravenous formulation that uses rubusoside to replace alcohol, Cremophor EL or albumin shows some promises. And even more encouraging is the hoped-for oral paclitaxel medication, which has never been available because of formulation limitations. Making this a success will affect human lives and provide economic development opportunities.

The LSU AgCenter has filed patent protection for the discovery of rubusoside and other natural solubilizers and made initial contacts with several major pharmaceutical companies about the new solubilization technology in reformulating old drugs. In addition to the use in pharmaceutical industry, foods, beverages, agricultural chemicals and functional foods could also apply this technology. ■

Zhijun Liu, Professor; Gar Yee Koh, Research Associate; Fang Zhang, Duane Jeansonne and Dong Liu, Postdoctoral Researchers, Medicinal Plant Laboratory, School of Renewable Natural Resources; Rhett Stout, Associate Director and Chief Clinical Veterinarian, Division of Laboratory Animal Medicine and Assistant Clinical Professor, LSU School of Veterinary Medicine; and Fred Enright, Professor Emeritus, Department of Veterinary Science.

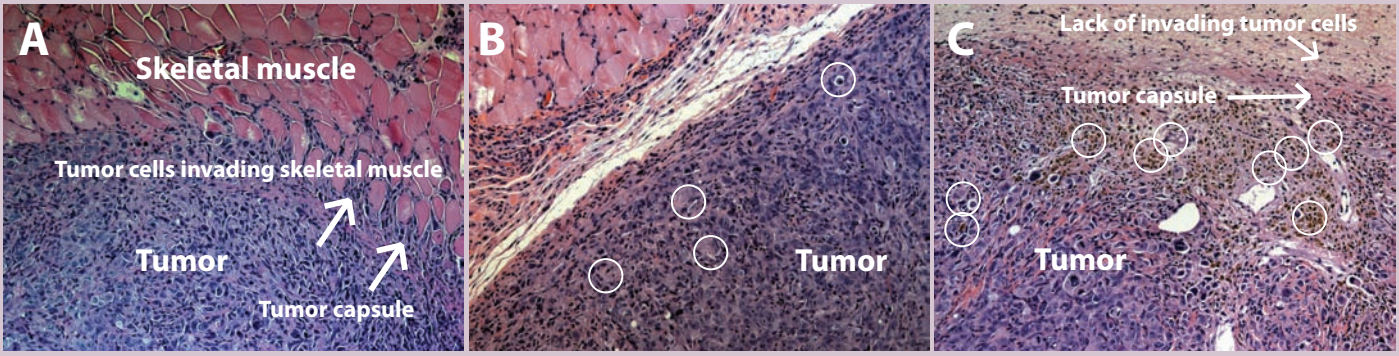


Figure 3. Hematoxylin-eosin stained section of PANC-1 tumors. Photo A is from a mouse treated orally with rubusoside once at 2.7 grams per kilogram body weight. The tumor was removed 14 days after inoculation. Photo B is from a mouse treated with NANO-PTX once at 5 milligrams per kilogram of body weight and once at 2.5 milligrams per kilograms of body weight. The tumor was removed 22 days after inoculation. Photo C is from a mouse treated with NANO-PTX once at 5 milligrams per kilogram of body weight and twice at 2.5 milligrams per kilogram of body weight. The tumor was removed 23 days after inoculation. Necrotic (dead) cells are circled. No necrosis was observed in rubusoside-treated mice, whereas increasing necrosis (circles) was found in NANO-PTX-treated mice as the frequency of dosing was increased.

Rice Variety Development

Breeders measure selection efficiency in Louisiana

Sterling Brooks Blanche and Xueyan Sha

The art and science of plant breeding has evolved much since it was first practiced during the early stages of crop domestication. And yet, some things remain the same. Historically, one of the greatest challenges plant breeders faced was to effectively differentiate between performance due to the plant and that of the environment in which the plant was grown. At some point in history, somebody probably tried to introduce the mango tree into Louisiana, and it likely didn't do well in our sub-tropical climate. Were poor growth and yield caused by an inferior variety (genetics) or by an unsuitable climate (environment)? In fact, both genetic and environmental factors can affect what plant breeders see and, ultimately, the selections that they make.

The term environment here encompasses any and all factors that affect yield and performance at a single location. These factors are numerous and difficult to characterize, but they include climactic (rainfall amount and timing, daytime and nighttime temperatures, humidity, the ratio of sunny to cloudy days, etc.), biological (insect, disease, and weed presence) and cultural (soil texture, fertility and organic matter) factors. Human-made factors, such as planting date, row spacing, plant population and pesticide choices also constitute the environment.

For example, assume a breeder is working with rice varieties at two locations – one of which normally produces high yields and the other produces lower yields because of high levels of disease. If only the high-yielding material was selected for consideration, then all selections would come from a single location. Not all of the varieties at the low-yielding location are necessarily inferior, however, and some might exhibit valuable levels of disease resistance. In either case, it is the breeder's job to sift through and use all of this information.

Progress in a breeding program depends on the ability of breeders to accurately quantify the variations among breeding lines and varieties. This critical ability encompassing both the art and science of plant breeding is paramount in the breeding and selection phase of variety development. All breeding programs are affected by environmental factors, and this is where the art of plant breeding is critical. Hundreds of factors interact to control what breeders view in the field, and it is impossible to scientifically model the environment so all factors are controlled or even understood. So, breeders use known standards to evaluate material on their merits in each situation.

No mathematical formula exists for selecting high-yielding plants; rather, it is an art of simultaneously considering a large number of yield-related factors or characteristics that contribute to high yields.

In 2007 and 2008, LSU AgCenter rice breeders evaluated the influence of different environments on their ability to estimate rice grain yield as part of the annual commercial-advanced trials. Trial locations included the Rice Research Station and on-farm test locations in Vermilion, Evangeline, Acadia and Jefferson Davis parishes. Two rice breeders visually evaluated 60 rice varieties for yield potential.

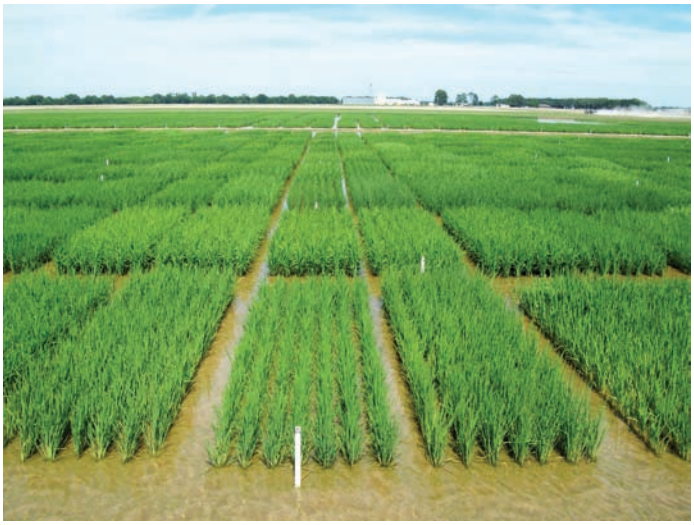
Each breeder's criteria are unique, but they generally include important rice characteristics that include the strength/thickness and height of the rice stalks (affects how rice can withstand high winds), the size of the rice panicle (total number of grains per panicle), the number of rice flowers that matured into whole rice grains on each panicle, the

