# MAFES Research Highlights

**Volume 64, Number 3**
**Summer 2001**


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## From the Director

For the last 200 years, our state's economy has had strong ties to agriculture. Mississippi farmers then and now have worked hard to provide the highest quality food and fiber products to consumers and to make a living.

Farming has never been easy but today, more than ever, farmers in this state and around the nation face tough times. Producers in the United States have had to contend with oversupply, lower demand and falling prices for many farm commodities, in addition to calls for even greater restrictions on agricultural chemical use and other inputs. In Mississippi, the farming situation was made all the more difficult last year by drought, which cost our producers more than $300 million in lost income and added costs.

However, as difficult as times seem, new technologies are presenting exciting opportunities to agriculture. Biotechnology, computer technology and spatial technology are leading the way to increased farming efficiency at reduced costs. These cutting-edge technologies have the potential to help our state's producers overcome existing difficulties, while securing an even brighter future for all Mississippians.

Here at the Experiment Station, we are committed to providing farmers with the tools and information they need to develop profitable production systems. MAFES research is directed at helping producers adapt new technologies and products to fit their needs and providing support for our farmers.

One of our accomplishments this past year was the establishment of the Life Sciences and Biotechnology

Institute, which will enhance our ability to address Mississippi's agricultural needs using biotechnology. The institute will also serve as a focal point for the development of new industries based on the agricultural and biological sciences in the state of Mississippi.

Helping farmers increase their farming efficiency is only one of the ways we support our producers. We have also directed our efforts toward developing value-added products that will open new markets for our farmers' goods. MAFES scientists are looking for methods to increase shelf-life and food safety, developing and testing new food and fiber products, and investigating alternative uses for our agricultural and forestry commodities.

In this issue of *Highlights*, our annual report, we have highlighted a number of projects that address the real problems facing Mississippi agriculture. We think you'll see that they reflect our basic philosophy of finding solutions to the critical problems facing Mississippi's agriculture, forestry and related sectors through sound science that provides good stewardship of the natural resources entrusted to us.

I am confident that MAFES research programs will help Mississippi farmers secure a strategic niche in the new global economy.

Vance H. Watson
Director

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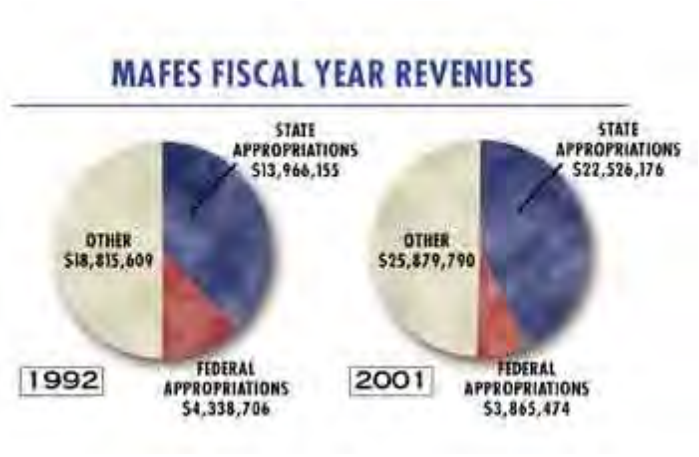
## Financial Report

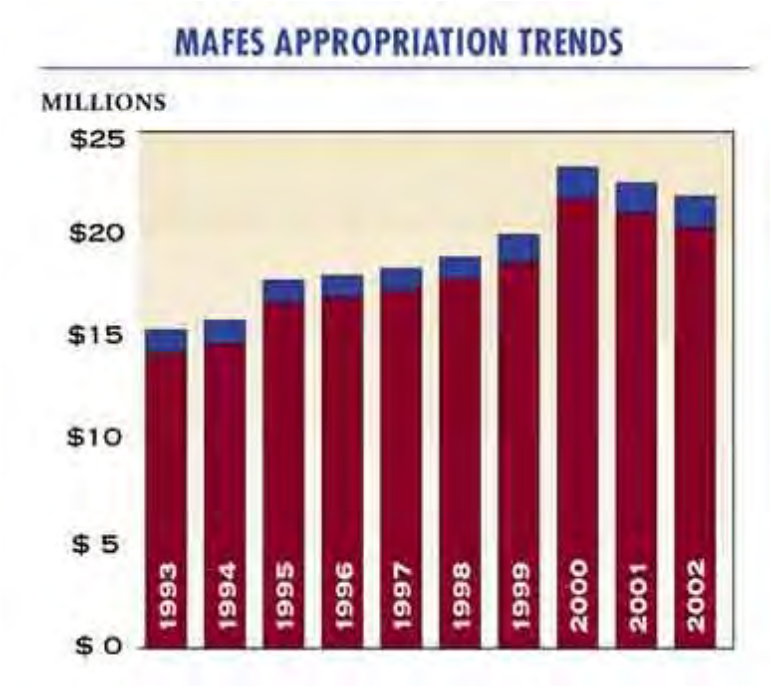
Since its establishment in 1887, the Mississippi Agricultural and Forestry Experiment Station has contributed to the improvement and advancement of Mississippi agriculture. Federal, state and private funds have provided support for research and enabled MAFES to address the changing needs of the state's agricultural industry. Over the last decade, MAFES has developed research partnerships that have leveraged appropriated sources.

The graphs on this page illustrate the level of state appropriations to MAFES in recent years and the relative amount of supplemental funds obtained through federal and private sources. Also shown is the amount of MAFES' state allocation compared with the total state general fund appropriations.

### MAFES ALLOCATION

Of every 100 Mississippi tax dollars appropriated by the state Legislature, MAFES gets 54 cents. By leveraging these state appropriations with external funds, MAFES has become one of the nation's top-funded agricultural research programs.






While MAFES state appropriations and educational enhancement funds have increased in the last decade, their impact on the total state budget has decreased. 2002 State Appropriations include $1,330,000 in one-time budget contingency funds.

## Other Sources of Support: Producer Checkoff Programs Play Important Role in Research

Every year, MAFES research receives a boost from producer checkoff programs. Several commodity groups set aside a portion of their sales income to fund industry research.

In 2000, funding from the Mississippi Soybean Promotion Board, the Mississippi Rice Promotion Board and the Mississippi Cotton Incorporated State Support Committee provided support for more than 20 MAFES projects. Research funds were also provided through checkoff money from the sweetpotato and pork commodity groups.

