Mississippi State University

# MAFES Research Highlights

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### From the Director:

1997 proved to be a very good year for Mississippi agriculture, and I am very proud of the accomplishments of our scientists and support staff.

Experiment station accomplishments include the development and release of 4 new corn and 2 soybean germplasm lines and 1 soybean variety in cooperation with the USDA-ARS, 392 sorghum lines, 1 new high-producing rice variety, a new cotton variety with improved fiber quality, and 3 wetland and conservation species in conjunction with the USDA's Natural Resources Conservation Service.

MAFES received 5 new patents and 4 provisional patents, it has 2 patents pending and 1 patent in the application process, and our scientists are responsible for 493 scientific publications.

Our elected officials recognize the importance of agriculture and that it contributes more than 25 percent of the state gross product. They continue to provide strong support for our programs. In addition, our scientists were successful in obtaining $8 million in competitive extramural funding.

A very significant change in program management involved statewide stakeholder involvement in setting research priorities. Stakeholders, through the commodity checkoff programs, also provided $1.2 million for new research and research enhancement efforts.

Infrastructure improvements during 1997 included dedication of the North Mississippi Research and Extension Center building that is located on the grounds of the Northeast Mississippi Branch

Experiment Station in Verona, completion of a Horticulture Research Unit at the Northeast Mississippi Branch, and completion of a Senate-sponsored dairy facility at the North Mississippi Branch Experiment Station in Holly Springs.

Other major building projects included completion of the Thad Cochran National Warmwater Aquaculture Center in Stoneville, site selection and preparation for a Central Mississippi Research and Extension Center in Raymond, and funding for Phase I of a new Coastal Research and Extension Center in Biloxi.

All of us associated with the Experiment Station work hard to make progress each year and adapt to the inevitable changes that come our way. We pledge to our citizens to continue to meet the challenge of providing research discovery that keeps Mississippi's farmers viable and competitive in a global economy. We appreciate your continued interest in and support of our agricultural research programs.

## Data Center aids economic growth

An 800,000-square-foot building rising out of a former cotton field on the outskirts of Indianola will soon be the workplace for more than 400 Mississippians. The facility is a regional distribution center for Dollar General Corporation, which operates discount stores in 24 states.

In announcing the site for the distribution center, Cal Turner, Jr., the chairman and CEO of Dollar General, cited the strategic location of Indianola as a factor in the selection of the Delta town for the facility. He also stressed that the community was a factor in the decision.

"It's because of the people here," he said. "There's a spirit about this place."

How do companies like Nashville-based Dollar General and their officials learn enough about a town like Indianola to be willing to make a multimillion-dollar investment in the community? Personal visits to the area by company officials play a role. So do the community leaders and economic development personnel in prospective locations. Another factor came into play with the Dollar General decision -- the accurate and detailed information provided by the Delta Data Center.

The Center is located in the Delta Council headquarters at the Delta Research and Extension Center at Stoneville.

"When we learned that a major retail firm was looking for a site for its Midsouth distribution center, the first priority was to see that a Mississippi location was selected," explains Delta Council Director of Development Mark Manning. "Our next objective was to promote the 18 counties in northwest Mississippi served by the Delta Council and the Delta Data Center."

The Data Center was established in 1993 as part of the Delta Project, a multiyear effort by the Social Science Research Center (SSRC) at Mississippi State University and the Delta Council to promote economic development in the Delta. MAFES provides part of the funding for the work of the Delta Project and the Data Center. MAFES also provides support for social and economic research being conducted in the Delta by SSRC Sociologist Larry Doolittle and other scientists.

"The original goal of the Center was to develop and implement strategies to enhance the social and

economic conditions of the citizens of the Mississippi Delta," says Doolittle. "The Center also has been given the general mission of providing up-to-date social and economic data and related services to the Delta."

The Data Center has handled more than 400 requests for services from about 150 different clients since opening in 1993. Most of the requests have come from development organizations and private companies.

"Requests for data are usually to support research, industry recruitment, or industry expansion," explains MAFES Research Assistant Beverly Fratesi.

Fratesi is located in the Delta Council headquarters and works with Manning and other Delta Council personnel to provide clients with the information they request from the Data Center. She also works closely with economic development leaders in the Delta and in other areas of the State to provide materials they need in their industry recruitment efforts.

"Clients are usually looking for demographics, tax-incentive information, labor-force information, infrastructure development, and financial data," she says. "The items we provide include maps, tables, reports, graphics, pamphlets, brochures, and direct mail campaign material."

Information provided by Delta Council helped convince Dollar General officials that a location in northwest Mississippi would be an ideal site for their new distribution center. Company officials then visited several towns in the Delta and began the process of deciding which one had the right combination of transportation, labor force, available land, and other necessary factors.