Photos by Sterling Brooks Blanche

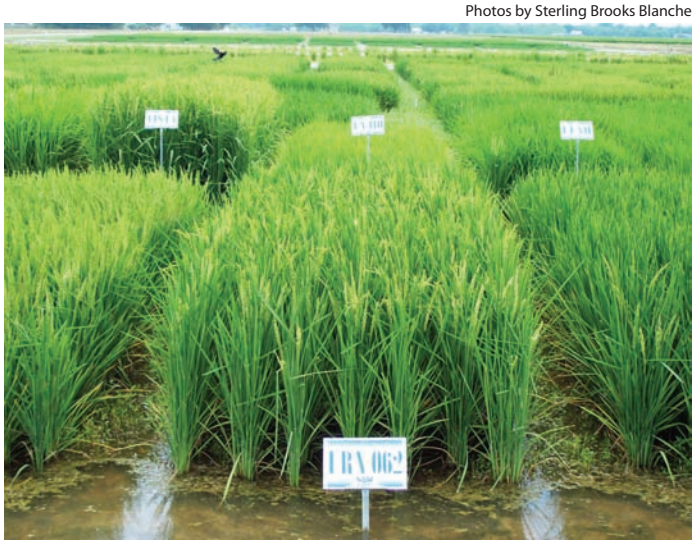
Brent Theunissen, a research associate at the Rice Research Station, uses a specially adapted harvester to harvest research plots.

Variety testing and evaluation are important for breeders and producers to get up-to-date information on commercial varieties.

Photos by Sterling Brooks Blanche



The differences among rice varieties for height and leaf color are apparent early in the season.



The rice front and center is a newly released medium-grain rice variety with excellent yield potential and a large, bold grain. Its name is Caffey after former LSU AgCenter chancellor and Rice Station director H. Rouse Caffey.

total number of panicles per square yard, seedling vigor (how aggressively the rice grows in cool, early-season conditions) and disease resistance.

The similarities between the actual yield and the estimates for each breeder were evaluated. A higher correlation indicates that the visual estimates were more predictive of actual yield than those with a lower correlation. The suitability of the environments for breeding purposes was based on the average yields of all varieties and the degree of differences among varieties at each location. Sheath blight disease ratings were recorded under significant disease pressure at the Vermilion and Jefferson Davis parish locations.

Rice yields varied between 5,114 and 9,266 pounds per acre across the seven environments. There were also significant differences in how much the environments separated the varieties. Some of the important environmental factors included a late planting date, high sheath blight disease pressure, excessive lodging (plants falling down), nitrogen deficiency, low tillering (production of multiple stems) and optimum yield conditions.

Table 1 shows the breeders' visual ratings in 2007 and 2008. A higher number suggests the breeders were more accurate in determining the yield potential of a variety. Alternatively, a low number indicates that the true yield potential of a variety was not easily estimated. The major factor in the accuracy of the visual ratings was the year effect. There were no differences between the two breeders in either year; however, their ratings were more accurate in 2007 than in 2008. This is not surprising considering the tremendous variation in Louisiana weather patterns, both week-to-week and year-to-year.

Many environmental factors affect the way plant breeders perceive yield potential. In 2007, two locations were heavily affected by sheath blight disease, which provided the breeders a good visual clue to the yield potential of the varieties. While the ratings were more accurate where sheath blight was present, plant breeders also must consider that the best varieties at any location might not have the highest genetic potential in the absence of sheath blight.

Across all years and locations, the breeders' yield estimates were similar to the actual yields, indicating that selections were highly effective. Research in other crops and locations has shown much lower predictive ability than in the current study. In some crops, researchers have not been able to demonstrate that visual selection was any more effective than randomly selecting plants regardless of their appearance. The variability in yield potential that the breeders perceived also was estimated. Not surprisingly, both breeders were more accurate in their selection of high yield potential when they perceived greater differences between varieties.

In agriculture, the overall challenge is to consistently produce a crop in spite of numerous variables. Each year presents different combinations of seasonal weather conditions that greatly affect the size and quality of the harvest. Variety development is a complex process that occurs over many years and in many different environments. Plant breeders must exploit rather than suffer from environmental differences and use them to their advantage. By the time an experimental line is considered for release, it has been exposed to many years of testing in many different locations. The hope is that the product of these efforts will be a time-tested variety that is well-adapted to the growing conditions and weather variables likely in Louisiana. ■

Table 1. Correlation coefficients between the breeders' estimates and observed yield and the standard deviation of the breeders' estimates in 2007 and 2008.

		2007	2008
Correlation Coefficients Between Breeders' Ratings and Observed Yield	**Breeder 1**	0.61	0.23
	Breeder 2	0.66	0.25
Standard Deviation of the Breeders' Estimates	**Breeder 1**	21.1	18.8
	Breeder 2	11.2	6.6

Sterling Brooks Blanche, Assistant Professor, Dean Lee Research Station, and Xueyan Sha, Associate Professor, Rice Research Station.

Spend, Make More

Propanil mixed with Newpath increases Clearfield rice yields, if weeds treated early

Eric P. Webster, Tyler P. Carlson and Michael E. Salassi

Weed management decisions in rice often drive the overall production system. Economic considerations determine the specific herbicides a producer will include in a weed management program. The adoption of a weed control program depends on saving money, maximizing yield or reducing inputs. Other factors important in weed-management decisions are perceived simplicity, manufacturer incentive programs and crop safety.

Red rice is one of the most troublesome weeds in Louisiana rice production and has been recognized as a weed in U.S. rice fields for more than 150 years. However, in 2002, imidazolinone-resistant rice, which was developed at the LSU AgCenter Rice Research Station and sold under the trade name Clearfield, became commercially available. This offered the opportunity to effectively control red rice with no effect on the crop. In 2010, approximately 70 percent of the total rice acreage in Louisiana was Clearfield varieties.

The main herbicide used in Clearfield rice is imazethapyr, sold under the trade name Newpath. It provides broad-spectrum weed control with both soil and foliar activity. Newpath has excellent activity on red rice and other grass weeds, but its activity is inconsistent on other weeds such as yellow nutsedge, hemp sesbania and Indian jointvetch.

Mixing two or more herbicides – often referred to as mixtures or tank-mixes – has been beneficial in improving efficacy and broadening the spectrum of weed control. For many years, the weed control program for rice in the South centered on the herbicide propanil, which has long been used to control annual grass and broadleaf weeds. Several formulations of propanil include Stam M4, Stam SC, Stam EDF, RiceShot and SuperWham. With this in mind, the objective of this study was to evaluate the economic effects of these various propanil formulations with Newpath applied at early postemergence or late postemergence in Clearfield rice production.

The standard program included Newpath at 4 ounces per acre applied early postemergence followed by Newpath at 4 ounces per acre applied late postemergence. When any propanil formulation was added at 3 quarts per acre in either first application of Newpath, red rice control increased compared with the standard program. Throughout the growing season, this trend was observed on red rice, barnyardgrass, alligatorweed and texasweed. From a weed control standpoint, SuperWham, RiceShot and Stam EDF appeared to be the better propanil formulations if used with the second application of Newpath.

