Vol. 55, No. 4, Fall 2012
Published Since 1957

LOUISIANA Agriculture

Assuring Our Future Through Scientific Research and Education

Moving technology into the market

LSU AgCenter
Research & Extension

LSU AgCenter
scientists at the vanguard

Agricultural research in the United States enjoys a long, rich history. While the need for such applied research was identified by President George Washington in the late 18th century, it wasn't until nearly 80 years later that states first began to gather resources and fund their own agricultural research efforts. By the time of the 1887 Hatch Act, 14 states – including Louisiana – had already established agricultural experiment stations. The Hatch Act was instrumental to provide federal funding for such stations, thereby creating an effective system to serve agricultural needs nationwide. These investment "seeds" have yielded abundant harvests of agricultural development and technologies, which in turn have enabled the United States to become not only a world leader in food production but also a model for integration of agriculture into the successful development of a nation.

The Hatch Act stipulated that federal funds be used to "promote scientific investigation and experimentation bearing directly on and contributing to the establishment of a permanent and effective agricultural industry." So the concept of economic development in agriculture was fundamental to the mission of the agricultural experiment stations. For nearly a century, research developments and technologies developed at these facilities were made available freely to agricultural stakeholders as part of the public domain.

All that changed in 1980 with passage of the Patent and Trademarks Law Amendments Act, commonly referenced as the Bayh-Dole Act. This legislation addressed ownership of intellectual property such as discoveries, inventions, devices, creative works and processes that arose from research funded by the federal government. The Bayh-Dole Act permits a university, small business or nonprofit institution to pursue ownership of any intellectual property that it develops. This act greatly expanded a university's ability to develop, license, commercialize and collect royalty payments from its discoveries.

Many universities have long been involved in developing technologies for medical, military, communications and computer applications. One needs look no further than Stanford University and its foundational role in what became known as Silicon Valley to understand the potential of university scientists to drive economic development. But while medical and engineering research programs were becoming well-engaged with industries, agricultural research programs largely retained their focus on free release and distribution of their discoveries and technologies. The Bayh-Dole Act was instrumental to open agriculture's eyes to the economic value of their research.

In the past three decades, commercialization of agricultural discoveries by university researchers has increased dramatically. And the LSU AgCenter, through efforts of Louisiana Agricultural Experiment Station scientists, is the leader in Louisiana and ranks among the nation's top universities in this area. As you will read in this magazine, the AgCenter has been successful – a rainmaker, if you will – in generating patents, licenses, startup companies and royalty income from its inventions. From rice and sweet potato varieties to bio-based pharmaceutical companies and from food science and beverage products to drilling mud additives, our scientists continually strive to develop better solutions to the problems associated with feeding, clothing and housing a growing world population. While no one is certain where the next agricultural technology breakthrough will occur, AgCenter scientists almost assuredly will be at the vanguard.

John Russin is the LSU AgCenter vice chancellor for research and director of the Louisiana Agricultural Experiment Station.

LOUISIANA Agriculture

EDITORIAL BOARD:
John S. Russin, Chairman
Linda Foster Benedict
Rick Bogren
Regina Bracy
Barbara Groves Corns
Matt Fannin
Jack Losso
Donald Thompson
Terry Tiersch
Eric Webster

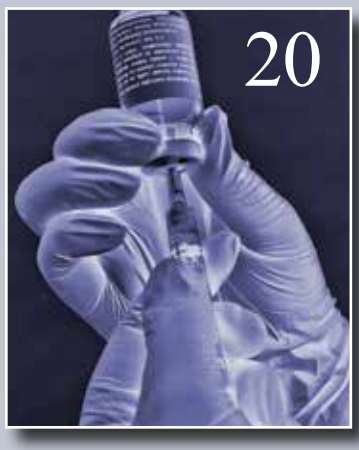
EDITOR: Linda Foster Benedict
ASSOCIATE EDITOR: Rick Bogren
DESIGNER: Kathy Kramer
PHOTO EDITOR: John Wozniak
CONTRIBUTOR: Tobie Blanchard, Craig Gautreaux, Rancy LaBauve, Johnny Morgan and Bruce Schultz
WEB DESIGN: Ronda Clark, Kathy Kramer and Megan Smith

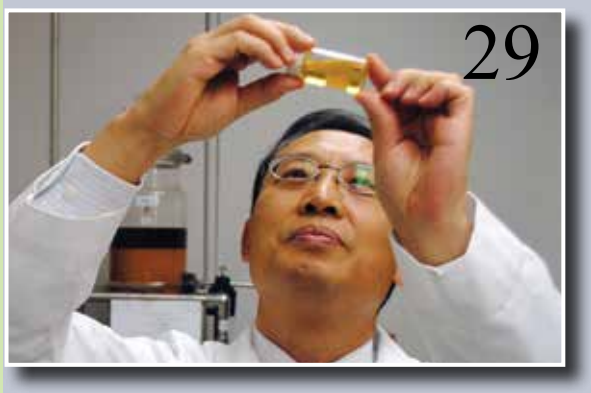
Louisiana Agriculture is published quarterly by the Louisiana Agricultural Experiment Station. Subscriptions are free. You may also subscribe to a Web version of the magazine, which is available at www.LSUAgCenter.com. Please go to the "Louisiana Agriculture Magazine" site if you would like to receive an email 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

William B. Richardson, Chancellor
John S. Russin, Vice Chancellor and Director of Research
Paul D. Coreil, Vice Chancellor and Director of Extension
The LSU AgCenter is a statewide campus of the LSU System and provides equal opportunities in programs and employment.





LOUISIANA
Agriculture

Vol. 55, No. 4, Fall 2012
Published Since 1957

Assuring Our Future Through Scientific Research and Education

On the cover: Herry S. Utomo is one of the LSU AgCenter scientists helping to create fast-growing plants for coastal restoration. Photo by Bruce Schultz

Intellectual Property Office celebrates 25 years

Wade Baumgartner

Right now is an exciting time to be engaged in the art of technology transfer and economic development at the LSU AgCenter. Since 2006, the AgCenter has obtained 24 issued patents and has gone from 16 active technology licenses to 67. Not only that, but the Office of Sponsored Programs and Intellectual Property has more than doubled annual revenue to $10 million. These royalty monies have gone to support research during this time of drastic fiscal constraints.

An equally important outcome of the work, represented in this issue, is the impact on Louisiana businesses and the state's economy. The efforts of AgCenter researchers have led to the creation of companies and the expansion of others across a spectrum of industries, including oil and gas production, functional food and beverage, pharmaceuticals, herbicide-resistant crops, advanced sugar technology, biofuels, termite eradication, coastal remediation and others. While AgCenter technologies have developed in nontraditional areas related to agriculture, the core production agricultural research of our university continues to provide critical improvements in varieties for rice, small grains and sweet potatoes, which are vital to maintaining the competitiveness of Louisiana producers.

The Office of Intellectual Property, which began in 1986, celebrated its 25th anniversary this year. In 1986, there were few companies focused on intellectual property assets. Today, however, it is rare to see any contract or agreement that does not focus a significant portion of its attention on the ownership and development rights of the intellectual property created.

The foundation for a university owning the intellectual property created by its researchers was the Bayh-Dole Act of 1980. Back then, the idea of a university owning a patent was fairly new, let alone the thought of a university being actively engaged in the development of the technology. Over the years the AgCenter's focus has been improving the lives of Louisiana citizens and beyond by leveraging the intellectual property of the university. The AgCenter can proudly claim to be a good steward of these assets, and the AgCenter is one of only 35 universities in the entire nation where the revenue generated through licensing its intellectual property not only covers the cost of the office itself but also plows a significant amount of investment back into the research endeavor of the university.

In the coming years, we see significant change coming to the enterprise of "technology transfer." The opportunities that exist to expand the relationship among the university, its stakeholders and industry will likely look different than in the past. Our office's focus continues to evolve from the early days of technology transfer. In 1986, a faculty member would bring an invention to the office, and then we would seek to find a commercialization partner. Today, we continue to promote university technology through that process, but more of our focus is on assisting faculty in developing relationships with industrial partners to solve real-world problems by applying the research strengths of the university. This approach is bearing fruit, and it is most rewarding to see industry-sponsored research addressing the real needs of Louisiana businesses and the results of that research reaching the marketplace to benefit our stakeholders through innovative products, more efficient use of resources and higher levels of employment. We look forward to building on these successes and encourage you to consider visiting with us if you are interested in starting a business based on university technology, adding a new revenue stream to your existing business by commercializing university technology, or allowing us to partner with you to research a problem and then bring that solution to market.

The first 25 years at the AgCenter Office of Intellectual Property have produced great results for the people we serve, and we expect the next 25 years to be just as successful.

Left to right: Joonhyung Cho, Intellectual Property Associate; Dirk Benedict, Marketing Coordinator; Wade Baumgartner, Director of the Office of Sponsored Programs and Intellectual Property; and Toni Strickland, Administrative Coordinator.

Wade Baumgartner is the director of the Office of Sponsored Programs and Intellectual Property.

LSU AgCenter research helps companies get a start

Johnny Morgan

In 2012, the LSU AgCenter Office of Intellectual Property celebrates its 25th anniversary. During that time it has become the leader in the commercialization of intellectual property within higher education in Louisiana.

"Our job is to connect our researchers with companies interested in the technologies that are being developed here at the AgCenter," said Wade Baumgartner, director of the Office of Intellectual Property.

Baumgartner's office handles the licensing of a number of different agreements that range from seed development to anticancer pharmaceuticals.

Since 2000, 15 new companies have started based on licensing technology from the AgCenter. Baumgartner explains the royalties from these companies and from other licensing agreements are distributed among the LSU System, the inventors and the AgCenter, where funds are funneled back into more research.

Royalties are distributed as follows: 40 percent to inventors, 15 percent to the inventor's department or research station, 10 percent to the LSU System Office, 25 percent to the vice chancellor for research and 10 percent to the chancellor's office.

Royalties from these companies and from other licensing agreements have generated more than $60 million since 1999. The most lucrative of these licensing agreements has been with the international chemical company BASF for a herbicide-resistant line of rice varieties known as Clearfield, which has generated more than $50 million.

One of the most recent products to go public is EX5, which is a sport's drink produced by H&B Beverages LLC of Covington, La. The drink has three times as many electrolytes as its leading competition, such as Gatorade and Powerade. The "5" refers to the drink's five benefits – quicker recovery, less sodium, lower calories, more electrolytes and less sugar, said the inventor, Brian Brothers.

Some other products that have gained attention in recent years are provided through Delta Land Services, which uses a mat system to help in marsh remediation and coastal restoration by catching sediment and building up the marsh areas that are continually being lost.

Other technologies have led to new crop varieties. In 2002, the development of Clearfield rice presented farmers with a variety that could be grown to withstand the use of herbicides that would kill the rice-like weed known as "red rice." This would not have happened without a collaborative partnership with BASF. Clearfield rice now accounts for about 60 percent of the rice grown in the southeastern United States.

Johnny Morgan is a communications specialist with LSU AgCenter Communications.

Facts

- As of December 2012, the total number of patents issued to the LSU AgCenter is 102, and the total number of plant variety protection (PVP) certificates is 37.
- The number of AgCenter faculty who have received patents or PVPs is 54, and 42 of them are currently on the faculty, which comprise 11 percent of our total research faculty.
- The first LSU faculty member to receive a patent was a Louisiana Agricultural Experiment Station scientist; this patent was issued to Donal Day at the Audubon Sugar Institute in 1984.

Startup companies and licensees

- H&B Beverages, LLC (2012). This sports drink company is based in Covington, La., and focuses on low-sugar, low-calorie products high in electrolytes and other valuable nutrients. Their drink line, EX5, uses technology developed by John Finley, Joan King, Darryl Holliday, Adriana Soto and Alfredo Prudente at the LSU AgCenter Department of Food Science to achieve this unique set of benefits with a great taste. EX5 is best known for having three times as many electrolytes as leading competing products, such as Gatorade and Powerade.
- American Utility Metals, LLC (AUM), (2012). A specialty stainless steels company that is based in Louisiana and operates globally has licensed the Louisiana Low Turbulence (LLT) Clarifier, a sugarcane clarifier technology. The clarifier reduces retention time and increases efficiency by more quickly separating solid particles from raw sugarcane juice and allowing more clear juice to pass through the system.
- Mt. Pelia Innovative Solutions, LLC, (2011). A Martin, Tenn., company has licensed the autonomous bird predation reduction device (also known as the "scarebot") from the LSU AgCenter. The solar-powered, self-propelled robot can move around watery areas, such as aquaculture facilities, to scare away birds by nonlethal means.
- Hole Pluggers (2009). A New Iberia-based startup was licensed by the AgCenter to produce Tiger Bullets, which are a new type of plastic-and-wood composite that prevents lost circulation in oil drilling wells.
- D&S Electrostatic Samples (2008). This Baton Rouge-based company has developed air-sampling technology that can screen for disease-causing spores.
- Energenetics (2006). This company produces resistant-starch products with the same cooking quality as regular food starch. The resistant starches have many health benefits such as preventing colon cancer and lowering the risk of heart disease. The technology will also allow for the introduction of recipes containing rice into low-carbohydrate diet programs, increasing the demand for rice and rice products, which will have a beneficial impact on Louisiana's economy.
- Esperance (2006). This biotechnology company, housed in the Louisiana Emerging Technology Center, produces cancer-treating drugs.
- NanoSolutions (2006). This company produces fabric dyes from miniscule amounts of precious metals. This dyeing technique creates lush colors that are permanent and not susceptible to bleaching or fading. The company is in Baton Rouge.
- OX-B (2003). This company produces cold sterilants used in the dental industry to sterilize dental equipment. The company is in Baton Rouge.
- TermiTech (2003). This Baton Rouge-based company licenses pop-up technology developed as an inexpensive, efficient way to monitor termites. The pop-up devices are available at a major national store.
- TransGenRx (2003). This biotechnology company produces specialized proteins, including vaccines and growth hormones, and is housed in the Louisiana Emerging Technology Center.
- Reprostat (2001). This Baton Rouge company produces veterinary drugs that can be used to sterilize dogs and cats.
- University Products (2000). This company, based in Baton Rouge, produces vaccines for the cattle industry.

Clearfield technology changes the rice industry

Steve Linscombe

Clearfield rice is grown around the world under exclusive license to BASF. Since 2003, it has brought in more than $20 million to the LSU AgCenter.

Clearfield rice production technology, which was developed by LSU AgCenter scientists, has dramatically changed rice production. It was originally licensed to the American Cyanamid Corporation in 1998. The company was later purchased by BASF, which currently commercializes the technology in a number of rice-producing countries. The technology has returned significant royalty revenues to the AgCenter and should continue to do so for the foreseeable future.

To understand the significance of this technology, it is important to know a little bit about the rice industry. Rice production is an important part of the agricultural picture in the southern United States, especially in the major producing states of Arkansas, Louisiana, Mississippi, Missouri and Texas. The mechanized production of rice began in the 1880s in southwest Louisiana utilizing some of the new agricultural implements invented during this period.

