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Harrison, Fuxa and sugarcane team win LSU AgCenter research awards

Stephen A. Harrison, James R. Fuxa and the Experiment Station's Sugarcane Breeding and Variety Development Team won the top research awards presented at the LSU AgCenter's Annual Conference Dec. 11 and 12, 2000.



Harrison

Harrison, a professor in the Agronomy Department, received the Doyle Chambers Research Award for meritorious contributions to agriculture. Harrison has gained a national reputation for his wheat and oat breeding projects. One of his more recent research projects addresses the problem of Louisiana's coastal erosion. Harrison employed traditional breeding techniques to genetically enhance seed production, plant vigor and other traits to facilitate use of native plants in coastal preservation.

Fuxa, a professor in the Entomology Department, received the Mississippi Chemical Corporation/Triad Nitrogen Award, which is given to the scientist who has made the most significant contributions to the LAES research program during the past five years. Fuxa's research has led to the discoveries that some genetically modified viruses intended for insect control were safe for nontarget organisms. And he has been a leader in the development of biological control of the velvetbean caterpillar and the soybean looper with baculoviruses.



Fuxa

This year's Tipton Team Award was presented to the sugarcane team, which includes Freddie A. Martin, head of the Department of Agronomy; Howard P. "Sonny" Viator, resident director of the Iberia Research Station; Keith Bischoff, assistant professor, and Kenneth Gravois, resident director, both at the Sugar Research Station; Jeffrey W. Hoy and James L. Griffin, both professors in the Department of Plant Pathology and Crop Physiology; and T. Gene Reagan, professor, Department of Entomology.

The work of this team has resulted in release of several varieties to the Louisiana sugarcane industry. One of these, LCP85-384, is particularly high yielding and has had a significant effect on planting, cultural practices and harvesting.

"This variety has increased the value of the Louisiana sugar industry by at least \$100 million per year," said R. Larry Rogers, LSU AgCenter vice chancellor for research. "And that is a conservative estimate." ■ **Linda Foster Benedict**



Martin



Viator



Bischoff



Gravois



Hoy



Griffin



Reagan

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Linda Foster Benedict, Editor

Louisiana Agriculture

P.O. Box 25100

Baton Rouge, LA 70894-5100

phone (225) 578-2263

fax (225) 578-4524

e-mail lbenedict@agctr.lsu.edu.

www.lsuagcenter.com

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On the Cover:

Lisa Barona McRoberts, LSU graduate and owner of an apparel design business in Baton Rouge, Lisa B. McRoberts, Inc., designed this evening gown as part of an independent study course under the direction of Yvonne Marquette, an instructor in the School of Human Ecology. The dress won top honors from Fashion Group International in both regional and national competitions. The dress features a bustier made of American alligator leather. Funding for this project was provided by the Louisiana Fur and Alligator Advisory Council. The skirt is made of satin accented with lace, hand-beaded appliques. The gown was produced as a prototype garment to promote the use of American alligator leather in fashion apparel products. See the article on page 11. The model, Nichole Durham, was photographed at the Old State Capitol in Baton Rouge. Photo by John Wozniak



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Advances in Rice Weed Control Technology

Bill J. Williams, Eric P. Webster and Ron Strahan

Advances in weed control technology have played an essential role in the development of the rice industry. Herbicides are necessary for obtaining optimum yield and maximum profit. Before the development of selective rice herbicides, weed control involved intensive hand labor. Even today, maintaining an adequate flood is important to managing weeds in rice. Combined with improved cultural and fertility practices and the development of high yielding varieties, selective herbicides have dramatically increased rice yields in the last 50 years.

The development of the phenoxy herbicides, propanil and Ordran represent three of the earliest advances

in rice weed control technology. The phenoxy herbicides were developed in the 1940s. The most common one used in Louisiana has been 2,4-D. Propanil was introduced in 1961, and quickly became the commercial standard for rice weed control. The commercial package mixture of propanil plus Ordran (Arroso) also became popular because it controlled larger annual grasses and provided some residual activity. Since the registration of Ordran in 1967, several herbicides have been registered for use in rice and are currently recommended in Louisiana. They include Blazer, Londax, Basagran, Whip 360, Prowl, Facet, Bolero and Grandstand.

These herbicides have greatly enhanced weed management by providing producers with effective options for controlling specific weed complexes unique to specific areas.

Even though herbicides are used on virtually all Louisiana rice acreage, weeds still cause considerable yield and grade losses resulting in significant revenue losses for producers. New technologies are not just needed to help manage current problems but to address new problems associated with herbicide resistance and "species shift," which means when one weed is removed, another takes its place. Herbicide resistance is rapidly becoming a serious problem. Since the first documented case of triazine resistance in the early 1970s, more than 100 weeds have evolved

resistance to virtually every class of herbicide including glyphosate. Because of increased dependence on Facet, problems with sprangletop are widespread and increasing. Perennial grasses (perennial barnyardgrass, paspalums and water bermuda) are also becoming increasingly problematic for many producers in southwest Louisiana. Red rice, the No. 1 weed problem facing Louisiana rice producers, is a close relative of commercial rice. They both belong to the same genus and species, which means they are similar genetically. Consequently, no herbicides are available that selectively control red rice in commercial rice.

Development of new, more effective and economical weed control technology has great potential for substantially reducing yield losses and production costs, thereby increasing profitability. Several new technologies are being developed for use in rice.

Herbicide-Tolerant Rice: Liberty Link and Clearfield

Herbicide-tolerant rice, a weed control technology currently under development, has the potential to revolutionize weed control and the way rice is grown in Louisiana. Liberty Link and Clearfield rice are the two herbicide-tolerant systems expected to reach the market in the next couple of years. The Liberty Link system is a transgenic technology with resistance to glufosinate (Liberty). Liberty is a broad-spectrum, nonselective, postemergence herbicide with no soil or residual activity. Clearfield rice is not a transgenic technology and is tolerant of a family of herbicides known as the imidazolinones. Scepter and Pursuit are two of the more familiar imidazolinone herbicides.

Bill J. Williams, Assistant Professor, Northeast Research Station, St. Joseph, La.; Eric P. Webster, Assistant Professor, Department of Crop Physiology and Plant Pathology, LSU AgCenter, Baton Rouge, La.; and Ron Strahan, Assistant Specialist, LSU AgCenter, Baton Rouge, La.



Perennial barnyardgrass, unlike annual barnyardgrass, has been rare in Louisiana. Unfortunately, its numbers are growing in southwest Louisiana. This photo was taken in a field near the LSU AgCenter's Rice Research Station in Crowley.

Initially, NewPath will be the only imidazolinone herbicide registered for use in the Clearfield system.

The importance of herbicide-tolerant rice is that it will be the first herbicide technology that can be used to selectively control red rice in commercial rice. Research has shown that two applications of Liberty or NewPath, in their respective systems, will be required to control red rice. The rates for Liberty and NewPath have not yet been firmly established. However, the rate for each application of Liberty is expected to be between 0.375 to 0.5 pounds active ingredient per acre, while the rates for each NewPath application will most likely be between 0.063 to 0.094 pounds active ingredient per acre.

Single applications of NewPath or Liberty have not increased rice yields or controlled annual grasses in most research trials, especially on clay soils. Annual grass control with Liberty is similar to that of propanil, requiring sequential applications or tank mixes with other herbicides. Single applications of Liberty are as effective as single applications of Arrosolo or Facet on small (two- to three-leaf) barnyardgrass but not as effective on larger barnyardgrass (four- to five-leaf).

Liberty following previous applications or tank-mixed with Facet, Prowl or Bolero provides excellent control of annual grass and broadleaf weeds. NewPath plus Prowl or Facet applied three to six days after planting but before rice emergence has been an excellent program for controlling annual grasses. NewPath plus Prowl has been more consistent for sprangletop control than NewPath plus Facet. NewPath plus propanil applied to two- to three-leaf rice has also consistently controlled annual grasses and several broadleaf weeds season-long.

Combinations of Liberty or NewPath with conventional herbicides do not improve red rice control. When red rice is present, two applications of Liberty or NewPath are generally required. The recommended programs for controlling red rice in the Liberty Link and Clearfield systems are also expected to control most annual grasses. The Liberty Link system will also control most of the common broadleaf weeds. The Clearfield system, however, will need help controlling several broadleaf weeds, especially hemp sesbania. Both the Liberty Link and Clearfield systems do not control sedges effectively.

TABLE 1. Characteristics of the new weed control technologies for rice

<i>System/Herbicide</i>	<i>Weed spectrum</i>	<i>Seeding method</i>	<i>Comments</i>
Liberty Link (Liberty)	Red rice Broadleaf weeds Annual grasses Weak on sedges	No restrictions	Transgenic technology (GMO)
Clearfield (NewPath)	Red rice Annual grasses Some broadleaf weeds Weak on annual sedges and hemp sesbania	Dry-seeded	Not a transgenic Carryover will be an issue
Command	Annual grasses	Dry-seeded	Excellent residual control of annual grasses. Generally, needs a follow-up treatment.
Permit	Sedges Some broadleaf weeds	No restrictions	Limited to pre-flood applications.
Aim	Most broadleaf weeds Suppresses rice flatsedge and alligatorweed	No restrictions	Timing is critical, works best on small weeds. Mixtures with Regiment look good on alligatorweed.
Regiment	Barnyardgrass, rice flatsedge, hemp sesbania, perennial barnyardgrass, brook paspalum and knotgrass Suppresses Mexican weed and morningglory Weak on sprangletop and broadleaf signalgrass	No restrictions	Mixtures with Aim look good on alligatorweed.
Clincher	Annual grasses	No restrictions	Excellent crop tolerance Good post-flood activity
RiceStar	Annual grasses	No restrictions	Good crop tolerance
Aura	Annual grasses	No restrictions	Fair crop tolerance Inconsistent on annual grasses with more than two leaves

The gene for Liberty or NewPath tolerance can be transferred from commercial rice to red rice if they flower in close proximity. Therefore, it will be extremely important that producers make both applications and do not cut rates. If red rice escapes control and cross-pollinates with a Liberty Link or Clearfield variety, the technology will be short-lived. It will also be important for producers to rotate these technologies. Continued use, especially since multiple applications are required, of one technology will place a tremendous selection pressure on red rice and eventually lead to herbicide-resistant red rice.