"Once the decision was made by Dollar General to locate the distribution center in the Delta, we were responding to requests by the company for information on various sites on almost an hourly bas is," Fratesi says.

Labor-force information was one of the company's critical needs. Working with the Mississippi Employment Service, the Data Center supplied that information on all the Delta communities under consideration.

Once the Dollar General officials had the site data, labor force information, and other facts about the potential locations in hand, the process of elimination began. In the end, Indianola was the selection because of several factors. One was its central location in the company's Midsouth growth area. Another was the cooperative effort of state officials, the Delta Council, Indianola's business and political leaders, and the Delta Data Center. That effort helped convince the company that they would get the best value for their investment in Indianola.

"This is a company that believes the best of business comes from the best of values," Dollar General CEO Turner said in announcing Indianola's selection as the site for the distribution center.

## Mississippi agriculture more diverse in wake of new farm legislation

The basics of farming remain the same, but Federal legislation has changed the way farmers make many of the decisions about what to plant.

The Federal Agricultural Improvement and Reform (FAIR) Act of 1996 significantly altered the structure and scope of Federal farm programs in the United States.

"The first Federal farm programs were authorized by the Agricultural Adjustment Act of 1933," explains Extension Agricultural Economist John Robinson. "This legislation was passed by Congress during the Great Depression and provided relief for farmers struggling with drought, dust bowls, debt, and depressed prices."

The original Federal farm program included artificially high crop support prices and provisions to reduce the amount of land in production. The 1933 legislation was updated every few years, with occasional attempts at major revision. The passage of the FAIR Act in 1996 is one such revision.

"Free-market political philosophies dominated Congress after the 1994 elections ," Robinson says. "The 1995 Farm Bill debate was overshadowed by the drawn-out budget process that emphasized reduction of the Federal budget deficit. In addition, tightening supplies of food and fiber crops created a situation of strong crop prices."

The economist adds that the designers and promoters of the FAIR Act of 1996 saw these conditions as an opportunity to implement a significantly different farm program. The result was legislation that fixed and reduced Federal spending, reduced planting restrictions, and provided short-run support for farmers, even while prices were high.

Payments are provided based on the acreage previously enrolled in Federal crop programs.

"The goal of the new farm legislation is to stabilize and support the income of people involved in agriculture," Robinson says. "Under the new bill, producers are more responsible for making market-based decision. Also, both producers and farm product suppliers are now more exposed to financial risks from price swings in the farm product markets."

One result of the new bill for Mississippi farmers is the flexibility to move out of cotton, a crop that was tightly controlled under previous farm legislation, into other crops.

The planting flexibility allowed the movement of 300,000 acres of cotton acreage into other crops in 1996. Most of the land previously planted to cotton was used to produce corn.

"The new farm bill removes planting decisions from the government program," Robinson explains. "The payments are decoupled; that is, they will be paid despite the crop planted. Producers should no longer view the payment as a return for growing any particular crop. Planting decisions should be made solely from the standpoint of profitability and risk management."

The changes in farm legislation have had a dramatic impact on the process farmers use to make planting decisions, according to Holmes County producer Willard Jack.

"Not being tied to planting a certain number of acres to cotton each year has us looking for the best crop mix for our farm," he says. "We have decreased our cotton acreage and are looking at a crop mix that includes more corn, soybeans, and rice. We are finding ways to be more efficient in terms of labor, equipment, and other inputs, but our need for information has increased."

The changing information needs of Jack and other Mississippi producers has MAFES administrators and scientists developing programs to provide the necessary research to meet the new demands.

"The decreased dependence on government programs has row crop producers looking more closely

at ways to make their entire farming operations more cost-efficient," says MAFES Director Vance Watson. "That has created a need for programs that incorporate research with total production systems."

Jack and other Mississippi producers say that approach is important in the wake of the change in Federal farm programs.

"The move from primary dependence on cotton to a more diverse cropping system has us looking for answers to questions we never thought about before." Jack says.

In response to the changing information needs of Mississippi farmers, MAFES has established research teams that cooperate on projects involving variety development, fertilization, pest control, crop rotation, and other aspects of crop production systems.

"The team approach does not diminish the importance of the work of individual researchers," Watson explains. "It does, however, allow us to obtain research results that meet the needs of today's farmers."

Two examples of the team approach is research currently underway in the area of advanced spatial technology and cotton insect management. Projects in these areas have brought together scientists from entomology, agronomy, plant pathology, engineering, and other disciplines to search for ways Mississippi farmers can use precision farming methods and insect management to improve their operations.