From the beginning of this industry, production was plagued by a weedy relative of commercial rice called red rice, which came in the first seed used by the fledgling industry. Most red rice biotypes are characterized by a red bran layer. Thus, if the grain is harvested and makes it through the milling process, it can cause quality reductions in the milled white rice sample. However, much of the red rice produced in a commercial rice field will never make it through the combine because red rice plants have a propensity to shatter as the seed reaches maturity. In addition, red rice seed has a pronounced dormancy mechanism. Because of the shattering and dormancy traits, once a field is infested with red rice, the seed will remain viable and problematic for many years. Because rice and red rice are so closely related, it has been difficult to develop a conventional rice herbicide that will control red rice without causing significant injury to the commercial rice crop. However, research conducted at the Rice Research Station in Crowley eventually led to the development of Clearfield rice production technology, which has allowed for the control of red rice in commercial rice production.

Because it was not feasible to develop a rice herbicide to control red rice without harming the commercial rice, the idea was to develop a new type of rice plant that would be genetically resistant to a herbicide that would control red rice. This was accomplished by a process known as induced mutation breeding, where a large number of seed is subjected to an agent that causes a high level of mutations or changes to the genetic makeup of the seed. The agent used was a chemical called ethyl methane sulphonate (EMS). After treatment with EMS, the seed were planted, and the resulting plants were sprayed with imazethapyr, a BASF herbicide known to effectively control red rice as well as conventional rice.

After 12 years of repeating this process with billions of rice seed, success was finally achieved when a lone plant survived the imazethapyr treatment. This single plant, along with several more resistant plants developed in a similar manner a few years later, allowed for the development of the Clearfield rice technology. It was finally possible to kill red rice without destroying the commercial rice crop. This then allowed, through conventional rice breeding, the development of new varieties that would be high-yielding and have the superior traits needed by the rice industry, while at the same time being resistant to imazethapyr and to a related BASF herbicide called imazamox, which is also used with the technology.

After 12 years of repeating this process with billions of rice seed, success was finally achieved when a lone plant survived the imazethapyr treatment.

The technology was first used on a limited acreage in 2002. This acreage has steadily grown through the years, and in 2012, Clearfield rice was grown on more than 60 percent of the rice acreage in the southern United States. This includes varieties developed by the LSU AgCenter, the University of Arkansas and the Mississippi State University breeding programs, as well as hybrids developed by RiceTec, a private rice-breeding company. The AgCenter receives a royalty for the resistance gene regardless of which breeding program develops the variety or hybrid. However, if the variety has been developed by the AgCenter, the royalty rate increases.

The Clearfield technology has allowed a dramatic improvement in the rice producer's ability to control red rice. Imazethapyr and imazamox also provide excellent control of many other problematic weeds in rice production. In addition to weed control, the Clearfield technology has changed

Clearfield rice allows southwest Louisiana rice farmers to drill-seed their fields, which is a practice better for the environment and less costly than aerial seeding into flooded fields. Before the advent of Clearfield, farmers had to rely on a combination of water-seeding and water management to try to prevent the red rice weed from sprouting. Photo by Bruce Schultz

the production systems used in rice farming. Before Clearfield rice, the only approach to minimize red rice on severely infested fields was a combination of water seeding and water management that prevented red rice seed from germinating. Water in soil keeps oxygen away from the seed and prevents germination. A typical system involved flooding a rice field in the early spring and then working the field in the water to destroy any red rice seedlings present. After this operation, pre-germinated seed was flown over the field. Shortly after seeding, the field was drained briefly to encourage rice seed root penetration into the soil. The trick was to leave the field drained long enough for the root to anchor but not so long that the soil cracks and oxygen finds its way to the red rice seed below the soil surface. This system only suppressed red rice, and its success was dependent on weather conditions and pumping capabilities that would allow a field to be quickly reflooded. Another major problem with this system was when fields were drained after seeding, the water leaving the field contained a high sediment load from the water tillage operation. This led to soil erosion and water quality problems in receiving streams.

The advent of the Clearfield technology meant these fields would no longer have to be worked in the water and could now be dry-seeded, in many cases using no-till or minimum-till techniques. So, in addition to improving weed control, Clearfield technology has greatly reduced soil erosion and improved water quality and overall environmental stewardship.

This technology has been rapidly adopted across the southern United States and has led to high-yielding, higher-quality rice. The reduction of red rice has also greatly benefited the milling industry, as well as consumers and other end users. In addition, Clearfield rice is also being grown today in a number of other rice-producing countries. While this research has become a very important intellectual property for the AgCenter, it also has led to dramatic improvements in productivity and environmental stewardship in rice production.

Steve Linscombe is American Cyanamid Professor for Excellence in Plant Genetics/Breeding/Biotechnology and rice breeder at the Rice Research Station. He is also the director of the Southwest Region for the LSU AgCenter.

. . . Clearfield technology has greatly reduced soil erosion and improved water quality and overall environmental stewardship.

Steve Linscombe: Rice Leader

Bruce Schultz

Steve Linscombe, director of the LSU AgCenter Rice Research Station and rice breeder, was surrounded by rice country as a boy in the town of Gueydan.

"I grew up working on a rice farm, starting when I was about 13 for a cousin, Keith Hair," he recalled. "He took me under his wing."

The young Linscombe learned how to grow rice from pulling red rice, driving a tractor and hauling 80-pound sacks of fertilizer. He worked for an uncle, Raleigh Linscombe, who owned a farm supply business in Gueydan.

Linscombe even grew his own rice crop in his family's backyard in a 100-square foot plot he impounded with levees dug with a shovel and applied herbicides and fertilizer. "It actually did fairly well."

He took vocational agriculture at Gueydan High School, where his father was principal.

He completed his undergraduate work in animal science at LSU, but remained interested in production agriculture. He obtained his master's degree in agronomy from LSU under Sonny Viator, director of the LSU AgCenter's Iberia Research Station, who was instrumental in his research training. He then went to Mississippi State University.

Linscombe said he worked alongside several Mississippi State scientists who studied a variety of crops. But he eventually focused on forage research, and he conducted a genetic study of tall fescue for his doctoral project. He credits Clarence Watson for preparing him for a career. "He groomed me as a future scientist. I owe a lot to him." Watson is now the director of the University of Arkansas Experiment Station.

Linscombe returned to Louisiana and the LSU AgCenter in 1982 as the rice specialist.

In 1988, he became the rice breeder at the Rice Research Station and has played an integral role in the development of the Clearfield rice technology.

"There were a number of people responsible for getting where we are today with Clearfield," Linscombe said. "Certainly, it all started with Tim Croughan, who did the mutation work and isolated the plant resistant to the herbicide imazethapyr. If it weren't for his work, we wouldn't have Clearfield today."

But Linscombe said establishing Clearfield and maintaining its status in the southern U.S. rice-growing region has required a considerable amount of work from scientists and their research associates.

Linscombe bred most of the varieties, and this year Clearfield varieties and hybrids made up 60 percent of the rice acreage in the South and more than 80 percent in Louisiana.

He said Eric Webster, LSU AgCenter weed scientist, had a key role with fine-tuning the herbicide used with Clearfield rice–Newpath. "He's done a substantial amount of work in optimizing performance of the herbicides in the system as well as minimizing the impacts of outcrossing."

Don Groth, LSU AgCenter pathologist, has been instrumental in helping to incorporate higher levels of disease resistance into Clearfield varieties.

Linscombe has become recognized as one of the top rice experts in the world, traveling extensively to all major rice-farming regions and speaking at numerous international conferences.

"His leadership has helped vault the LSU AgCenter to the position of premier rice research organization in the western hemisphere, perhaps the world," said John Russin, LSU AgCenter vice chancellor for research.

Steve Linscombe inspects a test plot at the Rice Research Station in Crowley, La. Photo by Bruce Schultz

Bruce Schultz is an assistant communications specialist with LSU AgCenter Communications.

Wheat and Oat Breeding

Intellectual Property Guarded, Used and Shared

Steve Harrison

The LSU AgCenter wheat research program has evolved over the past two decades into a full-scale breeding and genetics effort with significant economic impact and intellectual property value. The varieties developed by the AgCenter program and its Sungrains partners account for a large proportion of the wheat acreage and all of the oat, triticale and rye acreage grown across the southern United States each year, contributing millions of dollars to the farm economy. These crops are important as cash grain crops, in pastures to support the livestock industry, in conservation tillage, and for use as wildlife food plots.

Sungrains

Sungrains, short for Southeastern University Grains, was formed in 2005 as a partnership among five universities to develop improved wheat, oat, triticale and rye varieties for the entire region from North Carolina to East Texas. It is an unprecedented example of collaboration across state boundaries to efficiently utilize available resources for the benefit of the entire agricultural community. Sungrains initially included the LSU AgCenter as the founding institution, University of Georgia, North Carolina State University, University of Florida and Clemson University. Clemson dropped out when they discontinued their breeding program. Sungrains was endorsed for a second five-year period in 2011, and the University of Arkansas and Texas A&M AgriLife joined the partnership.

Germplasm

Germplasm is the lifeblood of any wheat breeding program. It is the assemblage and distillation of desirable genes that contribute to the genetic potential of a wheat variety in a given environment or region. The longer and more intensely a breeding program develops germplasm for a given region, the more valuable that germplasm is as intellectual property in churning out improved varieties. The germplasm base of the AgCenter program is uniquely adapted to the Gulf Coast region and has produced a number of highly productive varieties valuable for growers in the area.

Economic Impact

It takes 10 to 12 years of research to develop a new wheat variety, and program expenses are several hundred thousand dollars per year. But when a successful variety is released, it provides many millions of dollars in economic stimulus to the farm economy. As an example, Terral LA841 was released by the LSU AgCenter in 2002 and became the dominant wheat variety across the state and region within a few years. It has contributed millions of dollars each year to the local economy through higher yields and lower production costs, paying for program costs many times over. LA01110D-150 wheat released in the summer of 2012 will be licensed and available to growers starting in the fall of 2013 and should increase yields and profitability for growers for the next 10 years. Foundation seed was produced by the Georgia Seed Development Commission in 2012 under the auspices of the Sungrains agreement at no cost to the LSU AgCenter program, with commission costs being recovered through sales of foundation seed to the licensing company.

The LSU AgCenter breeding program has developed and released 10 oat varieties and six wheat varieties since 2005, which have all been exclusively licensed to various seed companies for distribution to growers. The program has also contributed to the development and release of numerous other varieties through the Sungrains partnership. All of these varieties carry a royalty fee returned to the AgCenter to help support the breeding program and the institution. Sungrains breeders have released 14 oat, 18 wheat and two triticale

Kermit, the small plot combine with full electronics, was purchased in 2009 to support the wheat breeding program. Such specialized equipment often costs as much or more than a full-scale farm version. Photo by Kelly Arceneaux

varieties in that same timespan.

Financing a public plant breeding program is complex and involves many funding streams. Thirty years ago most university plant breeding programs were funded directly through taxpayer dollars allocated by the state. There was little pressure on the plant breeding program to develop independent funding sources, an activity that has become almost as crucial as the science and art of plant breeding in recent years.

This all changed starting around 1980 when tax dollars to support agricultural research for the public benefit began to decrease. The LSU AgCenter wheat program was fortunate enough to gain support of the Louisiana Soybean and Grain Research and Promotion Board when a feed grain referendum was passed in 1985. Although the initial funding provided by the board was only a small portion of the total program costs, the effect was immediate and significant. This was discretionary funding that allowed for hiring of additional student workers and support, thereby laying the foundation for development of the program as it exists today. The board's funding increased the size and intensity of the program and progress toward variety development and germplasm enhancement.

This leads to the conclusion that wheat germplasm and varieties are a complex example of the value and ownership of scientific research products as intellectual property. Questions such as "Who owns the germplasm?", "How should it be protected and utilized?", and "Who should benefit from it?" are not easy to answer. This is, after all, a public plant breeding program financed in part by public tax dollars, although much of the funding is self-generated. Why should a grower pay a premium for a wheat variety marketed by a seed company if the variety came from a university program?

Unfortunately, without several hundred thousand dollars per year in support, public plant breeding programs cannot survive. Finding a balance between public and private funding with the overall goal of ensuring economic viability of the agricultural community is a significant challenge that requires consideration of all options.

Steve Harrison and University of Georgia wheat breeder Jerry Johnson in a foundation seed field of LA01110D-150 wheat, which was released in 2012. Through the Sungrains partnership, seed can be increased for release by the University of Georgia Seed Development Commission, which is efficient and cost-effective. Photo by Dan Bland

Utility Patents, PVPs, Brown-Bagging

Wheat and oat varieties developed by the program are protected under the Plant Variety Protection Act, which permits grower-saved seed but prohibits brown-bagging or sales of the variety for planting by anyone other than the licensee. This form of intellectual property protection ensures that a variety has economic value to the company that licenses it and that the institution receives a return on investment to support additional research and variety development. Some varieties are protected by utility patents, which generally do not permit grower plant-back and are more restrictive in how the seed may be used. Patents for all AgCenter-developed varieties remain AgCenter property, and only the exclusive marketing rights are licensed.

Licensing and Variety Release

A wheat variety goes through eight to 10 years of research and development, followed by about two years of seed increase, before it reaches a grower's field. In the final stages, seed purification occurs, and the breeding line is licensed as a variety to a commercial entity that has the infrastructure capable of producing, processing and distributing seed to growers. The primary concern when awarding a variety license is ensuring that the variety is produced and made available in a manner that serves growers. Also important is the economic return to the LSU AgCenter and subsequently program support to continue research and variety development.

When growers purchase seed of a variety licensed by the LSU AgCenter or a Sungrains partner, they are paying about $0.85 per bag in royalties to support the program, or about $1.50 per acre. This is a small portion of the crop value and certainly a worthwhile investment to ensure a continued supply of productive and locally adapted varieties available at a competitive price.

Shared Intellectual Property

Germplasm is the lifeblood of a plant breeding program, but it has value only if it is used, shared and enriched. Progress is made over time by intermating elite germplasm to produce even better progeny. The germplasm base of a breeding program has to be continuously enriched with new genes that meet the challenges of new diseases, insects and end uses. It has to be shared with other breeding programs and evaluated on a regionwide basis. Cleary, there is not enough wheat acreage in the Southeast for every state to have a wheat breeding program, which is true of most crops, so programs have to reach across state boundaries to be sustainable.

Within Sungrains there is complete

and open sharing of intellectual property, including all germplasm, research projects and resources such as testing environments and equipment. Scientists within Sungrains routinely co-develop and co-release new varieties. Sungrains nurseries are much more efficient because each breeder's material is tested across the entire region without the need to travel out of state for planting, note-taking and harvesting. Each breeding program has a vested interest in ensuring the success of Sungrains because they share revenue from new varieties and credit for that success. Sungrains has been a remarkably successful endeavor because the breeders and their respective institutions recognize the value and need to share intellectual property to preserve it.

Future of Wheat Breeding, Partnerships and Protecting Intellectual Property

There has been a lot of big-industry investment in wheat research in the past five years, and these companies will continue to play a role in providing wheat varieties to growers. Wheat yield must increase for the crop to be sustainable. To achieve that goal requires research investments comparable to those in soybeans and corn. The changing landscape will require that Sungrains and other university breeders partner more closely with industry. Such partnerships will meld the valuable germplasm and scientific expertise of Sungrains programs with the tremendous corporate infrastructure and economic engines to produce superior varieties for growers.

