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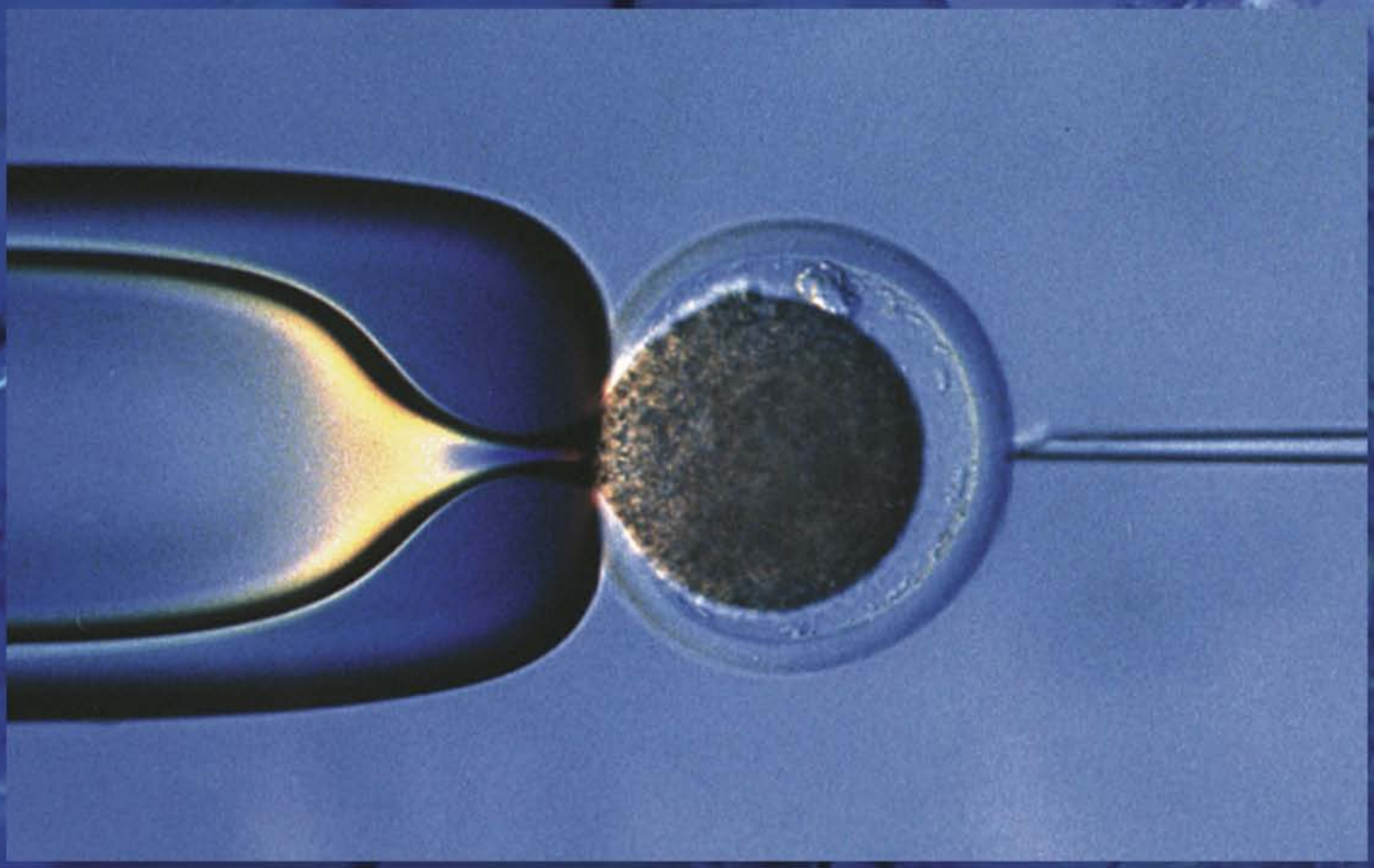

EPA gives okay for new sugarcane insecticide

Ag Center scientist plays key role

An LSU Agricultural Center scientist played a major role in helping bring to market a new environmentally friendly insecticide for sugarcane – so friendly that it won an award from the U.S. Environmental Protection Agency (EPA).

Called "Confirm," the insecticide was issued a Section 3 label in November 1999, which means it complies with EPA regulations and is registered for permanent use in sugarcane.

"It interferes with the molting process of the insect," said Gene Reagan, an entomologist who worked for more than three years trying to find a new insecticide to help control the sugarcane borer, the No. 1 insect threat to Louisiana sugarcane crops.

"The sugarcane borer is by far the most destructive insect pest in sugarcane. It's responsible for more than 90 percent of crop losses by insects," Reagan said, adding that losses could be as much as 50 percent to 60 percent of yield with improper management.

Confirm accelerates molting in only a few groups of lepidopterous insects. This group includes moths, such as the sugarcane borer. The chemical causes the insect to die by interfering with the completion of the molting process, primarily in the larval (caterpillar) stage.

The EPA gave Confirm the Presidential Green Chemistry Award in 1998 for two reasons, Reagan said. Confirm works on such a narrow range of insects that it is compatible with preserving and protecting beneficial insects. Second, it is a minimum-risk pesticide, which means it is much less hazardous to the applicator and the environment.

The red imported fire ant is a beneficial insect in sugarcane because it eats borers.

Reagan started his search for a new sugarcane insecticide in 1991, when six of the 21 documented fish kills in South Louisiana were attributed to use of the insecticide Guthion in sugarcane.

"The fish kills brought negative attention to the sugarcane industry," said Reagan, who then contacted chemical companies to help him identify more environmentally friendly chemistry that could be applied to control the sugarcane borer.

One of the companies, Rohm and Haas of Philadelphia, Penn., suggested two new chemicals, which at the time had no U.S. labels. One of these was Confirm.

"It did a good job in the first stage of our investigation," Reagan said.

Working with Dale Pollet, an extension entomologist with the Ag Center, and the Louisiana Department of Agriculture and Forestry, the EPA subsequently issued approval for a state emergency label (Section 18) on Confirm starting in 1997, and terminated the label for Guthion on sugarcane effective in August 1999.

As research continued, results proved Confirm effective and farmers readily adopted it.

Reagan explained that controlling harmful insects in production systems involves biological controls and cultural practices incorporated into a system of integrated pest management.

"There are three approaches to insect control in crops – insecticides, biological controls and host plant resistance," Reagan said. "We have a long history in Louisiana of developing insect- and disease-resistant plant varieties."

Reagan also gives credit for the sugarcane insect pest research to U.S. Department of Agriculture scientist Bill White at the Agricultural Research Service in Houma, La. ■

Rick Bogren, Linda Foster Benedict and Sam Rollason

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Linda Foster Benedict, Editor
Louisiana Agriculture
P.O. Box 25100
Baton Rouge, LA 70894-5100
phone (225) 388-2263
fax (225) 388-4524
e-mail lbenedict@agctr.lsu.edu.

www.agctr.lsu.edu

Louisiana State University Agricultural Center, William B. Richardson, Chancellor
Louisiana Agricultural Experiment Station, R. Larry Rogers, Director

Page 8

Page 16

Page 11

Page 27

LOUISIANA AGRICULTURE
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SCIENCE NOTES

On the cover: *An egg is held in place while a sperm is injected into it. This LSU Agricultural Center research was done with horses (1998 by Y. Sam Sun). This zebra was used in research on transvaginal oocyte aspiration from free-roaming zebras in South Africa (1995 by Robert A. Godke). In the center are the first split embryo calves born in the Ag Center's research program (1982 by Don Didier). The colt is the first born from a live mare using ICSI, intracyto-plasmic sperm injection (1998 by Richard A. Cochran). The research projects have all been published in the scientific literature. Read more on page 8.*

A Look at the Last Millennium

Experiment Station positions Louisiana for global agriculture

Because of the Louisiana Agricultural Experiment Station, the state's agriculture industry has become world class and competitive globally.

That is the opinion of three of the state's former experiment station directors—Doyle Chambers, Macon "Duke" Faulkner and Kenneth Tipton—as they reflected on turning points and milestones of the last millennium of the LAES.

Yes, they are biased. But the bottom line is that food and fiber production is not easy in Louisiana with its lush, warm environment attractive to all kinds of fierce weeds, insects and disease organisms.

However, because of the scientific breakthroughs achieved through the experiment station, which includes 18 departments on the LSU campus and 20 research stations strategically scattered throughout the state, agriculture contributes about $10 billion to the state's economy, second only to the petrochemical industry. And Louisiana is looked to worldwide as a leader in subtropical agriculture, particularly with sugarcane, rice and cotton production.

Research station prototype

The prototype of the research station started even before federal legislation made money available for such facilities. Louisiana farmers already knew they needed more science. In 1887, a group of sugarcane growers set up a research facility in New Orleans' Audubon Park so they could learn more about the granulation process. Likewise in 1888, a group of North Louisiana farmers pooled money to establish a station at Calhoun to study how to grow cotton, corn and vegetable crops and improve dairy production.

The Louisiana Legislature had authorized an agricultural experiment station as part of Louisiana State University in 1884. However, the experiment station was not officially established until 1887 when the legislators agreed to comply with the provisions of the Hatch Act passed by the U.S. Congress in 1887.

Doyle Chambers

"Louisiana was the first state to ratify and accept the terms of the Hatch Act," said Chambers, who was director from 1964 to 1985.

Then in 1890, Congress made money available to actually carry out this concept. To qualify for the money, LSU had to join with the New Orleans and Calhoun stations. The three entities became what grew to be the LAES.

The money was earmarked for research only, which led to a shake-up of the system.

Director was dean, too

"The director of the experiment station was also the dean of agriculture in the early years," Chambers said. "The feds came down with an audit and threatened to remove the funding."

With state funding short, the dean had used the federal research money to undergird the teaching program. Consequently beginning in 1931, two separate systems were established—one for research and one for teaching.

"Every department had a research head and a teaching head—duplicate heads," Chambers said. "It was an inefficient use of resources and talent."

J. Norman Efferson, the first chancellor of the Ag Center, changed that in the 1950s when he was the dean of agriculture. He persuaded the LSU administration to split the resources instead of the talent so faculty had joint appointments between research and teaching.

"This moved agricultural science forward," Chambers said.

Ag faculty could now teach and take advantage of student energy to carry out research projects. And students, the future ag leaders, could learn first-hand from the researchers.

Mixing up the money caused another problem, though. The infusion of federal dollars into the agriculture departments gave the appearance of inequities across campus, especially when student numbers were factored in. A solution put forth by a task force of outsiders was to split research and teaching.

Louisiana agriculture has come a long way from the days of "mule" power. Research at the Louisiana Agricultural Experiment Station has made possible the production of food and fiber in the state.

"I didn't want history to repeat itself," Chambers said.

As a former agriculture student at LSU, he had witnessed the effects of split departments. He knew this was not the best course for progress. A better solution was to make a separate campus of research and extension and keep the joint appointments with the College of Agriculture. Partly through his influence, the LSU Agricultural Center was born in 1972.

"Agricultural research had a difficult time competing with campus departments for funds," Chambers said. "As a separate campus with our own administrative structure, we could better meet the needs for agricultural research."

First rice station

Meanwhile, branch stations were added over the years. Some were created for specialized purposes, such as the Rice Research Station in 1909, the first of its kind in the country.

The agricultural producers themselves continued to be a driving force behind the establishment of stations. Farmers in Northeast Louisiana wanted to know more about growing cotton and other crops so put in some of their own funds for the creation of the Northeast Research Station at St. Joseph in 1929. A branch station was added at Winnsboro in 1949 to aid in research on two different soil types—the rich, alluvial soils of the Mississippi Delta and the lighter and poorer loessel soils upland on the Macon Ridge.

"A problem would have two different solutions, depending on the soil," Chambers said.

The "fruit and truck crop people" wanted a station near Hammond, which was the center of strawberry country and production of other fruits and vegetables. So in 1922, the Hammond Research Station was started. In 1949, the Citrus Research Station was also formed to do research on fruits and vegetables, including citrus, to help the farmers meet the produce needs of New Orleans.

Post-war economy

The technological demands of a post-war economy helped drive the formation of several branch stations soon after World War II. For example, farmers in the northwest corner of the state wanted to learn how to grow corn and better ways to grow cotton. Their request was met with the establishment of the Red River Research Station near Bossier City in 1947. Similar scenarios led to the Hill Farm Research Station near Homer and the Rosepine Research Station near Rosepine, both in 1947.

Sweet potato farmers needed a research station well north of the sweet potato weevil zone, which covers most of South Louisiana. In 1949, the country's first and only Sweet Potato Research Station was started in Chase.

"One of their functions was and still is to develop sweet potato seed free of this pest," Chambers said.

As these various stations were added, inequities arose in their funding. Even though they were part of the experiment station, they operated independently in budgeting. Some superintendents, which is what resident directors were called then, could generate more money than others.

"Some were starving. Others were blowin' and goin'," Chambers said.

To bring about a better planning, Chambers put them all under one budgeting system.

"Duke" Faulkner

"This was certainly one of the key turning points," said Faulkner, who was experiment station director for a year in 1988 and 1989. He had previously been the resident director of the Rice Research Station and director of international programs for the Ag Center.

This change allowed the research program to branch into new areas, including soybeans, aquaculture and forage production, all of which have led to better agriculture for Louisiana.

But the transition was not easy.

"Some of the superintendents were unhappy," Chambers said.

Another pivotal moment for agricultural research came in 1971, when commodity groups voted to mandate a check-off program to support research. The rice producers were the first group.

"This showed tremendous support for the work we were doing," said Tipton, who was director from 1989 to 1996.

Kenneth Tipton

One of Tipton's challenges was to minimize the effects of a number of years of declining financial support. However, one of the worst days of his career was when he was told to cut the budget by 25 percent.

"It was on a Good Friday," he said. "I felt like I was crucifying the research program."

Fortunately, he did not actually have to implement the cuts.