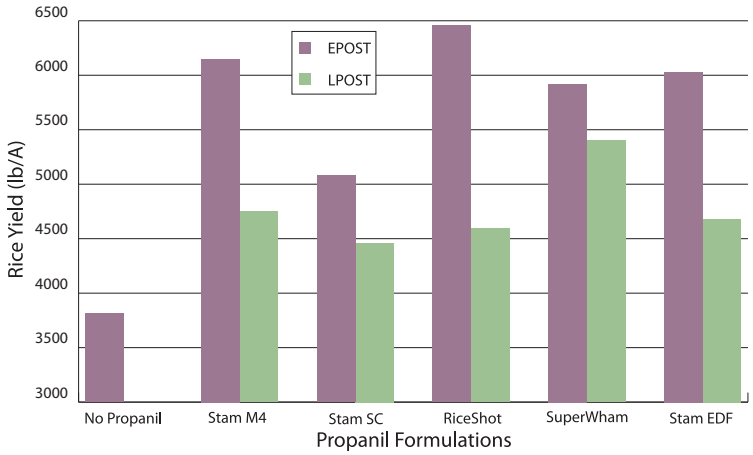
Regardless of timing, weed control with a propanil-Newpath mixture was equivalent to or higher than the standard program of two Newpath-only applications. The addition of propanil, regardless of formulation, also was observed to be more effective for weed control when added in the first application of Newpath instead of the second application. This increase in control indicates the benefit of incorporating other herbicides in a mixture with Newpath to maximize weed control across multiple weed species.

Rice yield, milling and rice grade were determined. Rice treated with the standard Newpath program had a yield of 3,810 pounds per acre (Figure 1). The percent whole rice kernels over percent whole plus broken rice kernels indicated that the standard Newpath program resulted in a milling yield of 65/71 with a rice grade of 3. Rice treated with propanil, regardless of formulation, in the first Newpath application or with SuperWham in the second Newpath application resulted in yield increases of 1,270 to 2,650 pounds per acre, compared with the standard program. However, no differences in milling yield and rice grade were observed.

In every case, rice treated with any propanil formulation mixed in the first or second application of Newpath increased rice yields compared with the standard treatment. Rice yields increased more when propanil was added to the first Newpath application compared with adding propanil to the second Newpath application. Previous research has shown that controlling weeds in rice within the first three to four weeks after emergence increases rice yields. This is why adding propanil in the first application of Newpath is more beneficial. The weeds are smaller, and control is achieved before competition from weeds can reduce rice yields.

Profitability of these herbicide programs can be determined by evaluating the total value, which was calculated by multiplying the rice yield by the rice price. Therefore, the effect of propanil in a mixture with Newpath on rice yield and quality will directly affect total product value. Also, the net returns above

Figure 1. Rice yield with Newpath plus propanil formulations applied at different application timings.



When weeds are controlled early, weed competition is reduced and yields are increased, producing higher profits.

herbicide cost can be calculated by subtracting the cost of the herbicide from total product value (Figure 2).

The standard Newpath program returned a total product value of $490 per acre and a net return of $450 per acre. Programs that included propanil with the initial Newpath application or SuperWham with the second application increased total product value by $160 to $340 per acre compared with the standard program.

Programs that included propanil in the initial Newpath application increased the net returns above herbicide cost by 29 percent to 71 percent compared with the standard program. The addition of propanil in the second application of Newpath increased net returns above herbicide cost by 11 percent to 42 percent. Even though total product value was increased with Stam SC, the overall increase was lower for each timing because of the increased herbicide cost. A mixture of Newpath plus RiceShot in the first application gave a 71 percent increase in returns over herbicide cost compared with the standard treatment.

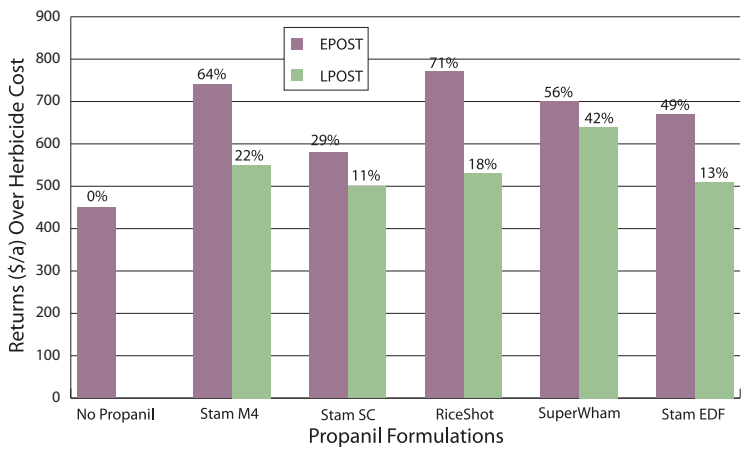
These data indicate that adding propanil in with Newpath increases profits, even though treatment costs increase. This increase in profit was due to increased weed control and higher rice yield, which increased total product value and made up for the additional herbicide cost.

Adding propanil in mixture with Newpath proved to be beneficial in a total weed-management program. The herbicide programs evaluated in this study resulted in higher rice yields and net returns when the early postemergence application included a propanil formulation. A herbicide program that included RiceShot or Stam M4 in the early postemergence application maximized overall economic returns. When propanil was applied in the late postemergence application, however, overall economic returns were maximized with SuperWham.

Increased weed pressure, even for a short time, decreases rice yield. Therefore, producers should treat weed problems early. When weeds are controlled early, weed competition is reduced and yields are increased, producing higher profits. ■

Eric P. Webster, Florence Avalon Daggett Professor in Rice Research, and Tyler P. Carlson, Graduate Research Assistant, School of Plant, Environmental & Soil Sciences; Michael E. Salassi, J. Nelson, Fairbanks Professor, Department of Agricultural Economics & Agribusiness.

Figure 2. Net returns above herbicide cost with Newpath-plus-propanil formulations. The percent increase in returns over herbicide costs compared with the standard program are listed above each bar.



About the Study

Weed scientists conducted the study at the LSU AgCenter Rice Research Station near Crowley to evaluate various herbicide programs. The long-grain rice variety Clearfield 131 was planted at a rate of 75 pounds per acre, and the herbicide programs included:

A propanil formulation in mixture with Newpath applied early postemergence (after the plants emerged from the soil) followed by Newpath alone applied late postemergence.

Newpath alone applied early postemergence followed by Newpath plus a propanil formulation applied late postemergence.

The propanil formulations evaluated were Stam M4, Stam SC, Stam EDF, RiceShot or SuperWham at the equivalent of 3 quarts per acre and Newpath at 4 ounces per acre. A crop oil concentrate, Agri-Dex, at one percent by volume was added in each application, except for Stam M4 and RiceShot, which are formulated so crop oil is not recommended.

Economic evaluations were based on an average long-grain rice price of $0.13 per pound with price deductions based on rice grade. Actual rough rice market prices are adjusted by grade, and these grade price discounts can vary across rice mills.

In this study, rice price deductions for grades 1, 2, 3, 4, 5, 6 and sample grade were zero, zero, $0.25, $0.55, $1.25, $1.50 and $2 per hundredweight, respectively. Newpath was priced at $525 per gallon, Agri-Dex at $15 per gallon, Stam M4 at $25 per gallon, Stam SC at $37 per gallon, Stam EDF at $15 per pound, RiceShot at $30 per gallon and SuperWham at $33 per gallon.