It is important that Sungrains and the LSU AgCenter protect the integrity of the germplasm base, which has been developed over the past 30 years to make sure growers have a supply of locally adapted and highly productive varieties at affordable cost, while at the same time using all available university and industry tools and technologies to provide a superior product. The future of wheat in Louisiana requires a willingness to change and adapt.

Steve Harrison is Walker T. Nolin Professor in Agronomy in the School of Plant, Soil & Environmental Sciences and a wheat and oat breeder.

Lure of Wheat Breeding

Tobie Blanchard

Steve Harrison was determined to be different from his dad. His father spent 30 years developing wheat and oat varieties in South Carolina for Coker's Pedigreed Seed Co. Harrison set out to study marine biology but eventually found his way into agronomy, studying under his father's major professor at the University of Georgia while working toward his master's degree.

In 1984, Harrison received his Ph.D. from the University of Illinois where he studied soybean breeding and took a job breeding wheat and oats at the LSU AgCenter, which he has been doing for nearly 30 years – just like his dad.

"I love being in the field, making selections and the long-term nature of plant breeding," Harrison said. "I really feel like I'm doing something positive, and that's appealing."

In that time, Harrison has grown the AgCenter's wheat breeding program from a nursery with about 100 yield plots and a few hundred hand-planted progeny rows when he started in 1984 to 8,000 yield plots with 50,000 progeny rows today.

He said it took hard work and determination to expand the program, and funding from the Louisiana Soybean and Grain Research and Promotion Board allowed him to hire research associates and upgrade equipment.

Without his efforts, wheat would be a relatively minor crop in Louisiana. His locally-adapted varieties make it possible to grow wheat in Louisiana's hot and humid conditions and under high disease pressure. Wheat has become an integral part of the cropping systems in the state, such as double-cropping with soybeans or cotton or planted in fallow years with sugarcane.

"It is a cash crop that comes in in June, so it helps finance the summer crops to some extent," he said.

Harrison has made wheat more accessible to growers not only in Louisiana, but also across the southeastern United States through Sungrains, a partnership he developed among six universities that work together to breed and release small grain varieties for the entire region.

Harrison conceived the idea for Sungrains while working on a project for a leadership program he participated in.

Harrison and breeders at the University of Arkansas, Texas A&M AgriLife, University of Florida, University of Georgia and North Carolina State University were already cooperating before joining Sungrains. He considered them good friends, so it was a natural partnership that allows sharing of genetic material, testing environments, financial resources and other capabilities to make all of the programs more effective.

No other universities had anything like it.

"It really is a unique program because we share so much," Harrison said. "We send each other breeding material all the time – that kind of thing that would probably drive intellectual property heads nuts."

Harrison said it took about two years to get the university administrations to agree to the partnership. Money was an issue because 25 percent of all royalties from released varieties are shared among Sungrains universities to offset the costs of additional testing activities, so there has to be some trust that all universities will contribute to overall productivity.

The cooperation worked so well for the first five years, it was extended for another five years in 2011, and two additional universities became members. He also sees it as a model for other breeding programs.

Creating Sungrains is a proud accomplishment for Harrison.

"I think we've contributed a tremendous amount to the economy of the state – many millions of dollars through improved wheat and oat varieties," he said.

While he is still drawn to the water, Harrison doesn't regret his career path that led him away from marine biology and into his father's footsteps.

"I really enjoy it." Harrison said. "I wouldn't have stayed 28 years if I didn't."

Tobie Blanchard is an associate communications specialist with LSU AgCenter Communications.

Harrison and breeders at the University of Arkansas, Texas A&M AgriLife, University of Florida, University of Georgia and North Carolina State University were already cooperating before joining Sungrains.

Demand for Sweet Potato Varieties Grows Worldwide

Don LaBonte

LSU AgCenter-developed sweet potatoes, including Evangeline, have brought in $200,000 through nonexclusive licensing agreements.

There is nothing more satisfying to a sweet potato grower than a new variety that has a 10 percent yield gain, is easier to grow at no extra cost, and resists damage from drought and flooding. Because the industry continues to face stagnating prices and escalating production costs, a new variety can signal renewal. This has been happening since the beginning of the sweet potato research program at the Louisiana Agricultural Experiment Station in the 1930s.

For many years sweet potato consumption was flat, even though the sweet potato, rich in vitamin A and other nutrients, was one of the best-tasting and healthiest vegetables on the market. In recent years, however, this has changed as Americans have become more concerned with health and nutrition issues. Just go to a local or national chain restaurant, and you are bound to find sweet potato fries and baked sweet potato on the menu – a big change in a relatively short period of time. Exports are up, too. Consumers in Europe have discovered this vegetable and like it.

The demands on the breeding program have changed, too. Louisiana is now the hub of the frozen sweet potato french fry business with the establishment of the ConAgra sweet potato processing plant at Delhi, La., in 2010. The need for varieties well-suited for the fresh market may not fit demanding processing specifications. AgCenter sweet potato breeders now need to develop varieties for the fresh market and other ones for the processing sector. Both require high yields, disease resistance and a good shape.

The AgCenter has added new nurseries over the years to deal with special needs like better processing quality and enhancing resistance to a given disease. As the costs of a sweet potato breeding program have increased, so has the funding model – and this is something national and not just in Louisiana. Years ago breeders simply released varieties to the public – no strings attached. Now, however, state support is diminishing, and federal dollars are more skewed toward short-term competitive grants. Breeding sweet potatoes is methodical and requires sustained, long-term funding.

Today's funding reality requires that licensing fees be charged for the use of new varieties to sustain the breeding program. The need for revenue has expanded the breeding program beyond the Louisiana borders. Many new varieties are now screened in other states for production. For instance, a red-skinned selection is being evaluated in California and shows promise. Although this skin color is not popular in the Gulf South, it has a following on the West Coast. So, instead of a selection heading to oblivion in Louisiana, it is now going out of state. This out-of-state testing also provides valuable feedback on performance that testing in-state does not. Yes, the program at the AgCenter exists to service Louisiana growers, but having out-of-state growers contribute makes for a stronger program.

AgCenter varieties are grown in many foreign countries as well. For instance, in Australia and New Zealand, the most popular variety grown is Beauregard, which was released by the AgCenter in 1987. Yet, the AgCenter has never received a penny in royalty income for Beauregard because procedures to capture the value of sweet potato varieties were not in place at that time.

Louisiana growers support the AgCenter research program with checkoff funds, and many times this has meant the dif-

ference in being able to continue the breeding program. Still, growers sometimes ask why they must pay a licensing fee for certain varieties. The answer is if they don't recoup a modest licensing cost plus a whole lot more, then they probably won't grow the variety.

The LSU AgCenter is also expanding partnerships with industry. A little known fact is that many restaurant chains and processors want their own variety and one their competitors don't have. It is a common and successful model used by many in the food industry. AgCenter scientists now breed and select unique varieties for private entities such as ConAgra. This company came to Louisiana for many reasons, and one was the sweet potato research and extension infrastructure at the AgCenter. Because of the needs of ConAgra's frozen sweet potato fry facility in Delhi, the AgCenter breeding program is developing varieties that resist skinning, can be harvested more quickly and resist storage damage.

The future of the breeding program is more assured by incorporating the licensing of intellectual property.

Don LaBonte is a professor and head of the School of Plant, Soil and Environmental Sciences and is the chief sweet potato breeder.

Quest for the next Beauregard

Craig Gautreaux

A Springfield, Ill., native, Don LaBonte headed south immediately after receiving his doctorate from the University of Illinois in 1988 and has had a long and productive career breeding sweet potatoes in Louisiana ever since.

LaBonte was quickly introduced to the culture of south Louisiana at a field day near Ville Platte. "Many of the farmers were speaking in French, which I did not understand. But they graciously accepted me and made me feel welcome. I knew this was a great place to do research."

Having a research station dedicated to sweet potato production helps the breeding program. "The Sweet Potato Research Station in Chase gives me the opportunity to look at thousands of varieties each year. It is so crucial to variety development," LaBonte said.

Don LaBonte in a reseach plot at the Sweet Potato Research Station in Chase, La. Photo by Linda Foster Benedict

LaBonte said coming up with a variety superior to Beauregard, the dominant variety in today's market, has been a daunting task. But, he believes the newly released variety called Orleans will eventually surpass Beauregard as the dominant variety in Louisiana. "It has the look and taste of Beauregard and a superior shape. A producer can expect more No. 1 sweet potatoes, which will increase his yield."

The ability to produce more premium No. 1 potatoes will translate to more revenue for the grower. Labonte estimates that only around 50 percent of potatoes are premium grade. Increasing the number to 60 percent or more will make a big difference to farmers and their bottom line.

LaBonte is encouraged by the growing consumption of sweet potatoes in the United States. "I believe that restaurants actively promoting sweet potatoes on their menus have contributed to more people eating them. That is a positive for the industry."

Breeding specialty-type sweet potatoes is a new venture for the breeding program. Two varieties that have found commercial success are Bonita and Murasaki. Bonita is a white-fleshed sweet potato that is popular in Hispanic markets.

"The great majority of sweet potatoes grown in the world are white-fleshed. It is around 98 percent," LaBonte said.

Murasakai is another white-fleshed potato, but its unique characteristic is that the skin is a purple hue. LaBonte said that it is popular in Asian markets.

LaBonte finds sweet potato breeding a fulfilling career. "I get the most satisfaction when growers tell me that a new variety is making a difference for their operation. It is the best compliment."

Craig Gautreaux is a communications specialist with LSU AgCenter Communications.

Human health benefits
from transgenic technology

Rick Bogren

A new wound-care product that uses a growth factor to stimulate wound healing is the latest product stemming from protein-expression technology developed by LSU AgCenter researcher Richard Cooper.

The technology originated when Cooper, a microbiologist, developed a mechanism for transferring genetic material from one species to another using a string of DNA called a transposon. Cooper was then able to force incorporation of a transgenic gene into another organism. The benefits include stable integration of the new gene and a higher percentage of success.

The successful process resulted in a patented catfish. But the transgenic catfish couldn't be grown commercially because of concerns it would escape into the wild. The only way transgenic, disease-resistant catfish could be raised commercially was to make them sterile – and that never happened.

So with the catfish success behind him, Cooper began applying the gene-transfer technique to chickens to make human pharmaceutical proteins in egg whites.

In the case of chickens, the goal was to have transgenic animals produce proteins for use in pharmaceuticals at a fraction of the cost of production methods used in the biopharmaceutical industry, Cooper said. And because the eggs aren't consumed and the birds are housed in pens, there's little or no problem with concerns about transgenics.

Transgenic refers to any organism that's altered by introducing foreign DNA molecules into it. Transgenesis is the use of genetic engineering technology to introduce foreign DNA into the genome of an animal so the cells, including the sperm and eggs, are genetically altered.

Biological therapeutic products – sometimes called biologics – comprise many products, including proteins, viruses, vaccines and blood components or derivatives. Therapeutic proteins include monoclonal antibodies, cytokines and growth factors.

Early success with transgenic chickens led to the formation of a biopharmaceutical manufacturing company – TransGenRx – which licensed two patents from the AgCenter. Since the company was founded in 2003, Cooper and his associates have received 11 new patents and have 12 other patents pending. The AgCenter has a 50 percent interest in each new patent, said Cooper, who also is president and chief science officer with TransGenRx.

Using cells from the chicken as a model for gene delivery, Cooper discovered an approach that caused protein expression rates to significantly increase. Although they planned to develop a system for increased production in the hens, the protein expression and secretion rates were so high in the cells, the researchers decided to pursue a cell-based system with which the FDA is more familiar, Cooper said.

That discovery in laboratory-based cell culture produced increased rates of protein expression to generate growth factor proteins intended for use in new human biopharmaceuticals. The pat-

TransGenRx, a biotechnology company started with LSU AgCenter technology, was the first tenant at the Louisiana Emerging Technology Center on the LSU campus in Baton Rouge. It occupies the entire third floor of the building as well as lab space on the first floor. Photo by Kathy Kramer

ented processes allow TransGenRx to develop custom proteins to target processes like protein production and gene therapy into virtually any animal or cell culture system.

The growth factor product uses an air-brush-type technique that mixes the growth factor with skin stem cells from the patient – usually burn victims who have lost skin to their injury. By harvesting skin stem cells from a 1-inch square of skin and combining it with a growth-factor solution, physicians are able to treat a burn in a process that takes 1½ to two hours. Sprayed on burns, the solution will stimulate new skin to regrow in six days.

Along with developing the growth-factor solution, TransGenRx also refined and developed a spray system that's portable and disposable. So instead of relying on a cumbersome device that only can be used in a sterile environment, the sprayer can be used in a variety of situations, including a remote military field hospital.

In addition to treating burns, the product has been used in a gel for treating skin abrasions.

"We have been able to formulate and stabilize the material and keep it bioactive," Cooper said. "The big thing is it works. We retain over 98 percent biological activity."

In another development, TransGenRx technology is being used in collaborative research conducted by three companies: Esperion Therapeutics, of Plymouth, Mich.; Cleveland (Ohio) Clinic; and Swiftwater Group consultants, of Philadelphia, Penn. The goal is to treat cardio-metabolic disease. Based on HDL, the body's "good" cholesterol, the therapy is designed to mimic or enhance the function of HDL in managing and removing cholesterol and other fats from the bloodstream and plaque on artery walls.

TransGenRx is producing protein-based materials for the process. "Cleveland Clinic has finished animal tests, which performed better than we anticipated," Cooper said.

"In terms of both costs and complexity, the development of protein-based therapies requires broad expertise and targeted, advanced technology to be successful," Cooper added. "At TransGenRx, our proprietary protein expression technology is uniquely suited to meet the key challenges in the production of therapeutic proteins."

Rick Bogren is a professor and science writer with LSU AgCenter Communications.

Patents lead to startup biotechnology company

Rick Bogren

After Richard Cooper earned his bachelor's degree in biology, he knew he wanted to do research. During his master's studies at Mississippi State University, he took an intensive class in fish diseases. "I fell in love with it," he said of the research. That spurred a move to the University of Georgia to pursue a Ph.D. in microbiology.

Doctorate degree in hand, he came to the LSU AgCenter in 1991 and began working with live attenuated bacterial vaccines for catfish. But with strong encouragement from Fred Enright, who was head of the Department of Veterinary Science, Cooper changed his focus to developing disease-resistant catfish.

Cooper's work with fish resulted in a DNA delivery system that created disease-resistant fish. "We may have been the first lab to move a gene from one organism to another organism and have it under control of the recipient's immune system," Cooper said. "The success rate in the gene transfer was more than 70 percent – significantly higher than anybody else at the time."

The gene-delivery technique Cooper developed with catfish led him to moving genes into chickens. That led to two patents and the eventual meeting with Bill Fioretti, of Dallas, who helped establish TransGenRx as a viable company for using chickens to produce components of human drugs.

