Office of Agricultural Communications

MAFES Research Highlights

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Contents

From the editor:

Corn is in the spotlight in this issue of Highlights. The crop is not new to Mississippi. It was a staple of the Native American diet when Spanish explorers first trekked across the lands o f the Chickasaw and Choctaw almost 500 years ago. Corn also was an important part of the mule- and horse-powered agriculture of the 19th and early 20th centuries.

The story beginning on page 10 explains why the crop is enjoying renewed popularity with Mississippi farmers and focuses on some of the things MAFES researchers are doing to solve problems associated with corn production.

This issue also contains reports on two important producer group meetings. The North

Mississippi Research and Extension Agricultural Advisory Committee held its annual meeting in Tupelo during February. The Advisory Committee is made up of producers of agricultural products from throughout north Mississippi and was formed several years ago to give producers a voice in deciding the activities of the North Mississippi Research and Extension Center. The other meeting was the first ever for the newly formed Central Mississippi Producer Advisory Council. The new group is providing the same type of producer guidance that has become an important part of research and Extension programs in the northern section of the state.

MAFES scientists also participated in other meetings during the winter months. They were among a large number of Mississippi State University participants at the Beltwide Cotton Conferences in New Orleans during January. The research report section beginning on page 18 contains some of the papers presented at the Beltwide.

Another gathering with MAFES participation was the 1997 Fish Farming Trade Show in Greenville. During the 2-day event, fish farmers from Mississippi and surrounding states were updated on ways research is meeting needs identified by producers as critical to the continued growth of their industry.

The winter meetings were an opportunity for MAFES personnel to learn about the research needs of Mississippi's agricultural producers. Responding to those needs will be an important part of the work of MAFES scientists during the months ahead.

Top red Brahman herd at home on MAFES range

One of Mississippi's most outstanding red Brahman herds is now residing at the Prairie Research Unit, thanks to the generosity of an Okolona couple.

Mr. and Mrs. Bob Anderson recently donated the herd of 28 cows, 5 calves, and 1 bull to Mississippi State University. The animals' new home at the Prairie Unit was already the residence of the MAFES herd of 25 mostly grey Brahmans.

The gift from the Andersons was made through the MSU Foundation.

The recent donation to the MAFES herd is not the first for the Andersons. In 1991, they donated embryos out of three of their red Brahman cows bred to their top purebred sires.

The Andersons agree their previous experience with MAFES livestock researchers at the Prairie Unit played an important role in the decision to make the latest donation.

"Knowing what the University can do with the cattle made it a very easy decision to make the donation," explains Bob Anderson, who has served as a member of the Mississippi Cattle Industry Board and is a past president of the Mississippi Cattlemen's Association.

Another factor in the Andersons' decision to donate the Brahmans to the University was their desire to focus more of their attention on a recently acquired herd of Gelvieh, a German breed of cattle.

Rick Evans, MAFES livestock researcher and superintendent at Prairie, says he was glad to receive the high-quality Brahman cattle.

"Bob Anderson has some of the best cattle around," Evans explains. "Good genetics are worth a lot, and the red Brahmans are essential if the MAFES herd is to serve the Brahman seedstock producers of Mississippi effectively."

Evans and other MAFES personnel at Prairie work closely with members of the Mississippi Brahman Association to select and match genetic materials to further enhance the Unit's herd, which is the source of bulls for MAFES beef herds at six locations across the state.

Thanks to the gift from the Andersons and donated semen from other red and grey Brahman breeders, Evans says Mississippi State will have an outstanding herd at Prairie.

"The herd at the Unit will provide the genetic base and diversity to help Brahman breeders throughout the state improve their registered herds well into the 21st century," he says.

Central Mississippi producers discuss program needs

The first meeting of the Central Mississippi Research and Extension Agricultural Advisory Council was held at the Eagle Ridge Conference Center on the Hinds Community College campus in Raymond during March.

"The purpose of the Advisory Council is to give the people involved in agricultural production in central and south Mississippi an opportunity to discuss the research, marketing, and educational programs they would like to see and to communicate their wishes to the people in charge of those programs," said Central Mississippi Research and Extension Center Head Butch Withers. "The Council is organized along the lines of the North Mississippi Research and Extension Agricultural Advisory Committee that has served the northeast area of the state very effectively in recent years."

More than 175 producers, industry leaders, Extension personnel, and MAFES scientists representing five production areas met in breakout sessions during the morning and reported the results of their discussions during an afternoon general session.

The beef cattle producers on the Advisory Council would like to have a summary of vaccines and dewormers published in an easily accessible form and updated annually, according to MAFES Animal Scientist David St. Louis. The beef producers also requested two or three informational meetings each year in the central and southern areas of the state. Their research requests included ryegrass variety trials to identify varieties that can be planted late yet mature early enough to be used in a double-cropping system.

The dairy report was presented by Joey Murphey, superintendent and dairy scientist at the Coastal Plain Branch. He noted that the producers would like as much information as possible about any new products or management systems available for their operations.

The dairy producers also would like to see research with bermuda and ryegrass expanded, and they suggested a quarterly report on dairy research.

Cotton, soybean, corn, and small grain producers were represented in the Council's field-crops group. MAFES Agronomist Carl Hovermale was the spokesman for the group and noted that fertility and deep- tillage trials, as well as ultra-narrow-row research, were

topics of interest to the area's cotton producers.

The field-crops group suggested additional research with the new Bt corn varieties, expansion of the SMART program and more on-farm trials for soybeans, and additional fertility studies for small grains.

Fruit and vegetable producers requested research and Extension programs on the use of plastic mulch. Spokesman Boyett Graves, superintendent and horticulturist at the Truck Crops Branch, reported the producers also would like to see trials of the new seedless watermelon varieties and variety trials with cantaloupes to find good-quality melons that can be shipped. In addition, the producers suggested research into black-aphid control in pecans and organic production of greens.

Producers representing the ornamental plant industry pointed out the need for greenhouses and other research facilities at the South Mississippi Branch that are comparable to those now used in the industry. Extension Horticulture Specialist Norman Winter added that the group also discussed making Extension publications available for customers at retail garden centers.

In remarks following the group reports, MAFES Director Vance Watson pointed out that the dominant theme in the reports was communication.

"I don't know of any project I've dealt with that has failed because of too much communication," he said. "By having this group as a support base for the Central Mississippi Research and Extension Cen- ter, we can do things we would never think possible as individuals or small groups."