The profitability of each herbicide program was determined by evaluating the total value of the product, which was calculated by multiplying the rice yield by the rice price. Net returns above herbicide cost also were evaluated, with the net return equal to the total value of rice minus the herbicide cost. ■

Apply Newpath Early

Maximize returns of Clearfield rice

Eric P. Webster, Tyler P. Carlson, Michael E. Salassi and Jason A. Bond

Red rice is one of the most troublesome weeds of rice in the South. Because of genetic similarities, controlling red rice with traditional rice herbicides has been unsuccessful.

Imidazolinone-resistant rice is tolerant to the imidazolinone class of herbicides, which effectively control red rice with no effect on the crop. This rice is sold under the trade name Clearfield.

The target herbicide for use in Clearfield rice is imazethapyr, sold under the trade name Newpath. Clearfield rice should be treated twice with Newpath at a rate of 4-6 ounces per acre per application. Because of cost and weed management concerns, research was conducted to evaluate the weed control, crop response, cost, yield and overall economic return of Newpath at various application timings and rates throughout the growing season.

In this study the initial application of Newpath applied at rice emergence controlled 89 percent of the red rice and 90 percent of the barnyardgrass. When the initial application of Newpath was delayed by one to four weeks after emergence, control decreased below 60 percent. This indicates the importance of applying Newpath on small, actively growing red rice to maximize weed control.

Initial applications of Newpath applied at rice emergence resulted in a rough rice yield of 4,280 pounds per acre (Figure 1). By delaying the initial application by one to three weeks after emergence, yield was reduced an average of 1,360 pounds per acre. By delaying to four weeks after emergence, overall yield was reduced by 2,160 pounds per acre.

The rice industry measures the milling yield of rice by the percentage of whole kernels over the percentage of total kernels (whole plus broken) remaining after the hulls and bran layer have been removed through milling rough rice. When Newpath was applied at rice emergence, the milling yield was 61/69 with a rice grade of 3. Delaying the initial application of Newpath to one, two and three weeks after emergence resulted in 28, 37 and 30 percent decreases in rough rice yield, respectively (Figure 1). Milling yield and rice grade for these timings were 59/69, grade 5; 58/66, grade 6; and 61/70, grade 5. By delaying the initial application to four weeks after emergence, rough rice yield decreased by 50 percent, compared with the initial application at emergence, with a milling yield of 60/69, grade 6.

These data indicate that delaying the initial application of Newpath decreases rough rice yield because of the increase in weed competition. Results also indicate that weed control played a direct relationship on rice quality. When weed control was reduced, rice quality decreased. Rough rice yield and quality were maximized when the initial application of Newpath was applied at rice emergence.

Profitability of Newpath treatment programs can be determined by evaluating the total value product, which is the rough rice yield multiplied by the price of rice. Therefore, the effects of Newpath applied at different times on rough rice yield and quality will directly affect total value product. The initial application of Newpath applied at rice emergence resulted in a total value product of $550 per acre. Delaying the initial application to one, two or three weeks after emergence decreased total value product 38, 47 and 40 percent, respectively, compared with the program of Newpath at emergence followed by Newpath at two weeks after emergence. Delaying the initial application to four weeks after emergence decreased total value product 61 percent compared with the initial application applied at rice emergence.

Figure 1. Yield from Rice Treated with Newpath followed by Newpath Application.

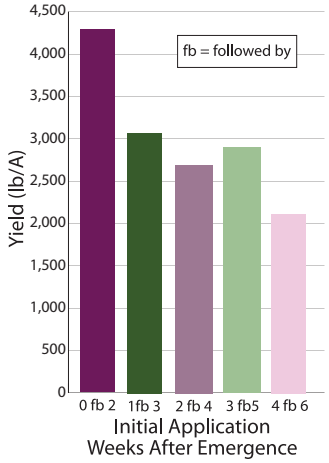


Figure 2. Net Returns above Herbicide Cost with Different Newpath Application Timing.

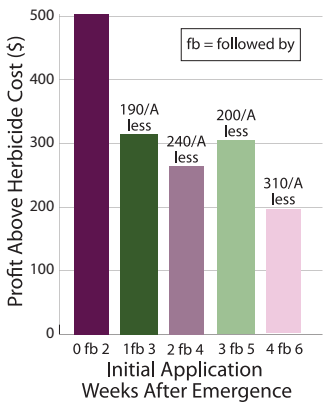


Figure 3. Yield from Rice Treated with Different Newpath Rates.

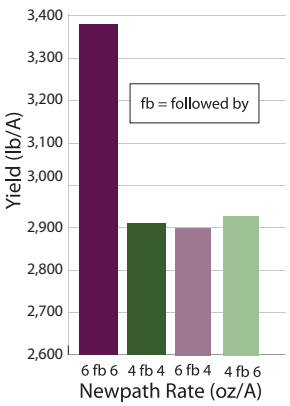
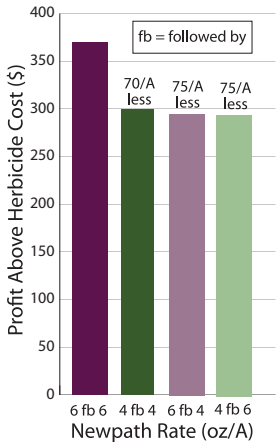


Figure 4. Net Returns above Herbicide Cost with Different Newpath Application Timings.



Net returns above herbicide cost were also evaluated, where the net return above herbicide cost equals the total value product minus the Newpath program cost (Figure 2). However, because all Newpath rates were averaged across application timing, the average Newpath cost was $45 per acre. Applying the initial application of Newpath at emergence followed by the second application two weeks later provided a $505-per-acre net return above herbicide costs. However, by delaying the initial application to four weeks after emergence, the net return above herbicide cost dropped below $200 per acre.

The standard Newpath program of 4 ounces followed by 4 ounces per acre resulted in a rough rice yield of 2,910 pounds per acre with a milling yield of 59/69, grade 5 (Figure 3). Newpath programs that included at least one 4-ounce-per-acre Newpath application resulted in a rough rice yield similar to the base Newpath program. However, when both applications were applied at 6 ounces per acre, rough rice yield was 3,380 pounds per acre with a milling yield of 62/69, grade 4. These data indicate that increasing the rate of Newpath for both applications to 6 ounces per acre increases rice yield and quality, which will directly benefit the total value product.

Because application rates varied, the costs of treatment will play a bigger role in overall profit compared with the timing evaluations. The standard Newpath program resulted in a total value product of $340 per acre. The cost was $40 per acre, which gave a net return above herbicide cost of $300 per acre (Figure 4). When Newpath was applied at 6 ounces followed by 4 ounces per acre and at 4 ounces followed by 6 ounces per acre, the total value product was $340 per acre for both treatments. However, the cost of each increased to $45 per acre and the net returns above herbicide cost decreased by 2 percent, compared with the standard program.

Newpath applied at 6 ounces followed by 6 ounces per acre resulted in a total value of $420 per acre. This program had the highest herbicide cost at $50 per acre; however, the net returns increased by 23 percent compared with the standard program.