"Farmers are looking to us for research results that will answer their questions, and by using the team approach, we reduce the amount of time it will take us to provide answers," Watson says.

Additional information is available at How the 1996 Farm Bill Will Affect Mississippi Farmers and Landowners.

## Environmental impact critical in agricultural biotechnology

By Bob Ratliff

Public opinion is mixed about the use of biotechnology, according to Terry Medley, administrator of the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS).

Medley was the guest lecturer for the 1997 Will Carpenter Adaptive Biotechnology Seminar at Mississippi State on September 19. He provides leadership for more than 6,000 employees responsible for protecting the health of the nation's plant and animal resources. The APHIS administrator is an internationally recognized expert on development of biotechnology products and environmental risk assessment.

Biotechnology uses the techniques of biology and engineering for the study and solution of problems concerning living organisms. It includes genetic engineering, which is the transfer of foreign DNA into plant or animal species. Examples include the FlavrSavr® tomato, genetically engineered to stay firm as it ripens, and Roundup Ready® soybeans, which are resistant to the herbicide Roundup®.

During the presentation, Medley noted that the public will picket the Food and Drug

Administration to speed up the

introduction of genetically engineered pharmaceutical products needed for the fight against terminal illnesses, while at the same time protesting the sale of genetically engineered vegetables.

"My feeling is that people look at the pharmaceutical area and say they have no other choices because you are dealing with terminal situations, such as AIDS," he explained. "You can, however, go to the supermarket 24 hours a day any time of the year and get fresh fruits and vegetables, so people are not willing to take any risk at all in the food area."

Recognition of the problem of public acceptance of new technology and awareness that adoption of new technology is necessary for U.S. agriculture to compete effectively in world trade are key elements in Medley's approach to the administration of APHIS.

"I'm very supportive of education to inform the consumer, but what I find in the final analysis is that the consumer has to be familiar with the technology and be comfortable with those responsible for oversight," he said. "We have designed our regulatory system so that before we ever make a decision, people are aware of what we are deciding. We want to provide an opportunity for input into the decision making process."

Medley noted that posting of information about pending decisions on the APHIS World Wide Web site is part of the campaign to keep the public informed.

Genetically engineered cotton and soybeans have been generally accepted, but the APHIS administrator said there still are concerns about use of the process with other crops. One area of concern is the use of domestic rice that has been engineered for resistance to herbicides for control of red rice, a weed. Producers fear that the domestic varieties could crossbreed with red rice, resulting in a herbicide-resistant strain of the weed.

Another area of concern is the environmental aspects involved with fish that have been genetically engineered to promote rapid growth or other characteristics.

"The area of aquatics is one where there are environmental issues we have to deal with," Medley said. "I would say, however, that those issues are not there because of biotechnology, but because of the area of application."

Some of the legitimate concerns, he continued, are based on the fact that native populations of fish often are displaced when new species are introduced into rivers, streams, or lakes.

"We know what can happen when certain nonindigenous organisms come into an aquatic system, and we know that domestic populations of fish interact with wild populations," Medley said.

The APHIS administrator concluded by noting that as biotechnology is applied to aquatics, there will need to be a separation of legitimate environmental concerns from those concerns raised just because of the presence of biotechnology .

The Carpenter Adaptive Biotechnology Series honors Dr. Will Carpenter, retired vice president and general manager of new products for Monsanto Agricultural Chemicals. Carpenter is a 1952 graduate of Mississippi State and a former executive-in-residence at the university.

The lecture series is sponsored by the Mississippi Agricultural and Forestry Experiment Station (MAFES) and the University's Division of Agriculture, Forestry, and Veterinary Medicine. The annual event is organized by the MAFES Adaptive Biotechnology Committee.

## MSU-HERB helps farmers make weed-control decisions

Choice is usually a good thing, but sometimes a person doesn't have the time or information to make the right decision, whether it be choosing a flavor of ice cream or the best weed-control method.

So it is with soybean producers making herbicide application decisions, which can be a daunting task even for weed scientists who deal with the subject daily. Producers, who must focus the majority of their time on other production concerns, can easily be overwhelmed by the decisions and choices available. Weed-control decisions for soybeans are complex and challenging because of such factors as weed species present and array, effectiveness, and cost of herbicides available.

Enter MSU-HERB, an expert computer decision aid that can evaluate all these factors and help producers, Extension personnel, and private consultants evaluate potential crop damage from weeds. The aid then determines if a herbicide treatment is economically justified and, if so, selects an appropriate herbicide and application rate. MSU-HERB provides an efficient means to disseminate a large amount of complicated information in a manner that easily can be used as an aid in herbicide application decision making.