Cooper is pleased the AgCenter gave him the freedom to develop his technologies and pursue the path to commercialization. He is confident TransGenRx will contribute significant royalty income to the AgCenter soon. Go to www.tgrxinc.com.

Rick Bogren is a professor and science writer with LSU AgCenter Communications.

Richard Cooper. Photo by Rick Bogen

The gene-delivery technique Cooper developed with catfish led him to moving genes into chickens.

Need to clarify sugarcane juice leads to new invention

Tobie Blanchard

A key step in processing sugar is removing solid particles from the sugarcane juice because the juice naturally contains dirt particles and plant residue. The clarifiers that sugarcane mills have used for decades are expensive to operate and are inefficient.

LSU AgCenter chemical engineering professor Vadim Kochergin works with the sugarcane industry and knows how ineffective these clarifiers are at allowing the solids to settle in the liquid.

"When you introduce liquid into a clarifier, it creates a turbulent jet, and this jet mixes it all up and prevents it from settling," Kochergin said.

In conventional clarifiers, the liquid typically travels horizontally outward. This horizontal movement slows throughput and creates circular motion inside the clarifier. Kochergin said multiple studies have revealed that the inefficiencies of the clarifier are caused by the presence of large-scale eddies caused by horizontal flows.

Kochergin saw the need for reduction or elimination of these flows to optimize the clarification process. So he developed a turbulence reduction device that solves some of the problems of a conventional clarifier.

"The initial idea was not working well, so we took a piece of two-by-four, stuck it in there, and it started working. It took off from there," he said.

Working with a graduate student, Kochergin created a working model. He said it took a while to tweak the design. He calls the system Louisiana Low Turbulence Clarifiers.

"The new device allows for reduction of the scale of turbulence within a clarification vessel by minimizing the momentum of the liquid jets at the entry into the clarifier," he said.

Figurers 1A and 1B illustrate the flow patterns when colored water is introduced into the tank through a single pipe or through the same pipe supplied with a turbulence reduction device (TRD). The new device does not allow any significant disturbance in the vessel.

A few sugarcane mills in Louisiana have put the device to commercial use. Figure 2, provided by Sterling Sugar Mill, illustrates how the new invention was incorporated into the complete clarifier design. A simple juice distribution system comprises a number of feed pipes uniformly distributed over the cross-sectional area. The exit points of the pipes are supplied with turbulence reduction devices that virtually cancel momentum of the feed juice, thus eliminating turbulence eddies.

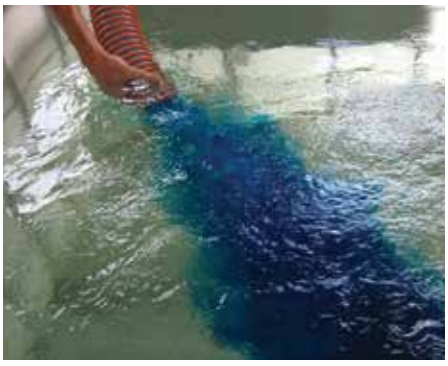
Kochergin said the new design is working well in the sugarcane industry. The factories report that they lose less sucrose in the clarification process. The new model also is about 35 to 40 percent of the cost of traditional clarifiers and is more energy efficient.

The device could also be used in other industries.

"We designed it specifically for sugarcane application, for settling solids and dirt out of the juice, but it can be used anywhere separation of solids is critical, such as wastewater treatment," Kochergin said.

Chromepion (formerly American Utility Metals), an engineering company involved in sugar industry applications purchased the exclusive license from the LSU AgCenter to market the new invention.

Tobie Blanchard is an associate communications specialist with LSU AgCenter Communications.



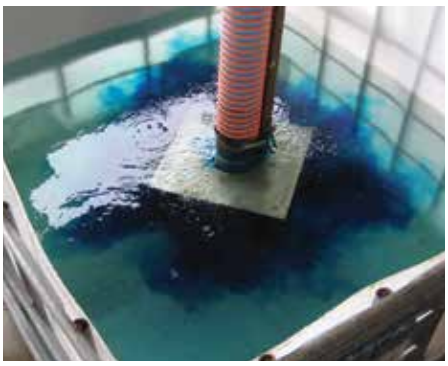


Figure 1A, left, shows what happens when colored liquid is added to the tank without the turbulence reduction device (TRD). Figure 1B with the TRD shows calmer water.

Figure 2, provided by Sterling Sugar Mill, shows how the TRD works in the clarifier design. The exit points of the pipes are supplied with TRDs that cancel momentum of the feed juice, thus eliminating turbulence eddies. For the past several seasons, these new clarifiers have been outperforming the existing design. Chromepion, an engineering company, purchased the exclusive license from the LSU AgCenter to market the invention worldwide.

Vadim Kochergin. Photo by Tobie Blanchard

Kochergin aims to improve Sugar processing

Tobie Blanchard

Vadim Kochergin is improving the way sugar is processed in Louisiana. The LSU AgCenter professor was trained as a chemical engineer in Moscow, Russia, and has used that knowledge to solve problems for the sugarcane industry.

"You have to question things," Kochergin said.

Questioning how his life may be better led Kochergin to leave behind his native Russia 1991 and come to the United States, where his mother already was a citizen.

"I told my mom I don't want to come with all my training and wash cars in the U.S.," he said. His mother, who also had a Ph. D. when she came to the United States in 1980, worked at a grocery store while learning English. "She told me there is nothing wrong with that as long as that is not your goal in life," he said.

Kochergin never had to wash cars or bag groceries. Shortly after coming to America, he got a job as a project leader for a research company in Idaho's sugar beet industry.

He had worked doing research and development on synthetic vitamins in Russia, so the transition to a different industry in a new country was a challenge.

"It was a steep learning curve but a very interesting experience."

Six years ago he took the knowledge he gained working with sugar processing in Idaho to the LSU AgCenter.

Kochergin specializes in solid-liquid separation, an important step in sugar refining because the dirt and plant residue must be removed from the sugarcane juice.

He patented a turbulence reduction device that helps solids settle out of the sugarcane juice more efficiently, resulting in less sucrose loss and cost and energy savings. The clarifier is being used in several sugar mills, but he continues to improve it.

Kochergin has developed and patented technologies that when applied commercially in the sugar and pharmaceutical industries have resulted in multimillion dollar revenues. He also serves as the director of the Louisiana Institute for Biofuels and Bioprocessing, which is working toward turning agricultural crops such as energy cane and sweet sorghum into fuels and chemicals.

As a child Kochergin couldn't have envisioned the work he does and the life he has now.

"We weren't allowed to cross the border, so that would have been a weird dream," he said with a laugh.

But he was surrounded by academics. His father also was a professor in chemical engineering, and his mother's Ph.D. was in electrochemistry. He said he had great professors at Mendeleev University in Moscow, who taught him to look at things differently. He tries to teach the same lessons to his graduate students.

"You have to keep questioning things, and then that raises other questions, and then you start answering, and you use the best of your knowledge and find the partners that can help you, and all of a sudden something's happened."

After 21 years working in the sugar industry, he still feels passion for what he is doing.

"It's unfortunate because it takes a lot of weekends and time," he said.

Tobie Blanchard is an associate communications specialist with LSU AgCenter Communications.

Harvested sugarcane is offloaded onto a conveyor that feeds the cane into the Lula Sugar Factory in Belle Rose for processing. Photo by Tobie Blanchard

TigerBullets and GEOUX$_{HPHT}$

Fiber-reinforced plastic composites for lost circulation control

Qinglin Wu

Research at the LSU AgCenter includes fiber-reinforced plastic composites that are widely used for such applications as building components and automobile parts. The AgCenter has patented a technology that uses composite blends reinforced by natural cellulosic and inorganic fibers to control what is termed "lost circulation" of drilling fluids in the oil and gas industry.

Drilling fluids, often referred to as drilling muds, are used in well drilling. The fluid, which may be water-, oil- or synthetic-based, circulates within the well bore, carrying cuttings to the surface, lubricating the drilling equipment and acting as a cooling agent. These fluids are lost when they enter into a porous or fractured formation and are not returned and reused. Many drilling hazards such as hole collapse, struck pipe and even blowout have been the result of lost circulation, costing the industry about $1 billion per year in the United States alone. And the lost materials themselves represent as much as an additional $250 million. High-performance lost circulation materials are needed to solve the problem.

The LSU AgCenter recently patented two composite lost circulation materials, TigerBullets and GEOUX$_{HPHT}$. They are made of a thermoplastic polymer, cellulosic or inorganic fibers, and other additives for use in reducing lost circulation in drilling wells.

The TigerBullets product line is targeted for low- and moderate-temperature applications, while the GEOUX$_{HPHT}$ products are for high-pressure, high-temperature (HPHT) drilling applications. The materials are economical. They seal fissures and cracks more rapidly, more efficiently and at higher temperatures than most commercially available lost circulation materials. They can be mixed with water to form slurries or muds shortly before being pumped into a well bore as part of the drilling fluid. In fractured formations the particles can settle, absorb water and swell in size, while maintaining rigidity. The swelling property, which is from the cellulosic-fiber-based blends, helps lock the particles into the fracture and seal it against drilling fluid leakage.

The use of the composite material allows more readily controlled distribution of the particles than mixtures of the individual components. In particular, the TigerBullets product line provides a significant value-added option for wood fiber resources in Louisiana.

Engineering

The composites can be manufactured using extruders with various ingredient combinations. Materials can include plastic and wood fibers (TigerBullets), inorganic mineral fibers (GEOUX$_{HPHT}$), minerals such as calcium carbonate and other additives. The materials are mixed under heat and pressure to form composite particles, which are cooled and then pelletized or ground into granules of various sizes. For plastics-based TigerBullets blends, special extrusion techniques were developed. GEOUX$_{HPHT}$ products are compounded with engineering plastics, mineral fibers and additives in a single-step process at elevated temperatures. The compounds are then milled to form target particle size distributions.

Strength Properties

Lost circulation materials need to have sufficient strength to form strong bridges over fractures. The bridges will fail if the material is too weak and undergoes plastic deformation or brittle fracturing under the well-bore pressure. Thus, the maximum sealing pressure of a bridge or a plug is a function of the particles' mechanical properties, such as compression strength, and their sizes and shapes relative to the fracture.

The PET-based TigerBullets are formulated with compression strength over 9,000 psi and GEOUX$_{HPHT}$ is formulated with compression strength of 12,000 psi, which are much stronger than most wood-based material (such as mixed nut shells), glass and concrete. Both laboratory and field test data show that these particles in combination with more flexible materials such as wood fibers form effective plugs.

Controlling Particle Size Distribution

For particulate-based lost circulation materials, particle size distributions, relative to the fracture size, particle composition, volume and viscosity of the mud, influence whether a seal is established in the fracture or at the fracture mouth. TigerBullets and GEOUX$_{HPHT}$ are made in various sizes through grinding and screening of the extruded materials. Different particle size distributions are formed by controlling screen size during grinding or by recombining the screened materials for different geological formations. Combinations include coarse particles to plug or bridge the largest opening in the formation and medium

and fine particles to fill the voids between the coarse particles to produce a tight seal or filter cake.

Permeability Plugging Testing

Standard tests were performed with water-, synthetic- and oil-based mud systems. TigerBullets or $GEOUX_{HPHT}$ at various target loading levels were blended into the mud. Some basic mud properties influenced by the added TigerBullets or $GEOUX_{HPHT}$ were measured. The mixture was then loaded into a cylinder equipped with a slotted metal disc. A differential pressure of 1,000 psi was established, and initial spurt loss and filtration losses through the slot at various times were measured. Replicated tests demonstrated that TigerBullets and $GEOUX_{HPHT}$ had no negative effect on mud properties and provided quick sealing of the fracture by forming strong mud cakes.

Commercialization and Field Use

TigerBullets is currently being manufactured by Wallace Molding and Millwork Inc., in Columbia, La. – a traditional wood products company – and is marketed by MI-Swaco Inc., in Houston, Texas, (a Schlumberger company) and HolePluggers LLC in New Iberia, La. So far, more than 3 million pounds of material have been manufactured and sold. The material has been used by major oil companies, including BP, Exxon, Chevron, XTO, Pioneer and OXY in more than 300 oil wells across the United States. Markets for $GEOUX_{HPHT}$ are currently being developed for high-pressure, high-temperature drilling operations.

TigerBullets and $GEOUX_{HPHT}$ are designed to seal permeable formations, reduce differential sticking, increase lubricity, and control lost circulation. Additionally, they can be used as a lost circulation material for oil-well cementing operations. TigerBullets and $GEOUX_{HPHT}$ also can be used as a pretreatment to control differential sticking or seepage.

Both products use recycled green materials and are partially acid-soluble and nontoxic. They have combined rigidity and elasticity, controlled formulation, strength properties and particle size distributions, and serve dual functions as lubricants and lost circulation materials for minimizing differential sticking. The materials are compatible with synthetic-, oil- or water-based drilling fluids with improved field handling and performance. Most importantly, the TigerBullets product is based on renewable natural resources in Louisiana.

Qinglin Wu is Roy O. Martin Professor in the School of Renewable Natural Resources.

Scientist finds valuable uses for recycled materials

When he came to the LSU AgCenter in 1996, Qinglin Wu believed he had found a place that offered strong potential for career development. So he joined a team of productive scientists in the Forest Products Development Center.

"Forest products at the AgCenter was one of the few expanding research programs in the country with state and university support," Wu said. "Louisiana has a large forest resource and a strong forest products industry to work with."

After earning a bachelor's degree in agricultural engineering from Henan Agricultural University in Zhengzhou, Henan, China, Wu began his career in wood processing in a master's program in engineering science at the University of Tasmania in Hobart, Tasmania, Australia. His focus was on modeling lumber drying processes with a mathematical model.

He then continued in a doctoral program in forest products at Oregon State University and a post-doctoral program at Michigan State University. There he worked with Otto Susland, one of the wood scientists who led the development of wood-based composite research in the United States.

At the LSU AgCenter he developed a comprehensive research program in wood-based composite in the School of Renewable Natural Resources.

"My laboratory is currently equipped with some state-of-the-art equipment in wood, polymer composite and nanomaterial processing and testing," Wu said.

Wu holds the Roy O. Martin Sr. Endowed Professorship in Composites/Engineered Wood Products. His research in wood-based material technology has been supported by the Louisiana Board of Regents, the Governor's Biotechnology Initiative, the U.S. Department of Agriculture National Research Initiative Competitive Grants Program, the National Science Foundation and the wood-products industry.