These data indicate that the higher rates of Newpath applied at both locations resulted in increased profits, even though costs of treatment increased. This increase in profit was due to higher rice yield and quality, which increased total value product and overcame the additional cost of herbicide.

The effectiveness of Newpath will depend on the weed spectrum and weed densities. However, earlier Newpath applications were more effective in controlling red rice and barnyardgrass. Newpath programs evaluated in this study produced higher rough rice yields, rice quality and returns when the initial application of Newpath was applied at rice emergence. A program of 6 ounces per acre followed by 6 ounces per acre increased rough rice yield and quality.

The data indicate that Newpath application timing, averaged across various rates, increases weed control, rice yield and overall economic returns when applied early. Also, data indicate that Newpath applied at the higher rate for both applications, averaged across different timings, was more beneficial. Therefore, it may be concluded that the initial application of Newpath applied at 6 ounces per acre at rice emergence followed by a second application of 6 ounces per acre two weeks later would maximize overall rice production. Increased weed pressure, even over a short period of time, decreased rice yield.

Producers are encouraged to be aggressive and treat weed problems early in the growing season. When weeds are controlled early and the crop has minimum weed competition, rice plants produce higher yields, which in turn produce higher profits. In this study, economic returns nearly doubled when the initial application of Newpath was applied at rice emergence. ■

Eric P. Webster, Florence Avalon Daggett Professor in Rice Research, and Tyler P. Carlson, Graduate Research Assistant, School of Plant, Environmental & Soil Sciences; Michael E. Salassi, J. Nelson Fairbanks Professor, Department of Agricultural Economics & Agribusiness; Jason A. Bond, Associate Professor, Delta Research and Extension Center, Mississippi Agricultural and Forestry Experiment Station, Stoneville, Miss.

About the Study

Weed scientists conducted the study at theLSU AgCenter Rice Research Station near Crowley and the Mississippi State University Delta Research and Extension Center near Stoneville, Miss. The long-grain rice cultivar Clearfield 131 was drill-seeded at both locations.

The initial application of Newpath was applied at plant emergence or at one, two, three or four weeks after emergence followed by a second application of Newpath 14 days after the initial application of each treatment. Newpath was applied in four combinations:

- 4 ounces per acre for both applications.
- 6 ounces per acre for both applications.
- 6 ounces per acre followed by 4 ounces per acre.
- 4 ounces per acre followed by 6 ounces per acre.

A crop oil concentrate was added in each application at 1 percent by volume. Red rice and barnyardgrass pressure was high with 40 to 60 plants per square yard.

The economic analysis was based on the average long-grain rice price of $13 per hundredweight with price deductions based on rice grade. Actual rough (unmilled) rice market prices were adjusted by grade, and these grade price discounts can vary among rice mills.

Rough rice price deductions for grades 1, 2, 3, 4, 5, 6 and sample grade were zero, zero, $0.25, $0.55, $1.25, $1.50 and $2 per hundredweight, respectively. These price reductions are representative of actual market price discounts based on the grade of rice for sale.

Newpath was priced at $525 per gallon, and the crop oil concentrate was priced at $15 per gallon. Profitability of the herbicide programs was determined by evaluating the total value product, which was calculated by multiplying the rough rice yield by the price of rice. Net returns above herbicide cost also were evaluated using the net return (the total value product) minus the herbicide program cost. ■

Biofuel Profitability

Paths to prosperity for small and medium-sized producers in Louisiana and Mississippi

Richard P. Vlosky

Baseline data is needed to help forest and agricultural producers determine their role in the rapidly growing biofuel and energy sector, including small and medium-sized producers. The supply chains for getting wood and other bio-based feedstock from producers to consumers have not been clearly established.

A team of researchers received $409,000 from the U.S. Department of Agriculture's Agriculture and Food Research Initiative to examine these issues in Louisiana and Mississippi. Small agricultural producers and forest landowners are those with 10-139 acres, and medium-sized producers are those with 140-999 acres. The project results will indicate how emerging bio-based technologies and markets can be integrated into business models, how new business opportunities can be identified and how innovative management strategies can be adopted to enhance profitability and diversify revenue streams. Forest residues, dedicated forest biomass production, agricultural energy crops and residuals, as well as poultry litter, are feedstocks being explored.

The study is being conducted in three phases. Phase I focuses on developing qualitative and quantitative information on agriculture and forestry in the focus regions. This is being done through focus groups and a mail survey to 9,000 small and medium-sized enterprises in Louisiana and Mississippi.

Phase II will be a more detailed examination of alternative market-product scenarios that will estimate county/parish, regional and state economic effects. Phase III will provide stakeholders the results from the first two phases through workshops and publications.

Three study regions were selected in the two states, each focusing on a unique potential biofuel-bioenergy feedstock from agriculture and forests as well as poultry litter. Each study region will receive an array of scenarios for different biobased products and business strategies. Financial risk will be evaluated, and estimates of regional and state economic effects will be made. A map showing the regions is available online. Go to www.LSUAgCenter.com and click on Louisiana Agriculture Magazine.

Delta Region. Poverty is a significant problem in the Delta Region, which contains some of the poorest census tracts in United States. Agriculture is a major land use in the region. Most acreage in the Delta is in soybean, corn and rice production, with additional acres in catfish production. Forests constitute about one-quarter of the land use, primarily in areas along streams unsuitable for tillage because of erosion. This region has some of the most productive soils in the world and will likely remain dominated by row-crop agriculture.

Central Mississippi. Central Mississippi is home to numerous poultry operations. Seven counties each produce more than 50 million broilers a year, and poultry production is important to the economies of more than 12 additional counties. Central Mississippi is dotted with poultry houses interspersed among forests and pastureland. The poultry industry comprises a large number of independent producers that sell to major manufacturers such as Sanderson Farms, Tyson and others. This region is a significant producer of timber, the state's No. 2 agricultural commodity. Diversifying income streams through additional revenue sources would enhance productivity of these producers, most of whom have small to medium-sized farms.

Southwest Louisiana. Compared with northwest Louisiana and the Louisiana Florida Parishes north of Lake Ponchartrain, the southwest region of the state has a relatively low current level of forest utilization. ■

Study Summary

Following is a summary of finding from the focus group sessions:

The energy industry has an interest in incorporating biomass feedstock.

Farmers feel a poultry industrywide approach will be needed for biofuel production. This structure may include annual payments and crop specifications provided by the biofuel production facilities.

It may be easier to transition from forested areas into forest biofuel production than from agricultural enterprises because agriculture is more geared toward annual land payments in the form of crop revenue or land rental.

Forest owners are skeptical of planting non-native, energy-crop tree species, like eucalyptus, for biofuel production because of the effects on wildlife and a lack of alternative if biofuel production is unsuccessful.

Many farmers and forest owners mentioned a willingness to be on the forefront of the development of the biofuel industry because the maximum potential for return on investment comes from being an early investor.

The top concerns are profitability and risk. A secondary concern is the environmental impact of biomass growth and harvesting on wildlife habitat, soil nutrients and erosion.

The pulp and paper industry will accept competition for forest biomass, but only if there are no biofuel subsidies that create a competitive imbalance.

Subsidies are useful mechanisms to bolster the establishment of a biofuel industry, but the sector or venture must be economically sustainable without subsidies.