Mississippi Cooperative Extension Service Director Ron Brown also emphasized communication in his comments to the Advisory Council.

"Our Extension programs have been reorganized to take advantage of new electronic communication methods," he said. "MAFES and Extension are going to use the resources we have in the most efficient way to deal with the high-priority issues that you identify."

New technology takes aim at corn pests

Oklahoma, according to the song, is where corn grows as high as an elephant's eye. The crop also is reaching new heights in Mississippi.

Corn acreage in Mississippi went from 300,000 in 1995 to 630,000 in 1996. Current expectations are that this year's plantings will range from 500,000 to 700,000 acres.

"The disastrous yields of the 1995 cotton crop helped boost corn acreage in Mississippi last year," according to Mississippi State University Assistant Agronomist Erick Larson. "Strong prices and the new `Freedom To Farm' bill also have attracted more producers to rotate to corn."

Larson, who conducts MAFES research in the area of corn production and serves as the Mississippi Cooperative Extension Service's corn specialist, was flooded with interest in corn production during producer meetings this winter.

"One of our meetings was scheduled for Mississippi Chemical Corporation's board room in Yazoo City, which has a capacity of about 60," he explains. "Response was so heavy we had to move the meeting to Yazoo City's National Guard Armory. More than 160 producers registered for the meeting."

Corn research has al-ways been a part of the work of MAFES scientists, but the recent acreage surge has scientists exploring new ways to support Mississippi corn producers. Some of the new research involves the use of biochemistry and genetic engineering to fight pests that attack corn.

One of the factors limiting corn production in Mississippi and other southern states is insect damage. A significant pest is the fall armyworm, which can reduce corn yields by 20 to 30 percent or more. The potential for fall armyworm damage makes early planting almost a necessity and reduces the chances of successfully double cropping corn following other crops.

MAFES and USDA/ARS researchers have joined forces to search for corn lines that are resistant to the ravenous appetite of the fall armyworm.

"The corn breeding program at Mississippi State has been going on since the late 1960's," says USDA/ARS Research Geneticist Paul Williams. "Since that time, Frank Davis, USDA/ARS entomologist, and I have released a number of inbred lines with resistance to the fall armyworm and the southwestern corn borer."

Although the USDA/ARS researchers knew certain lines of corn they developed were resistant to some insects, they did not know why. The search for the secret to the resistance began in 1992. That's when MAFES Biochemist Dawn Luthe and graduate research assistants under her direction began working with callus from resistant corn seed.

"Callus is similar to the oatmeal-like clump of cells that sometimes form around plant wounds, " Luthe explains. "The USDA/ARS researchers had initiated callus from the seed of resistant corn plants and allowed fall armyworm larvae to feed on it. The larvae reared on the resistant callus were significantly smaller than those reared on callus from susceptible plants."

Using molecular and other lab techniques, the scientists traced the resistance to an enzyme produced by a gene found in callus from plants of two corn germplasm lines: Mp 704 and Mp 708.

After pinpointing its location on a segment of DNA from the callus, the researchers made a duplicate, or clone, of the gene. The enzyme produced by the gene has been dubbed Mir1 by the researchers.

"We have not yet determined exactly what role the Mir1 enzyme plays in resistance," Luthe says.

"However, we are conducting laboratory experiments that we hope will provide this information."

She adds that it's possible the enzyme retards the ability of the worms to break down

proteins, which is crucial for growth.

The researchers have released to plant breeders seed of the corn germplasm lines that harbor the enzyme- making gene. They hope that through cross-breeding the insect resistance trait can be passed on to higher yielding commercial hybrids.

The germplasm lines containing the Mir1 gene provide plant breeders with a distinct advantage over conventional cross- breeding methods.

"Biotechnology offers the promise of transferring a trait, such as insect resistance, without the garbage, or the undesirable traits that the donor line might possess," Williams explains.

He adds that it also can save time on the years-long process of field testing and insect evaluation that accompanies conventional breeding. If current research goes as planned and commercial interest holds, worm-resistant corn could be commercially available in 2 to 3 years.

Two projects under the direction of MAFES Geneticist Nancy Reichert also seek to provide corn producers with improved corn varieties.

One of those projects deals with getting desirable traits into corn plants through genetic transformation.

"In the past, we relied solely on plant breeders to introduce new traits into plants in order to improve a crop," Reichert explains. "However, some drawbacks they encountered included the fact that they were limited to working with traits present in plants that were sexually compatible, so the trait could be introduced via pollen."

She adds that it could take years to produce plants with the desired traits using traditional plant-breeding methods. To speed the process, Reichert and Research Assistant Vanishree Rudraswamy have developed corn tissue culture regeneration protocols, or systems, that work on 22 different corn lines.

The researchers also have developed genetic-transformation protocols for use with corn tissue. A transformation system for a plant is the formula needed to introduce an outside gene into a plant. The system developed by Reichert and Rudraswamy is being used to introduce DNA containing desirable traits into the corn.

To get the DNA into the corn tissue, the researchers are using a device commonly called a "gene gun."

"The device works similarly to a scatter gun, but gun powder is not used as the propelling force," Reichert says. "The DNA, which is coated onto tiny tungsten metal particles, is `shot' into corn tissues with the aid of the force exerted by helium gas flooding into a chamber previously held under vacuum."

The scientists have used the procedure to successfully introduce DNA into all 22 corn lines they are researching.

A near-term practical application of the genetic research is in the area of root-knot

nematode resistance for corn.

USDA's Williams and Research Plant Pathologist Gary Windham have identified and developed inbred corn lines that are resistant to root-knot nematodes, a major pest of corn in Mississippi.

"Postdoctoral Research Assistant Linas Padegimas and I are in the process of trying to identify genes in these inbred lines that are responsible for the nematode resistance," Reichert says. "Two possible genes have been identified and are currently being studied to determine their potential roles in root-knot nematode resistance."

She adds that if the genes prove to be directly involved in providing resistance, they could be introduced into susceptible corn lines using the transformation and regeneration protocols already developed in her lab.

MAFES Corn Research Initiative

In 1995, MAFES initiated a 5-year research initiative to coordinate efforts to improve Mississippi's corn production. The following projects and publications are part of that initiative.

Plant populations:

A study was conducted in 1996 to evaluate corn hybrids from early-, medium-, and late-maturing groups grown using a wide range of plant populations at four separate locations. The objective of the study was to determine the adaptability of hybrids from different maturity groups and to test yield responses to varying plant populations.