Recently Registered Herbicides: Command, Permit and Aim

A Section 18 label, which is granted on a temporary basis, allowed use of Command in rice during the 1999 and 2000 growing seasons. A Section 3 label, which is full registration, for Command

use in rice is expected soon. Though Command was widely used in 1999 and 2000 in Louisiana, it can be used only on dry-seeded rice, and applications are restricted to ground equipment. Command can cause some injury to rice plants in the form of bleaching or "whitening." This is more likely to occur when Command is preplant incorporated but may also occur with preemergence applications and even delayed preemergence applications. However, yield loss from Command injury is rare, even in the most severe cases where moderate stand thinning is observed.

Most producers have been pleased with Command's performance. However, some were disappointed because of the need for follow-up treatments after permanent flood. One problem with Command is that residual control begins to run out about the time permanent floods are being established (four to five weeks). As a result, many of the newly germinated and emerging annual grasses are overlooked, and the need for a



Water paspalum likes water so it is a problem for rice growers in southwest Louisiana. There is currently no control for this weed. This photo was taken in Jefferson Davis Parish.

follow-up treatment is not recognized. Annual grass control is usually optimum when Command is applied at 0.3 to 0.4 pound active ingredient per acre on silt loam soils and 0.5 to 0.6 pounds active ingredient per acre on clay soils. The higher rates of 0.4 on silt loam soils and 0.6 on clay soils are justified when permanent floods are delayed (more than four to five weeks after application). In many cases, Command can control annual grasses until permanent flood, if the higher rates are used and floods are established within four to five weeks after application. Excessive water (high rainfall or frequent flushing) reduces the residual control of Command. If sedges or broadleaf weeds are present, a program for controlling them will be required. Propanil plus Grandstand has been one of the most common and successful follow-up treatments.

Two herbicides registered for use in rice (Permit in 1999 and Aim in 2000) will help manage broadleaf weeds and sedges. Permit is slow-acting and usually takes two to three weeks to kill weeds. However, Permit stops weed growth within a few hours of application. Research indicates that Permit has the potential to injure rice when applied preemergence, especially on silt loam soils. Therefore, Permit applications should be limited to postemergence. Permit injury to rice from postemergence applications has been minimal. The method of rice seeding (water- or dry-seeded) is not restricted on the label. However, the best fit for Permit is in dry-seeded rice because it is limited to pre-flood applications.

The weed spectrum for Permit is being investigated. Though Permit controls both hemp sesbania and sedges,

the control of hemp sesbania taller than 8 inches or after permanent flood has been inconsistent. However, even at low rates, Permit controls sedges. Permit rates as low as 0.012 pound active ingredient per acre have controlled moderate infestations of yellow nutsedge and purple nutsedge when applied with Londax or Grandstand.

Aim is a fast-acting contact herbicide and is

labeled for both dry- and water-seeded systems. Rice has demonstrated excellent tolerance to Aim. Aim controls morning-glory, hemp sesbania and several other important broadleaf weeds in rice. Aim is a contact herbicide so coverage and timing are critical. Aim's effect is reduced with weeds taller than 4 inches.

Future Herbicides: Regiment, Clincher, RiceStar and Aura

Regiment belongs to the sulfonyleurea herbicide family, which includes Londax. Regiment is slow-acting and usually takes two to three weeks to kill weeds. However, Regiment stops weed growth within a few hours of application. Because of injury potential, Regiment application to rice before the three-leaf stage will not be recommended. Regiment is active on barnyardgrass and has killed plants as tall as 15 inches, making it a good option for managing barnyardgrass escapes. Regiment has also demonstrated good activity on rice flatsedge and hemp sesbania. The main benefit of Regiment to producers in southwest Louisiana is its ability to control perennial barnyardgrass, knotgrass and brook paspalum. However, proper weed identification will be important because Regiment does not control all of the perennial grasses found in southwest Louisiana. Another strength is its ability to control alligatorweed when tank-mixed with Aim. A serious weakness of Regiment is its inability to control sprangletop and broadleaf signal grass.

Clincher, RiceStar and Aura belong to a class of herbicides commonly referred to as the graminicides, which include Select, Fusion and Poast Plus. The graminicides control only grasses,

and in the case of Clincher, RiceStar and Aura, only annual grasses. The main advantage of these herbicides over other rice herbicides is that they are safe to use around broadleaf crops. Aura has been less consistent than RiceStar or Clincher in controlling annual grasses with more than two leaves. Of the three graminicides, Clincher has been the most consistent at controlling annual grasses after permanent flood. Research indicates that Clincher and RiceStar can potentially be tank-mixed with Regiment to control sprangletop. Because the potential for antagonism exists, rate and adjuvant selection will be critical.

No 'Silver Bullet'

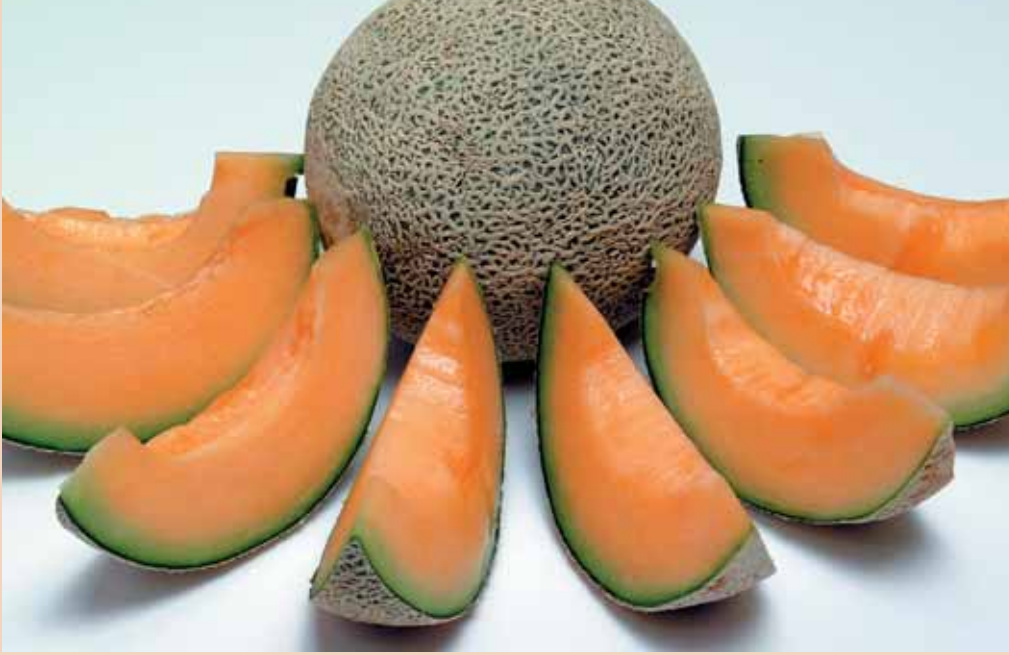
None of the new technologies is a "silver bullet." Nevertheless, the new technologies will give producers the tools needed to control several troublesome weeds. The herbicide-tolerant systems are going to be excellent tools for controlling red rice and other important rice weeds. However, multiple applications will be required and application timing will be critical. So, in that sense the programs for the new technologies will be similar to those for propanil. One important result of the herbicide-tolerant systems is that water-seeding and particularly muddy water practices will not be required to control red rice. Producers will be able to employ more agronomically and environmentally desirable seeding methods. The conventional herbicides provide producers with the tools needed to manage resistance, species shifts and troublesome weeds without having to use one of the herbicide-tolerant technologies. Red rice will be the only weed the herbicide-tolerant systems control that cannot be controlled with conventional herbicides. ■

Acknowledgment

Louisiana Rice Research Board

Aim Available for 2001

Aim (carfentrazone) has just recently been labeled for use in rice. The herbicide is similar in mode of action and performance to Blazer, says Ron Strahan, weed scientist with the LSU AgCenter. Its advantage may be in its lower use rate. It is labeled for use in more crops than Blazer. Strahan says it is excellent on morningglories and hemp sesbania.



Rotating Cantaloupes with Nematode-resistant Tomatoes Produces Higher Yields without Chemical Control

Root-knot nematodes cause significant yield losses in many horticultural crops. Recent estimates indicate nematode injury to cantaloupes in the United States exceeds \$40 million each year. Development of commercial tomato cultivars resistant to root-knot nematodes has reduced the risk of losses from this pest without environmental damage; however, no cantaloupe cultivars with high resistance to root-knot nematodes are commercially available to provide similar protection. Cantaloupe growers use nematicides to control this pest, but use of these pesticides may be restricted or eliminated in the future.

The Norwood sandy loam soil prevalent in the Red River Valley in northwest Louisiana is prone to nematode buildup because of continuous farming with susceptible crops such as cotton. The number of root-knot nematodes found in plots previously planted with nematode-resistant tomatoes was significantly lower than the number found in plots planted with susceptible tomatoes. Our earlier research indicated that double-cropping cucumbers with nematode-resistant tomatoes can be a viable alternative to soil treatment with nematicides to improve cucumber yield in soil infested with root-knot nematodes.

The long growing season in the South offers the potential for double-cropping mulched and drip-irrigated beds. Double-cropping tomatoes with cucumbers or other members of the cucurbit (gourd) family reduces production costs because succeeding crops use the existing polyethylene mulch, drip tape and fertilizers applied to the first crop. Black polyethylene is preferred for growing spring tomatoes because of its warming effect on the soil, but heat accumulation under the black mulch during sunny days in mid to late summer or early fall limits its use for double-cropping. This experiment was conducted to compare nematode-resistant and susceptible tomato cultivars mulched with black or white polyethylene on growth and yield of succeeding crops of cantaloupe.

Studies were conducted in 1996 and 1997 on a Norwood sandy loam soil at the LSU AgCenter's Red River Research Station in Bossier City. Celebrity (nematode-resistant) and Heatwave (nematode-susceptible) tomatoes were transplanted on black or

white polyethylene-mulched and drip-irrigated plots (raised beds) in early April of each year. Fertilizer rates and other cultural practices consisted of standard recommendations for growing staked tomatoes for fresh market production.