But despite limited funding, the caliber of the research and contributions to the state remained top rate. For example, during Tipton's administration the Louisiana Forest Products Laboratory was added to expand research on the state's No. 1 agriculture crop, timber.

Both Faulkner and Tipton credit Chambers for setting a tone of excellence and a reverence for ideas.

"He was an idea man," Tipton said, who had served as resident director of the Red River Station and associate director under Chambers.

Research milestones of the last millennium cover a gamut because of the diversity of Louisiana's agriculture. Experiment station scientists have been pioneers in the crossbreeding of cattle, tissue culture and the introduction of new varieties that have kept certain commodities viable in the state, such as the sweet potato.

World leaders

Experiment station scientists are considered world leaders in *in vitro* fertilization and the development of herbicide-resistant rice.

Direct applicability to the urban audience includes the work with the Formosan subterranean termite and red imported fire ant.

The LAES begins the new millennium plump with past accomplishments yet poised for future needs. The scientists are breaking new ground in gene transfer, which holds the answers to greater yields with less chemical use. The station is also a leader in patenting and licensing some of the technologies developed to help offset some of the ever-increasing costs of doing research.

But continued success requires continued public support.

"Without that, we may go to the grocery store and find the shelves empty," Chambers said. "Without the Louisiana Agricultural Experiment Station, there would be no agriculture in Louisiana." ■ **Linda Foster Benedict**

Carcass and Palatability Traits of Brahman-Composite and Angus Steers

Thomas D. Bidner, Wayne E. Wyatt, Paul E. Humes and Donald E. Franke

Brahman-composite breeds were developed from Brahman-crossbred cattle. The Santa Gertrudis, Brangus and Beefmaster breeds were among the first Brahman-composite breeds, all British-based, developed in the United States. When the Continental European breeds of cattle came to this country in the 1960s, they too were crossed with Brahman for commercial calf production in the Southeast. Development of Brahman-composite breeds from these crosses followed along the lines of development of the Brangus. Most of the Brahman-composites were developed to contain 5/8 of the Continental or British breed and 3/8 of the Brahman breed. The 3/8 Brahman composition gives some tolerance to the heat and humidity of the Southeast and some ability to withstand various insects and parasites. In addition, a 5/8-3/8 breed composite retains about half the heterosis (hybrid vigor) expected in the first cross.

One of the advantages of composite breeds is that they can be mated *inter-se*, or like to like, and reproduce their own kind with the same breed composition generation after generation. Thus, replacements are produced within the system, as in purebred cattle. This is especially important for producers with cow herds not exceeding 100 animals.

Research has consistently shown that Brahman and Brahman-cross cattle have less tender meat than do British and Continental breeds. Only limited data are available on the carcass and palatability traits of the Brahman-composite breeds, however. Because the Certified Angus Beef Program has set the standard for the beef industry, we compared steers sired by the Brahman-composite breeds to Angus in this study. The project was initiated at the Idlewild Research Station near Clinton and compared several of the more popular Brahman-composite breeds to each other and to Angus. The steer calves were finished at the Iberia Research Station feedlot along with a similar group of Angus steers. All were slaughtered at the LSU Agricultural Center Meats Laboratory.

Photo by John Wozniak

Brooke Bellard, left, and Micah Blazek, both undergraduate students in animal science, cook steaks to an internal temperature of 70 degrees F. The samples are chilled and then prepared for shear force analysis.

Five calf crops

Groups of British-based composite breeds (Brangus and Beefmaster) and Continental-based composite breeds (Gelbray and Simbrah) females were assembled at the Idlewild Research Station before the 1987 breeding season. Females in these breeds consisted of yearling heifers and young cows, mostly donated by breeders from Louisiana, Mississippi and Texas. Brahman x Hereford first-cross females were purchased from a Mississippi producer. Cows in this study produced five calf crops, starting in 1988. Some of the composite heifers born in the early years of the study were developed for replacements and also produced purebred calves in the last two years of the study.

Brangus, Beefmaster, Gelbray and Simbrah sires were mated to cows of their breed and to Brahman x Hereford first-cross cows, but they were not mated to other Brahman composite cow breeds. For example, Brangus bulls were mated to Brangus and to Brahman x Hereford cows, but not to Beefmaster, Gelbray or Simbrah cows. Brahman x Hereford cows were reassigned randomly each year to the composite sire breeds so they would have a chance to produce calves from several sire breeds.

Artificial insemination was used in the first 60 days of the breeding season, followed with natural matings. Sires used for artificial insemination were some of the more prominent sires within each of the composite breeds at the time

Thomas D. Bidner, Professor, Animal Science Department; Wayne E. Wyatt, Associate Professor, Iberia Research Station, Jeanerette, La.; Paul E. Humes, Professor, and Donald E. Franke, Professor, Animal Science Department, LSU Agricultural Center, Baton Rouge, La.

Table 1. Influence of breed type on carcass traits

Breed	Carcass wt., lb.	Maturity	Quality grade	Ribeye area, sq. in.	Yield grade
Angus	623	A^{74}	Select ^{75}	10.9	3.0
Brangus	736	A^{80}	Select ^{65}	11.5	3.1
Beefmaster	729	A^{84}	Select ^{25}	11.1	3.2
Gelbray	752	A^{94}	Select ^{35}	12.7	2.8
Simbrah	803	A^{88}	Select ^{70}	12.9	2.9

A^{00} is the youngest maturity score and A^{99} is the oldest within A maturity. In quality grade, $Select^{00}$ is the lowest and $Select^{99}$ is the highest. The Angus was significantly different from the other breeds in maturity, quality grade and ribeye area. In yield grade, the Brangus and Beefmaster were significantly different from the Gelbray and Simbrah.

of the study. During the five-year period, 210 steers were available.

After the stocker growing period on ryegrass pasture, the steers were transported to the Iberia Research Station and placed on a high concentrate ration. Steers were weighed and evaluated for fat cover over the 13th rib every 28 days. After at least 84 days on feed, steers attaining 0.4 inch of backfat were weighed and transported to Baton Rouge for slaughter.

After carcasses spent three days in a cooler, data were collected. Upon completion of the grading procedure, a 1-inch steak from the 12th rib was vacuum-packaged and frozen. After 10 days of aging, two more 1-inch steaks were removed and frozen for future sensory panel and tenderness analysis. The sensory panel included eight to 12 trained panel members who rated the steaks for juiciness and tenderness. An Instron instrument was used to determine shear force of the steaks, which is a measure of tenderness.

Carcass traits

Both the Brahman-composite breeds and Angus had significant influence on beef carcass quality traits. When the Angus steers were compared to the Brahman-composite steers, the Angus steers had lighter carcass weights, more youthful, or less mature carcasses and a higher final quality grade. Because all steers were fed to the same fatness endpoint (0.4 inch), these data indicate that the Angus steers matured earlier.

Even though Angus steers had a higher quality grade when compared to all the Brahman-composite carcasses, the average quality grade for all the steer types was USDA Select. The quality grade is a combination of factors that predict palatability (tenderness, juiciness and flavor) of beef.

When the British-based composite breeds were compared to the Continental-based composite breeds, the British-based breeds had lighter carcass weights and more youthful carcasses. This was expected because Angus, Herefords and Shorthorns have a smaller mature size than Gelbvieh and Simmental. When Brangus steers were compared to Beefmaster steers, Brangus had a higher quality grade than Beefmaster.

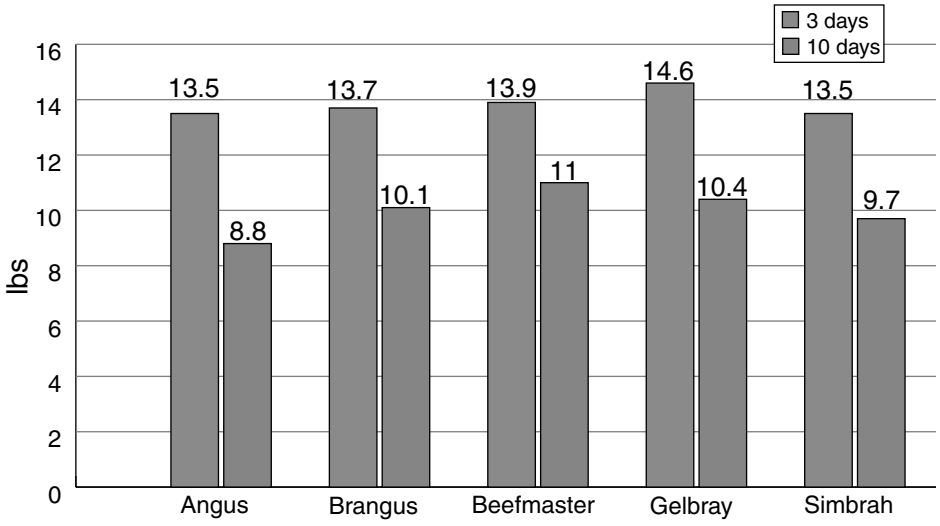
The Angus steers had smaller ribeye areas than all the other steers but larger ribeyes when this trait was divided by the hot carcass weight. Thus, the Angus steers had smaller actual ribeye muscle but larger ribeye muscle expressed on a weight basis. The ribeye area is an indicator of total carcass muscle.

The Continental-based composite breeds had larger ribeye muscles when expressed either as actual ribeye or on a ribeye per unit weight basis compared to the British-based composite breeds. The Continental-based composite breeds also had a superior yield grade compared to the British-based composite breeds. A lower yield grade indicates more meat. This finding was expected because Gelbvieh and Simmental are more heavily muscled breeds of cattle than Angus, Herefords and Shorthorns.

Breed, palatability

All the steaks were similar in tenderness with three days of aging, but at 10 days of aging, the steaks from Angus steers were more tender as indicated by sensory panel ratings and the Instron shear data compared to the steaks from Brahman-composite sired steers. Steaks from the Angus were the most tender at 10 days of aging. These steaks aged (became more tender) more rapidly than did the steaks from the Brahman-composite breeds. Steaks sold in supermarkets normally have been aged seven to 14 days. This suggests that steaks from Brahman-composite steers age more slowly than Angus steaks, and it would take longer than 10 days of aging to tenderize these steaks. All the steaks were similar in juiciness. ■

Figure 1. Influence of breed type on shear force of steaks aged for 3 and 10 days



Oocyte Aspiration for *In Vitro* Embryo Production in Farm Animals

Joel A. Carter, Marius Meintjes, M. Shane Bellow, Richard Cochran, Kay Graff and Robert A. Godke

Males of an animal species have an advantage over females in the propagation of their genes. For example, in wild populations, it is common for males of many of the hoofstock species to mate with seasonal female breeding groups, as long as the male is strong enough to ward off subordinate males. Also, sperm cells can be produced by the testes throughout the male's life in almost unlimited amounts.

Joel A. Carter, Marius Meintjes, M. Shane Bellow, Richard Cochran, Kay Graff, all graduate students, and Robert A. Godke, Professor, Department of Animal Science, LSU Agricultural Center, Baton Rouge, La.

In contrast, the female is born with all the oocytes stored in her ovaries she will ever have. For example, a beef heifer at birth may have 200,000 primordial follicles containing oocytes in her ovaries. Since a beef cow might have only 10 calves in her lifetime, what happens to the remaining 199,990 oocytes? First, nonpregnant cows exhibit estrus and ovulate, with this sequence of events occurring again 20 to 22 days later (the estrous cycle). Follicles in cattle develop in waves of four to 12 follicles at a time, and a cow may have two to three waves of these growing follicles during a 21-day estrous cycle. Over this estrous cycle, 12 to 36 follicles develop to varying degrees and most then regress during this interval, with usually only one follicle ovulating. Thus, only one oocyte has a chance to become fertilized each cycle.

Photo by Marius Meintjes

This is the first calf in the world produced from an in vitro *fertilized embryo where the egg was harvested from a live pregnant cow. The Brangus donor female remained pregnant and produced her own calf from artificial insemination after a normal-length gestation. This IVF calf was carried by a surrogate female and was born a little over a month later than the AI calf born to his biological dam.*

Valuable female genetic material

This difference in male and female physiology presents the problem of how to maximize genetic material (gametes) from valuable females. Embryo transfer (ET) was the first procedure to enhance the female's reproductive potential. With ET, females are superovulated with hormones so that their ovaries release more than one egg before fertilization. Over the years, embryo transfer technology has been used to increase the number of possible offspring from selected females.

This approach has a few drawbacks, however. For example, some females do not respond or stop responding to the stimulatory agents or develop physiological conditions that make it difficult to retrieve the embryos. One of the major concerns with the overall ET procedure, however, is that cows are most often kept "open" so they may be hormone-stimulated for subsequent embryo collections. Cows that are superovulated and collected may take 60 days or longer to become pregnant either with artificial insemination or natural mating. A small percentage of hormone-treated donors also may develop cystic follicles on their ovaries.

The advent of *in vitro* fertilization (IVF), or fertilization in a test tube, changed animal reproductive management. This technique was first successfully used to produce offspring in rabbits (1959) and a healthy bull calf (1982). Even after years of research, IVF methodology is still being tested and fine-tuned for farm animals.

Slaughterhouse ovaries used initially

Initial *in vitro* embryo production (IVP) used oocytes from slaughterhouse ovaries. This worked well during early experimentation when large numbers of immature eggs (oocytes) were needed to develop procedures. In the 1980s, it was proposed that the application of IVP in animals would likely be its use in rare exotic animals and in genetically valuable seedstock. Early attempts at retrieving oocytes from potential donor cattle included surgical and less invasive laparoscopic procedures, but there was a limit to how many procedures could be performed without causing injury. At this stage, there was essentially no safe, repeatable method of harvesting the oocytes from live farm animals.

Then in the late 1980s, a method was developed in humans for retrieving oocytes using ultrasonography to visualize the ovary while a needle was guided transvaginally into the follicle. The oocyte could be aspirated from the follicle and subjected to *in vitro* maturation, fertilization and then culture procedures. These efforts paved the way for the new reproductive technology now available for farm animals. Currently, transvaginal ultrasound-guided oocyte aspiration (TUGA), also known as ovum pick-up (OPU) in human medicine, is now used in cows, goats, mares and more recently in pigs and exotic hoofstock species.