The 1996 results indicate similar yield levels for each maturity group and inconsistent hybrid response to varying plant populations. Erick Larson

Planting dates:

A planting-date study designed to evaluate stand establishment in stale- seedbed and no-tillage cropping systems began in 1995 and continued in 1996.

The study results indicate adequate stands are much more difficult to achieve in the no-tillage system than in the stale- seedbed system. The presence of raised beds and higher soil temperatures in the stale- seedbed system encourages less stand variability and allows earlier successful planting dates. Adequate stands were achieved beginning around March 15 in the stale-seedbed system. Adequate stands were not achieved until around April 1 in the no-tillage system. In the study, an earlier maturing hybrid had better stand establishment at the earliest planting date.

Yield data from the study show that maximum yields were obtained for planting dates within 4 weeks after adequate stand establishment was achieved. The late-maturing hybrid's yield was less responsive to changing the planting date. Erick Larson and Glover Triplett.

Full-season vs. early-maturing varieties:

Two years of data have been compiled on early-maturity corn compared with full-season varieties. The data show selected 95- to 108-day maturity and 109- to 118-day maturity varieties produced yields equal to full-season varieties. Seed moisture for the 95- to 108-day maturity varieties was 13 percent and 15 percent for the 109- to 118-day maturity varieties. Maturity for full-season varieties took 123 to 124 days and seed moisture for those varieties was 20 to 22 percent.

Another study showed that Roundup applied with a hooded sprayer when corn was 12 to 16 inches tall and repeated on 30-inch-tall corn had no effect on corn growth, chlorosis, yield , test weight, or plant population. N.W. Buehring

Seedling disease study:

Pathogenicity of different soil organisms has been evaluated for conventional tillage (CT) and no-till (NT) corn management systems using four planting dates at two locations. Pythium ultimum, P. irregulare, Rhizoctonia solani, and binucleate Rhizoctonia sp. were the most frequently isolated pathogens. More lesions were observed in NT than in CT. L. Trevathan and Punnee Barrera

Corn insect pests:

Tillage, planting date, and insecticide treatment were evaluated for their influence on corn insects. Four species that are damaging to corn and two species that are predators on the damaging insects were found at greater frequency for plantings after April 15. Two damaging species, Delia platura (seedcorn maggot) and Blissus lecopterus lecopterus (chinch bug), were more frequently encountered in CT than in NT. Insecticide treatment had little influence on any insect species in plots. Extensive sampling failed to show corn as either a host or refuge for Lygus lineolaris (tarnished plant bug), a cotton insect. The study shows that it is likely that corn does not contribute to high numbers of plant bugs in cotton in the hill areas of Mississippi. H. Pitre, J. Reed, and Angus Catchot

Publications:

Barrera, P.S. and L.E. Trevathan. 1996. "Seedling disease of corn: Effect of planting dates and tillage on the incidence of Pythium and Phizoctonia spp." Miss. Academy of Sci. 41:41.

Barrera, P.S., L.E. Trevathan, and J.T. Robbins. 1996. "Effect of tilled and no-tilled cultural practice and time of planting on the occurrence of Phizoctonia solani and Rhizoctonia spp. in corn." (Abstract). Mississippi Association of Plant Pathologists and Nematologists, Greenville, MS.

Defoliation work group accomplishes mission

Is cotton defoliation an art or a science? Many cotton producers have traditionally treated the process as an art, often with mixed results. Since 1991, a group of researchers from across the Cotton Belt have worked to replace some of the mystery of defoliation with science.

MAFES Plant Physiologist Charles Snipes serves as coordinator of the Cotton Defoliation Work Group.

"We started at a seminar in 1991, when I and some other researchers were discussing what we called `the art of defoliation,'" says Snipes. "We got the idea that we should try to standardize some of our evaluation practices and look at the whole process on a more uniform basis."

The discussion that began at the seminar led to the formation of the Work Group, which includes 16 researchers from throughout the Cotton Belt. The project is sponsored and funded by Cotton Incorporated, with administrative support by Uniroyal Chemical Company, Inc.

Members of the Work Group are assembling the findings generated by 5 years of research for presentation to the cotton-growing public. Evaluation of harvest aid performance was an important part of the Work Group's mission.

Snipes says in addition to the performance characteristics of individual materials, optimum environmental conditions and tankmix combinations also were identified.

"One of our most important conclusions confirmed the usefulness of harvest aid combinations," he explains. "We found that when a grower uses two different products with two different areas of strength, they can be an effective hedge against unexpected conditions."

The group also studied the relationship between the use of harvest aids and lint quality. They found that when producers follow label directions, fiber quality is not affected.

"Textile mills have thought for some time that harvest aids have adversely affected lint quality," says Auburn University re-searcher and Work Group member Mike Patterson. "But the data we have collected so far show just the opposite."

The group's findings will be published by the Cotton Foundation and made available to the public in 1998. Although the formal association of the Work Group will end following this cotton season, Snipes feels cooperation among the members will continue.

"Good research always turns up more questions than answers," he says. "Now we've got to answer some questions we uncovered."

Research yields new equipment for catfish industry

Fish farmers from throughout Mississippi and surrounding states were updated on research progress in key areas of their industry during the 1997 Fish Farming Trade Show in Greenville. Catfish harvesting research was one of the areas in the spotlight.

The catfish industry has made numerous advances in production methods in recent years, but there has been little advancement in harvesting gear or methods, according to C. "Wendy" Taylor, fishery methods and equipment specialist with the National Marine Fisheries Service (NMFS) at the Stennis Space Laboratory. He told producers attending the general session at the trade show that there was significant progress in harvest research during the past year.

"Two years ago, the Catfish Farmers' Strategic Planning Committee identified the proper sizing of fish during harvest as a top priority in eliminating obstacles to the growth of the

industry," he said.

"Industry representatives say the loss to producers from harvesting undersized fish ranges from $25 million to $40 million per year."

An informal cooperative research initiative between the National Center for Catfish Research (NCCR) at Stoneville and NMFS was implemented during 1996. The purpose of the agreement was to evaluate the potential for incorporating new harvesting technology into the catfish industry.

"A gear specialist from the NMFS Mississippi Laboratory worked with the NCCR staff and catfish producers to identify potential ways to improve catfish harvesting gear and techniques," Taylor said. "The gear specialist made recommendations for development of prototype catfish harvesting gear that incorporates features that have been used successfully in marine fish harvesting."