Under the present checkoff program, producers representing the various commodity groups are part of a scientific peer review process that decides which projects receive funding. The program gives producers direct input into the types of research that are needed.

### Sample projects supported by the Mississippi Soybean Promotion Board:

Optimization of planting dates, row spacing and herbicide systems in conventional and transgenic early-maturing soybeans.

Development of seed treatment techniques for inoculating seed with biological control agents in control of charcoal rot in soybeans.

Enhancement of Mississippi Soybean Variety Trials entry standardization.

Evaluation of private and public soybean varieties and breeding lines for resistance to stem canker, *Phytophthora* root rot, frogeye, leaf spot, soybean mosaic virus and other diseases.

Dynamic approaches to improve soybean yield in the Mississippi Delta.

Application of information technology systems for soybean production in Mississippi.

Evaluation of Maturity Group V soybean for ESPS.

Development of value-added soybeans and development/identification of charcoal rot resistance in soybean.

## Sample projects supported by the Mississippi Rice Promotion Board:

The economic and environmental benefits of rice production in the Mississippi Delta.

Winter rice breeding nursery in Puerto Rico.

On-farm fertility management in Mississippi rice production.

Red rice control in rice.

Rice weed control.

Development of resistance to rice water weevils via genetic engineering.

Control of rice water weevil.

Identification and control of *Burkerholderia glumae*, causal agent of panicle blight.

Determination of rice varietal and breeding line sheath blight resistance and tolerance by comparing yield under high and low disease pressure.

Optimum economic return from the use of Quadris and Tilt on rice.

Supplement for rice promotion seed stocks program.

## Sample projects supported by the Mississippi Cotton Incorporated State Support Committee:

Nitrogen and phosphorus management in cotton/corn rotations — rotation benefits and economic impact.

Reducing herbicide-induced cotton seedling stress by substitution of Roundup for conventional herbicides on Roundup Ready and adding hopper-box or in-furrow fungicides.

Validation of COTMAN expert system rules for early season insect control, irrigation scheduling and defoliation.

Develop improved harvesting methods for ultra-narrow row cotton.

Continued breeding of cotton for resistance to root-knot nematode.

Influence of reduced tillage systems on ground cover residue.

An entomological, physiological and economic evaluation of Bt cottons and non-Bt cottons.

Management systems for transgenic cotton in ultra-narrow rows.

Advanced spatial technology use in cotton production.

Application techniques, economic comparison and cotton tolerance for newly developed over-the-top herbicides for use in cotton.

Mississippi Cotton Pest Monitoring Program.

Development of new control methods of the tarnished plant bug, *Lygus linolaris*.

Developing insect resistant cottons for Mississippi.

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## Agriculture Value Continued to Decline in 2000

**By Bonnie Coblentz**

Recently revised estimates indicate that last year's Mississippi farm and forest products values continued their three-year decline from 1997's high of $5 billion.

The total estimated value of Mississippi agricultural and forestry production for 2000 was $4.7 billion, according to data from the U.S. Department of Agriculture's National Agricultural Statistics Service. Instead of showing a 2000 crop value increase from the previous year as earlier predicted, the state came in 1.2 percent lower than the $4.76 billion value registered in 1999.

John Lee, MAFES agricultural economist and head of agricultural economics at Mississippi State University, said final figures for many commodities just became available.

"When the final reports came in, the drought had a bigger impact on yields than we thought," Lee said. "Another factor is that for storable commodities, the sales year extends well into the next year, and final sales figures for some crops are not yet in."

Low prices and drought-reduced yields took their toll on the overall value of farm and forest production in Mississippi in 2000. The drought alone is estimated to have cost state producers more than $300 million in lost revenue and added costs.

"The top four commodities remain poultry, forest products, cotton and catfish," Lee said. "The value of poultry and forestry declined as large supplies depressed prices."

Higher acreage and prices helped cotton's value increase despite lower yields. The total value of field crops fell to below $1 billion for the first time in recent history, Lee said. Most notable was the decline in soybean value, which fell 20 percent last year and now at $174 million, registers less than 40 percent of its 1997 value.

"Even record high federal assistance payments totaling $464 million in 2000 failed to compensate crop producers for the loss in market value since 1997," Lee said.

Oversupply problems are causing the low prices seen in most major crops. Lower poultry prices reduced the value of this commodity by 7 percent to $1.38 billion in 2000.

"Net returns to poultry producers were further reduced by higher prices for energy, a major cost in modern poultry production," Lee said.

MSU Extension Service forestry department figures show this industry's production dropped 1.2 percent in value from 1999 to $1.25 billion. Sawlog prices were steady but slightly lower, but pulpwood prices dropped 18 percent for pine and 16 percent for hardwood.

"One of the bright spots in the farm value numbers was catfish values, which continued their slow but steady climb, reaching $300 million in 2000," Lee said. "Higher prices for cattle, calves and hogs pushed the value of livestock products up more than 10 percent to $348 million despite a $14 million decline in the value of milk produced."

Other crop values are cotton, up 16 percent to $483 million; corn, up 0.8 percent to $73.2 million; rice, down 28 percent to $72 million; and sweet potatoes, down 37 percent to $33.5 million.

## Estimated Value of Farm and Forest Production Mississippi, 1999-2000

| Commodity | 1999 ($1,000) | Preliminary 2000 ($1,000) | % Change 1999-2000 |
|---|---|---|---|
| **Poultry, Total** | **$1,481,387** | **$1,376,300** | **-7.1%** |
| Broilers | 1,323,180 | 1,22,835 | -7.7% |
| Eggs | 158,207 | 155,465 | -1.7% |
| **Forestry, Total** | **$1,261,871** | **$1,246,245** | **-1.2%** |
| **Crops, Total** | **$978,578** | **$965,538** | **-1.3%** |
| Cotton Lint/Seed | 415,085 | 482,930 | 16.3% |
| Soybeans | 217,446 | 173,800 | -20.1% |
| Corn | 72,540 | 73,150 | 0.8% |
| Rice | 100,193 | 72,027 | -28.1% |
| Hay | 68,638 | 55,680 | -18.9% |
| Wheat | 19,635 | 32,959 | 67.9% |
| Grain Sorghum | 9,257 | 11,068 | 19.6% |
| Sweet Potatoes | 33,527 | 21,254 | -36.6% |
| Horticultural Crops | 42,257 | 42,670 | 1.0% |
| **Catfish, Total** | **$294,876** | **$300,303** | **1.8%** |
| **Livestock, Total** | **$314,846** | **$347,932** | **10.5%** |
| Cattle/Calves | 180,996 | 218,413 | 20.7% |
| Milk | 89,976 | 75,616 | -16.0% |
| Hogs | 43,874 | 53,903 | 22.9% |
| **Commodities, Total** | **$4,331,558** | **$4,236,318** | **-2.2%** |
| Gov't Payments | $431,100 | $463,901 | 7.6% |
| **Grand Total** | **$4,762,658** | **$4,700,219** | **-1.3%** |