Following plant removal after the last harvest of tomatoes in early July, the plots were sprayed with a herbicide (glyphosate) at 3 pounds per acre. Athena cantaloupe seedlings were transplanted into tomato plots during the third week of July in both years. Cantaloupes were double-cropped with both nematode-resistant and susceptible tomato cultivars and were mulched with both black and white polyethylene. Cantaloupes were harvested and evaluated for grade according to U.S. Department of Agriculture standards and then weighed. Fruit that were well formed, well netted and free from decay, damage and sunscald were graded as marketable. Fruit that were deformed, cracked, rotten or weighed less than 1 pound were culled. All plants in each plot were removed after the last harvest, oven-dried and weighed. Healthy roots were separated from galled ones, and the percentage of galled roots was calculated.

Cantaloupes planted after the nematode-resistant tomato cultivar Celebrity produced significantly higher marketable yields and more fruit per acre than did those planted after the nematode-susceptible tomato cultivar Heatwave in both years. Percentage of culls was not significantly affected by treatment in either year. Plant dry weight was heavier and percentage of galled roots was smaller for cantaloupes planted after the nematode-resistant than after the nematode-susceptible tomatoes. Mulch color had no significant effect on cantaloupe marketable yield, fruit number, percentage of culls, plant dry weight or percentage of galled roots.

This study indicates that double-cropping cantaloupes with a nematode-resistant tomato cultivar can improve cantaloupe yields in soils that have a history of root-knot nematode. Study results also indicate that growth and yield of cantaloupes were similar when planted on black or white polyethylene mulch. ■

H.Y. Hanna, Professor, Red River Research Station, Bossier City, La.

LIGHT INTERCEPTION: A Way for Soybean Farmers to Determine When to Spray for Defoliating Insects

James E. Board and David J. Boethel

Insects that eat soybean leaves, such as the soybean looper, velvetbean caterpillar and green cloverworm, usually attack in late August and September. With the exception of varieties planted in April, most soybeans planted in Louisiana are in the mid to late seed-filling period at this time. Economic thresholds have been developed to indicate to farmers when insecticide application is required to avoid yield loss, but these thresholds do not reflect the soybean's increased tolerance to defoliation as it progresses through the seed-filling period and, therefore, may be overly conservative. For example, total defoliation of the plant at mid seed filling reduces yield by about 40 percent, whereas total defoliation at late seed filling reduces it only by 20 percent. Because determination of economic thresholds for each specific stage of seed filling is difficult, an alternative approach based on light interception was investigated.

Light interception by a crop is the percentage of the sun's light intercepted by the canopy. It can easily and rapidly be measured with an instrument called a light bar or approximated with an experienced eye. Light interception is a good candidate for use as an insecticide-application criterion, because it is based on the mechanism of how defoliation during seed filling reduces yield. Many researchers have recognized that insect defoliation reduces yield primarily through reduced photosynthetic activity caused by decreased light interception. Previous studies have demonstrated the importance of maintaining 95 percent light interception (of whatever the control level is) during seed filling for



Photo by John Wozniak

This light bar is used to measure light interception in a soybean field. At midday when the sun is at its highest point and there are no shadows, the bar is placed on the ground diagonally between two rows to measure the light that gets through. Another measurement is taken above the plants, and these two measurements are compared. The amount of light that reaches the plant affects the photosynthetic reactions and thus the growth of the plant and ultimately the yield, says James E. Board, agronomy researcher.

optimum yields. Our objectives in the following studies were to determine specific light interception criteria for insecticide application at the mid and late seed filling stages and to determine if these criteria are applicable across a broad range of soybean varieties.

Defoliation Study

Centennial soybeans were planted two years (1993 and 1994) at an optimal date and subjected to partial and total defoliations at the mid and late seed filling periods. Treatments at both stages were no defoliation (control), 33 percent defoliation, 66 percent defoliation and 100 percent defoliation. Actual defoliation levels differed somewhat from these desired levels and are reported in Table 1.

Because defoliation treatments affected yield similarly in both years, data were averaged across years. Results confirmed the greater tolerance to defoliation at late compared with mid seed filling. At mid seed filling, a small drop in light interception from 98 percent to 92 percent (caused by a 41 percent reduction in leaf area) was sufficient to significantly reduce yield by 4 bushels per acre.

Yield losses became higher as defoliation increased and light interception declined. Thus, optimum yield at mid seed filling depended on keeping light interception at 95 percent of the control level. In contrast, at late seed filling a decrease in light interception from 90 percent (because of leaf loss,

James E. Board, Professor, Department of Agronomy, and David J. Boethel, Professor, Department of Entomology, LSU AgCenter, Baton Rouge, La.

the control level of light interception declines as seed filling progresses) to 74 percent, created by a 61 percent reduction in leaf area, did not significantly reduce yield. Significant yield losses (large enough to justify insecticide application) at this time occurred only with total defoliation. Based on this result, avoiding yield loss at late seed filling depended on maintaining light interception at 82 percent of the control level.

Tests on 10 Varieties

Ten soybean varieties representing Maturity Groups IV, V, VI and VII were tested in 1997 and 1998 to determine if the criteria for insecticide application described above were applicable across a range of different varieties. These varieties were given a partial defoliation treatment at the midpoint of seed filling sufficient to reduce light interception to just below 95 percent of the control level and a total defoliation treatment at late seed filling. Yields for these treatments were compared to a control to determine if yield losses were similar to those for Centennial in the previous experiments.

In 1997, partial defoliation at mid seed filling for all varieties, except DP3478 and Hutcheson, resulted in small yield losses (Table 2). In five cases, yield losses were large enough to be statistically significant. When averaged across all varieties, there was a 5 bushel per acre yield loss, a reduction similar to the 4 bushel per acre loss with Centennial. Yield losses in 1998 were similar, although a little larger, compared to 1997. Yields for all varieties were reduced by partial defoliation at mid seed filling (Table 2). Significant reductions occurred for six of the varieties. Averaged across all varieties, there was a 6 bushel per acre yield loss. Results from both years supported the criterion that insecticide application at the midpoint of seed filling is required whenever light interception falls to 95 percent of the control level.

Results from the 1997-98 studies confirmed insecticide application at late seed filling is justified to prevent total defoliation. In 1997, yield reductions caused by total defoliation were significant for all varieties except Hutcheson. In 1998, total defoliation resulted in significant yield losses for all varieties. The yield reductions, averaged across varieties, were 11 bushels per acre in 1997 and 12 bushels per acre in 1998, figures similar to the 10 bushels per acre yield loss by Centennial in the previous

Table 1. Effects of partial and total defoliation on yield, leaf area index (LAI) and light interception (LI), averaged across two years.

	Defoliation treatment	Yield	LAI	Actual Defoliation Levels	LI
	%	Bu/A		%	%
Mid Seed Filling	0	46	4.61	0	98
	33	42	2.71	41	92
	66	38	2.01	56	84
	100	23	0	100	52
Late Seed Filling	0	45	3.92	0	90
	33	44	2.47	37	81
	66	44	1.54	61	74
	100	35	0	100	49

Table 2. Yield losses caused by partial defoliation at the midpoint of seed filling and total defoliation at late seed filling for 10 soybean varieties grown near Baton Rouge in 1997 and 1998.

Maturity Group	Variety	1997			1998		
		Control Yield	Yield/Partial Defol. Mid Seed Fill	Yield/Total Defol. Late Seed Fill	Control Yield	Yield/Partial Defol. Mid Seed Fill	Yield/Total Defol. Late Seed Fill
IV	DP3478	60	60	46	48	46	35
	HBK49	58	57	52	50	43	33
	RVS499	62	51	45	47	41	33
V	Hutcheson	57	57	52	50	44	41
	HYP574	71	61	54	46	42	39
VI	A6961	63	59	51	45	38	38
	P9641	64	55	57	50	44	37
VII	DYN3682	68	58	50	50	42	38
	H7190	65	62	57	53	51	40
	Stonewall	64	58	51	46	41	38
	Mean	63	58	52	49	43	37

Partial defoliation is defoliation sufficient to reduce light interception to just below 95% of the control level.



95% light interception; gaps begin appearing between leaves and a small amount of ground is visible



85% to 90% light interception; ground area makes up 10% to 15% of viewing area



75% to 80% light interception; ground area makes up 20% to 25% of viewing area

Photos by James E. Board

study. Based on these results, insecticide application at late seed filling is justified when light interception falls to 82 percent of the control level.

Light Interception Criteria

Use of light interception criteria for insecticide application by farmers and consultants depends on proper identification of the mid and late seed filling periods, as well as determination of light interception. Developmental periods for soybean varieties within a maturity group tend to be similar because of strong genetic control. For May plantings, approximate times for mid and late seed filling for the different maturity groups are listed below.

	Mid Seed Filling	Late Seed Filling
Early Maturity Group IV:	Early August	Mid August
Normal Maturity Group IV:	Mid August	Late August
Maturity Group V:	Mid to Late August	Early September
Maturity Group VI:	Late August to Early September	Mid September

Light bars can be purchased commercially for about \$1,500 to \$2,000. Recordings should be taken between 11 a.m. and 3 p.m. while the sun is not blocked by clouds. More research is needed to determine the optimum number of samples required per field. However, the technique offers an alternative to the traditional method of sampling and assessing the insect population and the defoliation level to determine whether an insecticide application is warranted. With training and experience, private pest management consultants, extension agents and farmers may be able to accurately assess light interception levels by visual observations. This would be advantageous because it would avoid the expense of the light bar and reduce sampling time. Also, determinations could be made at any time of the day, as long as the field could be entered. ■

Finding New Markets for Louisiana's Alligator Industry

**Teresa A. Summers,
Bonnie D. Belleau,
Terri Von Hoven,
Kelly L. Nowlin
and Yingjiao Xu**



Photo by John Wozniak

This skirt and vest duo was designed and developed by Bonnie D. Belleau, human ecology professor. The fitted vest features princess lines and hornback American alligator inserts in the front. The back and lining are made of brocade fabric. The vest is finished with an American hornback alligator belt in the back. The garment is worn by Rachael Yoho, a senior majoring in apparel merchandising.

Alligators and fashion may bring different images to mind, but the combination offers potential for Louisiana's economy. A research initiative to explore ways to increase domestic demand for finished products made with American alligator leather began in 1997. The goal is to find more opportunities for Louisiana's alligator business.