Richard P. Vlosky, Crosby Land and Resources LLC Professor and Director of Forest Products Development, School of Renewable Natural Resources.

Hessian Fly

An emerging wheat pest in Louisiana

Fangneng Huang, Stephen Harrison, B. Rogers Leonard, Mukti Ghimire and Paul P. Price III

Photo by Fangneng Huang

Larvae of Hessian fly usually feed on stems at the joints under the leaf sheath, preventing leaf growth and nutrient movement.

Hessian fly is one of the most destructive pests of wheat worldwide. This pest was first detected in the United States on Long Island, N.Y., in 1778, and is thought to have been introduced to this country by the Hessian soldiers during the Revolutionary War. Hessian fly may feed on rye, barley and wild grasses, but wheat is the preferred host. The larvae usually feed on the stem at the joints under the leaf sheath (See photo), which prevents elongation and nutrient transportation. Stunted stems may lead to plants breaking or lodging, reduced grain fill and even death, especially in early plant growth stages. The number of generations of Hessian fly per year in Louisiana is unknown, but four to six generations may occur each year in the southern United States.

Serious Hessian fly problems are usually associated with susceptible wheat varieties, summer double-cropping in reduced-tillage production systems, increased wheat acreage, early planting and mild winter temperatures. Among these, wheat variety susceptibility to Hessian fly is often the most important factor.

Hessian fly occasionally has been observed in Louisiana wheat fields but has not been a yield-limiting problem until recently. Wheat is planted in fall and harvested the following spring. During the 2007-2008 crop season, Hessian fly seriously damaged wheat in many fields across Louisiana. Yield losses were estimated to be 60-80 percent in some south Louisiana fields. Planting Hessian fly-resistant wheat varieties appears to be the most effective strategy for managing this pest.

Hessian fly was not a significant problem in Louisiana before 2007; therefore, research evaluating management strategies is limited. Hessian fly resistance historically has not been considered an important factor when Louisiana producers select wheat varieties.

LSU AgCenter scientists conducted field trials to clarify the occurrence and damage of Hessian fly on wheat and to provide information on genetic resistance to local Hessian fly populations. To do this, 26 wheat varieties were selected from the LSU AgCenter wheat performance trials and evaluated for the presence of and injury by Hessian fly at two locations during the 2008-2009 crop season. For details, see the table in the online version of the magazine. Go to www.LSUAgCenter.com and click on Louisiana Agriculture Magazine.

Location one was a wheat field at the LSU AgCenter Macon Ridge Research Station near Winnsboro, La. This field was managed to maximize over-summering of Hessian fly populations. Location two was a producer's field near Maringouin, La. Many wheat fields in this area were severely damaged by Hessian fly during the 2007-2008 crop season.

Natural Hessian fly populations in both trials were high, and susceptible wheat varieties were damaged heavily during spring 2009, particularly in the trial near Maringouin. (View photos in the online version.)

The relative occurrence of Hessian fly for a given variety was generally consistent between the two locations. Six of the seven varieties with the lowest fly populations and four of the seven varieties with the highest insect populations were the same in both locations. The number of larvae and pupae on the seven varieties with lowest Hessian fly populations in the trial near Winnsboro ranged from zero to 1 insect per plant. Of the seven varieties with the highest Hessian fly populations, numbers ranged from 3.8 to 6.6 insects per plant. In the trial near Maringouin, the number of larvae and pupae on the seven varieties with lowest Hessian fly populations ranged from zero to 0.9 insects per plant, while the larvae and pupae on seven varieties with the highest populations ranged from 5.7 to 9.9 insects per plant.

Overall, grain yield was higher in the Winnsboro trial than in the Maringouin trial. Yield was negatively correlated to the relative Hessian fly populations in both locations, especially during the early growth stages. Yield of the seven varieties with the highest yields in Winnsboro ranged from 71 to 74.9 bushels per acre, while the seven varieties with the lowest yields ranged from 41.1 to 56.5 bushels per acre.

In the Maringouin trial, yield of the seven varieties with the highest yields ranged from 37.5 to 73.5 bushels per acre, while the seven varieties with the lowest yields ranged from 2.2 to 5.9 bushels per acre. The lowest yield, incidentally, was 97 percent lower than yield for the resistant variety in the trial. Several varieties with the smallest populations of Hessian fly also demonstrated good yield performance in both trials.

The results of these trials demonstrate that high yielding and Hessian fly resistant varieties are available in Louisiana. Additional wheat varieties are being evaluated, and LSU AgCenter scientists are conducting field trials to evaluate seed treatments and foliar-applied insecticides. Data from these studies will be used to develop effective strategies for Hessian fly management. ■

Fangneng Huang, Associate Professor, Department of Entomology; Stephen Harrison, Walker T. Nolin Professor of Agronomy, School of Plant, Environmental & Soil Sciences; B. Rogers Leonard, Professor and Jack Hamilton Chair in Cotton Production, Macon Ridge Research Station; Mukti Ghimire, Research Associate Specialist, Department of Entomology; and Paul P. Price III, Extension Associate, Macon Ridge Research Station.

Louisiana Farmers Markets

How LSU students, who are millennials, will shape the future of these food outlets

Joshua D. Detre, Benjamin M. Clark, Tyler B. Mark and John Westra

The establishment of a local farmers market poses many challenges for stakeholders. Not only must they contend with supply-chain issues and government rules and regulations, but they also must worry about sufficient demand to make the market economically viable. In particular, operators of and suppliers to farmers markets should pay particular attention to the fresh produce shopping habits of the millennials, individuals born in the 1980s and 1990s.

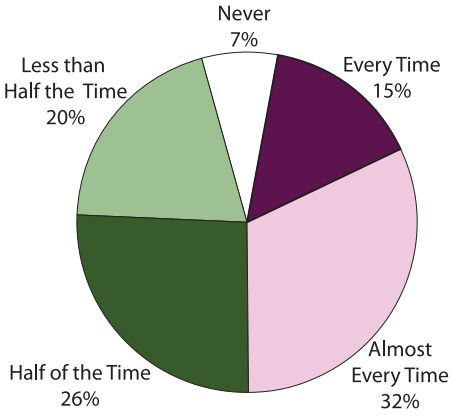
The first group of millennials has begun transitioning into adulthood, joining the workforce and starting families. Millennials are different from their predecessors – Generation X (1960-1980), the baby boom generation (1946-1960) and the Silent Generation (1930-1945). Millennials are more highly educated and technologically connected. They have different attitudes, values, behaviors, lifestyles and ethnic diversity.

Farmers markets should promote quality products with good nutritional content at affordable prices.

A majority of these millennials have just entered or will soon enter college and represent a highly sought-after market segment, given their numbers, trend-setting ability and purchasing power ($200 billion annually). Of particular interest to farmers market stakeholders is that college-educated millennials are more likely to engage in green and sustainable practices, such as buying local, buying organic or recycling, relative to other generations. Moreover, this generation is becoming increasingly concerned about health as they change their diet from one consisting of mostly fast foods to a diet rich in fruits and vegetables. Research shows that increased consumption of fruits and vegetables can lower the chances of developing chronic diseases such as heart disease and cancer. Farmers markets provide a viable shopping alternative to traditional retail outlets, and the millennial generation will likely help determine the future economic viability of farmers markets in Louisiana. Consequently, farmers market vendors must understand this generation's needs, particularly those that are obtaining a college education, and then develop strategies, which meet these needs.