Horses present unique problem

The horse has presented a unique problem for researchers working in the assisted reproductive technology area. Even though embryo collection and transfer are relatively simple in the mare, attempts to superovulate horses have produced poor results. Because of the unique anatomical structure of the horse ovary, only one ovum usually ovulates at the appropriate time during each estrous cycle. Also, for some yet unknown reason, typical *in vitro* procedures have not worked consistently in the horse. One of the goals of the LSU Agricultural Center's Embryo Biotechnology Laboratory has been to develop

Transvaginal Oocyte Recovery Procedure

Figure 1. The oocytes are recovered from the ovaries of a cow by puncturing the follicles through the anterior wall of the vagina with a 500-millimeter, 18-gauge stainless steel needle. Collection is guided by an ultrasound probe fitted at the distal end of the extended handle. The ovary with the follicle to be punctured is adequately positioned on the transducer head by the hand in the rectum.

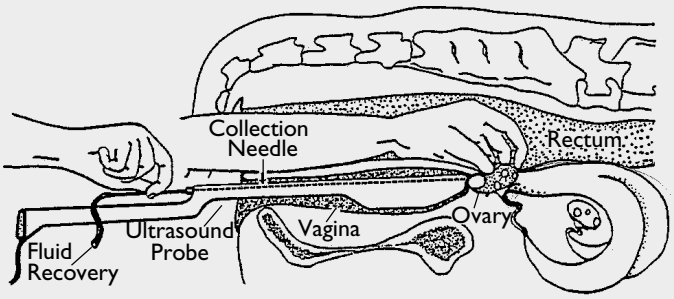


Figure by Elmarie Meintjes

Figure 2. Using an Aloka 500-V ultrasound unit with a plastic hand pump and negative pressure to collect oocytes from the developing follicles of both large and small mares.

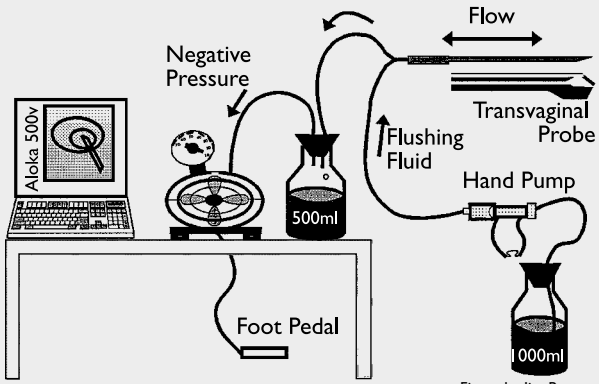


Figure by Jim Broussard

Figure 3. Diagram of the hand and probe placement for transvaginal oocyte aspiration of goats.

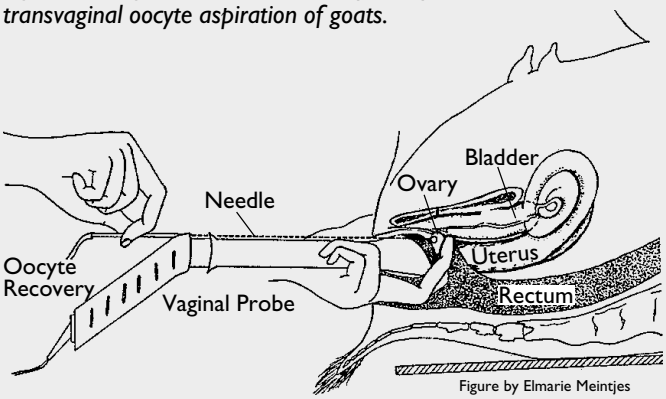


Figure by Elmarie Meintjes

Photo by Jim Zietz

LSU Ag Center scientists began work in the early 1980s on embryo and gamete biotechnologies using a variety of farm animals, including goats. This photo was taken at that time at the research farm near St. Gabriel. Robert A. Godke was and still is the director of reproductive physiology research.

assisted reproductive technologies to increase the number of offspring from genetically valuable mares.

Even though only one follicle normally matures and ovulates during an estrous cycle, mares also are thought to have one or two waves of multiple follicles during that cycle. Once again, this developing follicle population makes it possible to use transvaginal ultrasound-guided aspiration to collect oocytes from live mares. The first foals produced from aspiration of live mares were produced at the Embryo Biotechnology Laboratory in 1998, using a procedure called intracytoplasmic sperm injection (ICSI), where a single sperm cell is injected into the oocyte. After ICSI, embryos are surgically transferred at the 2- to 4-cell stage into the oviducts of suitable recipients, since the culture of IVF-derived equine embryos has still not been perfected.

Goats are another farm animal species in which *in vitro* embryo production has proved successful. Transvaginal aspirations have been performed successfully on cyclic and noncyclic adult goats by Ag Center scientists.

IV success with pregnant cows

Another problem with the larger farm animals is that their gestation periods are considered to be long in comparison with those of dogs (62 days) and cats (63 days) and that the animals are out of embryo production during their gestation. Cows have 9 ½-month and mares have 11-month pregnancies, but both are known to continue follicle wave development during early to mid-gestation. Another goal of the Ag Center laboratory has been to take advantage of these developing ovarian follicles and attempt to produce IVF-derived offspring from oocytes harvested from females during pregnancy.

The main concern was whether the oocyte aspiration procedure would affect the ongoing pregnancies. This oocyte aspiration approach proved not to be a problem, and pregnant donors were found to consistently produce more oocytes per collection than similar nonpregnant, cyclic females. The first offspring produced from oocytes collected by transvaginal ultrasound-guided aspiration from pregnant donor animals resulted from cows and horses at this Ag Center laboratory.

Ultrasound-guided follicle aspiration also has been used successfully in other animals, with modifications made primarily to account for anatomical differences of the donor animals. This aspiration technique has been used successfully to harvest oocytes from adult pigs, as long as rectal manipulation of the ovaries was possible within the donor females. Transvaginal ultrasound-guided oocyte aspiration has also been used successfully to harvest oocytes in llamas. This procedure, the same used for other exotic hoofstock, has been used successfully by members of this Ag Center laboratory team to obtain oocytes in the rare Bongo antelope and also the African eland.

There is still much to be learned in the use of assisted reproductive technologies to maximize reproductive potential in genetically valuable animals. Now that repeatable oocyte retrieval methods are being fine-tuned, it is likely these procedures will become routinely used to obtain oocytes for further gamete and embryo research and also by seedstock producers for *in vitro* embryo production from farm animals in the commercial sector.

Transvaginal ultrasound-guided oocyte aspiration is now used to harvest valuable oocytes from minor farm animal breeds, from domestic females representing rare bloodlines, clinically infertile females and cows too old to become pregnant. Research continues in our laboratory to find applications for this technology, including harvesting oocytes from injured females, young prepubertal heifers and early postpartum beef cows for *in vitro* embryo production. We also plan to use ultrasound-guided oocyte aspiration to obtain oocytes for *in vitro* embryo production to help preserve germplasm of endangered exotic species. ■

Automated machine helps remove plastic mulch

The use of plastic mulch is an important cultural practice in the commercial production of fruits and vegetables, but removal and disposal of the mulch cause problems. Commercial machines are available to lift and loosen the mulch, but many growers collect the mulch by hand. Commercial machines are available to collect the loosened mulch, but control of spool speed is a problem. The difficulty with mechanizing the collection of the mulch is the need to vary the speed of the spool on the collector to compensate for the increasing spool diameter as the mulch builds up on the spool. A simple, automated mulch collector has been constructed at the Hammond Research Station.

To simplify building and testing a prototype, the lifting/loosening operation was done by a separate machine similar to the available commercial machines (Figure 1). The prototype mulch collector is shown in Figure 2. The spool was driven by a hydraulic motor connected to the tractor remote hydraulics. An adjustable flow control valve was installed in the line to the motor. The motor was mounted on a swing arm suspended from a bearing on the spool shaft (see arrow in Figure 2). Travel of the swing arm was damped and limited by a pressurized hydraulic shock absorber. The swing arm was mechanically linked to the flow control valve so that the flow control valve, and thus the spool speed, was adjusted as the motor/swing arm assembly rotated in response to changes in load (torque) on the spool. It was possible to automatically reduce hydraulic flow (and thus motor speed) to zero. This allowed the tractor to be stopped completely without disengaging the hydraulic lever, making control of spool speed fully automatic.

The spool was designed to allow easy removal of the rolled-up mulch material. Two alternate spool systems have been used successfully. Two wood 2-by-4s were grooved so that they would form a square box over the spool shaft. Plastic mulch was wrapped onto the 2-by-4s, and then the 2-by-4s were removed and discarded with the plastic mulch. The machine was later modified to use fiber spools (the cylinders on which the plastic mulch was originally wrapped when purchased) to replace the 2-by-4s. The fiber spools were then discarded with the plastic.

The prototype was used to remove plastic mulch from a bell pepper crop. The prototype mulch collector worked as anticipated. The swing-arm mechanism effectively sensed torque on the collection spool and adjusted spool speed accordingly. The prototype effectively maintained operation when the tractor was slowed down, stopped and started. Once adjusted, operation was automatic. In addition to a tractor driver, one person was needed to tie the plastic mulch to the spool at the beginning of each row and whenever the mulch tore.

Observations on use of the prototype on several small research fields revealed that a crew of two could do in two hours, with less effort, the work that a crew of four to six had previously required three to four hours of hard labor to complete. ■

Richard L. Parish, Professor, Hammond Research Station, Hammond, La.

Figure 1. The primary purpose of this machine is to loosen and lift the plastic. It also slices the plastic which aids in soil removal.

Figure 2. The vertical bar on the left of the spool is a swing arm that allows automatic adjustment of the spool speed. Note arrow.

Farmers can also use a baler to remove plastic mulch. However, this works best if there is vegetative material, such as weeds or crop residue, that can be taken up with the plastic.

Urban Influences on Rural Land Values in Southeast Louisiana

Steven A. Henning, Lonnie R. Vandeveer, Gary A. Kennedy and Huizhen Niu

Traditionally, rural land values have been influenced by site characteristics such as soil quality, type of crops grown, size of tract, relative accessibility, improvements and government programs. More recently, population increases and economic development have expanded urban and suburban areas, resulting in an increased demand for rural land.

Few studies have measured the effect of potential economic development on rural land values. The objective of this study is to develop a model that measures the effect of location and economic development on rural land values in southeast Louisiana. Geographical Information Systems (GIS) procedures provided insight into the spatial characteristics of this land market, guiding the selection of measures of location and economic development.

Data for this study are based on rural land market sales collected using annual mail surveys of professional realtors, appraisers and financial officers familiar with rural land markets in Louisiana. From January 1993 through June 1996, 1,811 sales were reported statewide. For this study area, a subset of the larger state data base, with 204 reported sales, was used.

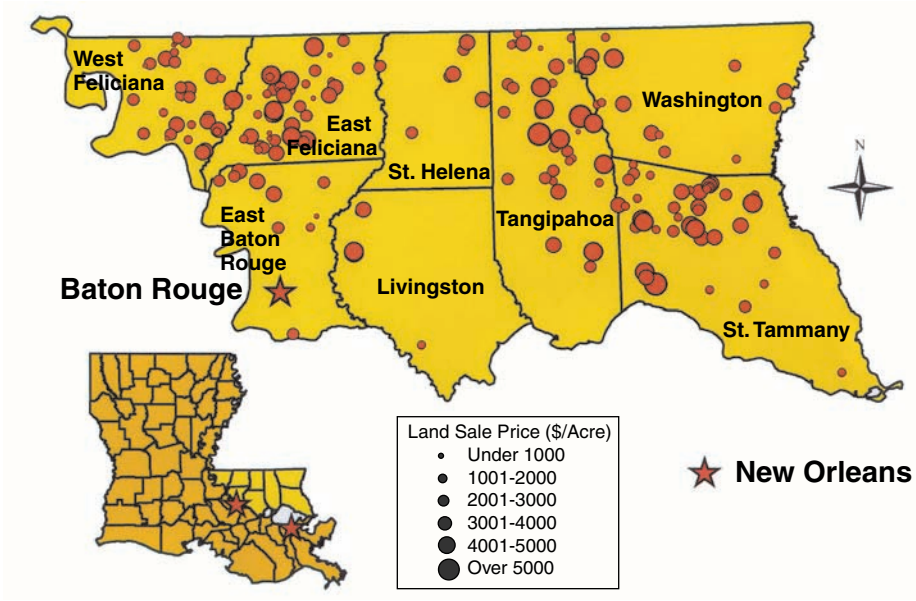
The study area (Figure 1) consists of eight parishes. The primary general soils are Southern Mississippi Valley Silty Uplands, Coastal Plain and Gulf Coast Flatwoods. The area is characterized by rolling hills with pine tree, nursery crop, dairy farm and other animal production activities.

GIS procedures

GIS procedures were used to review spatial characteristics of rural land sales data. An important feature of GIS is the ability to overlay data. Overlay is the process of stacking digital representations of spatial data so new information can be revealed, visualized and analyzed. For example, in Figure 1 the location of each sale tract is overlaid on a parish map. The overlay in Figure 1 not only provides a spatial view of the data but also suggests a positive relationship between the per acre value and proximity to Baton Rouge and New Orleans. It is hypothesized that relatively large per acre tract values in St. Tammany Parish result from the Pontchartrain Causeway that links New Orleans with this area. The bridge provides convenient access for commuters.

Relatively large per acre sales in Baton Rouge and New Orleans suggest that location has an influence in this market. GIS procedures were used to compute distance between each tract and the nearest city. These straight line distances were estimated and added to the rural land data base electronically. These distance estimates generally reflect three groups of sales: 1) north and within a one-hour commute to downtown Baton Rouge, 2) north and within a one-hour commute of downtown New Orleans and 3) a north-central section not generally considered a convenient commute to either metropolitan area.