The American alligator is indigenous to the South from the Carolinas to Texas, with the highest populations in Louisiana and Florida. Alligators have been hunted for their hides since the 1800s. From 1967 to 1987, the American alligator was listed as endangered. But that is no longer the case. They were brought back through programs that encouraged landowners to preserve alligator eggs and habitats in return for the right to harvest a percentage of the grown animals.

Alligator farming began in the late 1980s. About 100 alligator farms with more than 250,000 alligators operate in Louisiana and Florida. In 1999, alligators were produced on 64 farms in Louisiana and 24 in Florida. On farms about 90 percent of hatchlings reach 4 to 6 feet in length compared to only about 17 percent in the wild. Farmers are required by law to return a percentage of their alligators to the wild. Farmed skins are generally smaller but offer better quality than wild skins. This availability of alligator skins makes possible the expansion of markets for alligator leather goods.

The U.S. market for alligator leather has historically been limited to a fairly narrow range of products such as boots, belts and wallets targeted mainly to men. In contrast, in Europe alligator leather products are aimed primarily at women and include apparel and accessories such

as handbags and shoes. Because of these differences, the European market is stronger and more fully developed. Most alligator skins, raw or tanned, are sold to manufacturers in Europe or Asia.

Producers in rural Louisiana are an important source of raw skins, and a limited number of U.S. tanneries now process alligator skins, including Roggwiller Tannery of Louisiana (RTL) in Lafayette. Expansion of the alligator industry is constrained, however, by lack

Teresa A. Summers, Cliff & Nancy Spanier LSU Alumni Professor; Bonnie D. Belleau, Professor, School of Human Ecology, LSU AgCenter, Baton Rouge, La.; Terri Von Hoven, Graduate Student, Human Ecology, and Researcher, USDA-Southern Regional Research Center, New Orleans, La.; Kelly L. Nowlin (former student), Product Developer, Denton, Texas; and Yingjiao Xu (former student), Assistant Professor, School of Human and Consumer Science, Ohio University, Athens, Ohio.



This two-piece gown features a bodice made entirely of garment-finished American alligator lined in silk. The bodice has a scoop neckline in the front and back and falls just below the waist. Neckline and armhole edges are finished with wool binding to match the skirt. The straight, fitted skirt has a side slit and is lined with silk polka dot fabric. This garment was designed and created by a team of apparel design students as part of a class project directed by Yvonne Marquette. Student designers are: Lisa McRoberts, January Hart and Shoan Lodge. The model is Brianne Segura, an apparel design major.

of understanding of potential markets in the United States. Little research has focused on determining markets for products made with American alligator leather.

Targeting Designers, Manufacturers

To provide information to designers and manufacturers interested in using alligator leather, we measured the physical and performance characteristics of the leather critical to successful product design, production and use.

For many apparel products, alligator leather needs to drape, must be colorfast, must resist perspiration and water absorption and must not abrade during use. For home furnishings, abrasion resistance and tensile strength are important. For other types of home textiles, flammability is critical. For automotive upholstery, all parameters are important.

Tests were conducted on alligator skins based on projected product end-use and included stiffness, abrasion resistance, tear resistance, breaking strength and elongation, flammability, wrinkle recovery, crocking (transferring color when rubbed), drape, image analysis, durability and colorfastness to drycleaning.

The garment-finished belly skin was soft and supple. The matte-finished horn-back skin was stiff. The gloss-finished belly skin was uniform in thickness and fairly stiff. Image analysis of the skins revealed networks of fibers whose organization varied with different sections of the skin. For all samples, the flesh side appeared to be a series of layers of fibers formulating a network. A single fiber

of the flesh side of the garment-finished skin indicated the fiber was made of smaller fibrils much like the fibers composing a yarn.

Further testing indicated the garment-finished skin had the best bending properties and would probably have better drape than the gloss- or matte-finished skins. Tensile properties, particularly for the garment finish, demonstrated that alligator skin has the strength to perform well in upholstery products, home furnishing products and accessories. Shearing and bending properties also hinted directly at drape,

showing that the garment finish had less shearing rigidity than the gloss finish and would be appropriate for apparel applications. For the tear test, the gloss-finished sample performed the worst.

Results suggest alligator leather is appropriate for apparel with limited drape requirements; the garment- and matte-finished skins will drape better than the gloss-finished skins. Alligator leather will make fine home furnishing products as well as accessories, particularly the gloss-finished leather because of its ability to retain shape. Belts, trim, handbags and luggage are good applications of alligator leather for its strength and abrasion resistance properties. In addition, jewelry is another option for alligator leather.

Consumer Survey

To explore U.S. demand for alligator leather products, a survey was



This elegant evening gown combines alligator with silk. The bodice is made of black classic (refers to the finish on the skin) American alligator. It was designed with princess lines to provide a close fit that hugs the body. The skirt is made with 10 yards of silk fabric, black lined with red. The gown is trimmed with silk lace. Retail value is approximately \$10,000. This garment was designed and created by a team of apparel design students as part of a class project directed by Yvonne Marquette. Student designers are Debbie Cifreo, P.J. Carlton and Melanie Smith. Wearing the gown is Jessica Garcia, a senior apparel design student.

sent to 800 consumers located in key markets to determine their attitudes, perceptions, knowledge and intent to purchase exotic leather products. The sample was drawn from members of Fashion Group International, an organization of professionals in design, marketing, manufacturing, retailing, advertising, publishing, and those who provide research, financial and educational services to the fashion industry. The response rate was 50 percent.

Almost all respondents were female, Caucasian, at least 45 years old and held a bachelor's degree or higher. Half were engaged in professional occupations, about one-third were self-employed and approximately one-fifth held management positions. Approximately three-fourths of respondents worked full time, while about one-sixth worked part time and a few were retired. Most earned more than \$50,000 annually.

Respondents reported limited experience with exotic leather apparel and preferred classic/traditional styles over fashion-forward styles. Most respondents were unaware that the American alligator is no longer on the endangered species list, believed exotic leather requires special care and knew that exotic leather is a durable material. Half stated they would purchase exotic leather apparel because of its unique qualities, and almost all believed that wearing exotic leather is socially acceptable. In general, respondents indicated they preferred garments constructed entirely from exotic leather as opposed to its use as trim.

Product Prototypes

With input from designers, manufacturers and additional survey findings, product prototypes have been developed by the researchers. These items have received recognition in regional and national design competitions and have been shown at multiple trade shows.

Potential Markets

The continuing focus of this project is to explore the factors that drive product adoption and market demand for finished goods made with American alligator leather. Physical property testing and survey data collection continue. The ultimate goal of the project is to provide information useful to the alligator industry to help expand market opportunities.

Findings reveal a potentially lucrative domestic market for women's apparel and accessories made with

alligator leather. Physical and performance characteristics of alligator leather indicate products traditionally made with leather as well as nontraditional products can be produced effectively to satisfy consumer demand. But consumers must be provided accurate information about the correct legal status of the American alligator as well as the uses and care of alligator leather in products. Education and promotion are vital to improving

domestic marketing opportunities for American alligator leather products. ■

Acknowledgment

Louisiana Fur and Alligator Advisory Council, Louisiana Alligator Farmers and Ranchers Association, Louisiana Board of Regents Support Fund Research and Development Program, Roggwiler Tannery of Louisiana and members of the American alligator industry.

Photos by John Wozniak



This day-to-evening ensemble consists of a short gored skirt, halter top and jacket designed and developed by Bonnie D. Belleau, human ecology professor. The halter top front is made entirely of garment-finished, supple American alligator in a soft brown. The top lining and back of the garment are made of faux suede in electric blue. The halter top is finished with a faux suede binding around all the edges. The accompanying jacket is styled with princess lines for a closer fit. It is finished with a collar and lapels of American alligator. Modeling the ensemble is Jacquelyn LaCroix, a senior apparel design student.

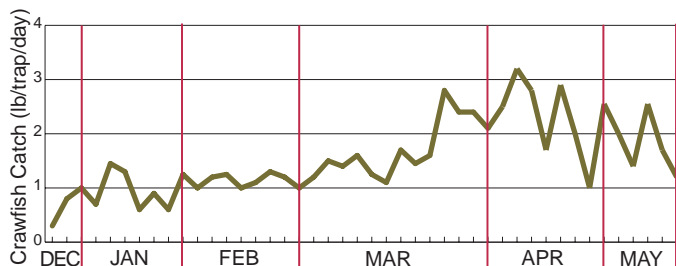
How Research Helped Reduce Crawfish Harvest Costs

Robert P. Romaine

Over the past decade, researchers at the LSU AgCenter's Aquaculture Research Station have investigated crawfish harvesting methods to reduce production costs and increase management efficiency. Crawfish are harvested differently from other types of cultivated fish such as channel catfish. These other fish are harvested once or several times a year with nets and seines. However, the presence of cultivated crops such as rice or volunteer vegetation, grown as food for crawfish in ponds, interferes with seines and requires that crawfish be harvested with small, baited traps over an extended period, beginning as early as mid-November and continuing through April or June.

The seasonal catch in crawfish in ponds is highly dynamic, often varying as much as 200 percent daily (Figure 1). It is influenced by many factors including water temperature, water quality, type and quantity of vegetative forage, weather, lunar phase, as well as crawfish reproduction, growth and molting

Figure 1. Seasonal Changes in Crawfish Catch in Experimental Crawfish Ponds



patterns. Generally, two-thirds of the crop is harvested from March through May, when densities of marketable crawfish are highest. Trapping is labor intensive, and nearly two-thirds of total production costs in crawfish farming operations are associated with harvest. Bait and labor are the major costs. Clearly, modest increases in trapping efficiency can significantly reduce production costs and increase profitability.

Research at the Aquaculture Research Station has focused on investigating trapping and baiting strategies for crawfish with the highest potential to reduce bait and labor costs. The studies were conducted in six large experimental ponds (4 to 5 acres each) managed for crawfish production according to commercially recommended practices.

Robert P. Romaine, Resident Director and Professor, Aquaculture Research Station, LSU AgCenter, Baton Rouge, La.