The software evolved from the HERB soybean weed-control computer model developed at North Carolina State University in the 1980s. MAFES Weed Scientist David Shaw and Associate Weed Specialist John Byrd refined HERB for Mississippi growing conditions.

"The program works really well if good data are put in. You have to incorporate common sense into the program," Shaw said of MSU-HERB.

HERB and SWC (Soybean Weed Control), developed at the University of Arkansas, were designed to aid producers in determining an economical and effective herbicide treatment for weed control in soybeans.

The Mississippi Soybean Promotion Board funded Shaw and Byrd's first research project. The scientists, with the assistance of Research Assistant Jon Ruscoe, ran the HERB and SWC models at different locations and the models generated a recommendation. The researchers would also make and compare their own recommendations with the models, including weed-control methods and costs involved.

HERB and SWC did as well as or better than the human-generated recommendations, according to Shaw. Although both models did overestimate yield loss in some instances, HERB did have less variability when they compared the actual to predicted losses.

Shaw and Byrd then used a program that allowed them to modify the database that HERB uses in calculations. They were able to adjust the competitive index for each weed and weed control from ea ch herbicide, as well as add new weeds and herbicide treatments, to better reflect Mississippi conditions.

In subsequent field tests over a 3-year period, Shaw, Byrd and Research Assistant Al Rankins went back to the field to compare the old HERB to the new version in order to determine if adjustments were valid.

"Performance was fairly comparable. But any time there was a difference, the advantage went to the MSU version, so we felt like the adjustments were warranted," Shaw said.

MSU-HERB ranks weeds from 0 to 10 based on competitiveness of the weed with soybeans and ranks herbicides on their ability to control weeds.

To use MSU-HERB, the user enters into the computer:

1) number of weeds of each species in 100 square feet

2) average size of the weeds

3) environmental conditions, such as optimum or drought

4) herbicide prices

5) cost of herbicide application

6) expected weed-free yield

7) expected selling price

The model predicts the yield loss that will be associated with each weed and the effectiveness of each herbicide option in terms of improving yield. The computer model currently contains about 75 weed species and about 45 herbicide options; additions are in the works.

"It is a fairly small program," Shaw said. "We use a laptop in the truck and can run the model in the field when we are ready to spray. With a printer, the program will generate a written report on why it made specific recommendations. This gives the consultant or Extension agent written justification for why a decision was made, and is also a great record-keeping tool."

In addition to the economic benefit MSU-HERB provides users, the program also helps protect the environment because only as much herbicide as is needed is used, and decisions are based objectively on herbicide efficacy and weed threshold concepts.

The soybean herbicide recommendation computer software program is available for use at no charge to farmers at all county Extension offices, or they may obtain copies by contacting Byrd.

## New technology for precision farming promising

Researchers have more questions than answers about precision farming, according to panelists discussing the emerging technology at a Mississippi State University forum.

"Precision Farming: Opportunities and Challenges" was one of the sessions during the 1997 annual conference of MAFES and the MSU Extension Service. The meeting was November 6-7 at the Bost Extension Center.

Panelists from MAFES were Assistant Agronomist Michael Cox, Weed Scientist David Shaw, Agronomist Wayne Ebelhar of the Delta Research and Extension Center, Entomologist Randall Luttrell, and Associate Bioinstrumentation Engineer Suminto To. Extension Soybean Specialist Alan Blaine joined them.

They discussed research projects underway involving global positioning systems (GPS) and other advanced spatial technologies. Precision agriculture uses satellites, computers, lasers, ground-based monitors, and yield counters to bring the latest science to farming. An example is a tractor with a computerized system that automatically spreads fertilizer in the exact amounts needed for the crop more in some places, less in others based on data from infrared satellite images.

The panel members noted that the technologies used in precision farming are new to them and new to producers. They added that their goal is to find applications for the technology that will produce benefits for Mississippi farmers.

"It is so important for us to begin to understand this technology and how to advise producers on the right things to do," said MAFES Agricultural Economist David Laughlin, who moderated the forum.

Cox said the researchers' overall view of precision agriculture is optimistic and he sees it as the mode of production for the future, referring to it as site-specific agriculture. He predicted that the placement of fertilizer and chemicals in the field will be much better than it is now. One central piece of equipment that needs to be looked at, he said, is the yield monitor because it is the only way to measure yield trends.

In addition, Cox said precision farming research should be long term and that one must look at it from the point of view of integrated crop management before seeing benefits from it.

Ebelhar said, "We may not spend less money if we go this way (but) it allows us to spend our money efficiently and fertilize the parts of our fields that are doing poorly."

