MAFES Research Highlights

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Contents

From the Director

My first full year as Experiment Station director has been the most exciting year of my professional career. It has provided non-stop opportunities to interact with a broad cross-section of people and to develop a much deeper appreciation of Mississip pi's great natural resources. It has been a pleasure to help position our clients in a competitive place in the global economy supported by a strong research program.

One of the most gratifying things that I've seen during my 32 years at Mississippi State is the deep concern that the Experiment Station faculty and staff have for the world around them. MAFES scientists work on real problems that face Mississippi and often have the pleasure of seeing the fruits of their labors put to work in their State.

Over its 110 years the Experiment Station has changed to meet the needs of today's agriculture, but the basic philosophy remains the same: meeting the food and fiber needs of society through sound science that provides good stewardship of the natural r esources entrusted to us.

Our basic goals are to:

- Protect and enhance environmental quality and conserve natural and renewable resources.
- Increase value added from processing Mississippi's agricultural products and enhance food safety, quality, and market efficiency.
- Enhance the socio-economic development of rural communities, the farm family, and the economy of Mississippi.

- Enhance animal and crop production systems.
- Enhance the efficiency of the aquaculture and seafood industry in Mississippi.

We deal with a wide range of sciences, but emphasize five major programs:

1. Remote sensing/precision agriculture
2. Biotechnology
3. Environmental monitoring
4. Animal waste management
5. Food quality and food safety

This annual report spotlights a number of projects that are making a difference and takes you to every corner of the State where we conduct our research.

In the Delta, our involvement in the Mississippi Delta Management Systems Evaluation Area is helping the state get ahead in developing well-balanced agricultural environmental policies.

From outer space to the fields of Mississippi, precision farming research is bringing NASA and MAFES together to make our farms even more efficient and environmentally sound.

Our economists are working to broaden Mississippi producers' toolkits for managing farming's inherent and increasing risks.

Vance Watson, MAFES Director

Resources Used Wisely

The Mississippi Agricultural and Forestry Experiment Station conducts research under State and Federal mandates and in partnership with other agencies and industries. Throughout the 1990s, funding has shifted to greater dependence on non-appropriated sources.

In 1990, the State of Mississippi appropriated $16.52 million (67.8 percent of the MAFES budget), the Federal government appropriated $4.3 million (17.8 percent), and sales and other sources generated $14.4 million (42 percent). Grants, contracts, and designated funds provided an additional $11.7 million for an operating total of nearly $36 million.

Over the decade, Federal funds have dropped as a portion of total funds. Meanwhile, the proportion of the total funds depending on non-appropriated dollars increased to being nearly equal with the State appropriations which have remained relatively sta tic.

From 1990's $16.52 million State appropriation to the decade low of $13.97 million in 1992, MAFES appropriations have worked back up to $20.22 million for 1999.

Since 1993, the Experiment Station has benefited from Educational Enhancement Funds from a 1 percent tax set by the 1992 Legislature. Despite a 13.2 percent growth in actual State appropriations since 1990, the station's portion of the state budget ha s decreased from .87 percent ($1.908 billion total State outlay) in 1990 to .60 percent ($3.119 billion state budget) in 1999.

High-tech Agriculture Improves Mississippi

By Rebekah Ray

Today's technology and research are helping agriculture expand as never before. Discoveries arise daily and are waiting at our fingertips. MAFES and Mississippi State University work closely together to keep farmers, farm suppliers, and other members o f the agricultural community informed through the latest research findings.

MAFES research is coordinated through four Research and Extension Centers located across the State, including Biloxi, Raymond, Stoneville, and Verona, in addition to Mississippi State University. At 14 branch sites, MAFES scientists carry out research under conditions similar to those on farms. Researchers maintain close contact with cooperating producers to ensure that actual needs of Mississippi farmers are being met.

Begun 110 years ago, the Mississippi Agricultural and Forestry Experiment Station has worked closely with farmers as agriculture, the world's basic industry, has changed to meet society's demands. True to its purpose, MAFES works to meet the food and f iber needs of society through sound science that provides good stewardship of natural resources.

Agriculture is one of the Mississippi's most important industries, and farm income contributes about $4.8 billion annually. The total value-added increase from agriculture and forestry-related industries is over $15 billion, or about 26 percent of the gross State product. The State has about 43,000 farms, and crops provide about 35 percent of the State's annual farm income.

Mississippi ranks fourth among the 50 states in cotton production, the State's most valuable row crop. Soybeans are the second most valuable row crop.Other crops include rice, hay, wheat, corn, sweet potatoes and pecans.

Livestock, poultry, and catfish provide 40 percent of the State's yearly farm income. Broilers, eggs, catfish, and beef cattle are Mississippi's most valuable livestock. The State ranks fourth in marketing broilers. Dairy products, hogs, and other anim als round out this sector.