Those features include square-mesh construction, an enlarged and tapered funnel, a traveling mud roller line, and zippers developed for marine use.

"The 1 3/4 inch square-mesh design allows the seine meshes to remain fully open under strain, as opposed to the traditional diamond-mesh design, which closes under strain, trapping undersized fish," Taylor explained. "Tests of the square-mesh design show it retained only 1.4 percent of the fish under three-fourths of a pound and 13.5 percent of those between three-fourths and 1 pound."

He added that the enlarged tapered funnel design on the prototype allows fish to pass easily from the seine into the sock and avoids stress and mortality, and the mud rollers allow ponds to be seined quickly with little bogging. The zippers used on the prototype ease the replacement of components.

The prototype seine was evaluated on Bear Creek Farm in Moorehead, and a video of the seine was made in the clear waters of St. Andrews Bay, FL, during 1996.

"The results of the preliminary evaluations indicate the new technology offers the potential for selective harvesting of optimum-sized fish, resulting in improved efficiency during harvest," Taylor said.

A formal gear development program has been proposed for the National Center for Catfish Research.

Producers attending the trade show general session also were updated on a new type of feeder by James Santucci, engineering shop supervisor at the Delta Research and Extension Center, and James Steeby, area Extension agent for aquaculture.

"It's a simple design that has gotten away from the big cotton-picker type of fans. Most catfish producers have experienced problems with bearings going out and blades slinging off that type of fan on their feeders," Santucci said in describing the advantages of the new feeder, which uses a gear-type main pump turning at about 3,000 r/min to move feed from a hopper into an airlock chamber.

The airlock contains a fan turning at 20 to 30 r/min. Cavities in the airlock chamber fill with

feed as the fan turns. The airlock mechanism is constructed so that no air is lost on the backside as the fan turns. The new design produces more pressure than is generated by feeders currently in use. The increased pressure causes feed to be thrown farther into a pond.

"This design eliminates the big fan and much of the noise, plus it is capable of consistently throwing feed 80 to 120 feet," Santucci explained. "That prevents feed being wasted by landing on the pond bank or on aerators near the shore."

The research session also included an update on catfish feeding research by Ed Robinson, coordinator of the National Center for Catfish Research, and a report on off-flavor research by Kevin Schrader, a postdoctoral research assistant at the Delta Research and Extension Center.

Insect pest control possible benefit of flame cultivation

Flame cultivation was a common method of weed control in the 1950's and 1960's. Its use declined with the rise in liquid propane (LP) gas prices and introduction of effective and economical herbicides in the 1970's.

The practice of flame cultivation has come back into favor in recent years because of increased herbicide costs, environmental concerns, and revisions in worker protection standards.

In 1993, Charles Snipes, plant physiologist and weed researcher at the Delta Branch Experiment Station, began a study to evaluate the effectiveness of flame cultivation in cotton. Beginning with the 1994 growing season, he has achieved good weed control using the method in test plots.

An additional part of the flame cultivation study was conducted by Simone Seifert, a visiting research scholar from Humboldt University in Berlin, Germany, who began her Ph.D. program at Mississippi State in 1995.

"In some areas of the United States, flame cultivation is used as an alternative to pesticides to control adults, larvae, and eggs of the alfalfa weevil," she says. "It's also possible that flame cultivation could be especially useful where insects have become resistant to pesticides used for their control."

In the 1994 field tests, she placed caged populations of adult tarnished plant bugs and lady beetles in the test plots at the soil surface and in the cotton canopy at heights of about 4 and 8 inches above ground level just before plots were flamed.

The tarnished plant bug is a significant pest in cotton. Lady beetles are considered a beneficial insect in the crop because they are the most well known predator of aphids and other insect pests.

After the plots were flamed, plant bug mortality was 100 percent at the soil surface and ranged from about 80 percent to 100 percent at 4 inches above the soil surface. Plant bug mortality from about 50 percent to more than 80 percent was recorded at the 8-inch height. Mortality increased as the LP-gas pressure to burners on the cultivator was increased.

Lady beetle mortality ranged from 100 percent at the soil surface to less than 40 percent at 8 inches above the ground.

"The research indicates that flame cultivation reduces the population of tarnished plant bugs to a greater extent than lady beetles," Seifert explains. "In addition, recovery of beneficial insects after flame cultivation should be higher than recovery after insecticide treatment because there would be no residues remaining in the field. If that is the case, the beneficial insect population can recover quickly and aid in the control of the remaining plant bug population."

The data from the Delta Branch study only apply to caged insect populations. Additional research is planned to study the effect of flame cultivation on mortality of the total tarnished plant bug population in the cotton canopy.

Botanical gardens evaluate north Mississippi plants

North Mississippi homeowners and horticulture professionals will soon be able to see which turf, shrubs, shade trees, and other plants perform best in their area. The plants will be part of the research work at the Magnolia Botanical Gardens located at the North Mississippi Research and Extension Center (NMREC) in Verona.

The pavilion that is the hub for the research gardens has been completed, and construction of the rest of the facility is underway.

Plans for the gardens were developed following a recommendation by the horticulture commodity group at the 1996 NMREC Advisory Committee meeting.

"At the 1996 meeting, the group recommended that the project of most benefit to the area's horticulture industry would be development of a horticulture garden to evaluate plant materials in a landscaped setting," says NMREC Head Pat Bagley.

Follow-up meetings were held with horticulture professionals, homeowners, garden club members, and others in Booneville, Tupelo, and Verona. Those meetings produced recommendations for the facility's major focus areas: annuals, perennials, wildlife attractions, xeriscape, a water garden, fragrant plants, shade plantings, and a vegetable garden.

Using the recommendations made at the meetings, Pete Poland of Landscape Services in Tupelo developed a conceptual plan for the gardens.

"The gardens will be divided into `outdoor rooms,' each with its own theme," Bagley explains.

"Horticulturists here at the Center will use the area to conduct evaluations of plants as well as of such cultural practices as weed control, pruning, and fertilization."

The entrance to the gardens will lead to the pavilion, from which paths will radiate to the various parts of the facility.

The Tupelo Rotary Club has donated the 28-foot hexagonal pavilion to the facility. The structure was dedicated during January as the Paul Harris Memorial Pavilion. Harris

founded the organization that is today Rotary International, which has more than 1.2 million members in 150 countries. The dedication of the pavilion was on the 50th anniversary of his death.