The MAFES staff at Stoneville are in the beginning of research with the technology, he said, upgrading computers and equipment. "I believe we're going to be in it for the long run."

To said MSU's Agricultural and Biological Engineering Department is developing a volumetric sensor system and yield monitor technology for cotton that can work with other commodities. The technology, he said, is nonoptical, nonintrusive, and portable, and it can work with other commodities. Needs for 1998, he said, are development of a mutually beneficial MSU-industry collaboration and continuation of funding to bring the technology to maturity.

Shaw said research he is working with includes developing maps showing where specific weed infestations are. Shaw said he is trying to link MSU-HERB technology (related story on page 14) with GPS-controlled sprayers, but that his research is still in its infancy. Besides economic and environmental benefits, Shaw said intangible benefits of the technology that he foresees include legal protection for applicators and farmers because they may be able to record what chemicals they used and where they sprayed them.

Luttrell is looking into the potential use of the technology in the management of cotton insects. Luttrell said more mechanical methods are needed for insect sampling and he does not see spatial

technology applying to that need, although, he said, aerial images could be used to identify hot spots with spatially registered data.

Blaine said that although producers want to adopt the technology, "We forget to do a lot we already know how to do," referring to the need to determine optimum soil-sampling size. "We need to get back to basics (of crop production) before we can capitalize on these new technologies."

Panel members noted that besides soil sampling, other factors, including drainage, soil compaction, and fertility, also need to be addressed.

During a question-and-answer session, panelists acknowledged that problems do exist with the loss of satellite signals.

Also during the session, representatives of the Mississippi AgrAbility Project gave an overview of its services. The program is offered cooperatively by the Mississippi State University Extension Service, the Mississippi Easter Seal Society, and the T.K. Martin Center for Technology and Disability.

The program identifies and serves people in agriculture with disabilities and their family members who can benefit from specialized rehabilitative services and agricultural engineering.

## MAFES awards given at 1997 annual conference

Award presentations to MAFES employees and branch stations were part of the 1997 MAFES-Extension annual conference November 6-7 at the Bost Extension Center at Mississippi State University.

MAFES employees Mark Kurtz, Ralph Brown, and Glover B. Triplett, Jr., were recognized for receiving national awards.

The Interregional Project 4 Technical Committee (IR-4) honored Kurtz with a resolution for "Contributions to Agriculture on a National Level." IR-4 is a USDA program to help producers of minor crops obtain registration of pesticides needed by their industries. Kurtz, plant physiologist at the Delta Research and Extension Center, served as IR-4 state liaison from Mississippi for 12 years.

Brown received the Rural Sociological Society Early Career Award, which included a $6,000 stipend to support him in his professional development. He is associate professor of sociology

with a joint appointment as an associate rural sociologist in the Social Science Research Center.

Agronomist Triplett was recognized for being named an American Society of Agronomy Fellow. Triplett and his colleagues developed management systems for no-tillage production based on their research in soil fertility and plant nutrition, the effect of mulch cover on soil moisture and on crop productivity for various soils, rainfall infiltration into untilled soil, and crop response to tillage. They demonstrated that leaving the soil untilled and mulch-covered helps stabilize the surface so that it resists erosion even when mulch is removed.

David Shaw received the MAFES Grantsmanship Award for bringing in the most grant dollars for awards -- more than $700,000.

The weed scientist was an investigator, along with David Evans and Wes Burger of the Forestry and Wildlife Research Center, Roger King of the Engineering Research Center (ERC), and Michael Cox of MAFES, for a project funded through NASA's Mission to Planet Earth. The $500,000 facilities development grant from the space agency was used to establish the Southern Remote Sensing Research and Training Center.

Shaw is also participating in projects funded by the USDA Cooperative States Research, Extension, and Education Service and the Mississippi Soybean Promotion Board (MSPB) to develop precision weed management strategies in soybeans using remote sensing.

In addition, Shaw has an active research effort in the environmental fate of herbicides. Funding through the Water Resources Research Institute has focused on the selection of novel species as vegetative filter strips to reduce off-site movement of herbicides in runoff.

Funding through the MAFES state-supported research initiative in water quality has been used to assess surface water quality in the Mississippi Delta, to determine the impact of tillage systems on herbicide movement, and to refine detection techniques for herbicides.

Shaw received substantial funding through various agrichemical companies to support his research efforts in soybean and wheat weed control.

The Black Belt, Coastal Plain, and Delta branches each received a MAFES Award for Excellence in Facility, Grounds, Maintenance, and Image of MAFES.

Food Scientist Zahur Haque received the MAFES Outstanding Scientific Publication Award for "Thermal Gelation of B-Lactoglobulin AB Purified From Cheddar Whey," which was published in the Journal of Agricultural Food Chemistry. Mallika Sharma was co-author.