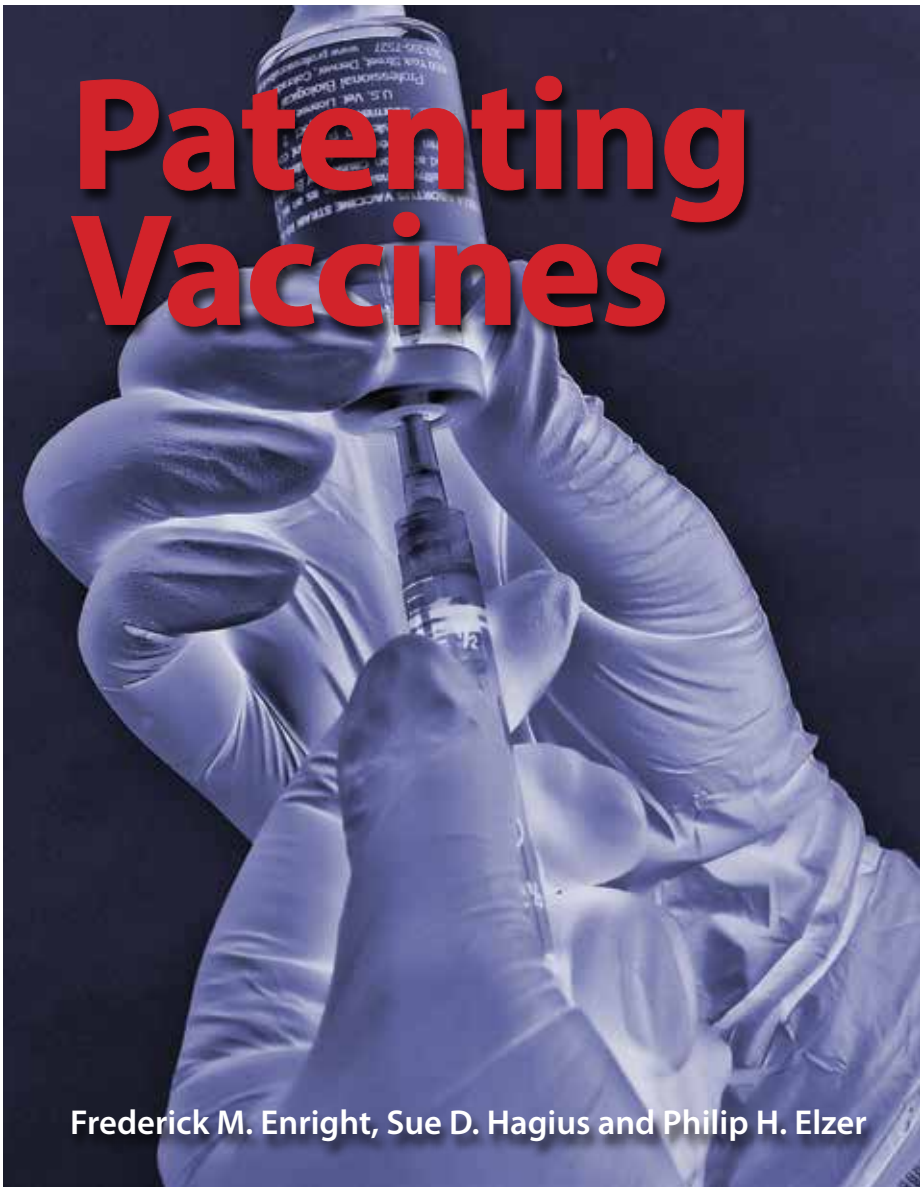
His program has generated more than 200 technical publications, four U.S. patent applications, and two marketable products – TigerBullets and $GEOUX_{HPHT}$.

Wu has been working on wood-plastic composites for building applications for many years. The wood-plastic products compete with traditional wood products with better performance but significantly higher costs.

"I felt that new, more valued-added applications for the wood-plastic materials could lead to significantly market opportunities and started searching for new applications," Wu said. "The drive led to the development of TigerBullets for oil well drilling applications."

It took about three years to develop and test TigerBullets formulations. The result was a high-performing product that's found a home in the marketplace.

Rick Bogren is a professor and science writer with LSU AgCenter Communications.



Patenting Vaccines

Frederick M. Enright, Sue D. Hagius and Philip H. Elzer

The immune system is the body's defense against foreign invaders such as bacteria, viruses and parasites. The innate immune response is the first line of defense to either stop invaders or to stimulate the body to send in more efficient cells to trigger the adaptive immune response. Components of innate immunity include barriers (skin, mucosa, normal flora), chemicals (the low pH of the gut and urinary tract) and white blood cells, which dump toxic granules on invaders. The adaptive immune response needs to be initiated by an infection or vaccination for the body to develop immune cell types and antibodies, which are proteins that circulate in the blood and neutralize offending microbes. In agriculture, proper animal husbandry includes vaccination to strengthen herd immunity, resulting in healthier and more productive livestock.

Vaccines trigger an immune response, enabling the body to respond to a foreign invader such as a disease-causing microbe. As early as the 15th century, people purposely exposed others to material from smallpox pustules so that the individual would get a milder form of the disease. Edward Jenner refined this practice in 1794 when he intentionally infected people with cowpox, a virus that normally infects cattle and causes only a slight infection in people. He was able to induce protection against small pox, which is caused by a related, deadly virus. This was the first vaccination as we know it, and the word vaccine is derived from the Latin word for cow, vacca.

To be effective, good vaccines share several characteristics:

- They stimulate appropriate protection against the intended microbe without causing the disease or dangerous side effects.
- The protection is long-lasting, ideally the life of the animal.
- The product is administered one time.
- The production of the vaccine is economical so the cost to the end user is not prohibitive.
- The vaccine is stable and easy to store, transport and use.

There are several vaccine types. They may be live but attenuated (weakened and do not cause severe infection), killed, subunit (only part of the organism is used), recombinant (molecularly modified to delete or add genes) or DNA vaccines (naked DNA). They are used to cause the host to produce protective proteins. The research to develop vaccines is arduous, costly and time-consuming. The offending organism and the immune response required to protect against it must all be understood before an effective vaccine can be developed.

Many of the early bacterial vaccines were made by isolating the pathogenic bacteria from pure culture on laboratory agar plates, killing the harvested organisms with either heat or a chemical agent, and mixing the killed bacteria with an additional component, called an adjuvant, that boosts the immune response to the killed pathogen. Killed viral vaccines have also been available for many years.

Within the past 40 years scientists have discovered how to genetically alter the disease-causing genes in bacteria and viruses, which allows for the development of attenuated bacterial and viral pathogen vaccines. In most cases one or several genes responsible for the disease-causing function of the bacteria or viral pathogen are removed. The resulting mutated organisms are almost identical to the parent organism but can no longer cause disease. These attenuated vaccines are often patented.

In the early 1990s, the LSU AgCenter patented its first animal vaccine. Lewis Hart, William Todd and Gene Luther developed a novel method to produce

an anaplasmosis vaccine. The vaccine effectively protected cattle from the bacteria that cause bovine anaplasmosis. The AgCenter scientists worked on the development of the vaccine for almost 15 years before it was patented. Because it was demonstrated to be effective and safe, the novel vaccine was licensed and marketed by the Mallinckrodt Company as Plasvax. When Mallinckrodt was purchased by another animal health pharmaceutical company, the vaccine was no longer produced, and the right to license the vaccine was returned to the AgCenter. This vaccine is no longer under patent protection but is still being produced as an experimental vaccine with U.S. Department of Agriculture approval by a Louisiana company, University Products LLC, formed by Luther. The company has permission to sell the vaccine to producers in 17 states and Puerto Rico.

In a similar time frame, Fred Enright's laboratory at the AgCenter collaborated with a laboratory at Virginia Tech University to demonstrate that a laboratory-manipulated strain of *Brucella abortus* was unable to establish long-term infections in goats, sheep and cattle and did not result in abortions when injected into fetal goats. Further work with the new rough strain, now named RB51, demonstrated that it was not only nonpathogenic but also effective as a vaccine in protecting laboratory animals and cattle from infection with pathogenic *B. abortus*. The first vaccination safety and protection studies in cattle were carried out at the AgCenter's farm under Enright's and Philip Elzer's direction. This vaccine, unlike the anaplasmosis vaccine, is a live attenuated bacterial vaccine. It is now the official brucellosis vaccine for cattle in the United States and many other countries.

In related research Enright and collaborators in other states developed an irradiated *B. abortus* RB51 vaccine. This vaccine was produced by gamma irradiating live cultures of RB51. The irradiated bacteria underwent a stress response and remained metabolically active but failed to replicate and were sterile. The metabolic activity and stress response were thought to result in an enhanced immune response, which protected laboratory animals from challenge infections with pathogenic *B. abortus*. This vaccine is now patented but has not been commercialized.

Another LSU AgCenter scientist, Tom Klei, developed an irradiated larval vaccine for *Strongylus vulgaris*, a nematode that parasitizes the large intestines of horses. This research was supported by grants from the USDA, Louisiana Board of Regents and a small Colorado-based biotechnology company. The research was never patented because shortly after the development of this vaccine, a worldwide pharmaceutical company commercialized a chemical compound that treated the parasite. This is a case where the potential market for an effective vaccine was eliminated by a completely different technology.

Richard Corstvet and Enright in the LSU AgCenter and Ray McClure at the LSU School of Veterinary Medicine patented several bacterial strains of *Mannheimia haemolytica,* which were initially recovered from a case of bovine pneumonia in a symptomatic calf. These isolated bacterial strains were capable of producing a capsular antigen and several other bacterial products, which stimulated excellent immunity to experimental challenges with pathogenic *Mannheimia haemolytica.* After eight years of research, this vaccine has not yet been commercialized.

Vaccine development is a team effort involving multiple disciplines to achieve the end product. Microbiologists, immunologists, pathologists, molecular biologists, laboratory staff and farm personnel, as well as livestock producers, are all involved in the process.

Another AgCenter scientist, Ron Thune, began working on fish vaccines in the late 1990s. His research involved a killed bacterial vaccine for use against enteric septicemia of catfish, caused by the bacteria *Edwardsiella ictaluri*. To be effective, the killed vaccine required multiple exposures and was not practical for field use. Further research demonstrated that the pathogen rapidly invaded the fish and was spread to multiple organs within 30 minutes. The killed vaccine was unable to do this. Therefore, the research team began development of a live attenuated vaccine that could invade the fish and persist in various organs for two to four days. This particular vaccine provided excellent immunity against experimental challenge in the laboratory, but moving the vaccine to the field for commercial application under a variety of environmental conditions proved difficult. This attenuated vaccine was patented but never commercialized.

Currently, research on the pathogenic mechanisms used by the bacteria to establish intracellular infections in fish host cells has led to a new live vaccine strain, which can persist much longer in tissues and stimulate an even stronger protective immune response. This new strain of attenuated *Edwardsiella ictaluri* is being patented at this time. Thune's research to develop this vaccine is an excellent example of the difficulty and time required (more than 15 years) to get a useful vaccine.

Vaccine development is a team effort involving multiple disciplines to achieve the end product. Microbiologists, immunologists, pathologists, molecular biologists, laboratory staff and farm personnel, as well as livestock producers, are all involved in the process.

It begins with a problem disease causing economic loss in a commodity and producers seeking help as to how to control the losses. Next, scientists try to identify the agent causing the disease and then they try to grow the microbe in the laboratory. At this stage the scientists attempt to attenuate or engineer the organism to determine its make-up and if it can be modified and made into a vaccine. Successful completion of the process benefits clientele by achieving healthier and more productive animals, which result in improved human and animal health in Louisiana.

Frederick M. Enright is professor emeritus; Sue D. Hagius, research associate; and Philip H. Elzer, professor, School of Animal Sciences. Elzer is also assistant vice chancellor and assistant director of the Louisiana Agricultural Experiment Station, LSU AgCenter.

Enright fights disease in animals

Randy LaBauve

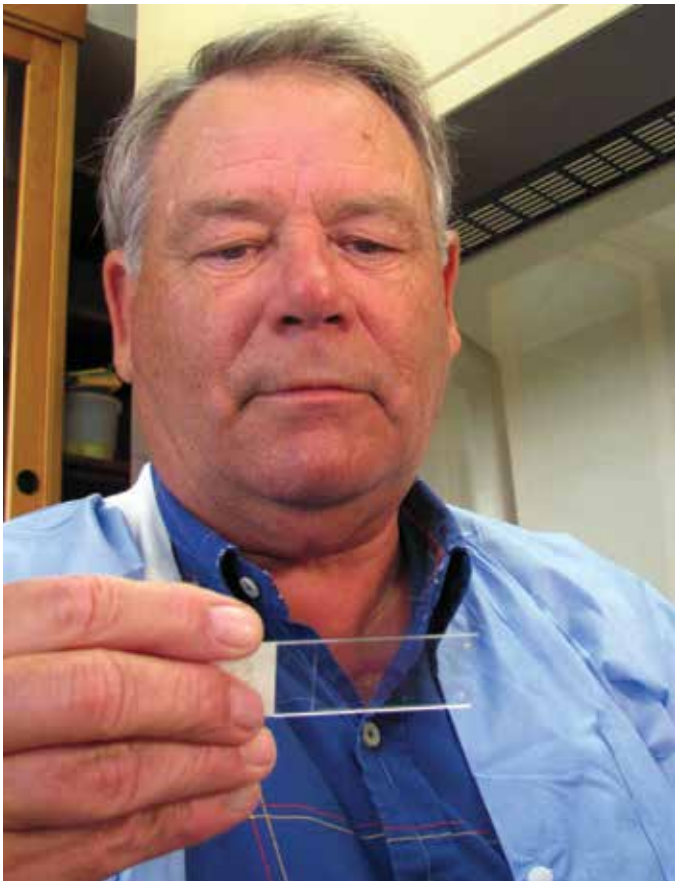
For Fred Enright, working with animals has always been a part of his life. His father was a Louisiana cattle farmer and gave every family member cattle to care for.

"It was interesting to have your own cattle at age 11," Enright said.

What started as a huge responsibility became an aspiration.

"I didn't want to be a doctor, but a veterinarian," Enright said. "I had never considered the research or academic aspect of it. The real shock was my second year in vet school when I found myself interested in disease mechanisms."

Enright went on to earn a doctor of veterinary medicine degree from Oklahoma State University in 1970. Four years later he received his Ph.D. in pathology from the University of California at Davis.



Fred Enright. Photo by Randy LaBauve

That effort led to Louisiana becoming a brucellosis-free state, ultimately saving millions of dollars in losses each year because of the disease.

In 1976, Doyle Chambers, Louisiana Agricultural Experiment Station director at the time and also an animal scientist, offered Enright a job to combat bovine brucellosis, a disease that was devastating cattle herds by causing late-term abortions. Enright collaborated with other veterinarians along with cattle farmers in southwest Louisiana to develop and implement a management system for addressing the disease.

That effort led to Louisiana becoming a brucellosis-free state, ultimately saving millions of dollars in losses each year because of the disease, Enright said. Those techniques were modified and applied to livestock around the world.

"The current vaccine that's used in the United States is RB51. LSU is the first place where we actually used the vaccine in cattle, and it worked," Enright said.

Yellowstone National Park and surrounding areas are the reservoir for brucellosis in the continental United States. The disease can spread from wildlife to livestock herds.

"Brucellosis is in bison and elk, which can't be herded up and vaccinated like cattle, and so we've done a great deal of research in the application of vaccines for wildlife," Enright said.

That important research has thrust the LSU AgCenter into a prominent national and international role.

In addition to other important work with diseases and vaccines, Enright teamed with the Pennington Biomedical Research Center for a project in 1999 that produced surprising results. While working on a specialized drug to sterilize cats and dogs, they discovered a compound that could combat major forms of cancer in humans.