Figure 1. Tract location and magnitude of per acre selling price, Rural Land Market Survey, Southeast Louisiana, 1993-1996.



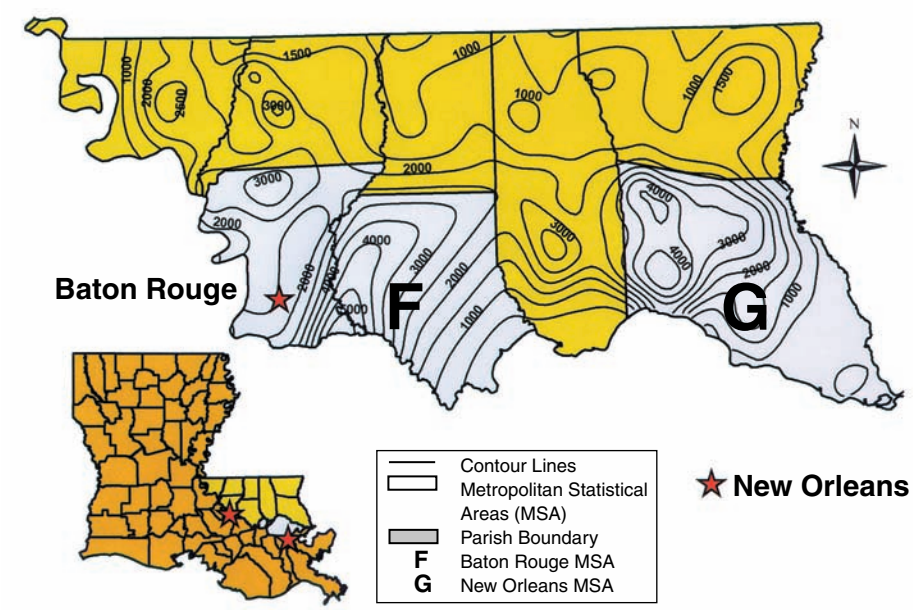
Contour maps

Another feature of GIS is the ability to develop a land value contour map. Similar to topographic maps that show equal elevation above sea level, the contour map in Figure 2 depicts areas with approximately equal per acre land values. Each contour line is drawn as a continuous line identifying land values at $500 price intervals. Lines located close together indicate rapid price changes within short distances, and lines located farther apart indicate much slower price changes.

In Figure 2, rapid land value changes lie at the heart of the Baton Rouge metropolitan statistical area (MSA). Similarly, a concentration of

Steven A. Henning, Associate Professor; Lonnie R. Vandeveer, Professor; Gary A. Kennedy, Adjunct Assistant Professor; and Huizhen Niu, Instructor/GIS Manager, Department of Agricultural Economics and Agribusiness, LSU Agricultural Center, Baton Rouge, La. Kennedy is also Assistant Professor, Agricultural Sciences Department, Louisiana Tech University, Ruston, La.

Figure 2. GIS land value contour map estimated at $500 increments and overlaid on metropolitan statistical areas, Rural Land Market Survey, Southeast Louisiana, 1993-1996.



contours in St. Tammany Parish, the northernmost parish of the New Orleans MSA, suggests that economic activity in this area has a positive influence in the rural land market. The concentration of contours on MSAs suggests that economic development has a positive influence on rural land values, implying a need to include this variable in a model of the rural land market.

The dollar contribution to total property value attributed to individual characteristics of that property are revealed to economic agents from the observed prices of different tracts of land and the specific quantity of an individual characteristic associated with each tract. Prices of these characteristics are implicit because there is no direct market for them. The implicit marginal price of each characteristic is an estimate of the amount by which the per acre land price changes, given a unit change in the characteristic.

The model analysis considered a number of agricultural and nonagricultural variables that could influence rural land value. The final model included only statistically significant variables. Variables in the final model explained 53 percent of the variation in rural land values in the study area. They were size, month of sale, percentage of timber, value of improvements, paved access, distance to nearest city and parish as part of an MSA.

Per acre land values

Marginal implicit prices are used to observe the magnitude and direction of influence of various model factors on per acre land values. The marginal implicit price for size of tract at the mean size and price is estimated to be minus $4.52, indicating that per acre land price declines by $4.52 with a one-acre increase in size at the mean (115.88 acres).

The marginal implicit price varies with the size of tract, however. For example, if the mean per acre size was 150, the marginal implicit price is estimated at minus $3.49 per acre, whereas if the average size was 50 acres, the marginal implicit price is estimated at minus $10.47 per acre.

The marginal implicit price for the value of improvements was an estimated $0.00629, suggesting that $10,000 of improvements on a tract of land in the southeast Louisiana study area would increase land value by $62.90 per acre, assuming all other factors constant. The marginal implicit price for time of sale indicates that each month between January 1993 and June 1996 adds $32.76 to per acre value.

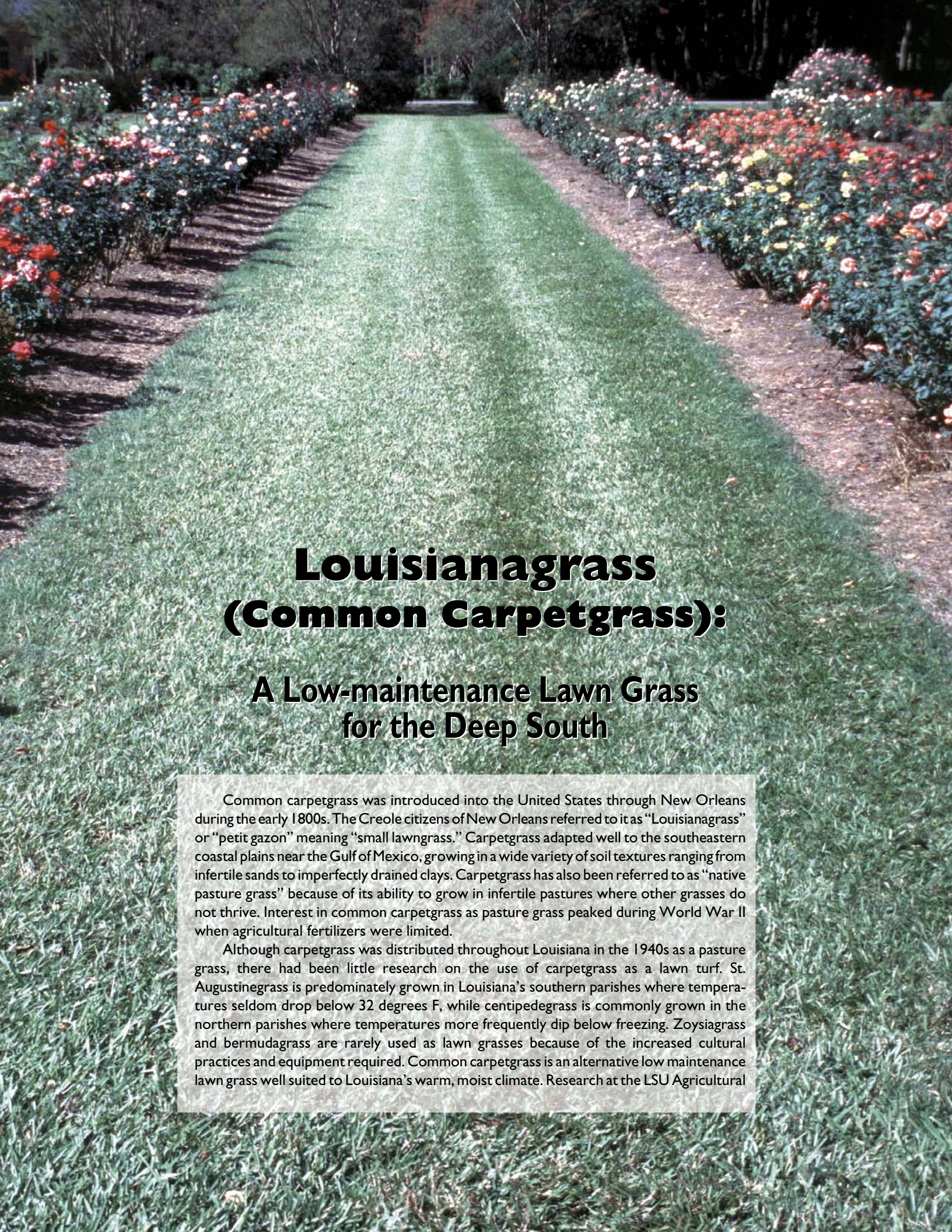
Development, location

Marginal implicit prices suggest that nonagricultural factors representing economic development and location (metropolitan areas, distance to nearest city and type of road adjacent to rural property) have substantial effects on rural land value in the study area. The marginal implicit price for the MSA variable indicates that tracts located in an MSA generally sell for $1,574 more per acre than tracts not located in an MSA. The effect of location suggests that as distance to nearest city declines by one mile, the per acre value of land increases by $27.69 per acre. Similarly, the marginal implicit price for paved road access (RT) is valued at $569.26 per acre. Timber was the only agricultural variable to be statistically significant, with an additional 1 percent of timber in a tract actually reducing land value by $2.92 per acre. Most timber observations in the data set represent cutover pine timber. The model estimate reflects the cost of clearing the land for other uses.

Visual observation, using GIS procedures, suggests the existence of a spatial relationship between per acre rural land values and the distance to the metropolitan statistical areas of Baton Rouge and New Orleans for the southeast Louisiana study area. Results of a statistical model of the study area indicate that the nonagricultural variables, distance to the nearest city and location in an MSA, affect rural land prices significantly. Selected tract characteristics (value of improvements, month of sale and paved road access) also influence tract value. The only agricultural variable to be statistically significant was percentage of timber in the tract, and it actually decreased tract value as the percentage of timber increased.

The model analysis supports several conclusions. One is that the value of rural land in southeast Louisiana is greater for land located within either the Baton Rouge or New Orleans MSA. In addition to the MSA effect, distance to the nearest city also increases the value of rural tracts, the closer the tract is to the city. Results of this study also support the conclusion that agriculture does not have a significant positive effect on land values in the study area.

Taken together, these conclusions support the proposition that alternative nonagricultural uses for rural land heavily influence land prices. Residential and commercial use of rural land may be driving the price of land in the southeast Louisiana area above agricultural market levels. With continued population increases and economic growth, the long-term implication is a continual transition of agricultural land to urban and suburban use for this area. ■



Louisianagrass (Common Carpetgrass):

A Low-maintenance Lawn Grass for the Deep South

Common carpetgrass was introduced into the United States through New Orleans during the early 1800s. The Creole citizens of New Orleans referred to it as "Louisianagrass" or "petit gazon" meaning "small lawngrass." Carpetgrass adapted well to the southeastern coastal plains near the Gulf of Mexico, growing in a wide variety of soil textures ranging from infertile sands to imperfectly drained clays. Carpetgrass has also been referred to as "native pasture grass" because of its ability to grow in infertile pastures where other grasses do not thrive. Interest in common carpetgrass as pasture grass peaked during World War II when agricultural fertilizers were limited.

Although carpetgrass was distributed throughout Louisiana in the 1940s as a pasture grass, there had been little research on the use of carpetgrass as a lawn turf. St. Augustinegrass is predominately grown in Louisiana's southern parishes where temperatures seldom drop below 32 degrees F, while centipedegrass is commonly grown in the northern parishes where temperatures more frequently dip below freezing. Zoysiagrass and bermudagrass are rarely used as lawn grasses because of the increased cultural practices and equipment required. Common carpetgrass is an alternative low maintenance lawn grass well suited to Louisiana's warm, moist climate. Research at the LSU Agricultural

Photos by Ed Bush

Figure 1. Common carpetgrass is often mistaken for St. Augustinegrass or centipedegrass.

Center has been uncovering information that indicates common carpetgrass is suitable for growing on lawns in all 64 parishes of the state.

Common carpetgrass is often mistaken for St. Augustinegrass or centipedegrass (Figure 1). Common carpetgrass is a perennial creeping grass that forms a dense sod, with light green, coarse-textured leaf blades. The color and texture of carpetgrass leaves are similar to centipedegrass. Leaves of common carpetgrass are short, blunt-tipped, smooth and folded in the bud. The prominent seedheads of carpetgrass are an easy way of distinguishing it from other lawn grass species (Figure 2). Seedheads typically range in height from 6 to 12 inches. Centipedegrass and St. Augustinegrass seedheads are shorter and less conspicuous.

Figure 2. The prominent seedheads of carpetgrass are an easy way of distinguishing it from other lawn grass species.

Carpetgrass adapts to wide soil types and pH ranges (4 to 7). It can easily be established from seed, sprigs or sod. Planting 1 to 2 pounds of pure, live seed per 1,000 square feet from June 1 to September 1 in Louisiana is a rapid and inexpensive way to establish a lawn. Commercially packaged seed mixtures of common carpetgrass and centipedegrass are being sold throughout the Gulf Coast region. Common carpetgrass germinates and establishes quickly, reducing the potential of seed washing and erosion. Soaking carpetgrass and centipedegrass seed in distilled water at room temperature 48 hours before seeding can reduce germination time by at least two days.

Nitrogen requirements are low compared to other warm-season lawn grasses. According to Ag Center research, quality carpetgrass lawn can be maintained by applying between 2 to 4 pounds nitrogen per 1,000 square feet per year and mowing weekly at 1.5 to 3 inches with a rotary mower. Mowing weekly will control tall seedheads associated with common carpetgrass. Application of newly developed plant growth regulators (PGRs) and herbicides with PGR attributes can chemically reduce seedhead production and vegetative growth and increase turfgrass quality.

Comparatively, common carpetgrass has fewer pest problems than most warm-season lawn grasses. This is essential in Louisiana where disease and insect pressures are high. For example, brown patch (*Rhizoctonia solani*) is often associated with large circular brown patches in St. Augustinegrass lawns during the spring and fall. This is less of a problem with common carpetgrass. Insects are also less of a problem with common carpetgrass. However, the best protection against pests is scheduled fertilization and irrigation.