Tippah County Growers donated plant material for the perimeter hedge around the gardens. The Lee County Board of Supervisors is paving the road leading to the garden entrance and is building a parking lot at the entrance.

Plantings in the gardens are already underway, and the facility will be fully developed in about 3 years.

"The gardens will be a place where nurserymen and garden center operators can see which plants perform best in north Mississippi and then produce those plants," says MAFES Research Associate Crofton Sloan. "Homeowners also will be able to see plants in a landscape type of setting and have an opportunity to see hardscape items such as walkway materials, fences, and retaining walls in use."

Sloan and Vegetable Horticulturist Kent Cushman are stationed at the Center and will be conducting research in the gardens as part of the work of the Center's Horticulture Unit. MAFES scientists from the Mississippi State campus and from other locations also will conduct research at the facility.

Gift to MSU continues work of "the father of the soybean"

During a career spanning nearly half a century, USDA/ARS Soybean Breeder Edgar Hartwig developed most of the soybean varieties grown in the southern United States and in regions around the world with climates similar to the Southeast. Because of his dedication and accomplishments as a soybean breeder, he is reverently referred to throughout the South and beyond as "the father of the soybean."

Dr. Hartwig died May 11, 1996, of a heart attack at his home in Leland. He was 83 and was completing work on a new soybean variety at the time of his death.

A $208,000 contribution to Mississippi State University by his widow, Mrs. Winifred B. Hartwig, will establish an endowed fund to continue his work. The Edgar E. and Winifred Hartwig Endowed Fund for Excellence will primarily support graduate assistantships in agronomy and plant and soil sciences at Mississippi State.

"Mrs. Hartwig also has designated Mississippi State as the beneficiary of her estate," says Charles Weatherly, director of development for the Division of Agriculture, Forestry, and Veterinary Medicine.

"When the University receives the bequest it will be used to support the Hartwig Fund for Excellence, along with the proposed Edgar E. and Winifred B. Hartwig Endowed Chair in Plant Breeding in the Department of Plant and Soil Sciences."

Hartwig was a world-class research scientist whose work benefited many countries around the world, says MSU President Donald Zacharias.

"Dr. Hartwig's name is synonymous with soybeans across the country and the world," Zacharias says. "His work through the years brought great recognition not only to himself

but to this university and this state. Through Mrs. Hartwig's generosity and love, her husband's important work will continue at Mississippi State for many years to come."

In a separate tribute to the researcher, the Mississippi Soybean Promotion Board is pledging $200,000 to Mississippi State to establish the Hartwig Endowed Fund for Soybean Research at the Delta Branch Experiment Station.

A native of Minnesota, Dr. Hartwig received a bachelor's degree from the University of Minnesota and master's and doctoral degrees in agronomy and plant breeding from the University of Illinois.

He came to the Delta Branch Experiment Station in 1949 as a USDA/ARS soybean breeder. He continued to work in that capacity for the next 47 years.

Dr. Hartwig announced his latest variety release to soybean growers attending the Delta Branch Soybean Field Day on August 26, 1993, his 80th birthday. That variety is Lyon, a Group VI maturity soybean with resistance to stem canker, phytophthora root rot, bacterial pustule, race 3 soybean cyst nematode, root-knot nematodes, and to feeding by the soybean looper. It has moderate resistance to race 14 of the soybean cyst nematode.

Other soybean varieties Dr. Hartwig developed are: Dorman (1952); Lee (1954); Hood (1958); Hill (1959); Bragg (1964); Semmes (1965); Dyer (1967); Pickett 71 (1971); Forrest and Tracy (1974); Centennial (1976); Bedford, Govan, and Dowling (1978); Alamo (1979); Tracy-M (1980); Jupitar-R and Nathan (1989); Cordell (1990); and Vernal (1992). In addition, he released nine germplasm lines to breeders for use in commercial breeding programs.

Dr. Hartwig received numerous awards during his career. One was in 1991, when a new soybean developed by breeders in Missouri was released and named Hartwig. One of the parent lines for the variety was Dr. Hartwig's Forrest.

Other awards received by Dr. Hartwig include the USDA Superior Service Award, USDA Distinguished Service Award, Scientist of the Year Midsouth Area, Delta Council Researcher of the Year, and ARS Hall of Fame.

In 1978, he was named Distinguished Professor at Mississippi State, an honor shared with only 12 other faculty members. He was an adjunct professor of agronomy at Mississippi State at the time of his death.

Mrs. Hartwig, also a native of Minnesota, received her bachelor's degree in home economics from the University of Minnesota, where she met Edgar. They were married in 1939 in her hometown of Montevideo, MN, but the couple made their home in Stoneville and Leland for 47 of their 57 years together. Through the years, Mrs. Hartwig has been a teacher, a homemaker, a rosarian, and an accomplished artist.

Weatherly says the Hartwig Fund for Excellence has been the beneficiary of several memorial gifts from friends and associates of Dr. Hartwig. Additional memorial gifts may be added to the fund. For more information on making a contribution to the endowed fund, contact Weatherly in Mississippi State University's Office of Development at (662) 325-3410.

MAFES bulletin targets hay production systems

Round hay bales sitting in pastures are a common sight throughout Mississippi. This type of hay storage may seem cheap, but it can be the most costly when you consider that a bale can lose about 30 percent of its total dry matter when left unprotected for 6 months.

The pros and cons of different types of hay storage is just one of the topics covered in the MAFES information bulletin The Dollars and Sense of Hay Production. The bulletin is based on research conducted by MAFES scientists at the Northeast Mississippi Branch, the Prairie Unit, and the North Mississippi Branch.

The bulletin focuses on the importance of managing forages for hay production. It suggests how producers can reduce costs and prevent nutrient losses in hay systems by improving management in production, storage, feeding, and supplementing.

The Dollars and Sense of Hay Production is available by sending a request for Information Bulletin 311 to North Mississippi Research and Extension Center, P.O. Box 456, Verona, MS 38879.

Soybean information

Soybean growers with Internet access now have a new resource to help them choose varieties to plant. Results of the MAFES soybean variety trials for 1994-96 are available online. The information is lo- cated at http://www.ces.msstate.edu/soyvar.

Information is available on yield, maturity dates, disease reactions, lodging scores, and long-term yield averages.

The Office of Agricultural Communications at Mississippi State, through funding from the Mississippi Soybean Promotion Board, posted the variety-trial information on the Internet and will update it yearly.