Unlike chemotherapy, these compounds, through the action of membrane disrupting peptides (MDPs), seek and destroy cancer cells, without harming normal cells. This new technology was the basis for a startup biotechnology company, Esperance, which has already begun human trials with new drugs.

"We are very excited about that," said Enright. "It just shows you how research can start off one way and end up another way."

Enright has received numerous awards including the LSU School of Medicine Distinguished Faculty Scholar Award, the LSU AgCenter Diversity Initiative Award for Excellence, a Fulbright Scholar award for research in Argentina, and a Distinguished Alumni Award from the Oklahoma State University Center for Veterinary Health Sciences. He also held the Doyle Chambers Distinguished Professorship.

He formally retired in 2010 and now embraces hobbies like fishing, turkey hunting and golf. But the veterinary pathologist is still there. Enright volunteers for research projects on deer disease and in the development of new vaccines for captive deer herds.

"It's been a real interesting career. I still love it," Enright said.

Randy LaBauve is an assistant communications specialist with LSU AgCenter Communications.

The LSU AgCenter Isolation Facility is designed with a ventilation system that uses negative air flow to filter contaminants and keep them out of the research environment. Photo by Johnny Morgan

LSU AgCenter offers containment lab space for research

Johnny Morgan

Recently completed laboratory and animal handling space at the LSU AgCenter Isolation Facility is available to any researcher who has a need for containment and isolation, said Phil Elzer, assistant vice chancellor for research.

The building was designed for any type of work that requires a project to be isolated or contained from the natural environment. This work may involve pathogens, plants, animals or insects. The setup is versatile and can be rearranged to fit many research requirements.

Anthony Bridges, LSU AgCenter research associate and building coordinator, said the 15 rooms in the facility where research can be conducted are totally enclosed with their own system for temperature and humidity control and directional airflow. There is a separate laboratory suite equipped for basic microbiology, tissue culture or molecular biology.

Each of the units can be adjusted in size to accommodate various sizes of animals or plants. Photo by Johnny Morgan

"Some of our researchers have conducted some large animal studies in the building," Bridges said. The facility offers animal handling, housing, necropsy and incineration facilities.

Sue Hagius, LSU AgCenter research associate, said her work at the facility will be part of Elzer's research on new vaccines for brucellosis.

"The disease has been eradicated in cattle in the United States, but it is still a problem in some wildlife species," Hagius said. The facility is specially designed for this level of biosafety research because each lab is fully contained.

Elzer wants university, commercial and private entity scientists to know that this facility is a place to conduct tests on plants, animals or food processing.

"The possibilities are pretty much unlimited," Elzer said. "If a scientist needs a fully contained facility to do experiments, we have it. And the features make it attractive for university or commercial-type research."

The building is designed with a ventilation system that uses negative air flow to filter contaminants and keep them out of the research environment. In addition to livestock animal research, the building can be fitted to do research on animals like white-tailed deer and alligators.

Bridges said there are only a few large animal containment buildings of this type in the country, and this is the only one in the South. The facility is located at the Central Research Station in Baton Rouge.

Johnny Morgan is a communications specialist with LSU AgCenter Communications.

Implications of Food Safety Research

Marlene Janes, Beilei Ge and Witoon Prinyawiwatkul

Food safety is of paramount public health concern and a focus of research in the Department of Food Science. Food scientists are finding ways to prevent food-related illnesses, which include quick and inexpensive methods for screening and detecting the presence of pathogenic bacteria in food. A number of innovations using new analytical techniques are rapidly evolving.

LSU AgCenter food scientists have developed rapid antibody-based methods for enumeration and detection of *Vibrio parahaemolyticus* and *Vibrio vulnificus* in seafood products.

In the United States, seafood is the food category causing the highest number of foodborne outbreaks. A majority of human infections caused by seafood are due to the consumption of raw or undercooked bivalve mollusc-an shellfish contaminated with vibrios. Gulf Coast oysters are being scrutinized for the presence and level of Vibrio vulnificus and Vibrio parahaemolyticus that are ubiquitous in the marine environment. Research efforts are in progress to develop technologies to eliminate or greatly reduce these pathogens in oysters. To complement these efforts and permit investigators to assess their endeavors, AgCenter food scientists have developed anti-flagellar core antibodies, which are reliable for detection and enumeration of *V. vulnificus* and *V. parahaemolyticus* in oysters and seawater.

A leading biotechnology company, bioMérieux, is interested in licensing the antibodies for *V. vulnificus* and *V. parahaemolyticus*. The company is testing the antibodies in their VIDAS system, which is a rapid test that detects multiple species-specific antigens. More than 2,000 food laboratories have chosen the VIDAS system for routine analyses of foodborne pathogens.

Traditional detection methods for foodborne pathogens are based primarily on microbiological culturing of the bacteria using enrichment and selective media followed by species identification and confirmation with biochemical tests, such as the ability to ferment sugars. Such processes are labor intensive and time consuming. Molecular-based DNA amplification techniques, primarily polymerase chain reaction (PCR) and recently real-time PCR, have been described for the rapid and sensitive detection of foodborne pathogens without having to culture them first. The main concern associated with these assays is the expensive thermal cycling instrument required by the technique. In the case of real-time PCR, the initial equipment setup can be more than $30,000. This is a significant cost for both regulatory agencies and the food industry. Additionally, an inherent limitation of DNA-based molecular detection assays is the inability to differentiate live and dead cells.

LSU AgCenter scientists have developed a technique for using loop-mediated isothermal amplification (LAMP), a novel and rapid molecular method based on DNA amplification technology, to accurately detect major foodborne pathogens of significant food safety and public health concerns. The LAMP assays are rapid (faster than real-time PCR), specific, sensitive and cost-effective. Additionally, the LAMP assays do not require sophisticated and expensive instruments such as a PCR thermal cycler. Final results can be obtained in a matter of a few hours. AgCenter scientists used this technique to detect virulent-type *Vibrio vulnificus*, viable *Salmonella* cells, and seven adulterant Shiga toxin-producing *E. coli* (STEC). In the *Salmonella* assay, propidium monoazide was used to differentiate live and dead cells and found to be specific for viable cells. This addresses the problem of false-positive results commonly associated with molecular detection assays. Three new inventions have been disclosed and filed, one for each pathogen group. A provisional patent has been filed for the set of LAMP assays to detect the adulterant STEC groups. A company in France – Flexx Innovation, Technology Assessment Group – is interested in licensing the LAMP method for *Salmonella* detection.

Because of the importance of the pathogens involved in foodborne illnesses, the rapid, accurate and cost-effective methods invented at the AgCenter offer reliable tools for the food industry and regulatory agencies to better control potential microbial hazards in the food supply.

Marlene Janes is a professor and Witoon Prinyawiwatkul is Horace J. Davis Professor in Food Technology in the Department of Food Science. Beilei Ge is a former professor in the department and now with Division of Animal and Food Microbiology, Office of Research, Center for Veterinary Medicine, U.S. Food and Drug Administration, Laurel, Md.

Personal illness leads to career in **microbiology**

Johnny Morgan

There are many reasons why people choose a career, but probably not many because of illness. But for LSU AgCenter professor of food safety and microbiology Marlene Janes, contracting a case of meningitis started her on the path to her current position.

"I actually wanted to go into social work, but then I became sick with viral meningitis. That's what made me interested in microbiology," she said. "Once I started to work in the field, I realized just how much I liked it."

Janes attended the University of Arkansas and majored in microbiology. After graduating, she landed a job at the University of Arkansas in the food safety and food microbiology lab.

Janes, who is originally from Missouri, had then found a reason to remain in Arkansas to complete her master's degree.

"After I finished my master's, I had a job interview with the city of Tulsa as their microbiologist," she said. "On my way back from that interview, all I could think about on that two-hour drive was how bored I would get with that job."

At that point, she decided that she really liked research and working with students, so she enrolled in the Ph.D. program.

"When I completed the Ph.D., I had a lot of job interviews with different universities," Janes said. "But I liked Louisiana State University and the LSU AgCenter the best."

Before coming to the LSU AgCenter, she had worked with food safety in poultry while in Arkansas. But since she's been in Louisiana, most of her work has been in seafood safety.

One of the bigger projects that she's worked on was a study with North Carolina State University and the Food and Drug Administration to see if icing down oysters would control *Vibrio parahaemolyticus* and *Vibrio vulnificus*.

"We work closely with the FDA at Dauphin Island, Alabama," Janes said. "Several of my students are preparing to go there soon to learn some of their food safety techniques with viruses."

Along with this research, Janes began working to develop antibodies for Vibrio, which was funded through the Louisiana Sea Grant program.

"This work looked at rapid methods for isolation and identification of various Vibrio pathogens," Janes said. "We kill the pathogen and inject it into mice or rabbits. When these animals produce antibodies against it, then we collect the antibodies."

With that information, she develops methods where she's able to detect pathogens.

"We've recently begun work on more viruses instead of bacteria," Janes said. "The project that we're working on now is the norovirus, which is a very contagious virus that causes stomach flu."

This virus can be spread from person to person or from contaminated food or water. The virus causes inflammation in the stomach or intestines or both, she said.

Her research in this area is part of a $25 million project called NoroCORE that involves 60 universities.

Janes said her work on the project involves seafood because that's a niche market for Louisiana.

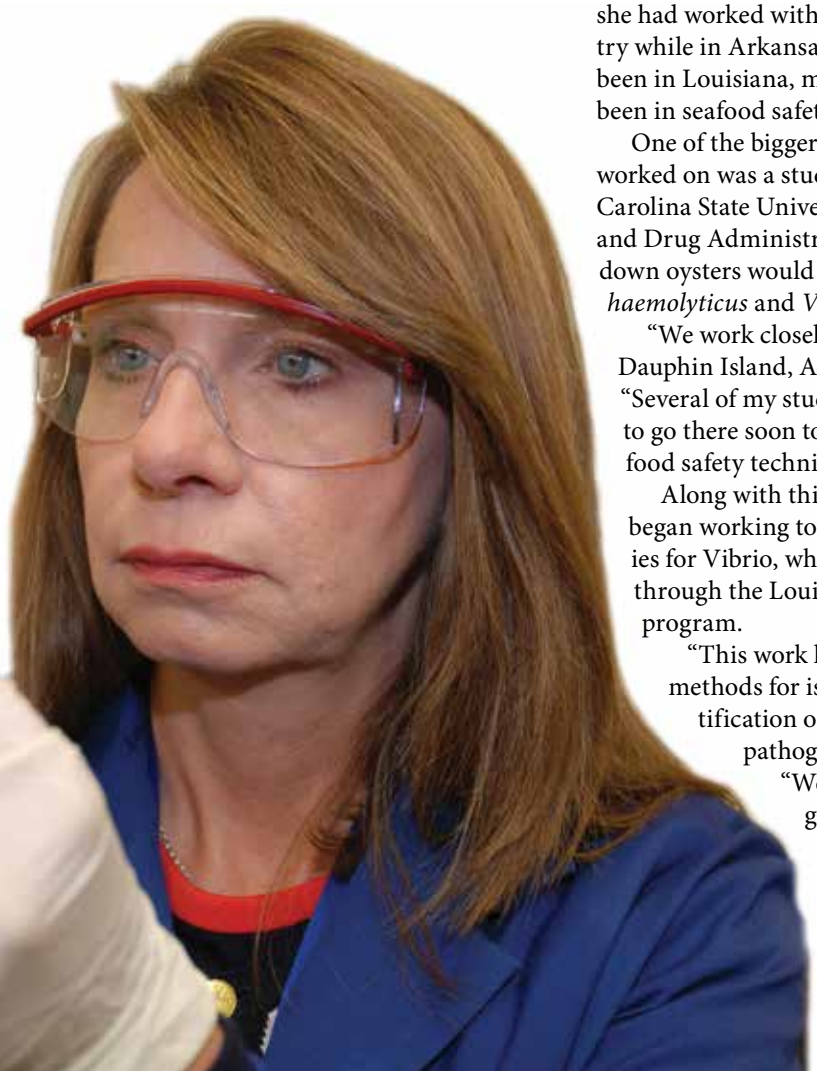
"We are working with oysters on this project, and again we are looking for ways to detect the virus," she said.

In addition to the oyster research, Janes is involved in testing for local food companies. One testing project is with a Louisiana company that makes hot sauce.

"They are having problems with the product spoiling while in the fermentation process," Janes said. "So we have a big project with them to help find the cause."

With the new food safety laws, a large number of small, new food companies are looking for her help to make sure their products are safe, and they are also looking for ways to increase the shelf life of their products.

"We work with many types of foods, from alligator to crawfish, shrimp, and we've recently worked with blue crabs because they also need to be tested.



Marlene Janes. Photo by Johnny Morgan

Johnny Morgan is a communications specialist with LSU AgCenter Communications.

Losso finds medicinal value in fish, alligator waste

Johnny Morgan and Linda Foster Benedict

Food science professor Jack Losso is determined to find medicine in a most unlikely place – waste products from seafood processing plants.

For some time now, Losso has believed that collagen, a protein with healing properties found in animal bones and skin, could prevent the development of certain human diseases. And this potentially valuable source of collagen is being thrown away by the tons every day.

Since graduate school, his research has been directed by the idea that there are compounds in food that can help prevent disease.

"When I came to Louisiana and saw the immense waste from seafood processing, I saw opportunity," he said.

Growing up in a rural area in Africa, in what is now The Democratic Republic of the Congo, Losso says his dad, a nurse, wanted him to become a medical doctor.

"I scored very, very high on the ACT in chemistry," Losso said. "On my application, my first choice of a major was medical school, my second choice was chemical engineering, but the government said chemistry. So that's what I did."

Losso's education was decided for him by the government because he was good in science and also because there was a shortage of students entering the more difficult majors, like chemistry.

After finishing college, he was required to work two years for the government, and then he was free to go where he wanted. In 1982, he enrolled in graduate school at Washington State University in Pullman and studied food science. His focus was food fractionation and the chemicals contained in food.

Following graduation at Washington State, he was offered a postdoctoral position at the University of British Columbia in Vancouver, Canada. While there, he followed research at the LSU AgCenter by reading the magazine Louisiana Agriculture. So, when a research position came open there, he applied and was accepted. In 1999, he moved to Louisiana and joined the AgCenter's Food Science Department.

Two of the food components with potential for biomedical applications most intriguing to him are lutein and collagen. He holds patents related to both.

Lutein, which is an orange-colored pigment, has been identified and recognized as one of the dietary strategies that can delay the onset and progression of macular degeneration – a condition that leads to blindness.

Jack Losso. Photo by Johnny Morgan

"Six milligrams of lutein per day can delay vision loss," Losso said.

Losso has patented a way to isolate lutein from corn waste and corn contaminated by aflatoxin, which has no other use.

Losso also has a patent for collagen isolation from calcified tissues, such as from fish and alligator skin and bones, which are waste products.

There are several types of collagen, Losso said. Type I can be used in tissue engineering and in the cosmetic industry. Type II can be used to treat osteoarthritis and other inflammatory diseases.

Collagen or collagen fragments, like lutein, can prevent the excess development of new blood vessels. New blood vessel development is associated with chronic diseases like cancer, diabetes and macular degeneration, he said.