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## Analyzing Risks to Make *Salmonella* Contamination Scarce as Hen's

# Teeth

**By Charmain Tan Courcelle**

A research and outreach program at Mississippi State is helping the state's poultry industry to meet new federal food safety regulations. The food safety program, which represents a partnership between MAFES and the College of Veterinary Medicine (CVM), will also enable the industry to continue to provide safe and wholesome poultry products for the consumer.

"New performance standards for poultry processors were imposed by the Food Safety and Inspection Service (FSIS) in 1996, but information on how certain food-borne bacteria spread and function during production and processing was lacking," said CVM researcher Hart Bailey.

"The poultry industry faced a challenge because the methods to control the spread of food-borne bacteria and to meet performance standards were not set up with these new regulations," he said. "Because of the limited understanding of the risk factors associated with each step of the production process, there was the potential that the industry would be vulnerable to plant closures from failure to comply."

Americans have come to expect food that is wholesome and healthy. Little wonder then that the highly publicized deaths and illnesses caused by food-borne bacterial pathogens in the 1990s produced a public outcry over food safety and spawned federal legislation to increase regulation of the meat and poultry industry.

FSIS regulations require that meat and poultry processors limit the presence of *Salmonella species*, *E. coli* O157:H7 and other pathogenic bacteria in all meat products. However, the task is complicated because these pathogens are found naturally in the environment and live in healthy food animals without causing disease, Bailey explained.

"We know that we'll never eliminate bacteria from the food animal's environment; the question is, how can we control these organisms in poultry products during production and processing?" Bailey said.

With CVM epidemiologist Bob Wills, Agricultural Research Service microbiologist Allen Byrd and the help of the Mississippi poultry industry, Bailey is identifying and evaluating risk factors that may contribute to the presence of bacteria on a poultry product. In a preliminary study, the group is looking at risk factors, or variables, such as environmental conditions, production and processing practices, processing machinery and equipment operation procedures, to test the impact of each on the levels of bacteria.

They are also determining the odds of finding food-borne microorganisms at one point of the production and processing line versus another. To do this, they are sampling carcasses at different points along the production line for levels of *Salmonella* bacteria. Bailey and colleagues are also looking for *Campylobacter*, which is not regulated by FSIS standards at present but may come under federal legislation in the future.

The information from these studies should allow the researchers to develop a risk assessment model. This model could then be used by poultry processors to focus their efforts on select processing steps that have the greatest likelihood of reducing bacterial pathogens.

"These mathematical models can be used to help poultry processors devise risk management strategies that make good use of limited resources and still meet FSIS performance standards," Bailey said.

CVM has coordinated a monthly food safety roundtable as part of a statewide outreach program that brings poultry industry food safety personnel, FSIS representatives and university scientists together to discuss current regulatory issues and questions related to food safety. Regular industry participants represent the poultry, egg and red meat industries in Mississippi.

Bailey said the outreach program provides a forum to identify evolving research needs and to transfer results of risk factor analysis and other research to the industry.

Another part of the food safety program is a cooperative effort with MSU Extension food technologist Anna Hood that provides Hazard Analysis and Critical Control Point (HACCP) training to meat and poultry industry personnel. Plants are required to have HACCP-trained personnel on staff to continue to operate under FSIS

regulations.

“We are fortunate in this country to have the safest food supply in the world, and we hope our studies will equip processing plants to provide an even safer product to the consumer,” Bailey said. “However, consumers should know that even with low bacterial levels, meat and poultry must still be handled as raw food products. The final safeguard for food safety is in food preparation and cooking, which destroys any potential pathogens that may be present.”

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## Off-flavor Catfish Shift Bottom Lines

**By Bonnie Coblentz**

Catfish farmers have economic evidence that battling the most common cause of off-flavor with copper sulfate brings higher profits.

Research shows that adding copper sulfate to catfish ponds to kill blue-green algae greatly reduces problems with off-flavor. By treating to keep the fish on-flavor, producers can expect higher profits.

Terry Hanson, MAFES aquaculture economist, did an economic analysis of nine ponds treated with copper sulfate and nine ponds left untreated. Before the research began, the decision was made to harvest in August when most off-flavor problems occur.

“We found that when copper sulfate is used, we can have an annual net return of $848 per acre per year of profit above cash costs. This profit does not include such costs as pond construction, land prices, machinery and equipment, and depreciation,” Hanson said, “In the control ponds without treatment, we got an annual net return of $569 above cash costs.”

When harvest-ready catfish are found to be off-flavor, they must be held in ponds until flavor improves. Getting a catfish back on-flavor can take from a few days to several months.

During this time, producers must continue to feed the catfish to maintain market weight, and many die during this wait.

“Treating ponds with copper sulfate stabilized catfish production, mainly by reducing delays in harvesting, which in turn reduced the losses of fish to infectious diseases,” Hanson said.

Key to managing the off-flavor problem is applying the copper sulfate correctly.

“Copper sulfate is a crystal, which means if you just throw it in a pond, it dissolves very slowly and falls in the mud where it is inactive,” Hanson said.

Research found that the best way to apply copper sulfate is to place it in a burlap bag inside a second burlap bag, which is placed 20 feet behind the pond’s aerator. The bags keep the crystals suspended so they can dissolve, and the aerator circulates the copper sulfate across the entire pond. The treatment rate developed specifically for ponds in the Mississippi Delta is five pounds per acre per week when water temperatures are above 70 degrees. Water quality may differ in other areas of the state, such as east Mississippi, and this treatment rate can be ineffective or dangerous to catfish. Catfish farmers should check with their local aquaculture extension specialist before treating ponds with copper sulfate.

“The research shows the Delta-based catfish farmer that if you use this application method and application rate, your off-flavor occurrences should be greatly reduced,” Hanson said.