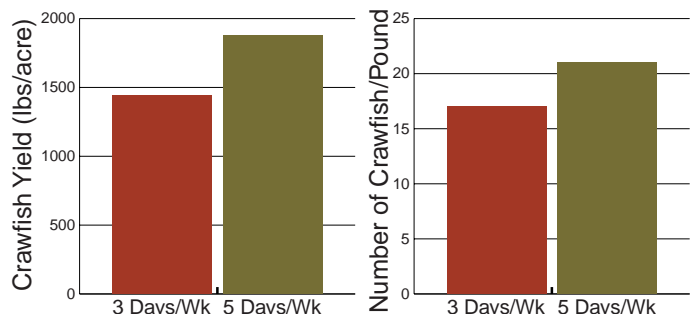
The seasonal catch in crawfish in ponds is highly dynamic, often varying as much as 200 percent daily.

Trapping Strategies

In one study, two traps – a pyramid design with three entrances and a stand-up pillow trap with two entrances – were evaluated. Crawfish were trapped three days a week. Pyramid traps had a 44 percent higher catch than stand-up traps. An increase in trap density from 12 to 24 traps an acre increased yield 49 percent, but the increase to 36 traps an acre increased crawfish yield only 8 percent. The most efficient harvesting strategy was to use pyramid traps set at 24 an acre. Because crawfish yield was excellent (more than 1,000 pounds an acre) with only three trapping days a week, follow-up studies were conducted over three production seasons to study the effects of trapping frequency (trapping days a week) on crawfish catch. Although several trapping strategies were investigated, including biweekly trapping and rotational trapping schemes, emphasis focused on harvesting crawfish five consecutive days a week, which was the standard, or three days a week. Pyramid traps were used at 24 an acre. Although crawfish yield was 17 percent higher with five days a week trapping (Figure 2), the 40 percent reduction in bait and labor cost and the 20 percent increase in crawfish harvest size demonstrated that three days a week was the most economical harvesting strategy.

Figure 2. Crawfish Yield (lb/acre) and Mean Crawfish Size (number or count/lb) from Experimental Ponds Trapped 3 Days/Week and 5 Days/Week.

Data are averages over three crawfish production seasons. Pyramid traps at 24 an acre were used in the trials.



Baiting Strategies

Bait, which is required to attract crawfish into traps, is the biggest expense in crawfish production, costing from \$40 to \$200 an acre. Two general types of bait are used, natural fish baits, such as gizzard shad and menhaden, and formulated baits manufactured by feed mills. Formulated crawfish baits were initially developed in the early 1980s by LSU AgCenter researchers. They consist mainly of cereal grains, grain byproducts, natural and synthetic attractants, and binders. Fish baits are about 20 percent to 25 percent more expensive than formulated baits and require freezers for storage and labor to cut the bait into trap portions. The amount of bait used varies widely but generally ranges from 0.25 to 0.75 pound per trap per day.

Gizzard shad and a commercially available formulated bait were evaluated in both cold (January to February) and warm (March to May) water over two trapping seasons. On average, shad caught 39 percent more crawfish than the formulated bait in cool and cold water (less than 68 degrees F). In contrast, the formulated bait was 41 percent more effective in warm water (more than 68 degrees F) (Figure 3). The two baits were equally effective at temperatures near 68 degrees F. In a follow-up study, two natural baits, gizzard shad and menhaden, were compared with two formulated baits in cold and warm water (Figure 4). Crawfish catch was 50 percent higher in cold water with menhaden or shad compared to the formulated baits, but manufactured baits were 18 percent more effective than the fish baits in warm water.

In a companion study to the type of bait experiments, gizzard shad and a formulated bait were each evaluated at four quantities – 0.25, 0.33, 0.5 and 0.75 pound per trap in both cold water and warm water. Although crawfish catch increased

Figure 3. Seasonal Changes in Crawfish Catch (lb/trap) With Gizzard Shad and a Formulated Bait from Experimental Crawfish Ponds

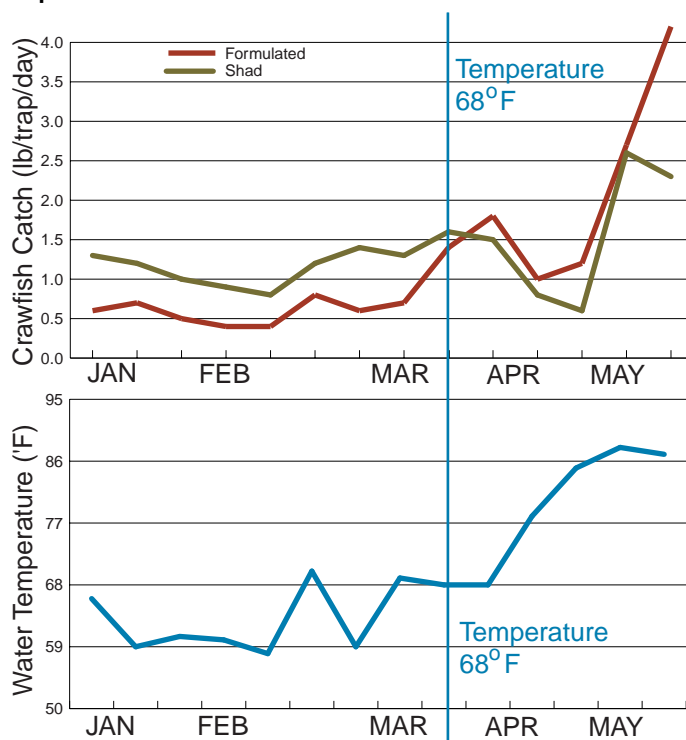
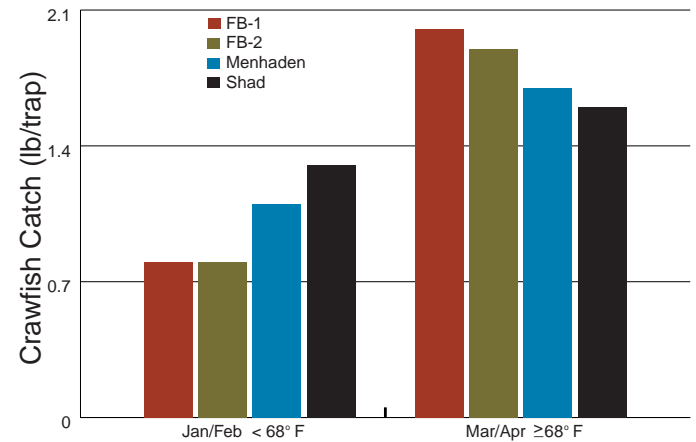


Figure 4. Seasonal Changes in Crawfish Catch (lb/trap) With Gizzard Shad, Menhaden and Two Formulated Baits from Experimental Crawfish Ponds



with an increase in bait quantity above 0.25 pound per trap at all temperatures, the increase did not compensate for the increase in bait cost. Highest profit (gross value of crawfish minus bait cost) was achieved with 0.33 pound of bait per trap for both gizzard shad and formulated bait in cold and warm water.

Management Recommendations

Results from these studies have led to new recommendations in harvesting strategies for crawfish farmers. Trap designs, bait types, and trapping and baiting strategies were identified that reduced harvest costs significantly without major changes in established production methods. Significant reductions in trapping days and associated harvesting costs can be attained with little or no reduction in yield by using pyramid traps. Many crawfish farmers once trapped five to six days a week (100 to 150 days a season) and used as much as 0.5 to 0.75 pound of bait per trap. Crawfish farmers can obtain a comparable yield, but with significantly reduced costs, by selecting the appropriate bait or bait combination based on water temperature, not exceeding 0.33 pound bait per trap, and reducing trapping effort to three or four days a week (60 to 90 days a season), if they use pyramid traps.

Adoption of these harvesting recommendations over the past several years has saved crawfish farmers \$2 million to \$3 million annually in lower bait and labor costs. Despite these improvements in crawfish harvesting, crawfish harvest practices are still relatively inefficient and labor intensive. Further advances in crawfish harvesting technology can increase crawfish production efficiency and decrease the cost in farming operations. Better trap designs that minimize crawfish escape, development of formulated baits with enhanced effectiveness in cold water, and improved harvesting machinery to access traps in ponds are needed. Crawfish researchers at the Aquaculture Research Station and the Rice Research Station maintain an active research program on harvesting with the goal of further reductions in the cost of producing crawfish and increased profitability for crawfish farmers. ■

Comparing Mating Systems for Producing Weanling Calves

Commercial cow-calf production is the primary beef cattle enterprise in Louisiana. The state has about 550,000 beef cows in 15,000 herds located in all parishes but Orleans. The primary product marketed from these herds is the weaned calf. At least 80 percent of the cow-calf herds in Louisiana use crossbred cows of one kind or another, and most of these crossbred cows have some Brahman inheritance.

Many producers prefer Brahman first-cross (F1) cows to produce calves for market because of their relatively high fertility, maternal ability and longevity in Louisiana's subtropical environment. This advantage is mostly due to hybrid vigor, or heterosis. A disadvantage of using Brahman F1 cows is that they do not reproduce themselves, and replacements for culled cows must be purchased or produced in auxiliary herds. One alternative is to use a rotational crossbreeding system. The advantage is that replacement females are produced within the system, and a reasonable amount of heterosis is maintained.

Producers have asked whether they should embark on a rotational crossbreeding system and whether this system would compete with the production of calves from Brahman F1 cows. To answer these questions, a study was conducted to compare production of weaned calves from Brahman F1 cows and from rotational crossbred cows that included Brahman breeding.

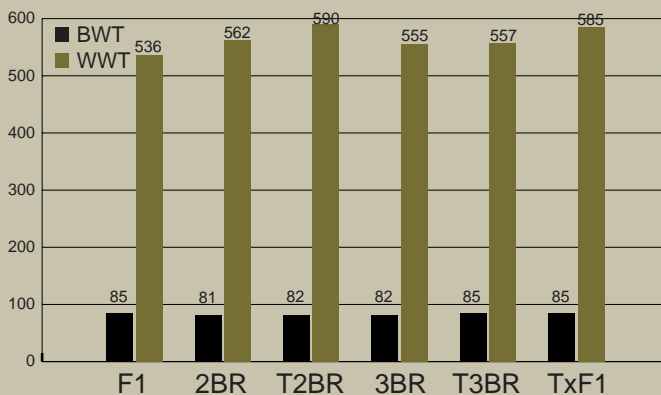
Two-, three- and four-breed rotational crossbreeding systems involving Angus, Brahman, Charolais and Hereford breeds were being studied at the LSU AgCenter's Ben Hur Farm in Baton Rouge. They were compared to straightbred Angus, Brahman, Charolais and Hereford cows producing straightbred calves, but not to Brahman F1 cows. In the fourth generation of the rotational crossbreeding study, the Angus, Brahman, Charolais and Hereford cows were mated to produce Brahman F1 calves. Brahman F1 heifers from these matings were retained for comparison to rotational crossbred heifers produced at the same time for generation 5.

