The Mississippi Delta is a major rice-producing area in the U.S.

Marco Nicovich

Research Center

By Charmain Tan Courcelle

Bring up the subject of Delta agriculture in a conversation and you're likely to hear talk of cotton and soybeans. But those in the know would tell you that the Mississippi Delta has also become a major national player in rice and farm-raised catfish production in recent decades.

Work at the Delta Research and Extension Center (DREC) has evolved to meet the changing needs of area producers. Whether it's been determining the best varieties of cotton, soybean, rice or corn to grow in the region or defining best management practices for crop and aquaculture production systems or solving crop disease and pest questions, DREC researchers have the goal of increasing economic profitability and improving the quality of life for Delta producers and residents. Following is a description of some of the research programs at the DREC.

Marco Nicovich

Flowering weeds, such as this vetch, harbor the tarnished plant bug, a cotton pest.

Controlling Emerging Pests Needed Part of New Insect Management Scheme

DREC researchers are developing insect management strategies to help cotton producers faced with a case of trading pests.

Bt cotton — cotton with built-in insect resistance — and the Boll Weevil Eradication Program have helped cotton growers reduce the amount of pesticides used for tobacco budworm, bollworm and boll weevil control. But reducing pesticide use has had an unintended side effect — the emergence of tarnished plant bugs and stink bugs as pests of cotton fields.

"On the one hand, it's a good thing that we've reached the point where we have low-insecticide management systems," said Aubrey Harris, MAFES entomologist. "But we've also opened the door for other pests to create problems. We've seen this to be particularly true for the tarnished plant bug and stink bug in cotton."

Harris said in the past, insecticides used for caterpillar pests and the boll weevil deprived occasional pests like tarnished plant bugs and stink bugs of the opportunity to flourish. For example, in 1995, before the introduction of Bt cottons and the Boll Weevil Eradication Program in Mississippi, 95,218 acres of the state's cotton fields were infested with stink bugs. In 2001, with lower pesticide inputs, 800,000 acres were infested, elevating the stink bug to the status of an "emerging pest."

Finding a solution to these emerging pests that balances environmental conservation with economic practicability is the goal of Harris' work. Last year, the scientist began assessing the use of crops, such as soybeans, as traps for stink bugs.

"Stink bugs prefer maturing soybeans to cotton," Harris said. "We wanted to find out whether we could

Supports delta agriculture

manipulate soybean planting dates and varieties so that any stink bugs present in a field stay in soybeans and out of cotton."

In 2001, Harris and his team tested this hypothesis using soybean maturity groups IV and V as their decoy crop. The group sampled soybeans and cotton for stink bugs during that year's growing season.

Results from this preliminary work were encouraging, Harris said. "We managed to keep stink bugs in soybeans and away from cotton."

Harris said the same strategy of varying planting dates will not work for tarnished plant bugs, which have a wide host range — more than 300 host plants are known — and move from wild host plants or corn to cotton early in the growing season. Instead, he thinks a strip or border of soybeans planted between corn and cotton plots may act as a temporary buffer to help manage this pest.

As part of his studies on tarnished plant bug control, Harris is determining how the order in which different crops are planted influences pest numbers and developing management schemes based on his findings. Nonchemical pest management strategies are especially important because the tarnished plant bug is resistant to a number of insecticides used in its control.

"Newer insecticides may eventually be developed for efficient control of the tarnished plant bug. But these same new products will probably be highly specific for one class of insects, increasing the cost of inputs from the need for multiple pesticide products," Harris added. "Management becomes more central to effective and economical pest control."

Harris said he hopes results from his studies will allow the full benefit of the Boll Weevil Eradication Program and insect-resistant crop technology to be realized.

"Eliminating key pests like the boll weevil and tobacco budworm removes the need for aggressive intervention. This means that simple, environmentally friendly solutions including trap crops and the use of natural pests can be explored," he said.

Marco Nicovich

Close-up of a cotton plant

Marco Nicovich

Research assistant Fanny Liu prepares a soil sample for nematode analysis.

Marco Nicovich

Close-up of an elutriator. DREC researchers use a combination of elutriation and centrifugation to isolate nematodes.

Marco Nicovich

This image shows a reniform nematode under a light microscope.

Survey Says — Nematodes on the Rise

Another threat to cotton comes from pests so tiny that their presence is hard to recognize except by the trained eyes of laboratory personnel. Worse yet, commercially available cotton varieties have little to no resistance to these minuscule invaders. A fact that has DREC scientists searching for the best and most accurate method to track and manage these pests.

Cotton nematodes are microscopic plant-parasitic worms that live in soil and feed on the roots of cotton. Nematode root damage to cotton plants results in stunting and can cause yield loss. Two of the most economically important species of these worms in Mississippi cotton fields are reniform and root-knot nematodes.

"The reniform nematode is a tropical nematode that has moved into Mississippi in the past 20 years and become a serious cotton pest," said Gabe Sciumbato, MAFES plant pathologist. "Cotton yields have been decreasing for a number of years, and these nematodes may be one reason why."