Hanson performed his economic analysis on research conducted in the late 1990s by Craig Tucker, MAFES aquaculture researcher at the Thad Cochran National Warmwater Aquaculture Center in Stoneville. Tucker’s research demonstrated that copper sulfate applied at the prescribed rate effectively controlled blue-green algae.

“In 1995, a Mississippi catfish farmer told us of his success at managing blue-green algae using frequent, low

doses of copper sulfate. Later that year, we initiated a controlled study to determine the effectiveness of this practice," Tucker said.

Tucker said he initially didn't think the procedure would work, but flavor checks provided some of the most clear-cut experimental data he had ever seen. The results were well replicated, too.

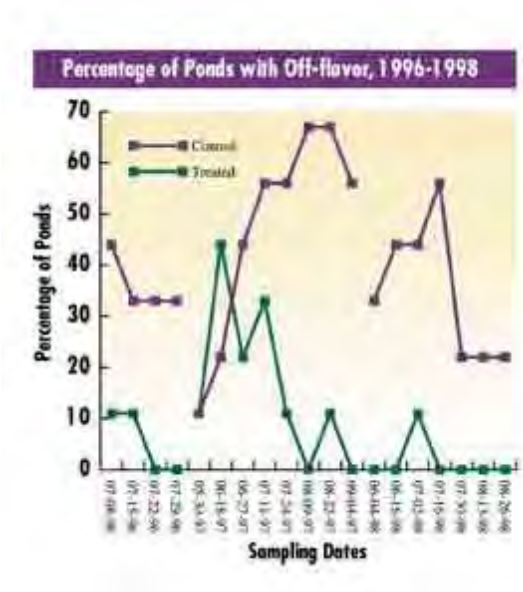
"The ponds we were treating with the low rate of copper were mostly on-flavor, but the ponds we weren't treating had half or so of the fish off-flavor," Tucker said. "The first year the data looked pretty good, but we still thought it was a fluke. The second year was more convincing and by the third year, we were sure."

The economic data now available on this treatment option, show it to be highly cost-effective.

A second, newer option is to use Diuron in the ponds to treat the blue-green algae. However, this substance is controlled by the U.S. Environmental Protection Agency, which must grant an emergency exemption each year it is used. Diuron is a liquid that is easier to administer to ponds than the copper sulfate in crystal form.

In 1997 and 1998, losses to off-flavor were estimated at $22.7 million and $23.2 million, respectively. In 1999, the first year Diuron was approved for use, off-flavor losses dropped to $14.7 million.

"We think Diuron had a large part in that. Diuron was a major management difference not available to farmers in 1997 and 1998," Hanson said.





## Study Shows Promise for Copper Sulfate Treatment

**By Bonnie Coblentz**

A short-term study of a common catfish pond treatment suggests copper sulfate is an environmentally sound procedure for controlling off-flavor problems.

John Hargreaves, MAFES aquaculture biologist with the Thad Cochran National Warmwater Aquaculture Center, completed a study of the effects of copper sulfate applications to catfish ponds over three years.

"Copper sulfate is most often used to kill the blue-green algae that cause the most common off-flavor in catfish," Hargreaves said. "It has even been used to treat off-flavor in reservoirs used to supply drinking water. Copper sulfate is one of the few approved chemical tools that we have available to us."

Many farmers now use the chemical Diuron to control blue-green algae. The Environmental Protection Agency and the Food and Drug Administration granted catfish producers an exemption in 1999 to use it. However,

these agencies reconsider the exemption every year and renewal is not assured. Copper sulfate is an approved chemical, and its use is not regulated by these agencies.

Without an approved means of killing the algae that cause off-flavor, producers with the problem must hold harvest-ready fish until their flavor becomes acceptable. Money is lost feeding fish to maintain weights and from deaths caused by diseases while the fish are held.

When producers add copper sulfate in low doses, it kills enough of the blue-green algae that cause off-flavor, but it does not completely eliminate the algae. Algae in ponds are desirable because they add oxygen to the water and remove some fish wastes such as ammonia.

Hargreaves' study looked at ponds that had been treated with copper sulfate at industry-recommended doses for three years and measured the concentration of copper in pond sediments. This research was part of a larger project related to an assessment of treatment methods to reduce off-flavor in catfish.

"We applied the copper sulfate according to a regime suggested by catfish farmers," Hargreaves said. "We found that it does not leave the pond. We could account for all the copper that was added to the pond. It ends up in a number of different forms in the soil. Over time, copper changes from forms more readily available to those that are less readily available.

"The main finding was that the copper ends up in the soil in forms that are generally not available to enter the food chain," Hargreaves said. "Preliminary data on the toxicity indicated that concentrations of copper measured in the sediment caused no problems."

Researchers tested for possible toxic effects of the copper by exposing two sensitive test organisms to sediment from ponds that had been treated with copper sulfate for three years. They found no problems when they exposed an aquatic invertebrate and cattail roots to the soil with elevated copper concentrations.

Results of this study suggest that older ponds with 10 to 15 years of copper sulfate applications would likely have high levels of copper in the sediment. It is likely that none of this copper will leave the pond and that it will have no negative effects on the pond's plants, fish or the environment. Hargreaves said further research is needed to test this hypothesis.

"In the time frame of the industry as it exists today, this was a fairly short-term study," Hargreaves said. "We don't know the long-term effects of copper sulfate use, but our limited data suggest that the effects of long-term copper sulfate applications will be confined within the pond."

Results of this research are being published in an upcoming issue of the *Journal of Environmental Quality*.

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## Keeping a Lid on Spray Drift

**By Charmain Tan Courcelle**

Producers and pesticide applicators trying to find the safest ways to use pesticides and reduce spray drift may find the answer blowing in the wind, say scientists involved in pesticide drift research.

"We've found that downwind distance is by far the most important variable that affects ground, boom spray drift," said David Smith, MAFES agricultural engineer.

Smith led a team that completed a field study in Missouri, and he cooperated with Illinois researchers to look at the factors affecting pesticide drift from ground, boom sprayers. Together, these investigations may pave the way for new ground, boom spray drift reduction guidelines.

Synthetic pesticides have been used widely since the mid-1940s to protect against pest-inflicted crop damage and losses. But exposure to pesticide residues from off-target spray drift can lead to significant health and environmental consequences, as well as cause damage to sensitive plants.