Common carpetgrass is one of the only turfgrass species recommended for wet sites. It often is found growing in areas with high water tables where other grasses cannot grow. Ag Center research has shown that carpetgrass can survive up to six weeks of continual soil waterlogging. This is essential in the Gulf Coast region of the United States where heavy rains and tropical storms can result in frequent soil waterlogging.

The low maintenance aspects of common carpetgrass, pest resistance and its adaptability to moist soil conditions make it a desirable turfgrass species not only in Louisiana but in the southeastern coastal plains of the United States. ■

Edward Bush, Assistant Professor, Department of Horticulture, LSU Agricultural Center, Baton Rouge, La.

Samples of common carpetgrass from Magnolia Mound Plantation in Baton Rouge are preserved at the LSU Herbarium.

Carpetgrass is often found at old plantations, such as here at the Burden Research Station.

Left: *Carpetgrass provides a cushioned walkway between blooming rose bushes at the LSU Ag Center's Burden Research Plantation.*

Timber management improves investment potential of non-industrial forest land

Terry R. Clason

The economic potential of non-industrial forest land in Louisiana is virtually untapped. Timber management is a cost-effective financial option on most non-industrial land because it can sustain timber production continuity and create an environment conducive for hunting, recreation or grazing. Since there are no general prescriptions for developing a highly productive forest resource, each tract must be treated as a unique entity based on biological conditions and landowner investment goals.

Photo by Mark Claesgens

The LSU Ag Center's Hill Farm Research Station near Homer includes about 300 acres of southern pine, in which various research projects are conducted.

Many landowners perceive timber management as too costly, especially when timber prices are low. Although timber prices have increased dramatically in recent years, removing timber without appropriate management guidelines affects ecological development by altering vegetative composition in favor of less desirable species.

A study to evaluate the potential of using timber management to improve investment potential of small tracts of non-industrial forest land was conducted in northwest Louisiana. The research area was a 30-year-old, 240-acre mixed pine-hardwood forest of average production quality. Nine, 20-acre treatment plots were established by identifying boundary lines and inventorying the existing timber. Inventory data were used to separate the nine plots into blocks of three plots. Subsequently, three management treatments, which differed by investment goals and management intensity, were assigned randomly to one plot in each block. Management treatments included:

No Thin: Allow initial timber value to accrue with no management intervention.

Thin: Provide periodic revenue from intermediate harvests.

Thin & Release: Provide periodic revenue from intermediate harvests and hunting lease income.

Intermediate harvests were completed on the Thin and Thin & Release treatments at ages 30 and 38. Wildlife habitat enhancement was initiated at age 32 with a hardwood suppression treat-

Terry R. Clason, Professor, Hill Farm Research Station, Homer, La.

Figure 1. Treatment Stand Stocking

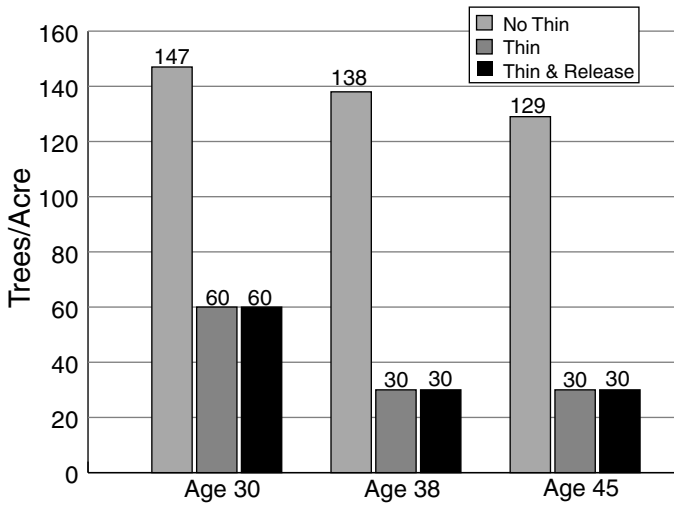
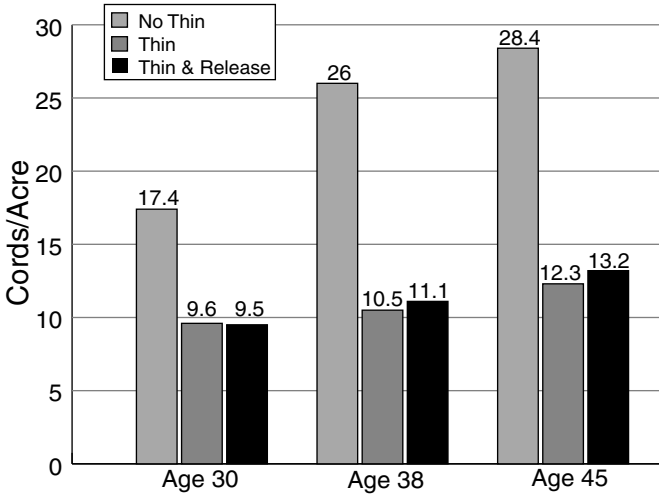


Figure 2. Treatment Stand Volume



ment and was continued with prescribed burns at ages 35, 38, 41 and 44.

Treatment plot growth and development were evaluated from age 30 to age 45. Tree growth data were collected from 20, 0.1-acre measurement plots per treatment plot at age 30 before treatment application and at ages 38 and 45. Cost and revenue data were maintained to determine the cost efficiency of each treatment. The financial evaluation for each treatment was based on these assumptions:

1) Mean investment assets at age 30 totaled $543.87 for timber only. No land value was included.
2) The 15-year investment period was from January 1984 through December 1998.
3) Cost values during the investment period were obtained from actual or published data.
4) Product stumpage values for ages 30, 38 and 45 were pulpwood $19, $23 and $27 per cord; chip-n-saw $44, $35 and $86 per cord; and sawtimber $178, $213 and $375 per 1,000 board feet.
5) The annual hunting lease averaged $5 per acre, and the lessee assumed liability insurance costs.
6) All costs and revenues were discounted annually at 8 percent.
7) Financial evaluations were based on before-tax dollars.

No Thin Treatment

Age 30 stand stocking, tree diameter, tree height and stand volume averaged 147 trees per acre, 8.9 inches, 65 feet and 17.4 cords per acre (Figures 1 and 2). Between ages 30 and 38, tree mortality reduced stand stocking by nine trees per acre, and stand volume growth averaged 8.6 cords per acre. Periodic stand mortality and growth from age 38 to 45 averaged nine trees and 2.4 cords per acre. Total mean stand volume growth was 11 cords per acre. Final harvest volume was 28.4 cords per acre, with distribution among wood product classes averaging 9.6 cords for pulpwood, 1.5 cords for chip-n-saw and 4,360 board feet of sawtimber (Table 1).

Table 1. Stand harvest volume and product distribution by management option

Option	Total Volume (cords/acre)	Product Volume		
		Pulpwood (cords/acre)	Chip-N-Saw (cords/acre)	Sawtimber (board feet/acre)
Age 30 Harvest				
Thin	7.6	3.4	4.2	——
Thin & Release	7.4	3.4	4.0	——
Age 38 Harvest				
Thin	7.0	2.4	——	1,280
Thin & Release	7.3	2.4	——	1,360
Final Harvest				
No Thin	28.4	9.6	1.5	4,360
Thin	12.3	1.7	——	2,720
Thin & Release	13.2	1.7	——	2,840

Thin Treatment

Age 30 stand stocking, tree diameter, tree height and stand volume averaged 143 trees per acre, 9.1 inches, 65 feet and 17.2 cords per acre. The first intermediate harvest reduced stand stocking and volume to 60 trees and 9.6 cords per acre (Figures 1 and 2). No trees died between ages 30 and 38, and stand volume averaged 17.5 cords per acre. After the second intermediate harvest, stand stocking and volume averaged 30 trees per acre and 10.5 cords per acre. From age 38 to 45, no trees died and stand growth averaged 1.8 cords per acre. Total stand volume growth was 9.7 cords per acre. Intermediate and final harvest volumes were 14.6 and 12.3 cords per acre with distribution among wood product classes averaging 7.1 cords for pulpwood, 4.2 cords of chip-n-saw and 4,000 board feet of sawtimber (Table 1).

Thin & Release Treatment

Age 30 stand stocking, tree diameter, tree height and stand volume averaged 141 trees per acre, 9.1 inches, 65 feet and 16.9 cords per acre. The first intermediate harvest reduced stand stocking and volume to 60 trees and 9.5 cords per acre (Figures 1 and 2). No tree deaths occurred between ages 30 and 38, and stand volume averaged 18.4 cords

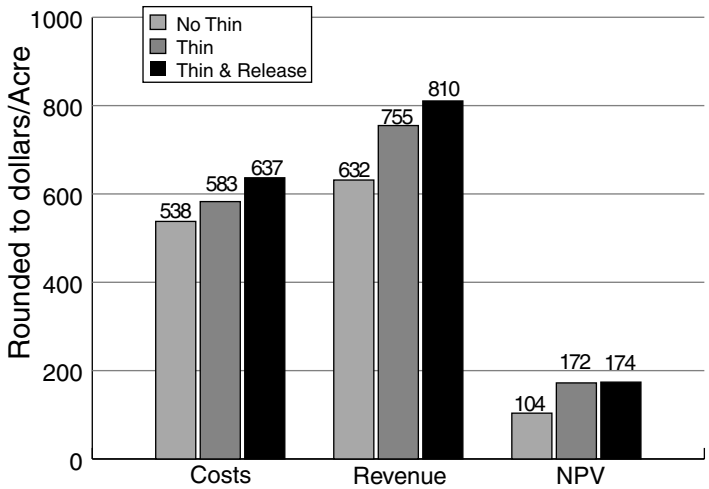
Table 2. Actual treatment costs and revenues in dollars per acre

Item	Age	No Thin	Thin	Thin & Release
Cost				
Stand Value	30	533.00	553.42	545.20
Harvest Costs				
First Thinning	30	——	16.21	16.21
Second Thinning	38	——	15.25	15.25
Final Harvest	45	15.27	15.27	15.27
Habitat Management				
Stand Release	32	——	——	58.16
Prescribed Fire	35	——	——	4.20
Prescribed Fire	38	——	——	5.00
Prescribed Fire	41	——	——	7.63
Prescribed Fire	44	——	——	10.00
Revenues				
Final Harvest	45	2,003.19	1,044.14	1,088.18
Intermediate Harvests				
First Thinning	30	——	248.62	239.76
Second Thinning	38	——	327.73	344.50
Hunting Lease	31-45	——	——	75.00

Photo by Linda Benedict

Dr. Terry Clason, who has been a researcher at the LSU Ag Center's Hill Farm Research Station since 1976, focuses on two major areas of research: managing competing vegetation in southern pine plantations and the effects of combining pastures with raising trees.

Figure 3. Financial Comparison



per acre. After the second intermediate harvest, stand stocking and volume averaged 30 trees per acre and 11.1 cords per acre. From age 38 to 45, no trees died and stand growth averaged 2.1 cords per acre. Total stand volume growth was 11 cords per acre. Intermediate and final harvest volumes were 14.7 and 13.2 cords per acre; distribution among wood product classes averaged 7.1 cords for pulpwood, 4.0 cords of chip-n-saw and 4,200 board feet of sawtimber (Table 1).

Wildlife habitat enhancement on the Thin & Release option was designed to increase accessibility, improve visibility and enrich the diversity of the shorter plants, known as the understory. The first intermediate harvest limited equipment movement to designated skid trails placed parallel at 50-foot intervals within the stand. All unwanted hardwood, except the mast species that produce nuts and seeds, were removed.

At age 32, a hardwood suppression treatment was applied with ground mobile equipment traveling along the existing skid trails. A contact herbicide was used to suppress the growth of hardwood sprouts and pine and hardwood seedlings, while minimizing damage to the residual mast trees. The understory was maintained by initiating a triennial burning schedule at age 35. It was continued through age 44.

During the 15-year investment period, intermediate harvests removed periodic volume growth, provided short-term revenue and enhanced stand market potential. The age 30 harvest removed 7.6 and 7.4 cords per acre from Thin and Thin & Release treatments. Volume distribution among product classes was similar for each option. Pulpwood and chip-n-saw accounted for 45 percent and 55 percent of the volume (Table 1).

Harvest yields at age 38 were 7.0 and 7.3 cords per acre for the respective treatments. Treatment pulpwood volume was similar at 2.4 cords per acre, and sawtimber volume was 1,280 and 1,365 board feet per acre for the Thin and Thin & Release treatments. Total stand volume production, which is the sum of final and intermediate harvest volumes for No Thin, Thin and Thin & Release treatments, was 28.4, 26.9 and 27.9 cords per acre. Although final harvest sawtimber volume differed among treatments, sawtimber production during the investment period for the respective treatments was 4,360, 4,000 and 4,200 board feet per acre.

Cost and revenue items for each investment goal are presented in Table 2 by year incurred and value. Actual management costs for the No Thin, Thin and Thin & Release treatments were $15.27, $46.73 and $131.72 per acre (Table 2). Wildlife habitat enhancement accounted for 65 percent of the Thin & Release management costs. Actual costs were discounted annually at 8 percent and combined with initial stand value to derive the respective investment treatment costs, which were $537.81, $582.69 and $636.56 per acre (Figure 3).

Actual total revenue from the No Thin treatment exceeded the Thin and Thin & Release by $382.70 and $255.75 per acre (Table 2), but the discounted revenues for the respective treatments were $631.49, $754.84 and $810.50 per acre (Figure 3). Hunting lease revenues from the Thin & Release treatment provided 5 percent of the discounted revenues and surpassed the discounted habitat enhancement costs by 30 percent.

Net present values at age 45, discounted revenues less discounted costs, show that the investment potential for all treatments exceeded a discount interest rate of 8 percent (Figure 3). Although the No Thin treatment accrued the lowest management costs, its net present value was $68.48 and $70.26 per acre less than Thin and Thin & Release treatments. The internal rate of return, which is the interest rate at which the difference between discounted revenues and costs equals zero, for the investment period was 9.2 percent, 9.8 percent and 9.8 percent for the No Thin, Thin and Thin & Release treatments.