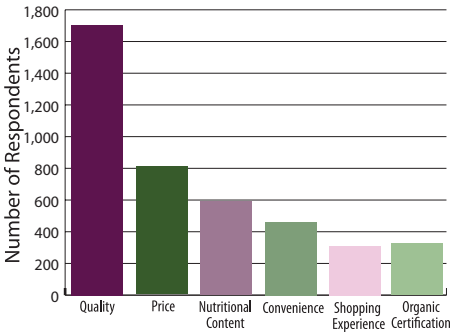
The principal goal of this study was to determine the fresh produce shopping habits of LSU students, part of the millennial generation, at farmers markets. In particular, LSU AgCenter researchers were interested in understanding the specific factors that influence students' decisions to shop at a farmers market because the motivation behind shopping at a farmers market is often different from the motivation for shopping at a traditional grocery market. The results of this research can be used in conjunction with the LSU AgCenter's Louisiana MarketMaker program. This free, online, searchable database allows consumers to search for locally produced food from farmers and farmers markets. Louisiana MarketMaker allows local food producers to develop business profiles that showcase their produce and farming operation, as well as use census data on local populations to help target certain demographics, such as millennials, or consumption preferences, such as fresh produce. Consequently, farmers markets and farmers can develop business profiles that appeal to the needs and wants of the millennial generation. For those local producers attempting to establish a farmers market, they can search for areas where there are large concentrations of college-aged and educated millennials.

Figure1. Breakdown of fresh fruit and vegetable use when cooking.



The student body at LSU has more than 28,000 students, most of whom are part of the millennial generation. As these students transition into higher paying jobs, they will become a coveted and important market segment to Louisiana farmers, especially those who plan to utilize farmers markets as an outlet for their product. To understand the factors and characteristics that influence students to shop at farmers markets, a university-wide questionnaire was administered to all LSU students through the university's e-mail system, a service that every registered student, faculty and staff has and must use to get official university messages. There were 2,802 completed and usable surveys returned for a response

Figure 2. Factors influencing the purchase of fresh fruits and vegetables.



rate of about 10 percent, which is considered reliable to provide data on student perceptions and buying habits associated with farmers markets.

Survey results show that college-educated millennials value fresh produce from a farmers market as part of their diet, but the factors influencing their purchase decisions are quite varied. More than half of the student respondents (57 percent) have previously attended a farmer market, while slightly less than a third (32 percent) of the students use fresh fruits or vegetables almost every day or every time they cook (Figure 1). Though this indicates that students are aware of farmers markets and of the importance of using fresh fruits and vegetables when they cook, there still exists a substantial amount of untapped market potential with millennials.

The top three factors (Figure 2) rated most important to students when they shop for fresh fruits and vegetables are quality (1,706 students ranked it No. 1), price (802 students) and finally nutritional content (591 students). Surprisingly, almost half of the students ranked organic certification as the fifth or sixth most important factor in shopping for fresh fruits and vegetables. These results indicate that Louisiana farmers and other stakeholders involved in the production of fresh fruits and vegetables in their promotion of locally sourced products should concentrate their marketing on promoting quality products with good nutritional content at affordable prices.

If locating in urban areas, it is essential that the market be on routes easily accessed via public transportation, such as a stop on a bus route, or convenient to major thoroughfares. Results from the survey indicate that 71 percent of the students at LSU say the primary reason for not shopping at a farmers market more often is that the locations are inconvenient. In addition, the results show that the students value convenience in the form of hours of operation, and that it was the second largest factor for why students do not shop at farmers markets more frequently (46 percent). Students indicate they would prefer to shop after 3 p.m., as opposed to the morning when many farmers markets are typically open. It is likely convenience in terms of hours of operation and location will become increasingly important as these college-educated millennials enter the workforce, often as part of a dual income family working a nine-to-five job. Thus, farmers markets will likely have to rethink their business model, location and hours of operation to adapt to the changing dynamics of the millennial generation.

In addition, many of the millennials on the LSU campus, much like many of the other millennials in Louisiana, may not have an agricultural background. This lack of an agricultural background (only 9 percent of survey respondents were agriculture majors) creates a knowledge barrier that must be addressed. Results from the survey show LSU students have concern about the facilities where farmers markets operate and the vendors. These knowledge barriers act as disincentives for millennials to shop at farmers markets. These results suggest that extension educators as well as stakeholders in farmers markets should develop educational material to overcome these knowledge barriers.

Farmers market organizations interested in locating in and around population bases that have a large concentration of college-aged or college-educated millennials are advised to focus on the attributes highlighted in this study. By appealing to these needs, farmers markets can develop business profiles that emphasize their commitment to providing quality products and reasonable prices in easily accessed locations. Appealing to these attributes will help ensure Louisiana-based farmers markets remain financially viable. Future research will attempt to provide a comprehensive analysis of the health and nutritional benefits the millennial generation wants to obtain by shopping at a farmers market. ■

Joshua D. Detre, Assistant Professor, and Benjamin M. Clark, Extension Associate, Department of Agricultural Economics & Agribusiness; Tyler B. Mark, Assistant Professor, Department of Agricultural Sciences, Morehead State University, Morehead, Ky.; and John Westra, Associate Professor, Department of Agricultural Economics & Agribusiness.

Photo by John Wozniak

Farmers market in Baton Rouge.

Isoxadifen-ethyl and Corn

How to mitigate injury from Resolve-Counter interactions

Bill Williams, B. Rogers Leonard and Rakesh Godara

Early visual symptoms of Resolve injury include intervenial chlorosis (yellowing of the leaves between the veins), reddening and twisting. Severely injured plants will exhibit severe stunting.

Corn producers who raised corn before the introduction of Roundup Ready varieties are aware of the interaction between sulfonylurea herbicides and soil-applied organophosphate insecticides, which were in use then. Producers often were faced with selecting the best postemergence grass control product, Accent, or the best insecticide, Counter. If Counter was used at planting and johnsongrass was a problem later in the season, Accent could not be used without the risk of severe injury to corn. In Louisiana, corn yield losses associated with injury from Accent following Counter often exceeded yield losses associated with weeds.

Use of Accent for johnsongrass control all but ended after the introduction of Roundup Ready corn, which is resistant to the herbicide glyphosate. The use of Counter for insect pest management also declined as producers adopted Bt corn and new, easier-to-use insecticide seed treatments. Resolve, another sulfonylurea herbicide, has become more popular because it improves annual grass control in Roundup Ready corn. At the same time, interest has increased for using reduced rates of Counter to supplement insecticide seed treatments for improved pest management.

In recent years, some producers have discovered the hard way that, as with Accent, severe corn injury occurs when Resolve is applied following Counter. Even in the absence of Counter, sulfonylurea herbicides can injure corn when environmental conditions favor rapid herbicide uptake or reduce a corn plant's metabolic activity. As result a safener, isoxadifen-ethyl, was developed to improve crop safety.