An award was also presented for the MAFES Publication With Most Relevance and Potential Impact to Mississippi Agriculture. Entomologist Aubrey Harris received this award for the bulletin "Monitoring Node Above White Flower as Basis for Cotton Insecticide Treatment Termination." Co-authors were fellow Delta Research and Extension Center employees Fred Cooke, Gordon Andrews, and Randy Furr.

## Tupper named Outstanding MAFES Worker

Agricultural Engineer Gordon R. Tupper has been named the 1997 Outstanding MAFES Worker. He received a $2,000 cash award and a plaque from Mississippi Chemical Corporation at the MAFES/Extension annual meeting.

MSU graduate Brent Langley, manager of field sales for Mississippi Chemical, presented the award for excellence in research to Tupper. Langley said Tupper's research during 28 years with MAFES has increased income and savings to cotton farmers by millions of dollars.

Although his work with cotton covers many different areas, two particularly stand out. The engineer designed a new subsoiler that reduces soil disturbance and power requirements. He also developed a deep-placement fertilizer applicator. Both are widely used across the Delta.

The inventor's low-till parabolic subsoiler, designed in 1993, has out-performed other subsoilers in increased yields and performance rates. It is also cheaper to pull and maintain than other subsoilers

in use.

Robroy Fisher, chairman emeritus of the Delta Council Advisory Research Committee, said Tupper "took a theory developed in England decades ago and combined it with basic research from Auburn University some 40 years ago and designed the parabolic subsoiler," which increased Cotton Belt yields by 100 to 150 pounds of lint per acre.

## Use of constructed wtlands in catfish production

The overall goal of this research project is to evaluate the effectiveness of constructed wetlands in improving water quality in aquaculture ponds and assess the potential economic benefits and costs associated with the new technology. The specific objectives of this research project are the following:

1) Evaluate the effectiveness of constructed marsh systems for improving water quality in aquaculture ponds.

2) Determine optimal design and operating criteria for constructed marsh systems used in pond culture.

3) Determine the accompanying reductions in risk of crop loss, incidence of off-flavor, and release of nutrient-laden effluent into the environment.

4) Determine the improvement in fish growth and feed conversion arising from the new technology.

5) Document the costs vs. benefits of using this technology in pond culture.

6) Provide information and technology transfer to the pond-culture industry.

The initial experiment conducted in 1993-94 at the MSU Coastal Aquaculture Unit evaluated the effectiveness and design criteria of newly constructed wetlands in improving water quality in ponds stocked with 5,000 catfish fingerlings per acre. The design criteria and effectiveness of the mature constructed wetlands in improving water quality in ponds stocked with 6,000 and 8,000 catfish fingerlings per acre were further evaluated during the 1995-96 and 1997-98 experiments, respectively.

The expected improvements in water quality among treatment ponds were achieved as the marsh systems reached maturity. Results show that after three growing seasons, the constructed wetlands have shown peak removal efficiencies.

Lower concentrations of selected water-quality variables (e.g., total ammonia, nitrite, nitrate, total suspended solids, total phosphorus) were observed in ponds with constructed wetlands. At a higher stocking density of 8,000 catfish fingerlings per acre, ponds with standard wetlands (25% of pond size and 2-day retention time) showed the highest removal efficiencies.

Preliminary economic analyses of the use of constructed wetlands in a 48-acre multienterprise

Mississippi Black Belt farm showed that the average annual cost of catfish production will increase by 7 to 8 cents per pound of catfish harvested. As the documentation of the effectiveness

of marsh systems in reducing water-quality problems progresses, future work could take several directions.

First, changes in marsh-system function with age need to be evaluated. After three catfish growing seasons, the constructed wetlands are already mature and have shown peak removal efficiencies.

Second, there is a need to evaluate the potential of improving yields of marketable fish through increased stocking densities to justify the added costs associated with the construction and operation of the wetlands.

Third, there is a need to investigate the culture of other economically valuable and environmentally sensitive finfish species (e.g., hybrid striped bass, freshwater prawns) to convert marked improvements in water quality into higher yields and revenues.

Finally, conducting pilot tests of this new technology in commercial scale in cooperation with the fish farming industry would be desirable.

Posadas is a marine economist at the Coastal Research and Extension Center. LaSalle is an associate specialist at the Center.