In moderately stocked, mixed pine-hardwood forests, intermediate harvests and understory vegetation manipulation can sustain adequate timber growth, generate periodic timber income and create an additional marketing resource. Although intermediate harvesting did not increase timber growth, the removal of periodic growth provides a short-term cash flow for investing in other financial instruments. Altering stand understory provides a resource for additional short-term cash flow and may reduce future reforestation costs. Thus, timber management practices can help landowners improve the financial potential of their forest land. ■

Nitrogen Fertilizer Management for Corn Production on Delta Soils

Many soil types are present in the Mississippi River Delta of Louisiana. Optimal nitrogen application rates and timing are needed for each specific soil type to enhance fertilizer efficiency, increase corn profitability, minimize environmental pollution and to create a database for precision farming practices. Research in other regions of the United States has indicated that fertilizer efficiency is enhanced with sidedress compared to at-planting applications. When nitrogen is sidedressed, an early-season nitrogen deficiency might be avoided by applying a starter fertilizer to supply nitrogen for early growth. The objectives of this study were to determine if time of nitrogen application affected fertilizer efficiency and to determine if an in-furrow starter fertilizer was beneficial with either timing of fertilizer application.

Field experiments evaluating six nitrogen fertilizer rates, two nitrogen application times and two starter fertilizer treatments were conducted from 1996 through 1998 on a Commerce silt loam at the Northeast Research Station near St. Joseph. Nitrogen fertilizer rates ranging from zero to 250 pounds of nitrogen per acre were knifed in on the side of the row (about 10 inches from the drill) at planting or at the six-leaf growth stage (sidedress). Two starter treatments were evaluated, a control and 10 pounds of nitrogen per acre applied in-furrow. The fertilizer nitrogen source for all fertilizer treatments was urea-ammonium nitrate solution containing 32 percent nitrogen. Pioneer brand 3167 was planted each year at about 28,000 seeds per acre. The test was not irrigated, and the previous crop was cotton.

Photo by John Wozniak

Maximum yield occurred at similar nitrogen rates, 150 to 200 pounds of nitrogen per acre, regardless of the time of fertilizer application, at-planting vs. sidedress, in two of the three years. Yields were highest for the at-planting application in 1998, probably because a relatively dry period after the sidedress application may have reduced availability of the fertilizer nitrogen to plants. Similarly, the yield responses to starter fertilizer tended to occur primarily at the lower nitrogen rates (100 pounds of nitrogen per acre and less) and had little effect on optimal nitrogen rates.

Results of this study suggest there is little benefit from sidedressing or using a starter nitrogen fertilizer in lowering optimal nitrogen rates on this Commerce silt loam soil. Growers typically wait until emergence to apply nitrogen fertilizer so they can evaluate plant population and yield potential. If nitrogen is applied sidedress, an application earlier than the six-leaf growth stage (about 30 days after emergence) will better ensure adequate fertilizer activation (availability to plants) by the time the nitrogen requirement of the plant exceeds the native soil supply. The starter fertilizer used in this test contained only nitrogen. Previous Louisiana research has indicated a significant early growth response and, in most years, a yield increase from in-furrow application of starter fertilizers that contain both nitrogen and phosphorus, particularly on the more coarse-textured, sandy soils. ■

H.J. "Rick" Mascagni Jr., Associate Professor, Northeast Research Station, St. Joseph, La., and Dennis Burns, former Research Associate, Northeast Research Station, and now Assistant Manager, Boll Weevil Eradication Program, Louisiana Department of Agriculture and Forestry, Winnsboro, La.

Effects of Internal Parasites on Replacement Heifers

Alvin F. Loyacano, J.C. Williams, Jeff Gurie and Andy DeRosa

Beef cattle in Louisiana are constantly infected with gastrointestinal nematodes, commonly referred to as roundworms. The brown stomach worm, *Ostertagia ostertagi*, is the most troublesome gastrointestinal nematode parasite. Also a problem in much of the Red River basin and the coastal marsh is the bovine liver fluke, *Fasciola hepatica*, a parasitic trematode. Between 50 percent and 100 percent of yearling and older cattle are infected with this pest. Young cattle (stockers and replacement heifers) are most susceptible to clinical parasitic disease and production loss.

This project was conducted to measure the production losses caused by roundworms and liver flukes in beef replacement heifers, to identify when these losses occur and the losses attributed to each type of parasite.

This study was conducted using 372 Angus- or Brangus-sired beef heifers from the 1993 through 1996 spring calving seasons. After weaning each year (approximately October 15), heifers were randomly allotted to three pasture groups and one of four treatments within each group. Parasite control treatments were as follows: Treatment 1 - no parasite control; Treatment 2 - roundworm control; Treatment 3 - liver fluke control; and Treatment 4 - roundworm and liver fluke control.

Roundworms were controlled with the injectable formulations of Ivomec (Merial) or Dectomax (Pfizer). Both products control the major nematode parasites for at least 21 days. Curatrem (Merial) drench was administered to control liver flukes. Heifers in this trial received no treatments for parasite control before the study. Treatments were initiated at allotment. Since the objective was to minimize the effects of the parasites, treatments were repeated at 28- to 84-day intervals, depending on time of year and risk of infection. The average of seven treatments per year was far in excess of a practical treatment regimen.

Weight and condition

Cattle were weighed and condition-scored at each treatment date. Fecal samples were collected per rectum from about half of each group. Parasite infection was monitored by fecal egg counts. Heifers remained in pasture groups until they were palpated for pregnancy diagnosis in October. Pregnant heifers were pooled at that time and pastured together through their first calving season and until their calves were weaned the next October. Calves were born during the spring calving seasons from 1995 through 1998. Calf weights were recorded at birth and at weaning.

Initial weights for the treatment groups were the same. By the beginning of the breeding season, heifers not treated for roundworms (Treatments 1 and 3) had gained significantly less and were significantly lighter than heifers treated for roundworms (Treatments 2 and 4). This relationship was maintained throughout the breeding season.

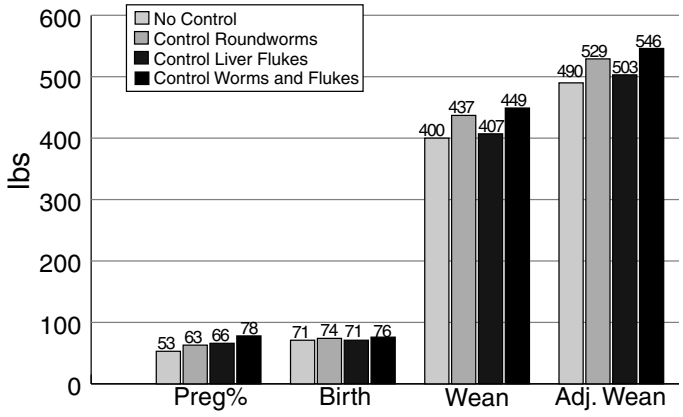
At palpation, heifers treated for roundworms and liver flukes (Treatment 4) had gained more than those heifers treated for only roundworms (Treatment 2), and heifers treated for only roundworms gained more than those not treated for roundworms. Condition scores also were affected by parasite infections. At the beginning of the breeding season, heifers that had not been treated for roundworms had lower scores than those treated for roundworms. By the end of the breeding season, heifers that had not been treated for either parasite (Treatment 1) had significantly lower scores than heifers that had been treated for flukes (Treatment 3). Heifers treated for only liver flukes had lower scores than heifers treated for roundworms. At palpation, heifers that received neither treatment had significantly lower scores than heifers treated for only one of the parasites. Heifers treated for both parasites had significantly higher condition scores than heifers treated for only one of the parasites.

Pregnancy rates

Parasite infections significantly affected pregnancy rates. Heifers repeatedly treated for both types of parasites had a 78 percent pregnancy rate. Heifers treated for flukes but not roundworms had a 66 percent pregnancy rate. Heifers treated for roundworms, but not liver flukes, had a 63 percent pregnancy rate, which was significantly lower than that of heifers treated for both parasites. Heifers not treated for either parasite had a 53 percent pregnancy rate, also significantly lower than that of heifers treated for both parasites. The parasites seemed to have a cumulative effect in that heifers treated for roundworms and liver flukes had higher pregnancy rates than heifers treated for only roundworms.

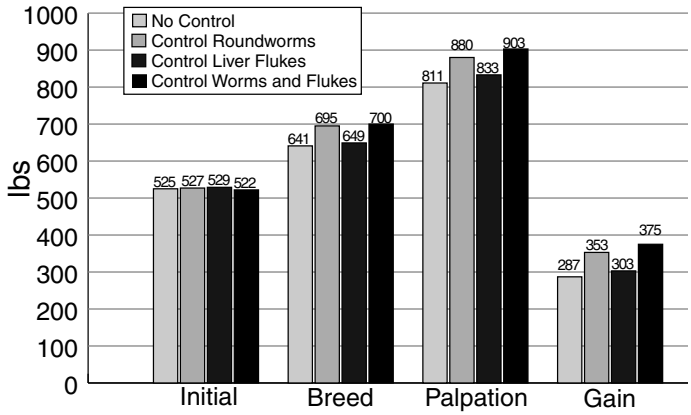
Treatment had a significant effect on calf birth weight. Calves from heifers treated for both parasites had heavier birth

Figure 1. Pregnancy and Calf Weights



Alvin F. Loyacano, Professor, Dean Lee Research Station; J.C. Williams, Professor, Department of Veterinary Science; Jeff Gurie, Research Associate, Dean Lee Research Station, Alexandria, La.; and Andy DeRosa, Instructor, Department of Veterinary Science, LSU Agricultural Center, Baton Rouge, La.

Figure 2. Heifer Weights



weights than those from heifers not treated for roundworms. At weaning, calves from heifers that had been treated for both parasites had the highest average weaning weights. Heifers treated for only one of the parasites produced calves with average weaning weights that were not significantly lower than those from heifers treated for both parasites. Calves from heifers that were not treated for either parasite were significantly lighter than calves from heifers that were treated for both parasites. Adjusted weaning weights followed the same pattern.

Initial nematode egg counts ranged from zero to 600 eggs per gram and were not different between treatments. At the beginning of the breeding season, an average of 46 days post treatment, heifers treated for nematodes had significantly lower average egg counts than heifers that were treated for flukes or that received no treatment. At the end of the breeding season and at palpation (60 to 84 days post treatment), there were no significant treatment effects on the nematode egg count. It must be emphasized that egg counts were not used to measure the efficacy of treatments. They were used to monitor infections and to demonstrate that heifers repeatedly reinfected with nematodes may have suffered some losses to nematode infections, despite repeated prophylactic treatments.

Initial liver fluke egg counts were not different between treatments and ranged from zero to 6.5 eggs per gram. The prevalence or rate of infection was 30 percent. At the initiation of the breeding season and throughout the rest of the study, heifers treated for flukes had significantly lower egg counts than untreated heifers. Fluke transmission is seasonal, occurring primarily in the spring and fall with a life cycle of up to 12 weeks. Animals that receive an effective treatment when transmission is not occurring can remain fluke-free for extended periods. Infection rates for heifers not treated for flukes were 41 percent at breeding and 80 percent at palpation. Infection rates for heifers treated for flukes were 7 percent at breeding and 35 percent at palpation.

In this study, roundworms reduced body weights and condition scores for yearling heifers throughout the test period. Fluke infections reduced body condition scores and weights by the end of the breeding season and reduced pregnancy rates. Heifers treated for both parasites had the highest pregnancy rates. Roundworm infections reduced calf birth weights. Treating heifers for roundworms increased the weaning weights of their calves. Treating for flukes resulted in weaning weights intermediate between those of heifers treated for roundworms and those receiving no treatment.

Roundworms, liver flukes affect growth

In the Red River region of central Louisiana, both roundworms and liver flukes significantly affect the growth and production of replacement heifers. Many heifers were obviously suffering from some parasitic disease before initiation of the trial each year. While treating for liver flukes did not increase heifer gains before the end of the breeding season, treating for roundworms resulted in increased gains during the first weigh period. Therefore, it must be assumed that roundworms were the major cause of the pre-trial effects of parasitism. This indicates that roundworms affected the heifers earlier than liver flukes did and that the optimum times for initiating treatment of the parasites is probably much earlier for roundworms. When both parasites are present, their effect seems to be cumulative.

In fluke-endemic areas, the strategic treatment of replacement heifers for both parasites is recommended. Timely treatments for roundworms should begin at least at weaning. Fluke control for spring-born heifers should be initiated by at least the beginning of their first breeding season. A product that controls both roundworms and liver flukes would be a good choice for use on younger heifers. Older animals might benefit more from timely treatments with a more effective flukacide and a broader spectrum endectocide. ■

Griffin, Tiersch and cotton team win 1999 research awards

James L. Griffin, Terrence Tiersch and the Louisiana Agricultural Experiment Station's Cotton Variety and Strain Evaluation Team won the top research awards presented at the LSU Agricultural Center's Annual Conference in December 1999.

Griffin, a professor in the Plant Pathology and Crop Physiology Department and weed scientist, received the Doyle Chambers Research Award for meritorious contributions to agriculture.

Tiersch, a professor at the Aquaculture Research Station, received the Mississippi Chemical Corporation/Triad Nitrogen Award, which is given to the scientist who has made during the past five years the most significant contributions to the LAES research program. Both of these awards include a $2,000 cash prize.

This year's Tipton Team Award was presented to the cotton team, which includes scientists at four locations. Team coordinator is David Caldwell at the Red River Research Station near Bossier City. The other members are Patrick Colyer, also at Red River; Steve Moore at the Dean Lee Research Station near Alexandria; Don Boquet and Merritt Holman, both at the Northeast Research Station near St. Joseph; and Ivan Dickson in the Agronomy Department. Because of their work, cotton producers in Louisiana can make informed choices about seed varieties so they can both save money in production costs and make money in yields. ■

The Feasibility of Marketing Louisiana Soybeans in Matamoros, Mexico

Wayne M. Gauthier and Kurt M. Guidry

The search for new markets is a continuing quest. To that end, the Louisiana Soybean and Feed Grains Promotion and Research Board funded a study to determine whether Louisiana soybean farmers could net more money by barging soybeans into Matamoros, Mexico, rather than selling them at harvest to local elevators.