Seaweed possible key to improved grazing

The nearest beach may be more than 200 miles away, but seaweed is showing up at the Prairie Research Unit.

Extract of seaweed, or Ascophyllum nodosum, is being used at the Prairie site in research with fungus- infected tall fescue. Fungus-infected tall fescue is a major forage for grazing in the northern half of Mississippi.

Fungus-infected fescue has attributes that make it a good source of grazing in Mississippi, including resistance to drought and insect damage. In part, those attributes result from the presence of the fungus Acremonium coenophalium. The fungus also creates some problems for cattle, most of which are associated with reduced reproductive ability.

"There is evidence that forage treated with seaweed extract has the potential to improve the ability of cattle to fight stress," says Prairie Unit Superintendent Rick Evans. "The reduced level of stress could help overcome the reproductive problems associated with

grazing the infected fescue.

The research at Prairie began in April 1996 and is being conducted by Evans, MAFES Agronomist Roscoe Ivy, and North Mississippi Research and Extension Center Head Pat Bagley.

The study at the MAFES facility is part of research trials being conducted at several locations, including Virginia Polytechnic Institute and State University, the Virginia/Maryland Regional College of Veterinary Medicine, and Texas Tech University.

Research already conducted in Virginia indicates that cattle grazed on seaweed-treated fescue may be less susceptible to diseases associated with long hauls to feedyards or other locations.

"It's too early to tell if grazing the seaweed-treated fescue will prevent shipping fever," Evans explains, "but the research has shown cattle in the program have an enhanced immune system."

The seaweed extract is provided by Acadian Seaplants in Nova Scotia. It comes in a soluble powder form and is available commercially. It is mixed with water and sprayed over grass.

The rate used in the study is about 3 pounds per acre, but the researchers note that no recommended rate of application has been established.

Cattle grazed on the seaweed-treated fescue at Prairie and in Virginia were shipped to the Texas Tech fed-cattle research center in Lubbock in October. Data from that group of cattle are being analyzed by Texas Tech researcher Vivien Allen and other researchers at the Lubbock facility.

Bagley notes that the application of seaweed extract to forage may sound like a "snake oil" remedy to some forage and livestock producers, but he points out that there is enough evidence from the Virginia and Maryland studies to warrant a closer look at the practice.

"This research is still in the early stages, and more laboratory and field studies are needed," he says. "But from what we have seen, this practice could be an important tool for improving forage quality and livestock production here in Mississippi."

Scientists from Mississippi, Virginia, and Texas presented a series of six papers on the results to date of using seaweed extract as a forage treatment at the recent meeting of the American Forage & Grasslands Council in Fort Worth, TX.

Research, education needs focus of producer meeting

More than 200 north Mississippi producers of products ranging from sweet- potatoes to beef cattle came together in Tupelo during February for the annual North Mississippi Research and Extension Agricultural Advisory Committee meeting.

The event provides producers of agricultural commodities an opportunity to tell MAFES and Extension Service personnel about the research and educational programs needed

by their industries.

"Success of agricultural enterprises depends on close relationships between producer groups, research and Extension, and the organizations that provide technical assistance, such as the National Resource Conservation Service," said Jim Newsome, the event's featured speaker and executive director of the Mississippi Cattlemen's Association. "All of these groups working together for the common cause of improving production and decreasing production costs is what it is going to take. An advisory group meeting such as this gets us involved in helping set priorities."

Those priorities were the main topics of discussion during the commodity group sessions at the meeting. Following the group sessions, a representative of each group gave a report of the discussions.

The grain crops group recommended studies with planting wheat on rows with 15-inch centers, according to producer chairman Lamar Pruitt of Monroe County. He noted that the 15-inch rows would be compatible with current corn and soybean cropping systems.

Grain producers requested more research with corn, especially in the areas of disease and insect control. They also asked for an evaluation of drilled soybeans as a production practice.

Forage research was the number one topic in the beef group. Noxubee County producer Robert Field reported that the producers would like to see more research and educational programs on how to better use grasses already established on north Mississippi cattle farms. The beef producers also requested more artificial insemination and pregnancy-testing short courses.

North Mississippi cotton producers would like to see studies with ultra-narrow- row cotton, according to the report given by Union County producer Larry Coker. The producer group also requested more educational programs on nematodes in cotton and on how cotton can fit into a crop-rotation plan.

The need for research dealing with sand buildup in waste lagoons was a major concern in the dairy group. Monroe County producer Ray Gallop also reported that the dairy producers would like to see more research in the areas of artificial insemination, parasites, and other areas of herd health.

Don Thompson of Tishomingo County said the fruits and vegetables group would like to see variety trials at the North Mississippi Branch with vine crops and lima beans, a demonstration of the plastic- mulch method of strawberry production, and a summer meeting on cultural practices, direct marketing, and the economics of fruit and vegetable production.

The fruit and vegetable producers' re-port also included a request that a forestry group be included in the 1998 meeting.

Expansion of Experiment Station facilities dealing with their crop was a concern of producers in the sweetpotato group.

"We're not where we are in the sweet- potato industry by accident," Calhoun County

producer Danny Bailey said in presenting his group's report. "Four or 5 years ago we were growing about 4,000 acres. In 1996, we had 8,200 acres, and I don't think we have reached our maximum."

Research areas the sweetpotato producers would like to see addressed include work with new herbicides and insecticides, a study on getting consistent quality across fields, and new variety development.

Monroe County producer Terry Patterson reported that the swine producers group agreed that nutrition, artificial insemination, and waste management are areas needing additional research and educational programs. The group also requested more publicity about the availability of quality gilts from the swine unit.

The ornamental horticulture group discussed the need for an education campaign to make the public aware of the benefits of hiring landscape professionals. The group report presented by Jim Wohlfarth of Tippah County also noted the need to have turfgrass producers represented at the 1998 meeting.

Other activities at the meeting included the announcement of Wiley L. Bean as the 1996 North Mississippi Producer Advisory Committee Man of the Year in Agriculture. Mr. Bean, who died in 1996, was a leader in the north Mississippi swine industry. A plaque recognizing his selection as Man of the Year was presented to family members by Northeast District Extension Program Director Robert McNeil.

North Mississippi Research and Extension Center Head Pat Bagley noted that the swine unit at the Pontotoc Branch Experiment Station was recently named the Wiley L. Bean Swine Demonstration Unit by an act of the Mississippi Legislature.