"Cancer, for instance, is a tumor that invades the body by forming new blood vessels so that it can go from where it is to other parts of the body, which is called metastasis," he said.

Losso said this formation of new blood vessels is good as with wound healing but bad when the body does not stop the formation when it should.

Though Losso didn't become the medical doctor that his father wanted him to, he is trying to find ways to make people healthier through food science.

About his African roots, Losso said some people still have a distorted view of Africa as a wild place.

"If your plane lands in Africa, it will not be in the bush," Losso said. "It will be in a major city where you have skyscrapers, paved roads, electricity, running water, and you can watch a movie or TV shows like Dallas."

Johnny Morgan is a communications specialist, and Linda Foster Benedict is a professor and associate director, both with LSU AgCenter Communications.

Solubility Enhancement Technology

Zhijun Liu

Although it is pretty easy to swallow medications in tablet or capsule form, it is not so easy to have them soluble after that. This is an important issue because drugs need to be soluble in the small intestines to be absorbed into the bloodstream and take effect. Many drug molecules are soluble or made soluble to meet this absorption need. However, more than 40 percent of new chemical entities emerging from drug discovery are not water soluble. Hundreds, if not thousands, of active pharmaceutical ingredients have been shelved from development because of poor solubility. Lack of solubility has been and continues to be a major roadblock to better medicines. An excellent molecule for a particular disease may be abandoned because of its poor solubility and unmet solutions. Major pharmas and various specialty formulation companies possess numerous tools to tackle the solubility issues, but each of these brings along substantial limiting factors related to toxicity and formulation. Solubility remains unsolved.

It is highly unexpected that a solution to poor solubility would come from the research of medicinal plants in an agricultural setting, such as the LSU AgCenter. Indeed, the medicinal plant research program was not set up to find solutions for poor solubility. Rather, it was established to understand how trees responded to environmental stresses such as drought or flooding and how fiber production could be maximized to provide sufficient and high-quality forest products.

After a brief but intensive cultivation research of medicinal plants, the direction of the research program changed into natural drug discovery to identify bioactive compounds and their potential synergism from plants, joining hundreds of other such laboratories in the world. Despite changes in research directions, each experience accumulates to back up creativity and innovation. For example, studying the mysterious ability of a plant to mobilize water-insoluble defense chemicals (e.g., antimicrobial) in their aqueous systems when herbivores attack led to careful observations and ultimately the discovery of several natural solubilizers. For example, steviol glycosides are better known for their sweetening properties, but when used with other water-insoluble compounds, they showed capabilities of holding them in water from otherwise precipitation. In numerous feasibility experiments, it was shown water-insoluble compounds were solubilized by the use of steviol glycosides by a minimum two-fold to as high as one-million-fold.

Poor solubility is easily seen by the naked eye. Curcumin, a pungent compound found in the curcuma root or more commonly curry spice, has poor water solubility and precipitates out easily. Etoposide, an old chemotherapeutic agent, is poorly soluble, and precipitation takes place as soon as it is mixed in water. Oil, such as vitamin E, is water-insoluble and forms the top layer when mixed with water. There are literally tens of thousands of poorly soluble compounds from natural and synthetic sources. To name a few, they include the anesthetic propofol, the anti-inflammatory celecoxib, the anti-fungal amphotericin B and nystatin, the anti-bacterial roxithromycin, azithromycin and erythromycin, the antiviral ritonavir, the immunosuppressant cyclosporine, the chemotherapeutic agents paclitaxel and etoposide, and many natural active agents including silybin, gingerol, tanshinones, coenzyme Q10, rutin, podophyllotoxin, capsaicin, artemisinin, resveratrol, genistein, quercetin, icariin, and oleandrin. AgCenter scientists have conducted experiments with all of these in the medicinal plant lab.

To illustrate the effect of solubility enhancement, curcumin is mixed with a steviol glycoside rubusoside and processed together. Without rubusoside, only a small amount of the curcumin remained in water, and the rest precipitated to the bottom (Figure 1 left). With rubusoside, all the curcumin was in water solution (Figure 1 right). By visualizing the intensity of yellowish color of the two water solutions, the solubility enhancing effect by some 5,000 fold is evident.

Solubility enhancement is one thing, whereas usefulness for medical research is another. Countless efforts have been undertaken to prove this utility. Since the discovery, more than 10 grant applications have been submitted to the National

Figure 1. Water-insoluble curcumin precipitated to the bottom of water solution (left) but went into water solution in the presence of rubusoside acting as a solvent such as DMSO or ethanol. Photo by Zhijun Liu

Institutes of Health (NIH) with little success. The skepticism is due to the lack of credentials and track record, lack of interest in pharmacological mechanisms-driven review, and the ever fierce competition for competitive federal grants. The good news is a two-year NIH grant award has finally come to the AgCenter team to study the use of this technology for converting an intravenous Taxol drug to an oral for cancer patients. This will not only allow the scientists to examine the potential in improving medications but also an opportunity to create a brand new chemotherapy that has the potential to help millions of new and ex-cancer patients in their fight against primary cancer or the threat of recurrence. Moreover, the success of this project could support expansion to other promising chemotherapy regimens that perform poorly in the clinical stages or are prevented from even entering the human studies as a result of unsolved poor solubility.

The LSU AgCenter has filed three patent applications. Because of the potential of broad applications, the AgCenter has taken the strategy of multiple licenses to allow industries to develop certain products in separate markets. The solubility enhancement technology so far has been licensed to a local food and beverage startup company to focus on food and beverage products. It has just been licensed by a Louisiana-based medical food company to develop improved versions of existing products and create some new products primarily for the medical food market. A Chicago-based cancer treatment center has been sponsoring research projects performed in the medicinal plant lab to develop about two dozen bioavailable formulations for its existing dietary supplements. The average survival of the center's patients has doubled so far, but the center plans on achieving an even higher rate. AgCenter technology could enable that goal and expand to other clinics in the United States and around the world. A license discussion has been ongoing and, if signed, would be the third license for this technology.

Outside the health arena, the solubility technology has been considered for agrochemical and agricultural uses. Many potential and new fungicidal, insecticidal and bactericidal agents are discovered, but poor solubility has been a major obstacle, in addition to much stricter environmental requirements. The AgCenter's natural approach and the use of non-toxic solubilizing agents could be the perfect solution to these needs.

The medicinal plant lab's search for new and more effective natural solubilizing agents is currently on hold because we have been busy developing those already discovered into proof of concept applications such as the NIH project and several sponsored research projects. Consequently, the medicinal plant lab has been re-geared to conduct bioavailability assessments using cellular and animal models with the goal of solving poor bioavailability encountered in many developmental projects. Continued internal and external support in terms of expertise and funding would facilitate the discovery of new and natural solubilizing agents at a much faster pace. This would indeed be very welcomed.

Zhijun Liu is a professor in the School of Renewable Natural Resources and leader of the Medicinal Plant Laboratory.

Liu journeys

Randy LaBauve

Zhijun Liu, professor in the LSU AgCenter School of Renewable Natural Resources, could have taken any number of career paths. He grew up in Henan Province, the cradle of Chinese culture and civilization and succeeded academically, while developing natural talents in music.

Liu learned to proficiently play multiple instruments, including the violin, erhu, accordion and others. If he would have further developed his musical skills, he could have become a concert conductor, he said.

He really wanted to be an engineer, but because of the Chinese Cultural Revolution from 1966-1976, his college options were restricted to forestry studies. Encouraged by his teachers and parents, he entered a field he didn't like at first.

But Liu excelled in forestry, earned his undergraduate degree from Henan Agricultural University and was offered the opportunity to come to the United States to further his studies. He earned an M.S. from Oklahoma State University and a Ph.D. from Michigan State University.

Initially, Liu's research focused on tree physiology and how to help grow bigger, taller trees. A year into his work with the LSU AgCenter, administrators asked him if he would be interested in growing trees believed to have cancer-fighting properties.

Liu's affirmative response would become a turning point in his career. For the ensuing 20 years, he has worked with medicinal plants, blossoming new technologies and applications for the improvement of human health.

"My career began to move from timber into leaves and bark, parts typically discarded by the forest products industry," Liu said.

In his first project, Liu used a forestry technique called "coppicing" to grow an annual crop of shoots from Tree of Joy plants. The shoot tips are rich in the chemical camptothecin, which is similar to alkaloids in the foliage of tea plants.

One project brought him back to China to gather and study extracts of sweet leaf tea plants, which, in collaborative studies with M.D. Anderson Cancer Center in Houston, the LSU Health Sciences Center in New Orleans and the Pennington Biomedical Research Center in Baton Rouge, were shown to minimize the recurrence of certain types of cancer and to have effectiveness in decreasing obesity.

Liu's first phase of research had expanded from traditional forestry into growing trees as medicinal plants. Next, he embarked upon a scientific journey to extract, purify and isolate active natural compounds, a field called natural product chemistry.

from forestry research to using plants to battle human disease

Subsequently, Liu and his researchers assumed a prominent worldwide position in addressing the problematic issue of poor solubility. Liu and his medicinal plants team developed safe, natural solubilizers and formulations for pharmaceutical drugs and nutraceutical compounds and perfected extraction processes that can improve the absorption rate of life-saving medicines, while decreasing levels of toxicity.

The LSU AgCenter Medicinal Plants Lab is one of the very few in the world doing solubility research of this kind, according to Liu.

Most recently, Liu's expanding research has focused on the integration of patented technologies that can directly improve the effectiveness of supplements and pharmaceutical drugs.

Liu became proficient in various new disciplines by studying scientific literature and adapting his research methods. He has received four highly coveted National Institutes of Health grants and secured numerous patents for the LSU AgCenter.

"When I do my research, I set my mind on finding practical solutions – real applicable technologies that can launch health-benefitting products," Liu said.

Because of his agricultural background, some medical and pharmaceutical experts initially viewed his research findings as the proverbial frog at the bottom of a water well, looking up only to see a small part of the sky, he said. It's a Chinese idiom expressing a limited vision.

But Liu has patiently overcome those stereotypes, built a reputation and initiated collaborative efforts with prestigious medical organizations like M.D. Anderson Cancer Center.

Although Liu didn't become a concert conductor, he has orchestrated successful research projects with professionals in diverse disciplines such as cardiology, obesity, microbiology, dentistry, oncology, veterinary medicine and toxicology.

"I learned to listen, to hear their challenges, to understand the problems and come up with solutions," Liu said.

Randy LaBauve is an assistant communications specialist with LSU AgCenter Communications.

Zhijun Liu. Photo by Randy LaBauve

LSU AgCenter first to patent native plant varieties for coastal restoration

Carrie A. Knott, Herry S. Utomo and Prasanta K. Subudhi

Louisiana is losing its coastal wetlands at an alarming rate. Although Louisiana has about 40 percent of the continental United States' coastal wetlands, it accounts for 90 percent of the nation's wetland loss. Each year numerous restoration projects are completed to protect and restore coastal wetlands in Louisiana. The most common restoration projects are involved in marsh creation, shoreline protection, river diversions, and beneficial use of dredged sediments.

Protection and restoration of Louisiana's coastal wetlands is important for many reasons. Healthy and functional wetlands are essential to reduce hurricane and storm surge and remove contaminants from the environment. Wetlands support a significant portion of Louisiana's economy; in 2011, revenues from industries dependent upon wetlands, such as seafood, fur, alligator, and hunting leases, exceeded $300 million. A significant portion of the oil and gas produced, refined and transported occurs within Louisiana's wetlands. Wetlands provide food and habitat for numerous estuarine organisms and the temporary home of migratory birds and waterfowl that overwinter in Louisiana on the way to and from Central and South America. Finally, Louisiana's wetlands protect coastal communities, industries and infrastructure vital to regional and national economies and energy security.

Plants play a major role in establishment of healthy and self-sustainable wetlands. Plants help reduce wetland loss by stabilizing and increasing soil strength with their roots. Plants also create land when stem densities are high by reducing the speed and strength of the water, capturing sediment from the water, and the decaying of the plant material. In contrast, erosion increases as the number and density of plants decrease because of increased water speed and strength and reduced production of plant material that builds organic matter and land mass. Decreased stem densities can occur for a variety of reasons, most of which are a response to environmental stresses.

The use of plants in restoration and protection projects is an extremely cost-effective and sustainable approach to rapidly increase the area of coastal wetlands and protect residents and communities of coastal Louisiana, when compared to construction projects. Most restoration projects use one clonal variety of smooth cordgrass, Vermilion, for planting because it is the only commercially available variety. When only one clonal variety is used to restore large areas, there is the possibility that the clonal variety will be unable to adapt to environmental changes, resulting in large scale death of plants. If many genetically different clonal varieties or a seed variety with a mixture of genotypes are used, it increases the chances of plants adjusting to the environmental fluctuations, which ultimately leads to successful establishment of healthy marshes.

In the late 1990s, LSU AgCenter scientists recognized that traditional plant breeding techniques could be used to develop improved coastal plant varieties. The Coastal Plants Breeding Program is the first and only plant breeding program in the nation to develop and patent native plant varieties for coastal wetland restoration. The main focus of the breeding program has been on smooth cordgrass, *Spartina alterniflora,* because it is the dominant intertidal saline marsh plant.

Development of Native Plant Varieties

Traditional plant breeding technologies were used to develop six smooth cordgrass varieties (Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche) using a recurrent selection breeding program. In 1998, the AgCenter's Coastal Plants Breeding Program partnered with the U.S. Department of Agriculture's Natural Resources Conservation Service (USDA-NRCS) to collect smooth cordgrass seeds from across coastal Louisiana (Figure 1). Seeds from 126 smooth cordgrass populations in 11 parishes were collected in the fall of 1998. Seeds of all populations were germinated in the spring of 1999 in controlled greenhouse conditions and evaluated for average percent germination, seedling vigor and seedling survival. Twenty populations with the highest germination, seedling vigor, and survival were selected for continued evaluations.

A total of 400 plants, 20 plants from the 20 selected populations, were evaluated in freshwater trials at the AgCenter Ben Hur Research Farm in Baton Rouge in October 1999. Plant performance was measured for the following attributes: plant height, spread, rust reaction, tiller density and plant vigor. The 40 best-performing plants, which originated from nine populations, were selected. Clonal plant material of selected plants was harvested from the field trials and used to provide plant material for additional testing.

In 2000, the 40 selected plants were evaluated in two replicated trials. One was in a freshwater trial at the Ben Hur Farm, and the other was at a created marsh site on Grand Terre Island. Plant performance was measured, and seven best-performing breeding lines were selected for additional testing.

The seven selected breeding lines were evaluated in 11 replicated trials from 2001-2009. Six of the seven breeding lines were selected for release as clonal varieties for use in coastal restoration projects in the northern Gulf of Mexico coast. The clonal varieties were named Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche.

Commercialization

The commercialization of Cameron, Terrebonne, Jefferson, St. Bernard, Las Palomas and Lafourche will require many years. The first hurdle to commercialization was to ensure that a system to maintain the purity and identify of the varieties was available. Beginning in 2008, the LSU AgCenter, USDA-NRCS, Louisiana Department of Agriculture and Forestry (LDAF) and native plant producers assembled to develop the first seed certification laws in the nation for clonal native plant varieties. After many deliberations over years, the first seed certification laws for native plant varieties were developed and adopted by LDAF in November 2012.