Sires from unrelated breeds, Simmental and Gelbvieh, were mated to the Brahman F1 females and to half the rotational crossbred cows in generation 5. The remaining half of the rotational crossbred cows were mated to Angus, Brahman, Charolais or Hereford bulls, as determined by their breed composition, to continue the rotational crossbreeding systems. Straightbred Angus, Brahman, Charolais and Hereford cows were mated to produce Brahman F1 calves for comparison to the calves from the Brahman F1 cows and to the calves produced from rotational crossbreeding.

Breed composition of rotational crossbred cows varied at the start of generation 5. Two-breed rotation cows were 2/3 Brahman and either 1/3 Angus, 1/3 Charolais or 1/3 Hereford. Three-breed rotation cows were: 4/7 Charolais, 2/7 Brahman, 1/7 Angus; 4/7 Angus, 2/7 Brahman, 1/7 Hereford; or 4/7 Charolais, 2/7 Brahman, 1/7 Hereford. Thus, two-breed rotation cows were 66 percent Brahman, whereas three-breed rotation cows were 28.6 percent Brahman. F1 cows were 50 percent Brahman.

A total of 1,180 calves were weaned in generation 5. Overall average birth weight was 83 pounds, and weaning weight adjusted to 205 days was 558 pounds (Figure 1). Terminal (T) is used to

Figure 1. Birth and weaning weights of calves from different mating systems. (F1 = Brahman F1 calves, 2BR = Two-breed rotation, T2BR = Terminal two-breed rotation, 3BR = Three-breed rotation, T3BR = Terminal three-breed rotation and Tx F1 = Terminal x Brahman F1 cows)



describe the mating of Simmental and Gelbvieh sires to Brahman F1 cows (T x F1), two-breed rotation cows (T2BR) and to three-breed rotation cows (T3BR).

Brahman F1 calves, Gelbvieh- and Simmental-sired calves from Brahman F1 cows, and Gelbvieh- and Simmental-sired calves from three-breed rotation cows were heavier at birth than calves from other mating systems. In these mating systems individual calves that weighed more than 100 pounds at birth often required assistance at birth, resulting in increased labor requirements and often a loss of the calf.

The differences shown in the bar chart (Figure 1) suggest that cows with 50 percent or more Brahman breeding apparently have more maternal ability than cows with predominant Angus, Charolais or Hereford breeding. Two-breed rotation calves were slightly heavier than three-breed rotation calves.

In rotation systems, heifers sired by each breed are retained as replacements. Study results suggest that rotational heifers sired by Brahman bulls are comparable to Brahman F1 cows when mated to the same breed of sire more so than rotational heifers sired by Angus, Charolais or Hereford bulls. The advantage of replacement heifers being produced within the rotation system may be offset by the maternal ability of Brahman F1 cows. Another advantage of the terminal sire x Brahman F1 cows appears to be more uniformity among calves produced for market. If one breed of sire is used on the Brahman F1 cows, all the calves have the same breed composition. In complete rotation systems where all sire breeds are represented, greater variation among calves can be expected. ■

Dian A. Williams, former Graduate Student, and Donald E. Franke, Professor, Department of Animal Science, LSU AgCenter, Baton Rouge, La.

Fertilizer Nitrogen Sources, Poultry Litter Rates Affect Annual Ryegrass Production

Marcus M. Eichhorn Jr.

Beef and dairy producers in north Louisiana plant more than 30,000 acres of hill land to annual ryegrass each fall for grazing cattle during the winter and spring. Nitrogen is the most limiting plant nutrient required for annual ryegrass production on these sandy Coastal Plain soils. Fertilizer nitrogen requirements for annual ryegrass pasture, baleage and silage production are the highest among the essential plant nutrients, and nitrogen is the most expensive nutrient in the fertilizer budget. Moreover, the source of fertilizer nitrogen can have a considerable effect on cost.

Because of a lack of information on the cost effectiveness of nitrogen fertilizer sources for annual ryegrass production on pastures in the north Louisiana Coastal Plain, two nitrogen fertility studies were conducted at the LSU AgCenter's Hill Farm Research Station at Homer. The objectives were to determine forage yields and cost effectiveness of readily available commercial fertilizer nitrogen sources and to determine forage yields and cost effectiveness of soil-incorporated poultry litter rates. Both studies were managed to simulate annual ryegrass production on pastures from fall plantings made into prepared seedbeds with forage yields determined at monthly intervals, mid-December through mid-May.

Commercial Fertilizer Nitrogen Sources

Five different nitrogen fertilizer sources were applied to Marshall annual ryegrass on a Mahan fine sandy loam soil for two years (Table 1). The total annual actual nitrogen fertilizer rate applied was 250 pounds per acre. This annual rate was applied at 50 pounds per acre on November 1 and 100 pounds after the mid-January and mid-March

harvests. The cost of nitrogen fertilizer applied by a forage producer using a commercial fertilizer buggy ranged from \$160 per ton for urea to \$189 per ton for ammonium nitrate. The cost per pound of actual nitrogen ranged from 17.4 cents for urea to 41 cents for ammonium sulfate. The per acre annual nitrogen fertilizer cost ranged from \$43.50 for urea to \$102.50 for ammonium sulfate for 250 pounds of actual nitrogen applied per acre. Marshall annual ryegrass yields on the Mahan soil were not significantly different among nitrogen fertilizer sources. Thus, with yield performances being nearly equal among nitrogen sources, maximum economic yield response occurred where urea was applied as the nitrogen source at a cost of .6 cents per pound of forage produced per acre. When available soil sulfur is at very low levels, using blended urea-ammonium sulfate as a source of nitrogen and sulfur would be more cost effective than a blend of ammonium nitrate-ammonium sulfate.

Poultry Broiler Litter As Fertilizer

Poultry production is Louisiana's largest animal industry. More than 150,000 tons of broiler litter manure waste are produced annually. The broiler

litter contains all of the plant nutrients required for crop production. Incorporation of broiler litter or commercial fertilizer into soil before planting a crop is the most "environmental friendly" fertilization practice to follow. Yield responses of Marshall annual ryegrass to soil-incorporated broiler litter rates of 1, 2, 3, 4, 6 and 8 tons per acre were determined for three years on Bowie fine sandy loam soil.

Concurrently, yield responses of Marshall annual ryegrass to soil-incorporated commercial fertilizer at rates of nitrogen, phosphate, potash and sulfur equivalent to those applied at each broiler litter rate were evaluated. Ammonium nitrate was the nitrogen source. Cost effectiveness of soil-incorporated nitrogen rates, as broiler litter or ammonium nitrate, for the production of Marshall annual ryegrass is reported in Table 2. Results indicate that as soil-incorporated actual nitrogen rates of either broiler litter or ammonium nitrate increased from 62 to 496 pounds per acre, Marshall ryegrass yields increased, and the nitrogen cost per acre for each pound of forage produced increased also. Soil-incorporated nitrogen rates as ammonium nitrate outyielded soil-incorporated broiler litter. Within an excellent seasonal

Table 1. Two-year mean cost effectiveness of commercial fertilizer nitrogen sources as influenced by the yield performance of Marshall annual ryegrass. There were no significant differences in yields.

Source and %N	Cost of Actual N Applied		Forage	
	(¢/lb)	(\$/A)	Yield (lb/A)	N Cost (¢/lb)
Ammonium Nitrate, 34%	27.8	69.50	7832	.9
Ammonium Sulfate, 21%	41.0	102.50	7793	1.3
Urea, 46%	17.4	43.50	7596	.6
AN+AS, 29.7%	30.8	77.00	7964	1.0
U+AS, 37.7%	21.8	54.50	7683	.7

Marcus M. Eichhorn Jr., Professor, Hill Farm Research Station, Homer, La.

annual ryegrass yield range of 7,000 to 8,500 pounds dry forage per acre, however, use of broiler litter was more cost effective than ammonium nitrate at current prices. Results also showed that a 248 pound per acre soil-incorporated rate of actual nitrogen, from either 4 tons per acre of broiler litter or 728 pounds per acre of ammonium nitrate, was sufficient for Marshall annual ryegrass production.

Selection of Nitrogen Sources for Annual Ryegrass Production

Results revealed that where ammonium nitrate, ammonium sulfate, urea and blends of ammonium nitrate-ammonium sulfate or urea-ammonium sulfate were broadcast on the surface of the crop during the growing season, yield performances were not significantly different among nitrogen sources. Urea was the most cost-effective nitrogen source on the basis of currently quoted vendor prices in north Louisiana. For ammonium nitrate to become more cost effective than urea, based on the ryegrass yield performance in this study, the cost per ton would need to be less than \$119. Results also revealed that soil-incorporated broiler litter was more cost effective than ammonium nitrate in the presence of actual nitrogen rates required for acceptable crop production levels. At the price of ammonium nitrate, broiler litter applied at 4 tons per acre had a nitrogen fertilizer equivalency value of \$16 per ton for ryegrass forage production.

Overall, these results showed that the source of nitrogen designated for annual ryegrass production will affect the cost of forage production. Livestock producers should consider the cost of actual nitrogen among nitrogen sources when preparing fertilizer budgets for intended fall plantings. ■

Table 2. Three-year mean cost effectiveness of soil-incorporated nitrogen applied as poultry litter or ammonium nitrate, as influenced by the yield performance of Marshall annual ryegrass.