State and federal agencies regulate the proper use of pesticides and provide recommendations for spray drift

reduction. Still, efforts by these agencies and scientists at universities and in industry have not provided all the answers to drift problems because of the number of variables affecting spray drift, and the possible interactions between some of the variables, Smith said.

“Researchers, Extension experts, and federal agencies have always told pesticide applicators, ‘here is a list of things that affect spray drift,’ but these variables have never been placed in priority order,” Smith said. “Without information about the variables that are most significantly related to drift, an applicator could focus on controlling one or two factors that have only a small, or no, effect on drift deposits.”

To find out what factors have greatest effect on spray drift, Smith evaluated how drift deposits were affected by 14 variables over three years in Missouri and 11 variables over nine years in Illinois. Some of the variables he examined included downwind distance, wind speed, air temperature, spray nozzle height, spray pressure, flow rate, nozzle orientation angle, and droplet discharge speed. Smith and colleagues collected a total of 6,370 and 5,841 data points for the Missouri and Illinois studies, respectively.

“The results from the two studies were complementary to each other,” Smith said. “In both these studies, we found that for ground, boom spray drift control, the applicator has to be most concerned about downwind distance.

“The next most important variable is wind speed, but it is clearly secondary in importance to downwind distance. Air temperature also had an effect.”

Smith’s results are in contrast to a previous theory that held droplet size to be the most influential variable in ground, boom spray drift.

“The most interesting thing that we found in these large-scale field tests is that droplet size doesn’t have as significant an effect on ground, boom drift as previously thought,” Smith said.

One possible explanation is the time available for the wind to interact with spray droplets during most ground, boom sprays is much less than for aerial and orchard applications, which have been used in the past as models for ground, boom spray drift.

Smith said he expects the results from these two studies will provide better-defined guidance for ground, boom drift control to producers, applicators and agricultural chemical companies.

“The variables we found to be closely related to drift deposits, like downwind distance to a sensitive area or crop, wind speed and air temperature, can often be managed by making spray applications near sensitive areas at selected times on given days,” Smith said.

Smith conducted the research with MAFES experimental statistician Pat Gerard and Loren Bode of the University of Illinois. Results from this research were published in *Transactions of the ASAE* (American Society of Agricultural Engineers).

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## Buffer Strips Influence Pesticide Fate

**By Charmain Tan Courcelle**

Environmentalists and citizens concerned about agricultural chemicals moving into the environment from farms may take heart from a project investigating the fate of pesticides.

MAFES scientist David Shaw has found that herbicides and other pesticides used by the Mississippi agricultural industry are present in ground water at amounts below health advisory levels, even at times of peak pesticide usage. In the few instances that they are present above allowable levels, naturally occurring microbial, chemical and photochemical processes appear to aid in their degradation.

Still, Shaw wanted to find ways to further reduce the impact of lingering pesticides on the environment.

“We certainly want to do everything possible to minimize the load of pesticides in the environment because of

the problems they can cause," Shaw said. "One question I asked was, 'are there easy things, which are both farmer friendly and environmentally friendly, that can be done to reduce pesticide amounts?'"

Shaw looked at grass filter strips — a type of conservation buffer — as a possible remedy for pesticide runoff. Conservation buffers are small, vegetated areas or strips of land that slow water runoff. They can be planted at intervals within fields or at the edges of fields. Some examples of buffers include contour grass strips, filter strips, riparian buffers, wetlands and grassed waterways. Shaw said effective placement of buffers in and around fields can reduce soil erosion, as well as nutrient and pesticide runoff.

As part of his studies, Shaw and then-graduate student Al Rankins evaluated five species of grass — big bluestem, eastern gamagrass, giant reed, switchgrass and tall fescue — for their ability to filter out different herbicide treatments.

"We found that all the grass species we tested were able to reduce herbicide load in runoff by 50 to 80 percent," Shaw said.

Because these grasses have a broad range of physical characteristics and soil adaptability, several options are available to producers, he added.

"There are a number of conservation programs that can be tailored to best meet the individual farm or farmer's needs," Shaw explained.

Shaw and graduate student Brooks Blanche also tested the filtering effectiveness of grass buffers used as part of a comprehensive conservation system. Conservation tillage practices, such as no-till, have been adopted by many producers as a way to reduce soil erosion. But Shaw said results from earlier studies evaluating the impact of no-till systems on water quality have been mixed.

"There is an automatic assumption that if you go no-till, it must be beneficial for the environment," Shaw noted. "While this is certainly true in the case of the movement of soil sediment into water, it's not as clear from a pesticide standpoint."

In his study, Shaw found that herbicide loss was two to five times higher in no-till and no-till, double-crop systems compared with conventional tillage. With a tall fescue buffer, herbicide runoff was reduced up to three times for no-till and no-till, double-crop systems. Shaw also saw reductions in herbicide loss when a tall fescue buffer was incorporated into conventional tillage systems.

"Just having a grass filter strip, even a small strip, has a significant effect on reducing herbicide runoff," Shaw said.

In other work, Shaw and then-graduate student Mark Shankle determined how buffer strips control herbicide runoff. To do this, they evaluated the soil properties of field areas planted with new and established buffer strips, and they compared them to areas that had not been planted with a buffer strip.

"Our results show that the organic matter content of soil increases by more than twofold when a buffer strip is planted," Shaw said. "This increases the soil's adsorptive rate, stimulates microbial populations resident in the soil and greatly increases the breakdown of herbicides in runoff.

"One of the most striking things we observed is that in an established buffer strip, herbicide half-life was only 12 days, compared with more than 100 days when no buffer strip was present."

However, while buffer strips are relatively easy to establish and maintain, Shaw said producers should be mindful of them and use good management practices to ensure their proper function.

"We've found that the grasses are sensitive to accidental oversprays or drift from many of the postemergence herbicides used in cotton and soybeans," Shaw said.

"Buffer strips are no panacea, but they are an effective tool for farmers in their efforts to maximize profitability, while at the same time preserving and enhancing our environment," he concluded.

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# GPS Technology Offers Wastewater Record-keeping Solution

**By Charmain Tan Courcelle**

In recent years, Mississippi swine producers have faced growing opposition from neighbors, concerned citizens and environmentalists over perceived environmental quality problems related to land application of wastewater.

Now, a team led by MAFES agricultural engineer Tim Burcham has developed a wastewater tracking system that may help reduce conflicts between producers and the public.