## Insulin can have positive effects on swine reproduction

Swine fertility can be increased by administering insulin to sows that have just weaned their first litters, according to results of MAFES research. Insulin was shown to increase ovulation rate, increase egg survival, and dramatically decrease the time between weaning and estrus. Related results indicated that administration of the growth hormone porcine somatotropin (pST) also benefits swine fertility. However, the positive effects of both insulin and pST may be contingent upon providing extra feed to sows while they are recovering from the stress of lactation and preparing for their next estrous cycle.

The porcine ovary contains thousands of follicles that contain ova (eggs). For these eggs to be ovulated, the follicles must grow and develop to mature, or preovulatory, size. However, in a process known as atresia, the follicles may degenerate and never release their eggs. Even eggs that are ovulated and eventually fertilized may not be able to implant as an embryo in the female uterus and then survive throughout gestation. So, both the number of eggs released from the ovary (ovulation rate) and embryo survival are elements involved in determining litter size in swine.

There are many factors that could influence ovulation rate and/or embryo survival, including nutritional status or metabolic hormones associated with nutritional status, such as insulin. Insulin is normally secreted by the pancreas when blood glucose is high, causing cells to take up the glucose for energy. When insulin is absent or very low, such as in untreated diabetes, ovulation does not occur, and pigs are infertile.

Post-lactational sows that have just weaned their first litters (primiparous sows) are especially sensitive to alterations that could influence reproduction. These sows are still allocating energy for growth and are trying to recover from the recent stress of lactation while also undergoing rapid preovulatory follicular growth (within 5-7 days). Therefore, a highly productive primiparous sow may experience a decrease in litter size or farrowing rate, making this animal model a prime candidate for reproductive optimization studies.

MAFES studies showed that insulin administration to normal cyclic gilts increased ovulation rate and decreased follicular atresia, but it must be used carefully to avoid other health problems. One study demonstrated that administration of insulin after weaning to more that 300 primiparous sows on commercial farms increased litter size. However, insulin causes a dramatic decrease in blood glucose (hypoglycemia) and may be life threatening if overdosed or given before adequate feed intake has been reached. This danger is the main limitation to the use of insulin on commercial farms.

Insulin was also shown to alter hormones such as insulin-like growth factor-I (IGF-I), which stimulates growth and health of the follicle. We found that insulin administration to sows after weaning decreased overall expression of the gene that controls the amount of IGF-I in the follicles. Insulin also decreased the hormone estradiol in large follicles; estradiol is an indicator of the health and developmental stage of follicles.

Other proteins associated with IGF-I, known as IGF-binding proteins (IGFBP's), generally inhibit IGF-I action. Insulin administration was shown to increase IGFBP's associated with immature follicles (IGFBP-4 and -5). However, insulin decreased IGFBP-2, which is associated with unhealthy follicles.

In the first study, pigs were fed a typical amount of feed for post-lactational sows. A follow-up study was initiated to gain a better understanding of how insulin works, with the ultimate goal of identifying safer methods to enhance swine fertility. In the second study, the researchers wanted to see if providing extra feed would alter follicle development in a manner different from that seen in the first project. This follow-up study also examined the use of pST on follicle development. In the follow-up study, 9 sows were given saline, 10 were given insulin, and 10 were given pST for 5 days after weaning and were fed 20 percent more feed than in the previous experiment.

These treatments had no effect on the total number of follicles, but enhanced fertility was still seen in insulin- and pST-treated sows. Both pST and insulin increased estradiol in medium and large follicles, indicating more healthy or more developed follicles. In contrast, only pST increased IGF-I, which enhances growth and health. IGFBP, which is found in unhealthy follicles, was not increased by either insulin or pS T. These findings indicate that both insulin and pST influence follicles in a positive manner, but they work through different methods and may require extra feed.

A third study, now underway, found further evidence of the benefits of insulin. In the earlier studies, the weaning to estrus interval (nonproductive days in which the animal is not nursing a litter and is not pregnant) was not influenced by insulin administration. But in a recent experiment using 43 sows, insulin decreased the weaning to estrus interval by almost 2 days.

Although still working on fine-tuning the mechanism, the researchers feel confident that insulin gives a positive signal. Overall, it is felt that insulin can positively influence reproduction, but the manner in which it works depends upon the metabolic state of the animal.

Cox is a professor and Whitley is a graduate research assistant in the Department of Animal and Dairy Sciences. Cox is also an assistant director in MAFES.

## MAFES Publications

Copies of MAFES publications are available at no cost while supplies last. This is a list of the

titles published during 1997. Requests, including number and title, should be sent to MAFES Publications, Office of Agricultural Communications, Box 9625, Mississippi State, MS 39762-9625.

Bulletins

1065--Beef Cow-Calf Production as Influenced by Forage Management System. March 1997.

994 (Revised--Soybean Yield Increases in Mississippi due to Rotation with Rice. April 1997.