The following reports were among almost 50 presentations made by MAFES researchers and other scientists from Mississippi State University during the 1997 Beltwide Cotton Conferences in New Orleans.

Proximity effects of a calcium nitrate starter fertilizer solution on cotton

Jac J. Varco

Current nitrogen fertilizer placement techniques minimize early-season contact with cotton roots. In most cases, nitrogen is banded at a spacing and depth that require cotton roots to proliferate the fertilizer zone for uptake to occur.

Because cotton is a primarily tap-rooted crop and root establishment is slow, adventitious root growth during establishment is not as prolific as with other crops.

This study was conducted to determine the effects of placing a low-salt calcium nitrate fertilizer solution in close proximity to planted cotton seed. Calcium nitrate was either applied in-furrow at rates of 3, 6, and 9 gallons per acre or banded at 1 inch to the side of the planted seed at a depth of approximately 1 inch at rates of 6 and 9 gallons per acre. A no- starter control was included, and the experimental design was a randomized complete block with four replications.

The soil at the test site is a Leeper silty clay loam (fine, montmorillonitic, nonacid, themic Vertic Haplaquept) with a pH of 8.1 and testing medium in phosphorus and low in potassium. All plots received a total nitrogen rate of 120 pounds per acre with 60 pounds per acre applied at planting using banded 32 percent urea-ammonium nitrate (UAN) solution. The balance was applied at early square using broadcast ammonium nitrate.

Varieties used in the study were DES 119 in 1995 and Suregrow 125 in 1996.

In 1996, dry conditions persisted after planting and a linear reduction in stand occurred with increasing rates of fertilizer applied in-furrow. After significant rainfall, stands improved for all in-furrow treatments, but a linear decrease from 19 to 15 plants per 6 feet of row for the check to highest in-furrow rate was still evident.

Lint yields decreased linearly for in-furrow treatments both years. The decrease is likely related to delaying stand establishment. Banding increased yield both years with maximum yield occurring at a rate of 6 gallons per acre. The 2-year average yield increase for the 6-gallon-per-acre banded treatment was 58 pounds of lint per acre.

The study indicates cotton can benefit from fertilizer nitrogen placed in close proximity to the germinating seed, but it also shows fertilizer should not be placed in direct contract with the seed.

Jac J. Varco is a MAFES agronomist at Mississippi State University.

Weed-control programs in Roundup Ready cotton

K.M. Bloodworth, D.B. Reynolds, C.E.Snipes, DrR. Shaw, N.W. Buehring, B.E. Serviss, and W.C. Elkins

In conventional cotton weed-control programs, the soil is tilled and herbicides are applied. The herbicide treatment can consist of a preplant incorporated (PPI) herbicide, a preemergence (PRE) herbicide, or a combination of the two. As many as three to four postdirect (PD) herbicide applications also may be made. Each application increases the cost of production, often without achieving the desired level of broadleaf weed control.

With the introduction of Roundup Ready cotton production systems, costs may be reduced by decreasing tillage and controlling troublesome species not adequately controlled by conventional herbicides. Additional savings in production may be obtained by lowering machinery inputs and allowing less expensive equipment to be used. Another benefit is the possibility of reducing the amount of herbicide applied to a field each year.

In 1996, field studies were conducted at the Delta Branch Experiment Station in Stoneville, MS, in a cooperator's field near Stoneville, at the Black Belt Branch Experiment Station in Brooksville, MS, and at the Northeast Branch Experiment Station in Verona, MS. The studies evaluated Roundup Ready cotton in conventional tillage versus reduced-tillage systems using conventional and Roundup Ultrar (glyphosate) herbicide programs.

Experimental units were arranged as a two by three factorial in a randomized complete-block design with four replications. Each experimental unit was 40 feet in length by 4 to 6 rows wide. Factor `A' consisted of tillage levels of no-till or stale- seedbed and

conventional tillage. Factor `B' was comprised of a conventional herbicide program, Roundup Ultra as needed, and Roundup Ultra as needed with a layby application of Bladexr (cyanazine). The conventional herbicide program consisted of Cotoran (fluometuron) PRE, Cotoranr + MSMA PD, Caparolr (prometryn) + MSMA PD, and Bladex + MSMA layby.

In the conventional tillage versus the stale-seedbed production system, weed control did not differ between tillage systems for each respective herbicide treatment. At 46 to 59 days after planting (DAP), spotted spurge (Euphorbia maculata J.) control was 94 to 96 percent with the Roundup Ultra treatments, compared to 84 to 86 percent in the conventional treatment. Broadleaf signalgrass [Brachiara platyphylla (L) Griscb.] control with Roundup Ultra treatments ranged from 95 to 97 percent, which was more than the 84 to 86 percent in the conventional treatment 46 to 59 DAP. Pitted morningglory (Ipomoea lacunosa L.) was controlled 87 to 95 percent and did not differ among herbicide treatments or tillage systems.

In the no-till system, Johnsongrass [Sorghum halepense (L.) Pers.] control with treatments containing Roundup Ultra was 87 to 95 percent. That was superior to the 70 to 75 percent observed from the same treatments in conventional tillage. Pitted morningglory control did not differ between tillage systems or among herbicide treatments. By 54 DAP, spotted spurge control was 93 to 94 percent in the Roundup Ultra treatments, compared to 85 percent in the conventional treatment. The addition of Bladex to the Roundup Ultra weed-control programs did not increase control on any species, regardless of tillage system.

Seed cotton yields were 1,340 to 1,590 pounds per acre and did not differ among herbicide treatments or tillage systems.

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Comparison of costs and returns associated with heliothis-resistant Bt cotton to nonresistant varieties

Joe W. Gibson IV and David H. Laughlin

In Mississippi, tobacco budworm, Heliothis virescens, and bollworm, Helicoverpa zea, destroyed more bales of cotton than any other insect in 1995. Mississippi cotton producers in the hill areas of the state suffered yield reductions averaging 23.27 percent, or 101,503 bales, as a result of budworm/bollworm damage that year. Producers in Mississippi as a whole had an average yield reduction of 8.03 percent, or 144,413 bales, because of budworms/bollworms.

More than 15 years ago, several companies joined a concerted effort to develop a variety of cotton capable of producing its own insecticide. The result of their effort is Bt cotton. Beginning in 1996, producers could purchase Bt cotton seed and commercially produce

transgenic Bt cotton. Monsanto is the first company to register and market Bt cotton. Monsanto markets Bt cotton under the trade name of Bollgard.