Once seed certification laws were adopted, plant patent applications were filed for three clonal varieties of smooth cordgrass – Cameron, Terrebonne and Jefferson – in 2012. These three varieties were released and are being distributed to interested producers.

Plant patent applications are in preparation for the remaining three clonal varieties – St. Bernard, Las Palomas and Lafourche. These varieties will be released and distributed to interested producers.

Future Work

The Coastal Plants Breeding Program has developed clonal varieties of sea oats (*Uniola paniculata*) and California bulrush (*Schoenoplectus californicus*). Seed certification laws were adopted for these plants in July 2012. Plant patent applications are in preparation for three sea oats varieties, which will be released in 2013. Six California bulrush varieties are also being considered for plant patents and are anticipated for release and public distribution in 2013.

The Coastal Plants Breeding Program will continue to develop, patent, and distribute improved clonal and seed varieties of native plants for coastal restoration in Louisiana.

Carrie A. Knott is an assistant professor and Prasanta K. Subudhi is an associate professor in the School of Plant, Environmental, and Soil Sciences. Herry S. Utomo is an associate professor at the Rice Research Station.

Figure 1. Seeds from 126 smooth cordgrass populations in 11 parishes were collected.

Smooth cordgrass is grown in containers at Burden. Photo by Bruce Schultz

Three scientists tackle coastal plants

Bruce Schultz

Three scientists from three different backgrounds have worked together at the LSU AgCenter on a project aimed at curbing coastal erosion along the U.S. Gulf coast.

They have contributed their expertise to improving native coastal plants – smooth cordgrass, sea oats and California bulrush – by breeding them for desirable traits such as increased seed production, saturation tolerance and salinity tolerance.

Prasanta Subudhi grew up in India and learned about rice farming at an early age.

"My mother would send me to supervise rice workers," Subudhi said.

He recalls as a youngster he could distinguish different rice varieties. But he said he didn't become a farmer because his father, a high school principal, encouraged him to get an education. He said his three brothers also got a college education.

After completing his master's degree in plant breeding and genetics, he obtained a Ph.D. in plant genetics from the Indian Agricultural Research Institute. He went to the International Rice Research Institute in the Philippines as the result of a Rockefeller Foundation Fellowship, and that allowed him to learn genetic mapping and markers-assisted selection. The main focus of his research program in the coastal plants project is to apply these tools to understand the molecular basis of genetic diversity and important biological attributes such as salinity tolerance.

Subudhi has made sure his daughter, Ipsita, pursued a college education, also. She is attending the University of Pennsylvania where she is majoring in biochemistry with advanced studies in cancer research.

"Maybe because of my influence, she was always interested in science," he said.

Carrie Knott grew up on a small tobacco farm in Kentucky. She was steered to a science career by college advisors, so she decided to pursue studies in an agriculture-related field.

"I really enjoy being outside, and I couldn't fathom the thought of being indoors," Knott said.

She earned her master's degree in tobacco breeding and her doctorate in wheat breeding. After completion of her doctoral work, several companies came calling to develop varieties of

Prasanta Subudhi. Photo Bruce Schultz

Carrie Knot. Photo Bruce Schultz

Herry Utomo. Photo Bruce Schultz

various crops. But she said she was drawn to the coastal plants project at LSU, and she is the plant breeder for the coastal plants, working with California bulrush, sea oats and smooth cordgrass.

"I wanted to do something that would make a difference," she said. "This was something no one else was doing or ever had done."

She said her parents now call her for farming advice. "I'm still diagnosing their pathology and agricultural practices."

She said her 3-year-old son is analytical like his father, an engineer, and is showing the potential to become another scientist.

Herry Utomo said as a boy growing up in Indonesia, he grew up in wonderment with the natural world.

"I was always curious about everything. I can remember looking at the stars and wondering what it was all about."

Utomo said his father, a science and math teacher, placed a priority on education.

"He always emphasized the importance of going to school."

He said a high school science teacher suggested Utomo consider a science-based career. He said he considered astronomy, but that would have required attending a more distant and more expensive college. So, he chose agronomy at a nearby college, Brawijaya University, Malang, Indonesia. He received his advanced degrees in plant breeding and genetics after moving to the United States – and M.S. from the University of Kentucky and a Ph.D. from LSU.

Utomo said plant breeding has always intrigued him. "It's life itself, how information is passed on to the next generation. I like the project. I like nature and I like being in the different environments."

Utomo's work emphasizes breeding and genetic studies to develop seed varieties of smooth cordgrass and development of salt-tolerant California bulrush. For both species, he uses DNA analyses to select for genetically diverse parental lines.

He is working on aerial seeding to carry out large-scale planting of the smooth cordgrass seed developed from his breeding and genetic studies.

Utomo's wife, Ida Wenefrida, is a rice researcher at the LSU AgCenter Rice Research Station. They met while he was a student attending University of Kentucky. She also assists Utomo in the coastal plants work.

They have become naturalized U.S. citizens and their daughter, Melissa, is working on her master's degree in business at Indiana University.

Bruce Schultz is an assistant communications specialist with LSU AgCenter Communications.

Controlling termites through innovation

Gregg Henderson

Termites have been feeding on wood for 200 million years. Thus, the idea that they can be eradicated can be somewhat amusing; however, it should not be that difficult to keep them from eating our most prized material possession – our homes.

The magic elixir chlordane effectively controlled subterranean termites in Louisiana until it was banned in 1989, after which less effective repellent termiticides came into use. By 1990, homeowners were seeing 30 percent of the treatments fail. Today, new nonrepellent liquid chemicals and toxic baits, some developed by LSU AgCenter scientists, are much more effective and every bit as good as chlordane ever was.

Of utmost importance to the future of termite control is developing better ways to locate termites and target them with these innovative treatments.

Termite patents in the AgCenter include new bait products, treatment methodologies for attracting and locating termites, and plant-derived repellents and toxicants.

A research goal has been to discover why termites behave the way they do so that new and better methods and devices can be developed to shorten their life span and reduce their damage to homes and trees. To be a termite detective requires looking for clues at the scene of the crime – the home invasion – and developing theories to explain what the evidence shows.

If worthy, these discoveries are patented. Patents are important because an invention usually requires further development by industry, which means financial investment. Without a patent to protect the knowledge from being used by a competitor, companies would have little incentive to invest.

Termite patents awarded to the AgCenter include new bait products, treatment methodologies for attracting and locating termites, and plant-derived repellents and toxicants.

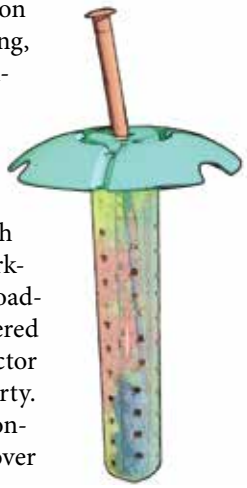
A patent from these achievements that brings in the most revenue to the AgCenter is a pop-up termite indicator. The ground monitoring bait station helps to indicate if termites are present and has been licensed for professional use and for over-the-counter sales in several home improvement stores across the United States. It was an important discovery to help in the battle against the Formosan subterranean termite, the most damaging termite wherever it occurs in the world.

The idea sprouted from a growing need of the pest control industry to have an easy-to-use way to detect termites. The industry was suffering from the daily chore of checking bait stations one by one. Companies were losing employees because the job was just too boring and repetitive.

A brainstorming session with research associate Jay Paxson initially centered on using a "sniffer" type device – one that would "sniff" for the compound naphthalene. Working with Roger Laine and other researchers in the LSU biochemistry department, AgCenter researchers had earlier discovered that naphthalene is an indicator of termites because they produce more of this substance than would be found normally around the home.

This discussion led to considering a mechanical detection device – one that might somehow operate by a spring. It was soon decided that a spring-loaded device would not work because termites would move into ground monitors and clog the works with mud. A spring pushing on a monitor probably would not signal anything, and a false negative (that is, no termites indicated but actually there) is worse than not having a monitor at all.

But the idea of using a spring lingered. Clearly, the idea had merit, but how would it operate? A couple of weeks of struggle with the idea led to a clear vision of the inner workings of what eventually became the spring-loaded monitor. A drawing of the idea was rendered and presented to Paula Jacobi, then the director of the AgCenter Office of Intellectual Property. She encouraged moving forward with the concept. Testing different trigger mechanisms over the next year helped perfect the invention. Companies quickly showed interest and licensed the invention.



Pop-up termite indicator

Today, the pop-up monitors and baits are prominently displayed in stores. Spectrum Brands owns the rights to the over-the-counter version, and Orkin licensed the pop-up for use in the professional market.

It is a simple invention. The trick was to have the spring pulling rather than pushing and to have it loaded near the top of the monitor where mudding up the works by the termites would be limited. Moreover, a wooden stick, which kept the spring taut against a plastic flag, would alert that termites were present when foraging termites ate through the stick and caused the spring to pull a signaling flag up through the monitor casing and into the air. Termites signal their own presence by simply doing what they do best – eating wood.

Gregg Henderson is Paul K. Adams Professor of Entomology in the Department of Entomology.

Childhood interest
leads to rewarding career

Rick Bogren

Gregg Henderson's interest in insects began when he was a young boy. "I would make ant farms, and along the sidewalks of my suburban New Jersey landscape, I would develop wars between different pavement ant colonies based on their territories," he said.

Henderson had recognized ants' territorial behaviors and how they established territories and their limits. But his interest in social behavior eventually turned to people, and he majored in psychology and biology at Rutgers University.

Following graduation, he went to work at the University of Pennsylvania as a technician and took courses in animal behavior and psychology on the side. These interests led him back to school to study behavior. "Not bird behavior, not fish behavior, not human behavior, but ant behavior – especially fire ants," he said.

Although he had never studied entomology before graduate school, Henderson earned his master's degree at Washington State University and his doctorate at the University of Wisconsin-Madison, where he specialized in the ecology of ants.

During his graduate studies at Wisconsin, he discovered that paper wasps produce a compound, methyl palmitate, that repels ants and mosquitoes. This led to a patent for using methyl palmitate to produce ant and mosquito repellents.

S. C. Johnson and Son, which produces Off, Raid, floor waxes and other consumer products, provided financial support for Henderson to do further research on this concept, and after graduation, he served as a consultant to the company.

Even though his specialty was ants, he joined the LSU AgCenter faculty as a termite researcher in 1990. "Termites are very different from ants," he said.

During his graduate studies at Wisconsin, he discovered that paper wasps produce a compound, methyl palmitate, that repels ants and mosquitoes. This led to a patent for using methyl palmitate to produce ant and mosquito repellents.

He found himself working with pest control companies and the chemical industry. And based on his experience with ants, he began developing termite baits.

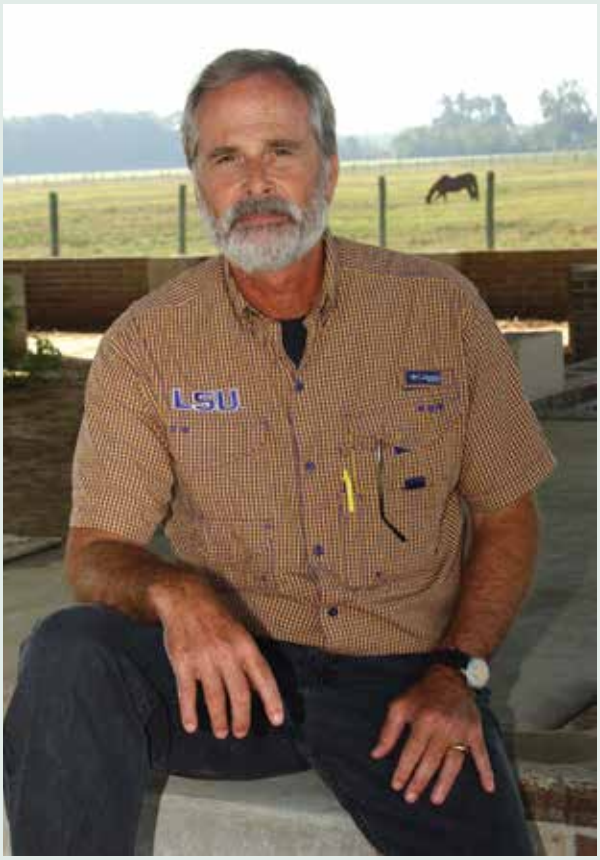
"I decided I needed to address the specific problems and concerns of homeowners," Henderson said.

He obtained samples of the insecticide sulfluramid from S. C. Johnson and developed it into the first termite bait tested in the United States in a major city – New Orleans.

Henderson's work with bait led to the pop-up bait station, one of his 20-plus patents. "I got goose bumps the first time I saw the product in Lowe's," Henderson said when it was licensed for home use.

Henderson's most recent provisional patents are for bacteria that can be added to bait to kill termites.

Rick Bogren is a professor and science writer with LSU AgCenter Communications.



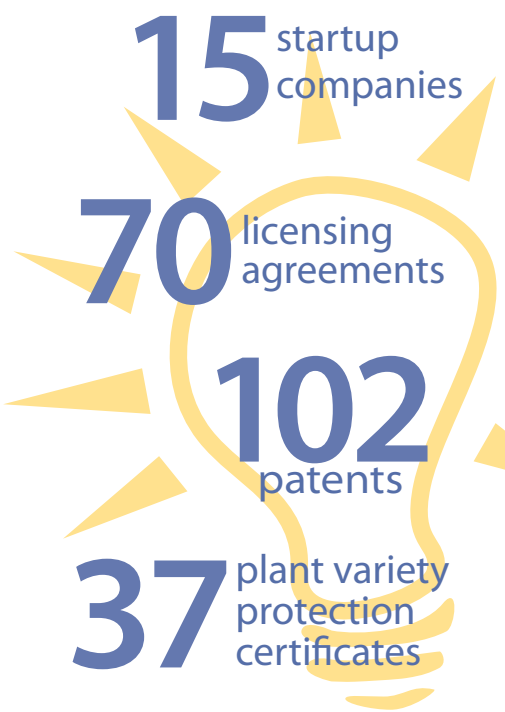
Gregg Henderson. Photo by Rick Bogren

Inside:

LSU AgCenter
128 Knapp Hall
Baton Rouge, LA 70803

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

*Making **connections** for the next generation of **innovation***



LSU AgCenter Office of Intellectual Property makes connections within networks of university inventors, attorneys and industry partners to ensure that university technologies are disclosed, protected and commercialized. Commercialization requires that these parties work together and transform an inventor's idea into a final product that provides benefits to companies and the general public.

These benefits extend across Louisiana and beyond—creating jobs, starting new companies, and providing millions of dollars in funding to university labs to help create the next generation of technology. Since its inception, the office has forged relationships that have led to more than 102 patents and 37 plant variety protection (PVP) certificates, 70 licensing agreements and 15 startup companies. The Office of Intellectual Property will continue to build on this success and looks forward to serving all of its stakeholders.

LSU AgCenter
Office of Intellectual Property
225-578-6030

and growing

more information @ **www.LSUAgCenter.com/intellectual**