Actual N Rate (lb/A)	Broiler Litter			Ammonium Nitrate		
	N† Cost (\$/A)	Forage		N‡ Cost (\$/A)	Forage	
		Yield (lb/A)	N Cost (¢/lb)		Yield (lb/A)	N Cost (¢/lb)
62	12.00	3642	.3	17.20	6462	.3
124	24.00	5130	.5	34.40	6306	.5
186	36.00	5130	.7	51.60	6786	.8
248	48.00	7098	.7	68.89	7434	.9
372	72.00	7332	1.0	103.38	8534	1.2
496	96.00	8424	1.1	137.88	9654	1.4

†Custom applied with spreader truck @ \$12/ton.
‡Applied with a commercial buggy @ \$189/ton.



Marcus Eichhorn Jr., a researcher at the LSU AgCenter's Hill Farm Research Station near Homer, is at a variety trial plot of Russell bermudagrass. This variety was developed jointly by the Louisiana and Alabama agricultural experiment stations and released in 1994. Russell continues to provide excellent performance and is widely used by Louisiana cattle producers for their pastures.

Johnsongrass Resistance to Graminicides in Northeast Louisiana

Photo by Jim Griffin

Discovery and introduction of aryloxyphenoxypropionate and cyclohexanedione selective postemergence grass herbicides (graminicides) in the late 1970s and early 1980s gave producers a highly effective means for over-the-top control of most annual grasses and perennial grasses, such as johnsongrass, in cotton and soybean fields. Effective johnsongrass control programs in these crops include initial over-the-top application of a graminicide with follow-up applications to control escaped plants, regrowth or populations that emerge after initial treatment. Continued reliance on these herbicides to control johnsongrass, as well as multiple applications in a single growing season, has brought about increased selection pressure for resistant populations.

Reduced johnsongrass control following treatment with these herbicides under ideal growing conditions was initially reported in the early 1990s in neighboring states. Greenhouse studies confirmed resistance to labeled rates of these herbicides when compared to plants collected from fields with no history of graminicide use. An increasing number of control failures, often following multiple graminicide applications and not attributable to poor environmental conditions or herbicide misapplication, has been reported in Northeast Louisiana. Documentation of johnsongrass resistance to graminicides is needed to alert producers to resistant populations and to provide options for control.

Greenhouse Study

A greenhouse study was conducted in 1999 to determine the extent of graminicide resistance in a suspected resistant johnsongrass population and to evaluate alternative control options. The suspected resistant population was located in a field in Franklin Parish with a history of repeated graminicide use. Johnsongrass rhizomes were collected and planted in the greenhouse at the LSU AgCenter's Northeast Research Station. Rhizomes also were collected from a susceptible population at the station, in which no graminicide had been used for 15 years. Plants were allowed to reach approximately 15 inches in height before herbicide application. Both the resistant plants and the susceptible plants were treated with five different graminicides—Assure II, Fusilade DX, Fusion, Select and Poast Plus. Resistant plants were treated with one (1x), two (2x) or four (4x) times the labeled rates. The susceptible plants were treated with only the labeled rate (1x) of each graminicide. The labeled rates used were 10 ounces per acre (Assure II), 12 ounces per acre (Fusilade DX and Fusion), 8 ounces per acre (Select) and 36 ounces per acre (Poast Plus).

Alternative herbicides—Liberty, Roundup Ultra, Touchdown and Accent—were applied to resistant plants to evaluate possible control alternatives, should resistance be determined. The rates were 28 ounces per acre (Liberty), 32 ounces per acre (Roundup Ultra), 26 ounces per acre (Touchdown) and 0.67 ounce per acre (Accent). Nontreated resistant and sus-



Johnsongrass control failures can result in significant yield losses in most agronomic crops. Johnsongrass resistance to graminicides is becoming more prevalent in Louisiana.

ceptible controls were included. A visual assessment of control, based on plant chlorosis (yellowing) and growth reduction, was made 14 and 28 days after treatment. Plant dry weight was determined following the 28-day visual assessment by harvesting all above-ground biomass per plant and drying for seven days.

Assessment

At the 14-day assessment, 4x rates of both Assure II and Fusion provided 20 percent control of resistant plants. Fusilade DX provided 18 percent control, and Poast Plus provided 64 percent control. This is compared to at least 94 percent control of susceptible plants. In contrast, Select at 1x, 2x and 4x rates provided 27 percent, 84 percent and 81 percent control, respectively, of resistant plants compared to 96 percent control of susceptible plants. Liberty, Roundup Ultra, Touchdown and Accent controlled resistant plants 95 percent, 83 percent, 95 percent and 94 percent, respectively.

At the 28-day assessment, 4x rates of Assure II, Fusilade DX and Poast Plus controlled resistant plants no more than 28 percent compared with at least 98 percent for susceptible plants. Poast Plus at the 1x and 2x rates provided no more than 25 percent control of resistant plants while 4x rate resulted in 85 percent control. Select at the labeled rate resulted in 18 percent control of resistant plants, whereas a 2x rate controlled 95 percent of the johnsongrass. Select and Poast Plus at labeled rates resulted in complete control of susceptible plants. Alternative herbicides evaluated controlled resistant plants at least 94 percent.

With the exception of the 2x and 4x rates of Select and the 4x rate of Poast Plus, resistant plants treated with all graminicide rates produced significantly more above-ground dry weight than treated susceptible plants. Nontreated resistant above-ground dry weight was 45 percent higher than that of nontreated susceptible plants, indicating increased vigor in suspected resistant johnsongrass plants.

A high level of graminicide resistance was observed in this study with a 2x rate of Select and a 4x rate of Poast Plus needed to achieve acceptable control of resistant plants. These herbicides are members of the cyclohexanedione family. In contrast, Assure II, Fusilade DX and Fusion, members of the aryloxyphenoxypropionate family, provided less than 30 percent control of resistant plants.

Although members of different herbicide families, the graminicides evaluated in this study act on the same enzyme system in grass species. Any alteration to this enzyme, which is the basis of most reported cases of graminicide resistance, can render a grass species cross-resistant to all graminicides. The fact that herbicides representing both two families did not control the johnsongrass at labeled rates in our study shows that johnsongrass was indeed cross-resistant. Therefore, producers are cautioned that switching to another graminicide following a control failure, when environmental conditions and misapplication can be eliminated as factors, can prove costly and ineffective. Based on this research, Liberty, Roundup Ultra, Touchdown and Accent are viable control options when a graminicide-resistant johnsongrass population is suspected. ■

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Nematodes Affect Beef Cattle Weight Gain

Nematode parasites make a big difference in the appetite of beef cattle and thus their weight gain. Left to right are four of the paddocks used in nematode research at the LSU AgCenter's Dean Lee Research Station near Alexandria. The road about a third of the way from the top serves as one border, and the tree

line at the bottom is another border. Each of the paddocks is about 4 acres and contains five calves. The differences in appearance are due to forage height and availability because of the decreased appetite of parasitized control animals. The paddocks that contain animals that have been treated for nematode parasites

are lighter in color, indicating less available forage. At relatively high stocking rates, treated animals may graze their paddocks closely enough that they do not have sufficient forage for optimum weight gain. Animals not treated, on the other hand, may have significantly more available forage and even though they desire less forage, they have all they want and can reach their performance potential. This can mask some of the differences between the treated and nontreated animals. Nematode infections as well as factors such as forage palatability and toxicity can also bias forage evaluation studies by affecting forage availability and nutritive value. Replicates of different stocking rates may be necessary to accurately evaluate differences. ■



Loyacano's research paddocks at the Dean Lee Research Station.

Alvin Loyacano, Professor, Dean Lee Research Station, Alexandria, La.

Preliminary Evaluation of Bollgard II Cotton

The commercial release of Bollgard cotton in 1996 gave cotton growers a new pest management tool. Bollgard cotton, a transgenic product, includes a gene from a bacterium, *Bacillus thuringiensis*. This transferred gene enables the plant to produce a toxin that provides significant control of the tobacco budworm, *Heliothis virescens*, and the pink bollworm, *Pectinophora gossypiella*, while being safe for humans, other animals and the environment.

Despite its usefulness as an insect pest management tool, Bollgard cotton has several weaknesses. With a toxin produced by a single type of gene (*cryIA*), Bollgard cotton is extremely effective against some caterpillar pests, like the tobacco budworm, but less effective against others including the bollworm (*Helicoverpa zea*), soybean looper (*Pseudoplusia includens*) and armyworms. Another concern with Bollgard cotton is the development of resistance in the pests it is meant to control. This is because Bollgard cotton has a single, highly toxic protein present season-long in all its plant parts.

To address these concerns, scientists at Monsanto, the company that produces Bollgard cotton, have introduced a second gene (*cry2Ab*) with insecticidal properties into the product. The result is a transgenic cotton, Bollgard II, which has increased insecticidal activity against pests that Bollgard was weakest on and makes resistance development less likely.

Bollgard II Trials

Bollgard II cotton was evaluated during 1999 and 2000 at the LSU AgCenter's Red River Research Station in Bossier City. Both years cotton was planted in late May on a Caplis very fine sandy loam. Bollgard II was compared with Bollgard and a non-transgenic cotton, DP 50. The experimental design involved both sprayed and nonsprayed plots. The sprayed plots received weekly applications (early July through mid-August) of an insecticide (Karate Z or Tracer 4SC) for worm control, and the other plots received no insecticide applications for worm control. All other insect pests were controlled on an as-needed basis, and applications were made to the entire trial. Insect damage was assessed weekly from early July through mid-August.

Both years, Bollgard and Bollgard II cottons had significantly fewer insect-damaged squares than the DP 50 cotton in both the sprayed and nonsprayed plots. In 2000, bollworm/tobacco budworm season-long mean square damage exceeded 15 percent in the DP 50 nonsprayed plots; the damage was only 6.2 percent in the DP 50 sprayed plots. The Bollgard II nonsprayed plots averaged 0.7 percent square damage compared with 1.7 percent damage in the Bollgard plots in 2000 (Figure 1).

In 1999, bollworm/tobacco budworm boll damage was not observed in the Bollgard and Bollgard II plots, regardless of whether the plots were sprayed. Boll damage in the DP 50 was 11.9 percent for the sprayed plots and 20 percent for the nonsprayed plots. In nonsprayed plots in 2000, season-long mean boll damage was 4.2 percent in the Bollgard plots and 0.2 percent in the Bollgard II plots, and DP 50 had 15.8 percent boll damage (Figure 2).