Forests cover more than half our State, and we typically rank among the top 10 leading states in the value of forestry production. Among the individual commodities, forest production income is second only to poultry in the State with a value of more th an $1.2 billion. Mississippi is third in the nation in pulpwood production.

Mississippi leads all states in farm-produced freshwater catfish, which yield an annual income of nearly $266 million.

As farm product demand continues to increase, the agricultural world faces problems brought about by declining numbers of farmers, decreasing labor and greater chemical use restriction. To help farmers meet the demands for their crops, MAFES scientists are employing new technologies, innovations, and a renewed dedication to agriculture. MAFES scientists and educators are also assisting Mississippi farmers on how best to apply this wealth of information.

New agricultural technologies such as computerized management systems, agricultural chemicals, genetically engineered plants resistant to insects and weeds, and precision farming using remote sensing and satellite imaging help Mississippi's farmers inc rease production and reduce costs.

To encourage a renewed dedication to agriculture, MAFES functions in five areas: remote sensing/precision agriculture; biotechnology; environmental monitoring; animal waste management; food quality and food safety.

Remote Sensing / Precision Agriculture - Precision farming, remote sensing, and satellite technology are helping farmers improve crop yields and reduce weed infestation. This space-age technology is enabling farmers to increase yields per acre a t a lower cost. The process and benefits of using precision farming are featured in this issue of Highlights in the article, "The Final Frontier Facilitates Farming."

Biotechnology, Environmental Monitoring and **Animal Waste Management** - Ham, bacon, pork sausage, and pork chops may be favorite dishes, but not all that comes from the swine industry has been held in such high regards. Our gain also has a downside - odors and solid wastes.

To help alleviate this problem, a group of Mississippi State University scientists led by associate professor of Agricultural and Biological Engineering Timothy N. Burcham developed a research program to study odors emanating from swine production faci lities and ways to make them more manageable. The team was funded by MAFES in a competitive grant program targeting environmental issues.

Since individuals have different thresholds for odors, the issue of actually measuring odor becomes very complex. To complicate matters even more, several hundred distinct odor compounds have been identified from swine waste. Team member Keith Cadwalla dar, associate professor of Food Science and Technology, will develop an expert panel composed of 10 to 12 individuals trained to assess various swine odors and their intensities.

While the use of human subjects may seem disagreeable, it is essential to this research since the brain is the coding center that registers how pleasant or unpleasant odors are, thus determining individual perceptions of odor. Feedback from this panel will provide subjective data, which will be compared to instrumental analyses of the same odors for objective data.

This research will help determine the correct amount of animal wastes to be used on crops without harming the environment, and is pertinent to cattle, poultry and swine production industries.

Food Quality and Food Safety - Most everyone enjoys eating. It's one of life's many pleasures. Because of research programs such as Food Science and Technology at Mississippi State University, Americans now have many more food choices available than did their grandparents or even their parents. Through research, more foods and food product alternatives are being developed.

Several researchers are testing ways to extend the shelf life of various foods by using organic acids and different packaging strategies to reduce bacteria. Food microbiologists Doug Marshall and Juan Silva, professors in Food Science and Technology, a re conducting similar but independent research projects to lengthen the shelf life of catfish products by improving the safety of these products without adversely affecting the quality. By combining several preservation techniques, such as low temperature s of storage, antimicrobial agents, and low acidities, to preserve food products, they are using the "hurdle technique" to determine which combinations work best for food preservation.

To most of us, bacteria have a bad reputation. *Esherichia coli* is one of the most deadly. Food Scientist MaryAnne Drake is working to reduce some of our fears of *E.coli*. By developing rapid bacteria detection methods on various foods, she is researching new ways to determine food-born pathogens such as *E.coli 0157:H7,* a bacterium that causes food-borne illnesses and can be fatal.

Food Science Professor Zee Haque is researching ways to utilize whey protein and is testing how it responds in different functions ranging from foam to gels to retaining shapes.

About 70 to 80 percent of milk is converted to cheese in this country. Whey contains about 20 percent of milk protein, so protein benefits are also lost when the whey is discarded. Research is showing this by-product is functional, nutritious, and has positive health effects such as reducing blood pressure.

Through entities such as MAFES and the Extension Service, Mississippi State University is continuing to reach out to serve all Mississippians. Research, extension, and education improve life for all of us.

Research Must Help State Face Market Changes

By Bonnie Coblentz

Strategic, long-term planning is the only way to stay ahead in today's global markets, a former U.S. Secretary of Agriculture and ambassador told Mississippi agriculture leaders recently.