Although Bt cotton has proven effective as a means of controlling tobacco budworms and bollworms, producers are concerned about the costs and returns of Bt in relation to non-Bt varieties.

In 1995, entomologists from Mississippi State University's Department of Entomology and Plant Pathology and the Delta Branch Experiment Station conducted experiments at five locations (Madison, Yazoo, Leflore, Lee, and Tallahatchie Counties) to examine the effectiveness of several different insect management practices, of which one option was Bt cotton. After the 1995 harvest, complete production data were gathered on a total of 9 Bt cotton plots and 24 non-Bt cotton plots. All Bt plots were treated for insects in one of four ways: sprayed as prescribed in the Mississippi Cotton Insect Control Guide; sprayed early with a pyrethroid for plant bugs and thereafter according to the Control Guide; treated for plant bugs with an early application of Orthene and thereafter according to the Control Guide; insect control measures as prescribed by a consultant.

Varieties compared in the study were Nucotn 33 (Bt cotton), Delta & Pine Land 5415, and grower- chosen varieties that included Surgrow 125, Stoneville 132, Hartz 1244, LA887, and Delta & Pine Land 50. Production and yield data for all plots were collected and entered into Mississippi State Budget Generator computer software to develop complete enterprise budgets for each field in the study. Budget data was then entered into a spreadsheet format for analysis.

Economic analysis of Bt cotton and non-Bt cotton generated from 1995 field- test-plot data showed that net returns above total specified expenses (net returns) varied widely from field to field. Net returns for Bt plots ranged from a low of $27.05 per acre to a high of $270.07 per acre. The average net return for the 1995 Bt test plots was $156.81 per acre. Per-acre net returns on non-Bt fields ranged from a loss of $212.20 to a return of $236.82. The average net return for non-Bt plots was $61.98. The difference between average net returns was $94.83 per acre more for Bt plots than for non-Bt plots. Yields for Bt were 118 pounds of lint per acre better than the average yield of the non-Bt fields. Bt plots yielded an average of 845 pounds of lint per acre, while non-Bt plots averaged 727 pounds. The higher yields increased revenue from Bt plots by an average of $79.20 per acre over non-Bt plots. The average total income per acre, including revenue from seed, was $567.09 for Bt and $487.89 for other varieties.

The economic advantage Bt cotton has over other varieties is rooted in the technology it possesses that enables Bt cotton to control insects, namely the tobacco budworm and bollworm, and thus increases yields by managing pests better. However, there is a charge for the technology. Producers are required to pay $32 per acre to Monsanto for Bt technology. In an ideal situation for the producer, this charge is less than the cost of controlling budworms and bollworms without Bt. If, however, the charge is equal to or slightly greater than insecticide savings, yield improvements may supplement per-acre revenue to the point that there is still an advantage to planting Bt cotton.

The 1995 test plots showed a savings in the cost of insecticide applications. Total insect control costs for Bt cotton averaged $32.58 per acre. Non-Bt plots averaged $91.13 per acre, a difference of $58.55 in favor of Bt. Since Bt technology is an insect control

measure and $32 is charged to producers specifically for Bt technology, it is necessary to include the technology charge in an analysis of insect control costs. The true savings in insect control costs in 1995 was $26.55 per acre when the technology charge is included.

In 1996, cotton producer lists were obtained from county Extension agents in the hill area of Mississippi. Producers in the survey area were contacted and interviewed individually to collect production data for Bt and non-Bt fields. As in 1995, the survey data were entered into the Mississippi State Budget Generator.

Results of the 1996 survey showed Bt cotton continued to hold an economic advantage over other varieties. However, some of the savings in insecticide costs observed in the 1995 field-test plots were not observed in the 1996 survey. Per-acre net returns from surveyed 1996 Bt fields ranged from a loss of $7.81 to a return of $561.83 per acre. The average net return for surveyed Bt fields was $246.30 per acre in 1996. Per-acre net returns for surveyed non-Bt fields ranged from a loss of $53.38 to a positive return of $628.87. The average net return per acre of surveyed non-Bt fields was $230.08. The average total income per acre for Bt cotton was $686.95 and $653.65 per acre for non-Bt varieties.

Data from the 1996 survey showed per-acre insect control costs in Bt cotton averaged $31.13. The per- acre average for non-Bt fields was $49.29, or $18.16 per acre more than Bt fields. When the charge for technology is added to the average insect control cost for Bt cotton in 1996, the total cost for insect control was $63.13 per acre, or $13.84 more than for non-Bt varieties. However, this increased cost was compensated for by increased yields in Bt cotton. Surveyed non-Bt fields had an average yield of 948 pounds of lint per acre. Surveyed Bt fields in 1996 had an average yield of 995 pounds of lint per acre, or 47 more than non-Bt fields. On average, higher yields from Bt cotton in the 1996 survey increased per- acre revenue by $28.20.

An additional cost for growing Bt cotton in 1996 was the cost of providing refuge acreage. Producers growing the Bt variety were required to plant non-Bt cotton on part of their acreage as part of a resistance management program. There were two refuge options. One required planting 20 acres for non- Bt for every 100 acres of Bt. This refuge could be sprayed for budworm/bollworm control with any insecticide other than a Bt foliar spray. The other option was to plant 4 acres of non-Bt cotton for every 100 acres of Bt planted. This refuge could not be sprayed with any insecticide that targets the budworm or bollworm.

With the costs and returns for the refuge acres included, Bt cotton had net returns of about $11.17 per acre more than non-Bt varieties.

In conclusion, the actual savings for Bt cotton will vary from year to year, depending on the level of insect infestation and the number of sprays required. In 1995, budworm/bollworm infestations were relatively heavy, although in 1996, infestations tended to be light. Varying levels of infestation will affect the amount of potential savings from Bt cotton. Producers should view Bt cotton and the charge for the technology as a risk management option. It is important to note that only 2 years of data were available for this study and the two data sets were from different sources, making it difficult to compare the results. However, with the data that are available, Bt cotton appears to produce higher net returns for producers than the average of other varieties.

Joe W. Gibson is a MAFES research assistant in agricultural economics and David H. Laughlin is a MAFES agricultural economist. The test-plot research for this study was conducted by MAFES Entomologists Randy G. Luttrell, Don Parker, Jack Reed, and Aubrey Harris.