For years, river barges have competed effectively against trains in moving Midwest and Louisiana grains to export markets. Louisiana soybean producers appear to have the advantage of proximity to a waterway infrastructure supporting barge shipments to Matamoros through Brownsville, Texas, and a climate that allows early planting and harvesting. There is a sense, however, that Louisiana farmers do not reap the full benefits of these advantages. Most Louisiana soybeans are sold directly to local elevators at harvest. Sales at harvest limit opportunities to participate in value-added activities.

Wayne M. Gauthier, Associate Professor, Department of Agricultural Economics and Agribusiness, and Kurt M. Guidry, Assistant Specialist, LSU Agricultural Center, Baton Rouge, La.

The Mexican advantage

Matamoros was picked as a potential market outlet for several reasons. First, it is just across the Rio Grande from Brownsville, Texas, and accessible to Louisiana producers by either train or barge through the Gulf Intracoastal Waterway (GIW). Barges generally offer the lowest per unit costs because they can transport 50,000 to 55,000 bushels per barge compared to 3,333 bushels per rail car. Second, the GIW links all major Louisiana river grain elevators with Brownsville because it flows in an east-west direction throughout the length of South Louisiana and intersects all of the state's major rivers. Third, Mexico has historically been and will likely continue to be a soybean-deficit country. Since 1994, Mexico has ranked among the top three buyers of U.S. soybeans. Nearly all of its soybean imports are from the United States, and 5.83 percent entered through Matamoros. The three soybean crushing plants in Matamoros make up 7 percent of Mexico's total soybean crushing capacity. Estimates of the annual need for soybeans in Matamoros ranged from 6.8 million bushels to 21.5 million bushels, or from 20 percent to 66 percent of Louisiana's 1997 soybean production. Fourth, most soybean imports entering Matamoros are being shipped from 1,200 to 1,500 miles by trains from Midwestern U.S. supply points. Distances from major Louisiana supply regions to Matamoros range from 470 to 1,087 river miles and from 541 to 765 railroad miles.

Economic feasibility

Regardless of source, feasibility for the Mexican buyer is defined by the lowest landed (elevator delivered) per bushel costs. For the Louisiana producer,

Table 1. Per bushel cost components for barging Louisiana soybeans to Matamoros, Mexico

Louisiana Supply Region	Production (Bushels)[a]	Equivalents[b] Barge	Rail	Total Miles Barged	Railed	Total Costs[c] with Transhipment by Truck[d]	Rail[e]	Total Costs Rail Direct
Lake Providence	8.15	163	2445	1,087	765	$ 0.84	$ 0.89	$ 0.85
Tallulah	2.45	49	735	1,056	737	0.81	0.85	0.83
St. Joseph	3.07	62	923	995	708	0.83	0.87	0.85
Vidalia	4.80	96	1439	962	686	0.82	0.87	0.85
Lettsworth	7.22	144	2165	912	637	0.84	0.89	0.87
Port Allen	0.52	10	155	825	628	0.80	0.85	0.82
Krotz Springs	5.37	107	1611	640	590	0.72	0.77	0.75
Mermentau	5.94	119	1782	470	541	0.72	0.76	0.75

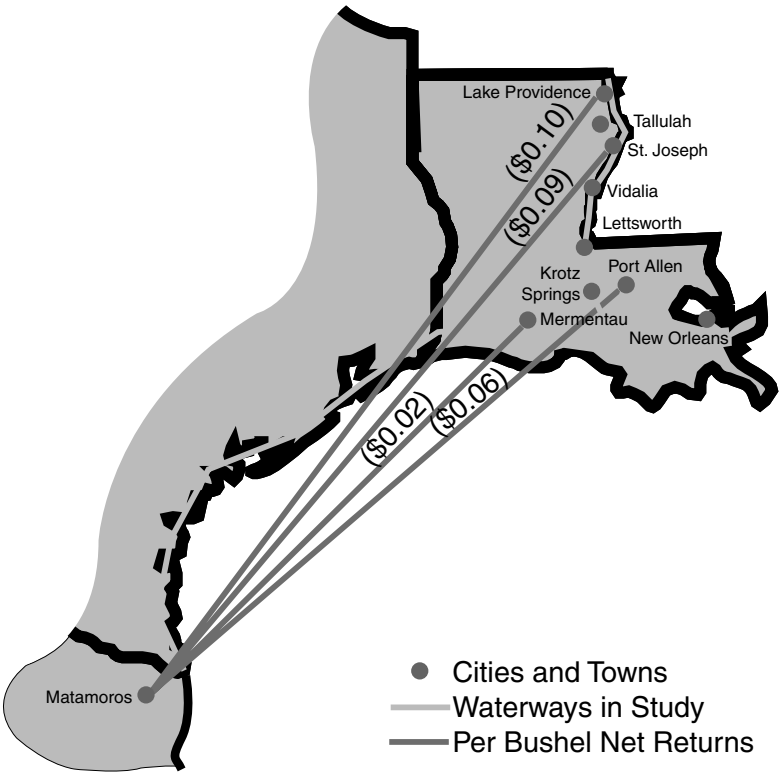
[a] Millions
[b] Barge and rail equivalents are the number of barges and railcars needed to transport the supply region's 1997 total production of soybeans.
[c] Total costs per bushel includes assembly, barging, transloading and transhipment. Assembly costs include trucking, elevator storage, barge loading and Federal Grain Inspection Service charges. Barging costs include barging on both the Mississippi River and the Gulf Intracoastal Waterway. Transloading costs include wharfage, stevedoring, elevator elevation and weight supervision costs at Brownsville, Texas.
[d] Transhipment costs by truck include trucking costs as well as costs for phytosanitary and customs paperwork.
[e] Transhipment costs by rail include rail costs as well as costs for phytosanitary and customs paperwork.

Figure 1. Estimated explicit costs and return relationships for eight Louisiana supply regions

Net bushel gain (loss) in exporting soybeans to Matamoros, Mexico, from alternate Louisiana supply regions.

Supply Region	Mode of Transport		
	Barge-Truck	Barge-Rail	Rail Direct
	$ per bushel		
Lake Providence	($0.10)	($0.15)	($0.11)
Tallulah	($0.07)	($0.11)	($0.09)
St. Joseph	($0.09)	($0.13)	($0.11)
Vidalia	($0.08)	($0.13)	($0.11)
Lettsworth	($0.10)	($0.15)	($0.13)
Port Allen	($0.06)	($0.11)	($0.08)
Krotz Springs	$0.02	($0.03)	($0.01)
Mermentau	$0.02	($0.02)	($0.01)

Per bushel net returns (loss) associated with barging soybeans to Matamoros, Mexico, with truck transhipment from select Louisiana supply regions.



feasibility depends on the difference between the prices paid by Mexican buyers and Louisiana local market prices. The difference must be greater than all the known costs of exporting – plus a risk premium. The risk premium must be large enough to make producers willing to assume the additional risk and uncertainty of exporting soybeans to Mexico instead of selling directly to local elevators. At any time, that difference is determined by the relative price relationships for soybeans in Louisiana and Matamoros, barge and rail transportation rates, associated explicit transaction costs and implicit risk premium costs.

Estimated explicit costs and return relationships for eight Louisiana supply regions are presented in Table 1 and Figure 1. The implicit risk premium that will create exports is an unpredictable, producer-unique number. The explicit risk premium is the difference between the price in Mexico less the sum of the local Louisiana elevator price and the explicit costs of exporting. The producer's decision to export instead of sell to a local elevator is the best indicator as to whether the explicit risk premium was sufficiently greater than the implicit risk premium.

Findings

Soybean production from 34 Louisiana parishes was assigned into eight supply regions. Assignment was based on distance of the parish seat from an existing elevator with barge-loading capabilities.

Table 1 identifies (1) the 1997 productive capacity of the supply region in terms of bushels and their barge and railcar equivalents, (2) the number of river and barged miles from each supply region and (3) the total estimated landed cost of a bushel of soybeans at the processing plant in Matamoros from three shipment combinations. The footnotes in the table identify the specific elements of the major components (assembly, barging, transloading and transhipment) of total costs.

Soybeans can be shipped from Louisiana by direct rail or barge to the Brownsville-Matamoros border. Barge shipment requires a transhipment by either truck or rail since the soybean processing plants at Matamoros are not situated on the Rio Grande and the soybeans must be transported inland. Soybeans arriving in rail direct shipments maintain the origin weight and product identity integrity established at loading. Thus, custom clearing border transactions costs for direct rail shipments are minimum as compared to barge shipments. Louisiana rail direct total costs for assembly and transportation from the eight Louisiana supply regions into the plants at Matamoros range from $0.75 to $0.87 per bushel.

Barged soybeans must be transferred into an elevator for subsequent reloading into either trucks or railcars for final inland shipment to Matamoros. Depending upon the supply region, the costs of exporting soybeans by barge were estimated to range from $0.72 to $0.84 per bushel with truck transhipment and $0.76 to $0.89 per bushel with rail transhipment. Of these costs, the costs of elevator transfer at Brownsville were an estimated $0.17 per bushel. Costs for transhipping grain by truck were estimated at $0.05 per bushel, and transhipping by rail was estimated at

$0.09 per bushel. Therefore, the total estimated costs to transload and tranship barged soybeans at Brownsville are $0.22 to $0.26 of the $0.72 to $0.84 or about 31 percent of the per bushel total costs for barged shipments to Brownsville and their respective truck and rail transhipments to Matamoros. This cost component reflects not only the physical costs of a second handling of the grain, but also the transactions costs associated with establishing weight and product identity so that the truck or rail unit can clear customs.

The legend in Figure 1 identifies the net bushel gains and losses from exporting soybeans to Matamoros compared to selling them in Louisiana by Louisiana supply region and shipment combination. These gains and losses are estimated using the identified costs from Table 1 and an estimated average December 1997 export price of $8.47 and Louisiana price of $7.73 per bushel.

The derivations of the per bushel gains and losses can be illustrated using a combination barge shipment to Brownsville with a truck transhipment to Matamoros from the Lake Providence supply region. Table 1 indicates that this barge shipment from Lake Providence to Brownsville with a truck transhipment to Matamoros had an estimated total cost of $0.84 per bushel. Given a $8.47 export price, the Lake Providence producer would have realized a net price of $7.63 (8.47 - 0.84) per bushel from exporting soybeans to Matamoros. Given a Louisiana price of $7.73, the Lake Providence producer would have netted $0.10 (7.73 - 7.63) less per bushel from exporting to Matamoros than from selling in Louisiana.

The set of net bushel gains and losses from exporting soybeans to Matamoros instead of selling them in Louisiana suggests that only producers from the Krotz Springs and Mermentau regions using a barge shipment/truck transhipment combination would have realized any gains from exporting soybeans to Matamoros instead of selling them in Louisiana in December 1997. The magnitudes of those gains, $0.02 per bushel, appear too small to generate the implicit risk premiums needed to export soybeans into Matamoros. But, the sets of relative relationships rendering export instead of Louisiana sale more profitable can change. Under profitable exporting conditions, the set of net gains and losses suggests that the barge shipment/truck transhipment would likely be the most profitable and the barge shipment/rail transhipment the least profitable.

A final consideration is competition from U.S. Midwest suppliers. Currently, unit trains of soybeans from the Midwest satisfy Mexican demand. If relative costs and returns were to make exports from Louisiana feasible, the next question is whether Louisiana could compete effectively with Midwest suppliers. Unit train rates from the Midwest were reported to average about $0.71 per bushel. Costs for Louisiana producers to export soybeans average more than $0.80 per bushel. Therefore, Louisiana does not seem to have a competitive advantage over the Midwest.

Competitive disadvantage

Despite proximity to the market and the economics of barge transportation, both direct rail and barges from Louisiana supply points were found to be at a competitive disadvantage to Midwest unit trains in supplying the Matamoros soybean market.

In addition, there are differences in assembly costs between supply regions in Louisiana and in the barging cost structure on the Mississippi River and the GIW. Assembly cost differences are attributable to cumulative farm-to-elevator distances between Louisiana supply regions. Barging costs structure differences are because of the capacity of the Mississippi River to accommodate up to 36 barges in a single tow as contrasted to a maximum tow of only six barges on the GIW. Also, the variety of economic activities on the Mississippi River creates abundantly more backhaul opportunities for barges on the Mississippi River than for barges on the GIW. Backhauls are both cost-offsetting and revenue-generating activities critical to profitability and influential in determining rates charged to shippers on the initial movement. ■

New Approach to 'Best Management Practices'

The LSU Agricultural Center has started an aggressive plan to improve the state's water quality with a new approach to best management practices.

This new BMP education and outreach program will cut across commodities toward a common goal of reducing nonpoint source water pollution. Traditionally, farm management has focused primarily on yields and production for individual crops. The strategy will embrace virtually all Louisiana agriculture, including forestry.

Water quality is a major concern both nationally and locally among the voting public, according to Paul Coreil, assistant director for environmental affairs. Louisiana farmers are not out of step with the public sentiment, he added. They are willing and eager to address the issue of water quality through voluntary practices. He said they are asking the Ag Center to develop practical, economical solutions based on research. They know that taking a wait-and-see attitude could invite regulations both unsuitable and unachievable under local conditions.

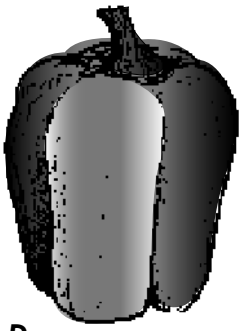
"The focus of land-grant institutions has been on yields and production," Coreil said. "Now, it is yields, production and water quality."