Burcham's swine effluent tracking system — dubbed GPS Wastewater Tracking System, or GWTS — uses global positioning system (GPS) and geographic information systems (GIS) technologies to help producers monitor their nutrient management practices, while providing environmental quality control assurance to the community.

"GWTS (pronounced gee-witz) provides the producer with geospatial data that can be used by a GIS for better management of applied nutrients," Burcham said. "Using this system, a swine producer can keep up with how much effluent has been put on any portion of a field and make site-specific management decisions based on what has been done."

Animal waste from swine production facilities is typically collected into lagoons and used as fertilizer or soil amendment for forage crops. But overapplication of lagoon effluent can be detrimental to both ground and surface water supplies.

"Balancing nutrient supply to crop uptake is needed to minimize environmental impact," Burcham said. "By applying lagoon effluent in a site-specific manner and implementing sound best management practices, maximum protection is afforded nearby water sources.

Farmers already collect this type of information using manual records, but digital collection using GPS technology could make this process easier, he said.

To develop such a system, Burcham, research scientist Paul Lee and graduate research assistant Rameshwar Elka placed a GPS receiver and data collection hardware on the nozzle-end of a hard-hose traveling gun irrigation system. Geospatial data is transmitted to the base computer system using radio modems. Using the gun's position and the nutrient application database, the computer system develops signal outputs that can be used for a number of purposes including variable-rate wastewater application, pump control and information relay.

During the development and testing phases of the project, the team worked to improve the dependability of GPS-based tracking.

"If we're going to use a record-keeping system based on position, we need to have it be robust, or accurate, in terms of position," Lee said. "We wanted to determine what the limitations of GPS systems are — what the systems are capable of doing and what they are not capable of doing."

The researchers looked at differential GPS to determine what level of accuracy was sufficient for their system. Differential GPS is different from conventional GPS because it uses a "fixed position" satellite as one of its reference points. Lee said this provides greater accuracy, but the team needed to know how much better differential GPS would fare compared with conventional GPS.

"In our in-field tests, we found that differential GPS gave us submeter accuracy — the reported position was usually less than 18 inches from the known position," Lee said. "With regular GPS, you see reported positions within 100 feet of their true position 95 percent of the time."

Besides providing better accuracy, differential GPS also has the advantage of real-time position determination, Lee added.

"Data collected using a regular GPS receiver has to be brought back into the lab and corrected to give the true position," he explained. "This is not the case with differential GPS receivers equipped with real-time position

data."

The combination of accuracy and real-time positioning that comes with using a wastewater tracking system based on differential GPS technology presents a range of possible applications. In addition to allowing the farmer to trace the movements of wastewater irrigation machinery unattended, the technology could also be used to guide farm machinery.

"There is the potential of using this system to control anything that a computer can control," Lee said. "Some of the outputs that can be manipulated by a computer include the speed or torque of a motor, which can be applied to achieve variable-rate wastewater application."

"Ultimately, when combined with other things like weather data or crop information — which is already available in digital form — the system can provide comprehensive decision support," Burcham added. "And, the technology is not limited to hard-hose irrigation systems. It can be implemented on virtually any nutrient delivery system."

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## Researchers Strive to Ensure Profitable, Healthy Catfish

**By Linda Breazeale**

MAFES and Mississippi State University's College of Veterinary Medicine (CVM) researchers are working together to reduce the health challenges mass production of catfish can bring.

"Anytime you have intensive management situations, you can have various outbreaks of disease or parasite problems," said Linda Pote, CVM, parasitologist. "Unfortunately, if producers reduce the numbers of fish or animals, they also will reduce their chances for making a profit."

Pote and other researchers based at the MSU campus and in Stoneville have been working to overcome health challenges facing the state's catfish industry. Two catfish production problems confronting catfish growers are proliferative gill disease (PGD), commonly referred to as hamburger gill disease, and trematode infections.

**Proliferative Gill Disease.**

PGD is one of the most commonly diagnosed problems of catfish in the Southeast. The disease causes severe gill damage leading to suffocation of the fish, with severe outbreaks often resulting in mortalities in excess of 50 percent.

Lester Khoo, CVM assistant professor at the Thad Cochran National Warmwater Aquaculture Center, said out of 1,647 submissions in 1998, the lab diagnosed 268 cases of PGD. Case submissions from farmers/producers increased to 2,007 with 602 confirmed cases the next year and increased to 2,189 submissions and 652 cases in 2000.

Researchers thought that a myxozoan parasite might be responsible for PGD, but they needed proof. They also wanted to understand how catfish were being infected and to learn more about the parasite's life cycle.

Pote joined Larry Hanson, CVM molecular biologist, to resolve the life cycle questions. Using a sensitive laboratory assay called the polymerase chain reaction, they confirmed the cause of PGD is a myxozoan parasite, *Henneguya ictaluri* n. sp., which requires an oligochaete worm as a host for part of its life cycle.

"It took approximately 10 years for us to figure out the PGD parasite life cycle," Pote said.

"Once Dr. Hanson and I confirmed its life cycle using molecular techniques, we could start looking for ways to protect the fish and get PGD under control," she said. "One approach for reducing the disease would be to break the life cycle of the parasite by eliminating the worms from the ponds, better yet finding a vaccine that will protect fish from this parasite."

Problems can happen in a new pond within the first year, or ponds can go for years with subclinical infections.

Testing gills is the primary way PGD is detected, but Pote and Hanson have also developed a test that farmers can use to detect very early stages of the PGD parasite in the worm, water and fish.

David Wise, MAFES fisheries biologist at the Delta Research and Extension Center and Thad Cochran National Warmwater Aquaculture Center, said researchers are focusing on management strategies to reduce losses associated with PGD.

“So far, chemical treatments have not been extremely effective in controlling the disease,” Wise said. “Chemicals currently approved for aquaculture use do not appear to have much effect on the spores that cause PGD or on the Dero worms that harbor the spores.”

Epidemiological studies conducted at the aquaculture center indicate that essentially all ponds have this disease, but they vary in severity.

“Seasonal changes also appear to influence the severity and number of outbreaks, with the most severe cases being observed in May and June,” Wise said. “Newly stocked fish are very susceptible to this disease and account for the majority of losses associated with PGD.”

Wise said “sentinel fish” are used to assess the risk or potential for severe outbreaks. Adopting this type of monitoring program may allow farmers to prioritize ponds by risk level and reduce PGD-related fish deaths in newly stocked ponds.