Soil analysis for nematodes is the best way to determine whether reniform nematodes are present in high enough numbers to cause yield losses. Because effective nematode control depends on the accurate identification of the type and numbers of nematodes in a field, Sciumbato and research assistant Fanny Liu assessed different methods of isolating nematodes from soil for lab analysis.

The scientists compared three common methods of extracting nematodes from soil samples. In one method, known as the Baermann funnel technique, soil samples are placed on a filter held up by a screen over a funnel. Nematodes in the sample move through the soil, past the filter and into the funnel where they are collected. A second method uses centrifugation and separates nematodes from soil particles and organic matter based on their densities. The third technique combines sieving through a series of wire meshes, a process called elutriation, with centrifugation to concentrate the number of nematodes collected from a soil sample.

"Our results have shown that the combination of elutriation and centrifugation provides the most efficient and reliable technique for us to extract reniform nematodes," Liu said.

Sciumbato and Liu have received a Research Enhancement Grant to survey for numbers and species of nematodes in cotton-growing counties in Mississippi. Don Blasengame, retired Mississippi State University Extension Service plant pathologist, conducted the previous nematode surveys and is collecting soil samples for the current effort. Three counties (Sharkey, LeFlore and Coahoma counties) were surveyed in fall 2001, and an additional seven counties will be surveyed each year after.

"Sharkey County was the most heavily infested," Liu said. "An estimated 88 percent of the cotton fields were infested with reniform nematodes. We also found a slight increase in nematode populations for LeFlore and Coahoma counties compared with survey data from 10 years ago."

The team is also working with help from research assistant Bart Freeland to map each collection site using global positioning systems (GPS) technology, which will allow the same site to be surveyed in the future. Survey results and GPS data will be used to develop maps showing the location, numbers and species of nematode present.

In addition, Sciumbato is collaborating with Harris to develop nematicide treatment protocols for cotton growers. Crop rotation is the best method of nematode control; however, this can be economically prohibitive unless a profitable nonhost crop can be grown as an alternative. Sciumbato and Harris are working toward

other methods that growers can use to control nematodes and still make a profit.

"We're looking for things that farmers can use right now to manage nematodes, including the incorporation of nematicides and the use of anhydrous ammonia as a nitrogen source," Sciumbato said. "Until cotton varieties with nematode resistance are available commercially, crop rotation is the best method of nematode control. However, if crop rotation is not feasible, nematicides may be needed to reduce yield losses."

Old and New Techniques Figure in Rice Breeding

Producers know that the weather, diseases and pests can wreak havoc in even the best managed fields, and rice farmers are no exception to this. MAFES researcher Dwight Kanter is leading a rice breeding effort at the DREC to develop rice varieties that can stand up to these challenges.

With more than 300,000 acres of rice fields — almost all of them in the Delta — Mississippi is the fifth largest rice-producing state in the nation. Kanter is working on finding new rice varieties that have improved yield and growth characteristics, disease and pest resistance and better milling quality, traits that he says will help the rice industry continue to grow in Mississippi.

"We're continuously trying to raise the yield bar for rice and developing superior cultivars with tolerance or resistance to disease and insects without sacrificing on quality characteristics," Kanter said.

Using locally adapted varieties and breeding lines, the top breeding lines from other states, the national and international rice germplasm banks and what he calls his personal elite lines as his source of parental materials, Kanter has made thousands of crosses all in the name of making improvements to currently available rice varieties.

One major accomplishment from Kanter's work was the development of the rice variety Priscilla. Priscilla is the first semidwarf rice variety in Mississippi with field tolerance to sheath blight — a fungal disease that reduces yields and milling quality. It yields an average of 16 bushels per acre more than Lemont, which has been the most popular variety in the state for many years. In 2000, three years after its commercial release, Priscilla accounted for 27 percent of the state's rice acreage.

Kanter said Priscilla took about 10 years in development using conventional breeding techniques. In recent years, a winter nursery has been established to reduce development time. In addition, Kanter hopes a one-year multistate collaborative project funded by the Rice Foundation will provide another technique to facilitate the rice breeding process.

The project involving Mississippi, California, Florida, Missouri and Texas will explore the use of marker-assisted selection for economically important characteristics. In marker-assisted selection the location of known genetic sequences, so-called markers, are used to locate genes controlling desirable traits.

The group will focus on plant type, blast disease resistance and grain quality (aroma) initially. Kanter said the technique offers the potential to more efficiently develop new rice varieties.

"In the case of blast disease resistance, for example, it's often difficult to tell whether you have a variety that is truly resistant. The right field conditions have to be present during each test for a good blast infection," Kanter said. "Marker-assisted selection removes the environmental variable. By looking at the markers present, you can positively determine if a cultivar has the trait you're interested in."

Marco Nicovich

MAFES rice breeder Dwight Kanter examines a rice variety growing in the DREC winter nursery.

Marco Nicovich

Close-up of a maturing rice head.