Research at the Macon Ridge Research Station has documented the interaction between Resolve and Counter and evaluated the effect of isoxadifen-ethyl on that interaction. Resolve at 1 ounce per acre reduced corn yields 10 to 15 bushels per acre, even in the absence of Counter with no visual signs of injury. Regardless of the Counter rate, a maximum of 13 percent injury was observed from Resolve applied at the growth stage when corn has three fully formed leaves (V3). However, when Resolve was applied at V3, corn height was reduced by 54 percent when Counter was applied at 0.5 pound of active ingredient per acre and 69 percent when Counter was applied at 1 pound of active ingredient per acre at planting. Yield also was reduced, at least equally, when Resolve was applied at V3 following Counter. Applying Resolve at V6 resulted in more injury, greater vigor reductions and greater yield losses than when it was applied at V3.

Applying Resolve with isoxadifen-ethyl eliminated any negative effects on corn injury or yield when applied at V3 or V6 in the absence of Counter. Isoxadifen-ethyl also reduced visual injury symptoms and vigor reductions when Resolve was applied following Counter. Still, when Resolve followed Counter at any rate, yields were reduced by an average of 10 percent at V3 and and 55 percent at V6.

Isoxadifen-ethyl significantly reduced corn injury from Resolve following applications of Counter. Still, yield losses are likely if Resolve is applied following Counter at rates as low as 0.5 pound per acre. Isoxadifen-ethyl may not eliminate the interaction between Resolve and Counter, but it does enhance corn tolerance to postemergence applications of Resolve. ■

Photos by B. Rogers Leonard

Severe field corn injury and vigor reduction occurred following a Resolve application made at V6, where corn had received a soil-applied, at-planting application of Counter.

Bill Williams, Associate Professor and Weed Management Specialist, Scott Research/Extension Center, Winnsboro, La.; B. Rogers Leonard, Jack Hamilton Regents Chair in Cotton Production, Macon Ridge Research Station, Winnsboro, La.; Rakesh Godara, Research Associate, Northeast Research Station, St. Joseph, La.

PowerFlex

A new herbicide for managing weeds in wheat

Bill Williams, Rakesh Godara and Suzanne Laird

Annual bluegrass and henbit are the most common and frequently targeted weeds in Louisiana wheat. Ryegrass is the most challenging weed to manage in Louisiana wheat and is increasing in abundance.

Finesse and metribuzin and are the most economical herbicides for managing annual bluegrass and henbit, but metribuzin is limited by wheat tolerance, and Finesse is limited by rotation. As a result, the herbicide Osprey is often the herbicide of choice for managing bluegrass and henbit. Osprey, however, often fails to control ryegrass beyond the four-leaf stage. Because of this the herbicide Axial has become the standard for controlling ryegrass, although it fails to control annual bluegrass or henbit.

The most effective herbicide programs for managing bluegrass, henbit and ryegrass in wheat consist of a late fall – November to early December – application of Sencor, Finesse or Osprey followed by a February application of Axial.

A new herbicide called PowerFlex has been evaluated in trials and demonstrations since 2007. The initial results were encouraging because PowerFlex controlled bluegrass and henbit as well as Osprey and controlled ryegrass as well as Axial. In 2008, however, Osprey, PowerFlex and Axial all failed to control ryegrass. PowerFlex also failed to control bluegrass in spring 2008.

It's not well understood why ryegrass and bluegrass control were less in 2008 than in 2007. Planting in 2008 was delayed until December, resulting in later herbicide applications. Since 2008, PowerFlex has consistently controlled bluegrass, henbit, ryegrass, canary grass, cutleaf evening primrose, white clover, swinecress, buttercup and vetch. PowerFlex also suppresses wild garlic, which can be controlled by adding 0.33 ounce per acre of the herbicide Harmony Extra.

PowerFlex, a broad-spectrum herbicide, can be applied from the three-leaf to jointing stages but should be applied before grass weeds begin to produce additional stems and before broadleaf weeds are 2 inches tall. PowerFlex is best used in November or early December.

In areas with severe ryegrass infestations, a follow-up treatment with Axial in February may be needed. Ryegrass management in wheat requires two herbicide applications, one in late fall and one in February, to maximize wheat yield. If only one herbicide application can be made, it should be made in November to early December. In research trials, wheat consistently yields around 25 more bushels per acre when ryegrass is managed in November compared with February. Adding the herbicide Prowl at 1 pound active ingredient per acre to fall applications of PowerFlex improves ryegrass control at harvest from about 75 percent to 85 percent.

PowerFlex is applied at 3.5 ounces per acre regardless of soil type, wheat variety or weed growth stage. It must be applied with a nonionic surfactant or crop oil concentrate, although crop oil concentrate increases the risk of wheat injury. In most cases, nonionic surfactant is preferred. The addition of 32 percent urea ammonium nitrate at 2 quarts per acre improves the control of larger or stressed weeds. Like Osprey, PowerFlex will not control ryegrass resistant to ALS-inhibitor herbicides. The label does not include bluegrass as a controlled weed, and this limits PowerFlex's usefulness in Louisiana.

Overall, PowerFlex is an excellent foundation herbicide. It does not have the tolerance issues associated with metribuzin or the rotation issues associated with Finesse. As with metribuzin and Finesse, PowerFlex takes care of most weeds in the fall and allows producers to focus on controlling ryegrass with Axial in spring. ■

Bill Williams, Associate Professor and Weed Management Specialist, Scott Research/ Extension Center, Winnsboro, La.; Rakesh Godara, Research Associate, Northeast Research Station, St. Joseph, La.; Suzanne Laird, Research Associate, Scott Research/Extension Center.

Super Plants promote nursery industry

It's tough to become a Super Plant. But once a plant gets that designation, it will be promoted as an ideal plant for Louisiana. Nurseries across the state will have good supplies.

The LSU AgCenter released its first group of three Louisiana Super Plants in October 2010. The second group of four was announced in February 2011.

"We'll be promoting Super Plants each spring and fall," said Regina Bracy, resident coordinator of the LSU AgCenter Hammond Research Station. "The plants are grown by Louisiana nursery growers and marketed through retail establishments across the state."

Super Plants have made it through two years of testing all over the state and have survived Louisiana's summer heat.

"The program will initially include annual and perennial flowers and later will include shrubs, trees, vines and ground covers, everything you can plant and grow in Louisiana," Bracy said.

The first group of Super Plants included the Amazon series dianthus, the Camelot series foxglove and ShiShi Gashira camellia. The Super Plants promoted for spring and summer 2011 are the Serena series angelonia, Butterfly series pentas, Frostproof gardenia and Shoal Creek vitex.

The LSU AgCenter aggressively promotes Louisiana Super Plants through the news media, flyers and on its website, www.LSUAgCenter.com.

The program generates interest and awareness of these hardy plants, which allows the homeowner and professional alike to benefit from using Louisiana Super Plants for a successful landscape experience, Bracy said.

"We will continue to reach out to the industry so all retailers and wholesale growers are participating," Bracy said.

The program is funded by the Louisiana Specialty Crops Competitiveness Program provided through the Louisiana Department of Agriculture and Forestry. ■ **Johnny Morgan**

Inside:

LSU AgCenter
P.O. Box 25100
Baton Rouge, LA 70894-5100

NONPROFIT ORG
U.S. POSTAGE
PAID
BATON ROUGE, LA
PERMIT NO. 374