1066--Costs and Returns for Cotton, Corn, and Soybeans in the Brown Loam Area of Mississippi, 1995. May 1997.

106--Soils of Native Prairie Remnants in the Jackson Prairie Region of Mississippi. June 1997.

1068--Monitoring Node Above White Flower for Cotton Insecticide Treatment Termination. June 1997.

1069--Pedigrees of Upland and Pima Cotton Cultivars Released Between 1970 and 1995. June 1997.

1070--1994-95 Mississippi Sweetpotato Cultivar Evaluations. July 1997.

1071--Beef Production from Holstein Steers on No-Till Ryegrass Pastures. October 1997.

1072--A Modified Implement for Constructing Wide Beds for Crop Production. Publication Pending.

Technical Bulletins

213--Form-Fill-Seal Machine for Mass Rearing Noctuid Insects. April 1997.

214--Effect of Vegetative Filter Strip Width on Reducing Fluometuron and Norflurazon Losses in Surface Runoff. April 1997.

215--Effects of Soybean Tillage Systems on Imazaquin Persistence. April 1997.

216--Potential Stale Seedbed Herbicide Combinations for Cotton. April 1997.

217--A Study of Cotton Insect Control Problems in Mississippi During 1995. June 1997.

218--MSTAX: A Computer Simulation for Mississippi Counties and Cities Designed for Tax Appraisal, Assessment, and Settlements. Publication Pending.

Information Bulletins

314--1996 Cotton Variety Trials. February 1997.

315--1996 Soybean Variety Trials. February 1997.

316--Turfgrass Weed Control Research Report. January 1997.

317--1996 Research Progress Report of the North Mississippi Research and Extension Center. February 1997.

318--1996 Research Progress Report of the Central Mississippi Research and Extension Center. February 1997.

319--Highway Vegetation Management Research Report. March 1997.

320--Weed Control Investigations in Soybeans and Wheat - 1996. March 1997.

321--Disease Investigation in Cotton, Rice, and Soybeans in the Mississippi Delta. March 1997.

322--Nematode Management Investigations in Mississippi. June 1997.

323--Forage Crop Variety Trials. August 1997.

324--Development and Implementation of Fisheries Bycatch Monitoring Programs in the Gulf of Mexico. August 1997.

325--Corn for Silage Variety Trials 1997. November 1997.

326--Corn for Grain Variety Trials 1997. November 1997.

Research Reports

22:1--Economics of Monocrop Winter Wheat on Clay Soils in the Delta. January 1997.

## Publications available online

Many MAFES publications are now available on the World Wide Web for those with Internet access. The publications are being posted electronically in no certain order. However, authors who want to request that their publications be given priority for posting should contact MAFES Assistant Director Nancy Cox.

Internet users may access these publications directly at mafes.msstate.edu/mafes/pubs. MAFES Research Highlights is also available electronically at mafes.msstate.edu/mafes/highlights. Back issues since May-June 1995 are online.

The MAFES Publications and MAFES Research Highlights sites can also be accessed via the MAFES Homepage at mafes.msstate.edu/mafes. Another route is through the MSU Division of Agriculture, Forestry, and Veterinary Medicine's homepage at mafes.msstate.edu/division.

This is a list of publication titles posted online as of December 15:

Bulletins

B995--Soybean Response to Quinclorac and Triclopyr.

B1015--Fall Deep Tillage of Clay: Agronomic and Economic Benefits to Soybeans.

B1021--Redvine Control in No-Till Soybeans With and Without Irrigation.

B1050--Costs and Returns for Cotton, Rice, and Soybeans in the Delta Area of Mississippi, 1994.

B1065--Beef Cow-Calf Productivity as Influenced by Forage-Management Systems.

B1070--Mississippi Sweetpotato Cultivar Evaluations for 1994, 1995, and 1996.

B1071--Beef Production from Holstein Steers on No-Till Ryegrass Pastures.

Information Bulletins

IB287--Wheat and Oats - 1995 Variety Trials.

IB295--Soybeans--1995 Variety Trials.

IB315--Soybeans--1996 Variety Trials.

IB324--Development and Implementation of Fisheries Bycatch Monitoring Programs in the Gulf of Mexico.

IB325--Corn Hybrids for Silage, 1997.

IB328--Soybeans--1997 Variety Trials.

Technical Bulletins

TB204--Open Storage of Soybean Seed in Mississippi.

TB210--Effect of a Long-Juvenile Trait Upon Flowering in Soybeans Grown in Short and Long Photoperiods.

Southern Cooperative Series Bulletins

SCSB386--Preservation and Utilization of Germplasm in Cotton.

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