MSU researchers also looked at industry stocking practices to find other ways to reduce the impact of PGD. They used cages to track the occurrence of the disease in Bear Creek Fisheries’ catfish ponds in Moorhead. Based on these results, the researchers recommend a change from stocking in the spring, a peak season for PGD, to stocking in December, January and February.

“Stocking before the peak months seems to improve the fish’s ability to acclimate to the disease,” said Austin Jones, a partner in Bear Creek Fisheries.

**Trematodes**.

Catfish’s other nemesis, trematodes (*Bolbophorus confusus*), are not easy to manage either, but they are more manageable than PGD.

The life cycle of *B. confusus* is complex and involves several intermediate hosts. It begins when the final host, usually fish-eating birds such as pelicans, release trematode eggs into ponds containing intermediate hosts. Ram’s horn snails, which serve as the next hosts, become infected with the hatched trematodes and later release larval trematodes straight into the water. The larvae infect fish, and the life cycle is completed when the infected fish are eaten by pelicans and other birds.

Wise said the key to controlling this species of trematode is reducing ram’s horn snail numbers and keeping fish-eating birds off ponds.

“Weed management is important because it reduces snail numbers,” Wise said.

*B. confusus* causes massive damage to the excretory system of the kidneys and liver of infected fish. Smaller fish appear to suffer the heaviest losses, but larger fish that survive develop anorexia and poor growth, making them unsuitable for market.

Outbreaks of *B. confusus* trematodes were first documented in 1999 in the Delta. Since then, the Thad Cochran Center has diagnosed 43 cases in 1999 and 127 in 2000, leading scientists to call B. confusus trematode infections “an emerging disease.”

Jones, the catfish grower, said trematodes had a major economic impact last year when they wiped out about a third of Bear Creek’s fingerling crop. A catfish producer since 1982, he said 2000 was the first year the industry suffered losses from trematodes.

“We’re trying to monitor more closely for pelicans and do snail inventories,” Jones said. “We’ve used biological control agents and treated the banks with hydrated lime to significantly reduce snail populations.”

# In Brief

## New Research and Education Facility Highlights Teamwork

**By Charmain Tan Courcelle**

MAFES and the Mississippi State University Extension Service recently celebrated the grand opening of a new research and extension facility in Raymond.

The new Central Mississippi Research and Extension Center will enhance research and educational programs in central and southwest Mississippi, said Charles Lee, MSU vice president of the Division of Agriculture, Forestry and Veterinary Medicine.

“This new center is part of a strategic network of research and extension facilities that lets us focus uniquely on the special needs of each region,” he said. “The Central Mississippi Research and Extension Center will have program emphases in agriculture and natural resources, 4-H and youth development, family and consumer education, and community development.”

Plans for the 18,500-square-foot facility were initiated in 1996, when it became clear that a new center was required to accommodate expanding research and education programs. CMREC staff, who previously were housed in temporary offices, and research and extension personnel from Alcorn State University will occupy the new center, which is located on the Hinds Community College campus. Staff at Hinds Community College will work closely with MSU on educational programs and special projects.

“This building represents a new level of cooperation and partnership among Mississippi State University, Alcorn State University and Hinds Community College,” Lee said. “It provides us with the opportunity to work together to improve the economy, environment and the quality of life for Mississippians.”

“Hinds Community College, Mississippi State University and Alcorn State University have worked very closely together for a number of years on numerous projects, including some of the most innovative projects in the country,” added Clyde Muse, president of Hinds Community College. “This center will be another step in that direction.”

Features of the central Mississippi facility include interactive auditoriums, distance learning centers and research laboratories.

“We’re excited about this facility and what it will bring to this area of the state,” said Butch Withers, head of CMREC. “With this modern facility and its capabilities, we’ll be better able to serve the citizens of central and southwest Mississippi.”

The $2.5 million center was built with bond money provided by the Mississippi Legislature.

“We’re grateful for the support of the state Legislature in providing the funding that made the construction of this facility possible,” said MSU president Malcolm Portera.

Also speaking at the March 29 dedication ceremony was Alcorn State executive vice president Rudolph Waters. Special guests at the event included Rep. William McCoy, chairman of the House Ways and Means Committee, and Carl Nicholson, Jr., president of the Institutions for Higher Learning Board.

## Cotton Bales Bulk Up with MISCOT

**By Charmain Tan Courcelle**

Two new cotton varieties developed through the MAFES cotton breeding program may provide relief for cotton

growers faced with stagnating yields.

MISCOT varieties 8806 and 8839 promise higher lint yields and could give Mississippi cotton producers a better chance of turning a profit.

“Farmers are paid for the number of pounds of lint they get, but in the last few years, the cotton industry has seen lint yields level off,” said Ted Wallace, MAFES agronomist and breeder of the new cotton varieties. “When I came here in 1988, my goal was to develop a high-yielding cotton variety adapted to Mississippi growing conditions that would help producers get over this yield plateau. Hopefully, these new varieties are a start in that direction.”

The MISCOT lines have performed well in 1999 and 2000 Mississippi variety trials conducted in the Delta and hill regions of the state, Wallace said. Two-year lint yield averages for MISCOT 8806 (1,313 pounds of lint produced per acre) and MISCOT 8839 (1,248 pounds of lint per acre) ranked number one and number four, respectively, in the Delta Region Variety Trials. The two-year yield average across all varieties was 1,119 pounds of lint per acre.

Wallace selected these new varieties out of a group of segregating populations resulting from his very first crosses between the Texas TAMCOT breeding line CDP37HPIH-1-1-86 and the high-yielding DES 119 variety. Following 13 years of extensive evaluations for yield, fiber quality, disease resistance and range of environmental adaptability, MISCOT lines 8806 and 8839 have proven themselves in Mississippi. They have also fared well across the Cotton Belt and led trials in Georgia, Arkansas and North Carolina in the 2000 growing season.

The new varieties now await formal approval for release and distribution to the cotton industry. Once the varieties are approved, Wallace said he expects a commercial seed company will introduce herbicide- and insect-resistant traits into the MISCOT lines before making them available to growers.

In the meantime, Wallace is continuing his efforts to develop best-performing cotton varieties.

Cotton industry experts think that the overuse of common parents in the development of commercial varieties is responsible for the yield plateau seen in recent years. So, Wallace is putting emphasis on developing varieties from crosses among cotton strains that are unrelated to current commercial varieties. These efforts will broaden the genetic diversity of cotton varieties and may help overcome the current yield plateau.