Nonpoint source pollution is the general runoff from the landscape. It includes potential contaminants from a variety of sources, such as sediment, fecal materials, fertilizers, pesticides and organic materials. All are spread by rainfall or irrigation water discharge. Because they do not observe property lines or parish boundaries, these threats become community or regional challenges. Homeowners, municipalities, industries and businesses all contribute.

Coreil said a series of BMP publications will be ready for distribution in mid-2000. Through most of 1999, extension and research personnel, along with producers and other agencies, have been examining and refining BMP recommendations for each commodity.

"The publications are a major part of the strategy to reach the producer," Coreil said. "They will be spokes in the wheel for education and outreach."

All information and publications eventually will be made available on an Ag Center website and on CD. ■ **Mark Claesgens**



A Decade of Pepper Fertility Research

Regina P. Bracy

Bell peppers are grown extensively throughout southeastern Louisiana, with production concentrated in Tangipahoa and surrounding parishes. Gross farm value in 1999 was about $1.6 million.

Bell peppers are produced using transplants, supplemental irrigation and raised, fumigated beds covered with polyethylene mulch. Because of the intensive production, the cost of establishing and producing the crop is estimated at $3,700 per acre, even before harvesting begins.

Fertilizer costs have always been considered a small, insignificant part of the overall cost of vegetable production, but growers are realizing that small savings in fertilizer add up over acres and years. Also, the environmental impact that leaching of excess fertilizer has on surface and ground waters must be considered.

Researchers at the Hammond Research Station conduct field studies to develop the most efficient and effective use of fertilizer for bell pepper production. A discussion of the findings of a decade of pepper fertility research follows.

Phosphorus, potassium

Recommendations for phosphorus and potassium fertilization of bell pepper had been based on early work with mixed fertilizers. Improved cultivars, extensive management practices and different cultural systems required a re-evaluation of fertilizer recommendations.

Four rates (0, 100, 200, 300 pounds per acre) of phosphorus and potassium were applied to bell peppers in three experiments. Nitrogen rates of 100 pounds per acre preplant and 40 pounds per acre sidedressed were kept constant over all treatments.

Phosphorus had a greater effect on bell pepper production than potassium when soil levels of phosphorus and potassium were low. Rates of 200 pounds per acre of phosphorus and 100 pounds per acre of potassium are adequate for bell pepper production on soils low in phosphorus and potassium. Adding phosphorus and potassium fertilizer to soils with adequate levels (more than 100 milligrams) of phosphorus and potassium is not necessary for bell peppers grown with plastic mulch.

Nitrogen rates

Evaluations of various preplant nitrogen rates (from 0 to 200 pounds per acre) have indicated that at least 50 pounds per acre of nitrogen should be applied initially (preplant) under the mulch. Higher rates of initial nitrogen (100 to 200 pounds per acre) did not increase yields over the 50 to 80 pounds per acre rates, if the crop was sidedressed.

Fall or spring N

Because spring rains often prevent timely field operations, many growers prepare the field and apply preplant fertilizer and mulch in the fall for the spring bell pepper crop. Although mulch may offer some protection from Louisiana's heavy rains, soluble fertilizer nutrients (particularly nitrogen) are still subject to leaching losses when applied in October for late March-early April planting.

Initial nitrogen rates of 0, 50, 100, 150 and 200 pounds per acre were applied in the fall and again in the spring to determine if initial fall fertilizer rates could be reduced. Phosphorus and potassium were banded in the bed center at the rate of 200 pounds per acre in October, and beds were covered with polyethylene mulch. Initial nitrogen treatments in the fall-applied treatments were banded with the phosphorus and potassium. The spring nitrogen treatments were injected through the mulch using a spoke-wheel injection system within one week of transplanting.

At higher rates of nitrogen, marketable and extra-large yields were not different for application timing. Applying the initial nitrogen fertilizer in the fall instead of the spring did not have an effect on production, if an initial nitrogen rate of more than 50 pounds per acre was used.

Sidedress

Using plastic mulch offers many benefits such as weed control and soil temperature modification. This method of production, however, hinders the application of fertilizer after the mulch has been applied. The common method of applying fertilizer after the mulch is in place is to drop the fertilizer in the furrow between beds or to punch holes through the mulch and manually place a small amount of fertilizer in the hole. A third method of applying fertilizer was introduced to the area several years ago and consists of injecting liquid fertilizer through the mulch with a spoke wheel.

Experiments were conducted to evaluate the effect of sidedress fertilizer applications on pepper yield and size. Plants were sidedressed twice after transplanting with nitrogen (40 pounds per acre) using one of three methods: (1) granular fertilizer mechanically dropped in the furrow between the beds, (2) granular fertilizer manually dropped between each plant in holes punched through the mulch and (3) granular fertilizer dissolved in water and injected through the mulch using a spoke wheel.

Yields of extra-large and marketable bell peppers were not affected (statistically) by the method of sidedress application, although there was a trend toward higher yields in plots sidedressed with the spoke-wheel injector. The use of the spoke-wheel injector increased yield at the first harvest, offering an advantage of producing more peppers during the early market when the price is usually most favorable.

Liquid fertilizer

By injecting liquid fertilizer through the mulch, spoke-wheel injectors offer more accurate placement of plant nutrients, reduce leaching and potentially improve plant-uptake

Regina P. Bracy, Associate Professor, Hammond Research Station, Hammond, La.

efficiency. If liquid fertilizer could be used to supply the preplant and sidedress fertilizer needs of the bell pepper crop, the practice of applying preplant granular fertilizer in the fall or spring would be eliminated. Applying mulch without preplant fertilizer would reduce fertilizer leaching and shorten the time needed for field preparation. Greater flexibility in timing of liquid fertilizer applications when the crop is growing could reduce overall fertilizer requirements, reduce potential losses through leaching and improve plant-uptake efficiency, since the fertilizer could be applied as needed.

Several studies were conducted to evaluate the effect of fertilizer type (granular or liquid), rate and timing on bell pepper production. Fertilizer treatments included a ½X, 1X and 2X rate of fertilizer applied at transplanting or split over two applications (at transplanting and two weeks after transplanting). Liquid fertilizer (10-10-10) was injected at the rates of 2340, 1170, 585 pounds per acre for the 2X, 1X and ½X rates, respectively. Granular fertilizer (13-13-13) at the rate of 900 and 450 pounds per acre for the 1X and ½X rates, respectively, was applied preplant in the fall.

Fertilizer type (granular or liquid) did not affect marketable yield or earliness, indicating that fertilizer application could be delayed until spring and a liquid formulation could be used. Splitting the fertilizer application, regardless of the rate applied, had a significant effect on size of bell pepper produced. Applying one-half the fertilizer two weeks after transplanting increased the yield of extra-large peppers.

Nitrogen sidedressing

Research at the Hammond Station has shown that bell peppers respond to additional applications of nitrogen fertilizer during the growing season. Sidedressing nitrogen has consistently increased total and extra-large yields, pepper weight and earliness in several different experiments. Applying additional nitrogen in sidedressing has had a more consistent effect on production than have preplant nitrogen rates. If sufficient initial nitrogen fertility (more than 50 pounds per acre) is provided, applying nitrogen fertilizer three to five weeks after transplanting has more effect on bell pepper size and production than either fertilizer rate, fertilizer type or fall/spring application timing.

What we learned

- Bell peppers respond to sidedress nitrogen application.
- Applying nitrogen fertilizer three to five weeks after transplanting had the most consistent and positive effect on production.
- Nitrogen rate and initial fertilizer timing were not as critical for production when the initial nitrogen rate was at least 50 pounds per acre and the crop was sidedressed.
- Rates of 200 pounds per acre of phosphorus and 100 pounds per acre of potassium are sufficient for production on most soil types.
- Liquid fertilizer can be used for initial or sidedress application of fertilizer without affecting yield or fruit size. ■

Tarnished Plant Bug

As field corn acreage has increased in the mid-South, consultants and farmers have often noted high tarnished plant bug populations in cotton fields adjacent to corn. The origin of the infestations in these cotton fields is often perceived to be a result of early population buildup in the pre-tassel stages of corn. In these troublesome fields, economic thresholds for insecticide treatments are usually reached earlier than in cotton fields not bordered by corn.

Plant mapping data taken from cotton fields adjacent to corn indicate a gradient in plant damage similar to insect population gradients detected by sweepnet. At cotton field margins adjacent to corn, square loss at nodes 4 to 9 ranged from 48 percent to 85 percent, indicating severe damage occurred shortly after the pin-head square stage of cotton. Cotton will compensate for moderate levels of early season square loss, depending upon water availability and late-season environmental conditions, but early season square losses of more than 30 percent can reduce yield, delay maturity and usually require expensive insecticide treatments. These studies were conducted to determine the origin of the tarnished plant bug infestations in cotton fields next to corn and to study the peak times for immigration of the insects.

Tarnished plant bugs in corn

Evaluation of tarnished plant bug movement into pre-tasseling corn and pre-squaring cotton was accomplished by using sticky traps, sweepnet samples and whole plant observation. Population surveys in 1998 used 40 sticky traps placed on 1-inch by 1-inch garden stakes in a grid pattern. Ten cards were placed at the corn/cotton margins, and these were replicated four times so that the grid pattern covered about 400 by 1,000 feet.

Regardless of the sample method used, low densities of tarnished plant bug adults were recorded in pre-tasseling corn, and no reproduction could be associated with the corn. Previous research also indicated that only limited plant bug reproduction occurs in corn. In these studies, plant bug adults ranged from a high of 85 per acre to a low of 11 per acre. Samples taken in the corn crop in mid-April with sweepnets confirmed that tarnished plant bug densities were very low.

Cotton planted adjacent to corn has been associated with early infestations of tarnished plant bugs.

Occurrence in Pre-tassel Stage of Corn Next to Cotton

Tarnished plant bugs in weeds

Tarnished plant bugs have numerous plant hosts, including many weed species common to Louisiana. Sweepnet samples of plant bugs in weeds near corn and cotton fields revealed large densities of plant bugs in all stages of development. From March to June, it was not uncommon to collect eight to 10 adults per 10 sweeps.

In mid-April, all stages of nymphs were present in the sweepnet samples in very high numbers. This indicates a key time in the life cycle of the tarnished plant bug, because the nymphs observed in mid-April represent the immature insects that would eventually infest cotton as new adults.

The weedy areas harboring large numbers of plant bugs included roadside ditches, field drains, point rows, highway medians, utility poles and other non-tillable areas such as wooded areas adjacent to fields. At one farm site, a waterfowl conservation site had floral vegetation after drainage and produced large numbers of plant bugs. The principal weeds that supported high populations of plant bugs were vetches, clovers and docks, but many broadleaf weeds that flower in spring were observed to harbor plant bugs.

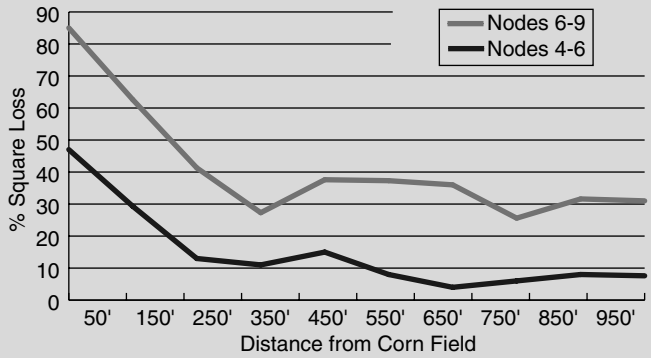
Direction for future research

These surveys indicate that plant bug densities in pre-tassel corn are too low to cause significant economic damage in adjacent cotton fields. Furthermore, the level of reproduction in pre-tassel corn was not high enough to account for the consequent damage. In contrast, development of plant bugs in weed habitats near these fields supported extremely high densities of tarnished plant bug adults. The peak numbers of adults and nymphs observed by mid-April probably account for the first infestations in cotton, however, the economic infestations occurring in cotton adjacent to corn cannot be attributed solely to weed refuges near corn, because weed refuges infested with tarnished plant bugs are abundant near fields far removed from corn and without similar problems.

Photos by Gene Burris

Sticky traps placed in field corn shortly after planting were used for detection of early tarnished plant bug movement.

Figure 1. *Fruit abscission at nodes 4 to 9 in a cotton field planted adjacent to field corn on July 16.*



One possible explanation is that corn is a barrier to local migration, because the flight of plant bugs is about 3 feet above the ground. Too, plant bugs may prefer cotton over corn as a food source. Most of the recorded hosts for plant bugs are broadleaf plants, and only a few are grasses. These are hypotheses only. The reasons for the high populations of plant bugs in cotton adjacent to corn need further evaluation.

The information gathered suggests that vegetation management of the weedy areas associated with high populations of tarnished plant bugs would have merit and could probably be accomplished with selective herbicides and mowing. A project has been initiated for the year 2000 with the U.S. Department of Agriculture's Agricultural Research Service to evaluate early herbicide programs and their effect on tarnished plant bug populations and their movement into cotton. ■

Eugene Burris, Associate Professor, and Eugene M. Holman, Assistant Professor, Northeast Research Station, St. Joseph La.

Surveys of tarnished plant bugs along roadsides indicated the first weed species attractive to plant bugs are vetches, clovers and docks.

Photos from the First Millennium

New technology is making it possible to archive historical photos in a more efficient, more easily retrievable manner. John Wozniak, photographer with Ag Center Communications, is in the process of digitizing and storing on CDs photos of past events and people. These three and one on page 4 are part of the Ag Center Photo Archive. Based on what we know so far, these photos show spraying for ticks some time in the late 1940s (right); early attempts to explain artificial insemination (bottom right); and a field day from the 1940s in which the mechanical harvesting of corn was demonstrated. See page 4 for more on the past.

Inside:

LOUISIANA AGRICULTURE
Louisiana Agricultural Experiment Station
Louisiana State University Agricultural Center
P.O. Box 25100
Baton Rouge, LA 70894-5100

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