In general during 2000, soybean looper numbers were too low to observe differences between varieties. On August 9, however, a significant number of soybean loopers were picked

Figure 1. Square damage, 2000.

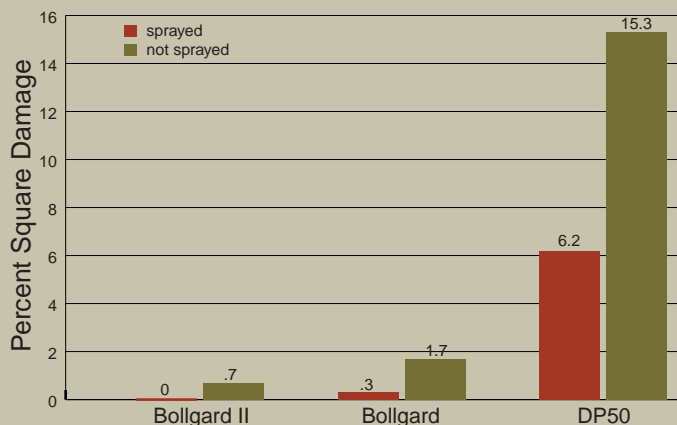


Figure 2. Boll damage, 2000.

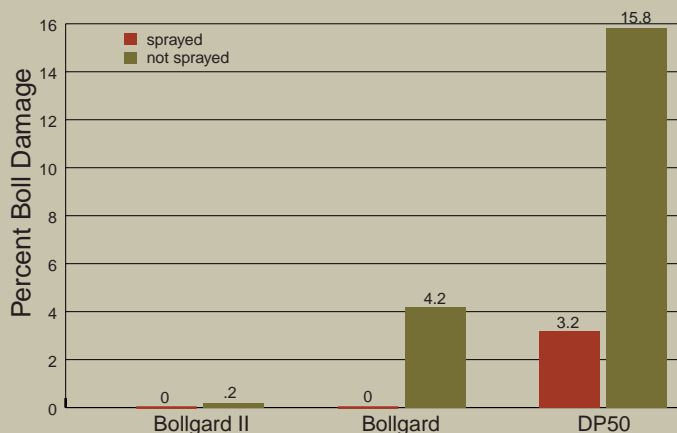
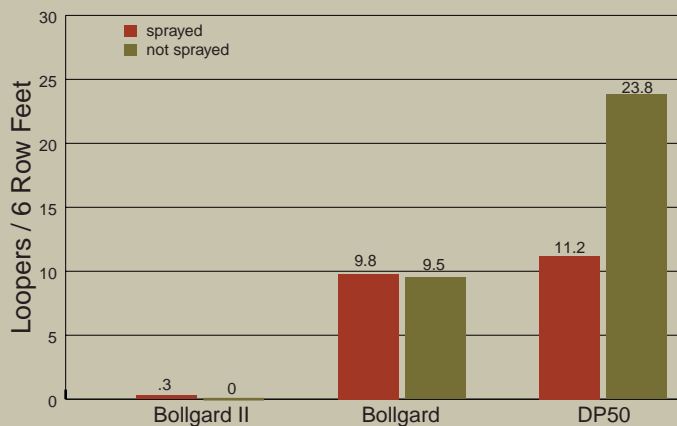


Figure 3. Looper numbers, 2000.



up. Bollgard II was more effective in controlling loopers than spraying with Karate Z, which was applied August 3 (Figure 3).

Yields from 1999 and 2000 are shown in Table 1. In 1999, yields in the sprayed plots were not significantly different among varieties. In 2000, the sprayed Bollgard and Bollgard II plots



Bollgard II trial area shows differences in crop maturity seven days after defoliation. Bollgard I and II plots have dropped almost all their leaves. DP 50 plots, both sprayed and nonsprayed, are still green. More opened bolls can be seen in the sprayed DP 50 plots than in the plots not sprayed.



A sprayed Bollgard II plot seven days after defoliation.

Table 1. Yield in pounds seedcotton per acre, 1999 and 2000.

	Sprayed		Not Sprayed	
	1999	2000	1999	2000
DP 50	2494	2886	1748	1753
Bollgard	2385	3245	2406	3332
Bollgard II	2336	3229	2717	3131

yielded significantly more seedcotton per acre compared to the DP 50 variety. Both years in the nonsprayed plots, the Bollgard varieties yielded significantly more seedcotton per acre than the DP50 variety. In the nonsprayed plots in 1999, the Bollgard II plots outyielded the Bollgard plots by 311 pounds seedcotton per acre. Although the differences were not statistically different, the trend was reversed in 2000 with the Bollgard plots yielding 201 pounds seedcotton per acre more than the Bollgard II plots.

Bollgard II Advantages

Bollgard II has several advantages over Bollgard. First, the addition of the new *cry2Ab* gene may reduce the likelihood of insect resistance in the insects the original Bollgard controlled. Second, some increased spectrum of insecticidal activity was observed. Soybean loopers, which were at best only suppressed by Bollgard cotton, appear to be controlled by Bollgard II. Bollworm/tobacco budworm damage was less in the Bollgard II plots than the Bollgard plots, although differences were small. No differences were observed in armyworm numbers, but populations of armyworms were extremely light during the course of these trials.

Pending approval from the U.S. Environmental Protection Agency, Monsanto will conduct trials in 2001 under an Experimental Use Permit. Full registration is anticipated by the end of 2001 with limited quantities available in 2002. ■

Stephen Micinski, Associate Professor, and William "Bill" F. Waltman Jr., Research Associate, Red River Research Station, Bossier City, La.



A sprayed Bollgard plot seven days after defoliation.



A sprayed DP 50 plot seven days after defoliation.



Photo by Charlie Johnson

LaSweet, LaRouge and LaBelle

Join List of LSU AgCenter Peaches

The LSU AgCenter has released three new peach varieties, which will be available commercially in the fall of 2001. Their names match their characteristics somewhat, says Charlie Johnson, horticulture researcher and developer of the varieties. LaSweet is low-acid and very sweet. LaRouge has a bright red skin. And LaBelle is a late-season peach that will extend Louisiana's fresh peach season into mid-July.

Johnson calls the white-fleshed LaSweet, which should ripen the first week in June, an exotic variety. Because it is low-acid, it almost doesn't taste like a peach. The sugar to acid ratio is 75 to 1, compared to 20 to 1 for most peaches.

"It will be in demand because it's very aromatic and flavorful," Johnson said. "It's firmer than most low-acid peaches but it's still hard to handle for packing and shipping because it bruises easily."

LaRouge's red color will show up well in the marketplace. It will ripen about the first of July so will most likely be promoted as a Fourth of July peach.

"The flesh is yellow, and the peach is very firm. It will hold up well for picking and packing," Johnson said.

LaBelle, at left in the photo, should ripen about July 8-10 so will help fill a gap between two popular Louisiana peaches, also recommended by the LSU AgCenter, LaFeliciano and Dixiland.

The LSU AgCenter has not released any new peach varieties since 1992, when Gala, Delta and Glory became available.

Developing a new peach variety takes on average 13 years, Johnson said. The LSU AgCenter started releasing new varieties in 1969 with LaPremier.

"LaPremier is still widely grown," Johnson said. "Peach varieties stay around for a long time."

LaSweet, LaRouge and LaBelle are Nos. 22-24 as the list keeps growing.

Johnson says the next releases should be in the next two or three years. Waiting in the wings are some more exotic, white-fleshed varieties.

"The trend is the development of varieties that can be aimed more at niche markets," Johnson said.

Louisiana's peach industry has not fared well the last few years with mild winters and surprise freezes during the spring.

"Peaches do best when the winters are cold – but when spring comes, it stays warm," Johnson said.

The three new varieties are best grown in Louisiana's mid region, which includes the Baton Rouge through Alexandria area.

■ **Linda Foster Benedict**

New Patented Process Helps Diagnose Insecticide Resistance

Cotton farmers may soon have a new way to evaluate the effectiveness of one class of insecticides, thanks to a new LSU AgCenter procedure that received a U.S. patent.

The patent was issued Nov. 21, 2000, to the LSU AgCenter and to the inventors James Ottea, entomologist, and Guomin Shan, one of Ottea's former students, now at the University of California. The patent involves a way to determine if insects are developing resistance to pyrethroids.

Ottea said there are two major types of resistance—metabolic resistance, when the insects develop something akin to an immunity to only one form (or structurally related forms) of the chemical, and target-site resistance, when the entire chemical class of the insecticide no longer is fully effective in controlling the insect population.

"The countermeasure you choose when insects are resistant depends on the type of resistance they have," he said.

If the problem is metabolic resistance, Ottea said the answer often is a matter of switching to another pyrethroid

compound that the insects cannot metabolize. If the problem is target-site resistance, however, the grower must change to a different class of chemicals.

The advantage of pyrethroids is they are less costly than alternative insecticides, Ottea said. But because insects have developed resistance, pyrethroids have been replaced by new compounds.

Ottea and Shan identified both metabolic and target-site resistance in tobacco budworms in cotton and used the information to develop a diagnostic kit growers can use to determine which type of resistance is in a population of insects. The kit includes two vials into which farmers put insects gathered from their fields. The first vial contains a standard pyrethroid and the second, a modified pyrethroid.

"We've put the essence of a panel of biochemical tests that took us a week to do in the lab into this one test," Ottea said. "It's easy to interpret—the insects die or they don't."

■ **Rick Bogren**



Classy Bracts

Although the most popular color continues to be red, poinsettias can be purple, pink, coral or yellow. A goal of poinsettia breeders is to create a pure white version, but so far that has not happened, according to Jeff Kuehny, LSU AgCenter horticulturist who does research with poinsettias. Poinsettias also come with colors intermingled for a painted, marbled or dotted look. The colorful

parts of a poinsettia are actually leaves, not petals, known as bracts. The true flowers are the small yellow buttons in the centers of the bracts. Kuehny said the oak leaf look with pointy bracts is re-emerging as a trend. "For a while only rounded leaves were popular," he said. About 80 to 100 Louisiana growers produce poinsettias for commercial sale. Each December, Kuehny hosts a showing of various varieties with the latest findings on how to grow them successfully.

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

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