## Two Bentgrass Germplasms with Brownpatch Resistance Released

MAFES scientists have released two new bentgrass germplasm lines for breeding purposes.

Lines MSRS-328 and MSRS-330 have enhanced resistance to the fungus *Rhizoctonia solani* Kuhn, the cause of brown patch disease. Brown patch disease can lower the performance of bentgrass on golf putting greens. Scientists selected the two lines based on their ability to survive exposure to *R. solani* and their high plant vigor.

The lines were approved for release in September 2000. They will be available to commercial turf grass companies for use as parents to develop high-performance, fungus-resistant bentgrass varieties.

MAFES agronomist Jeff Krans, one of the scientists involved in the project, said he expects varieties developed from these lines to give consistent brown patch resistance and to reduce the need for pesticides in *R. solani* control.

“These new germplasms will contribute to the golf turf industry’s ability to provide better turf for better golf,” Krans said.

Seed samples of MSRS-328 and MSRS-330 will be available for research purposes from H.W. Philley, P.O. Box 9555, Mississippi State, MS 39762.

## New Germplasm will Reduce Insect Damage on Corn

The U.S. Department of Agriculture's Agricultural Research Service (USDA/ARS) and MAFES released a new corn germplasm line for breeding and experimental purposes.

Germplasm line Mp716 is resistant to southwestern corn borers and fall armyworms, which feed on the leaves, stalks and ears of corn plants. Damage to corn plants by these insects can reduce yields and lower grain quality. Researchers used conventional plant breeding methods to select for insect resistance over several generations.

The line was released January 2001 for use as a parent to develop high-yielding, insect-resistant hybrid corn varieties.

Paul Williams, USDA/ARS geneticist and breeder of the new germplasm, said one reason Mp716 is able to resist insect damage is its increased leaf toughness. Leaves from this line have a higher fiber content. The line also has a much desired trait — genetic resistance to the southwestern corn borer and fall armyworm.

"In the past, insecticides have sometimes been used to control the southwestern corn borer and fall armyworm. But when the larvae got down into the plant, they were protected from insecticide applications," Williams said. "Because of the cost, controlling these insects with chemical insecticides isn't usually profitable in field corn. With genetic resistance, the corn plant is protected from insect damage over its life span, and without insecticides. We've found larvae that feed on Mp716 are smaller and grow more slowly on these plants.

"An added advantage of this line is increased protection from *Aspergillus flavus* infection," Williams noted.

Decreased insect damage means fewer entry routes for fungi, he explained.

For now, plant breeders in commercial seed corn companies will have primary use of Mp716, but farmers will eventually feel the benefits as seeds with built-in genetic resistance to these two major insects become available.

## The Internet — Entered Not by Rural Mississippians

The Internet has evolved from its early mandate as a military strategy in the 1960s into today's "global village," complete with schools, shops, libraries and town squares — an open highway on which news, information and goods travel freely. But in this climate of rapid information gathering and in-home shopping, are rural Mississippians being left by the wayside?

"Among rural consumers in Mississippi compared with five other states, Mississippians have less access to the Internet from their homes and tend to use computers less overall," said Sheri Lokken, MAFES researcher.

Lokken is part of a collaborative regional project that is examining the "Impact of technology on rural consumer access to food and fiber products." The first phase of this project, completed early in 2000, measured consumer attitudes toward the Internet before and after exposure to this technology.

"We found (rural Mississippians') attitudes were more positive, and they were more likely to report that they would use this technology. However, access is a big issue," Lokken said.

Results from this study support the idea of a "digital divide," the lack of computer and Internet access within rural communities. Major goals for Lokken and her collaborators are to provide policymakers with the information necessary to narrow this gap through an improved understanding of rural consumer habits, and to develop educational outreach programs.

"It is important for consumers to be educated on e-commerce; it can be an empowering tool for consumers," Lokken said. E-commerce has the potential to improve the elderly or disabled consumer's quality of life.

### MAFES to Assess Research Efforts

The Mississippi Agricultural and Forestry Experiment Station will conduct an internal survey to determine the strengths and weaknesses of its research program and to develop specific goals for the station. The work will be conducted as a collaboration between MSU scientists in the biological sciences and social sciences.

Patricia Knight, associate horticulturist at the Coastal Research and Extension Center, conceived the idea to assess the research culture at experiment stations. The idea came in response to MAFES administration's charge for resource accountability and as part of Knight's training in the Experiment Station Committee on Organization and Policy leadership program.

"What we hope to gain is a measure of the culture of an experiment station — the beliefs, the norms and the practices. Not only will it tell us what people believe they should do, but what they are actually doing," Knight said.

"Surveying the perceptions and attitudes of research personnel is a useful way to look at where we are and where we want to be," said Vance Watson, MAFES director. "We can use the results of an internal assessment to develop a plan to help us more effectively achieve our goals and to set new standards of excellence."

Social Science Research Center (SSRC) director Art Cosby, SSRC research scientist Liesel Ritchie and SSRC research assistant Georgia Hackney worked to develop the survey instrument. The first step of the survey development process took place April 6. A group of 19 research assistants, scientists and administrators participated in an anonymous electronic brainstorming session to identify survey topic areas and to generate survey questions.

"I'm excited by the possible applications for this survey tool," Knight said. "It has the potential to serve as a benchmark for measuring the culture of all land-grant universities and help with long-range planning and goal setting. In addition, this is something that we can do periodically to measure how the culture of the Experiment Station at MSU changes over time."

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## Calendar of Upcoming Events

Aug. 15, 2001 — Cotton Field Day, Delta R&E Center, Stoneville

Aug. 16, 2001 — Rice and Soybean Field Day, Delta R&E Center, Stoneville

Sept. 29, 2001 — North Mississippi Garden Expo, North Mississippi R&E Center, Verona

Oct. 12-13, 2001 — Fall Flower and Garden Fest, Truck Crops Branch, Crystal Springs

Nov. 7, 2001 — Mississippi Entomological Assoc. Insect Control Conference, MSU

Nov. 15, 2001 — MSU-MAFES Annual Production Sale, MS Horse Park, Agricenter and Fairgrounds, Starkville

Dec. 5, 2001 — Cotton Shortcourse, MSU

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**Mississippi Agricultural and Forestry Experiment Station**

Vance H. Watson, *Director*