"The bottom line of the challenge is how do we go about getting more people around the world to spend more dollars on Mississippi agriculture and forestry products," said Clayton Yeutter, who also served as president and chief executive offic er of the Chicago Mercantile Exchange.

Yeutter's comments came in April at the Agricultural Economic Summit hosted in Jackson by the Mississippi Agricultural and Forestry Experiment Station and the Division of Agriculture, Forestry, and Veterinary Medicine at Mississippi State University. T he summit brought together the State's agriculture leaders to map out goals for Mississippi's future.

"You can no longer think in terms of Mississippi and U.S. markets," he said. "You have to think in terms of global markets because that's where your competition is."

Mississippi has a good resource base from which to expand, Yeutter said. However, the State must do more than supply commodities.

"It's hard to get rich in the commodity business," Yeutter said. "To beat competition, you have to differentiate. Improve the quality or change the character of the product to give it marketability it doesn't have today."

Outside investment also is needed for growth in Mississippi's agriculture and forestry sectors. Yeutter said, "I suspect there is no state in the U.S. that doesn't need outside investment. With investment comes jobs."

Research helps keep Mississippi competitive in the global markets.

"The big edge the United States has today over the rest of the world is technology, and the only way we're going to keep that edge is through research," Yeutter said.

To compete globally, Mississippi must consider where its markets will be in 10 to 15 years. Latin America, one of the world's fastest growing areas, is virtually one of Mississippi's neighbors.

"Somebody will sell lots of products in Latin America," Yeutter said. "You have to be sure you do a better job marketing there than do others."

Kenneth Hood, chief executive officer of Perthshire Farms in Gunnison, says the days are gone when hard work, good weather, basic tools, and few insects meant success on the farm.

"To survive in today's global economy, farmers must rely on the knowledge and experience of research to help guide them through this new technology," Hood said. "Mississippi State University must play an important role as a partner with agribusiness, government agencies, technology suppliers and commodity groups. The alternative is a useless technology and a useless science."

As a producer, Hood looks to the Mississippi Agricultural and Forestry Experiment Station for research and validation of research, and to the Mississippi State University Extension Service to deliver the information.

Mitch Stennett, president of the Economic Development Authority of Jones County and president-elect of the Southern Economic Development Council, said agriculture plays a major part in economic development, along with manufacturing, mining, and tourism .

For rural communities to be revived, immediate needs such as water supply, high-speed networks, advanced technology training, wastewater treatment, and solid waste disposal must be met.

"The biggest challenge we face today is determining what our roles are," Stennett said. "We are stakeholders in agriculture and forestry in the State."

Farmers and Scientists Lead the Way to Improve Water Quality

By Linda Breazeale

Mississippi farmers have a history of concern for their environment. After all, they depend on it for their income, their families' health, and their year 'round enjoyment. Recent research indicates that current agricultural practices are improving the State's water quality.

For years, monitoring efforts were directed toward industries and cities with a pipe or pipes emptying waste water back into the environment. Today, there is an increased focus on non-point source pollution, such as storm drains, septic tanks, and agri cultural lands. Mississippi farmers and researchers have been preparing for this increased awareness.

"Research is showing that agriculture is not the bad guy some people make it out to be. Farmers are leading in cleaning up the environment with their voluntary practices, " said Jonathan Pote, MAFES researcher and co-chairman for the Mississ ippi Delta Management Systems Evaluation

Area Technical Steering Committee.

The MSEA, developed since 1995, combines the efforts of Federal, State, and local agencies to evaluate water quality enhancement programs at three oxbow lakes in two Delta counties. Oxbow lakes are water impoundments that remain after a river changes i ts course.

"The agricultural trends were already in place to make these lakes better than when we started the research about 4 years ago, " Pote said. "Water quality in the U.S. was at its worst in the '60s and '70s when Rachel Carson's *Silent S pring* blamed the general use of DDT for the destruction of bird populations. We didn't realize the impact we were having on the environment. "

Pote, director of the Water Resources Research Institute at MSU, said today's pesticides have shorter life spans, making any efforts to remove chemicals even more effective.

"Farmers in the '90s are plowing less and keeping away from the edge of the water, following soil sample information and using less fertilizer, and using safer chemicals with shorter life spans, " Pote said.

Charles Ed Snipes, MAFES plant physiologist and MSEA lead agronomist, explained that the project is validating practices used for some time. Farmers have been using many Best Management Practices (BMPs) that never have been scientifically evaluated.

"We're being proactive and gathering facts to support realistic environmental policies, " said Snipes.

Frank Gwin, Jr., project coordinator, is responsible for the daily operations and serves as the liaison between 11 farm operations, 19 agencies and private organizations, and 49 scientists.

"The major problem had been with soil eroding into the lakes. They are much clearer now, " Gwin said.

There is a balancing act in decreasing soil loss, the greatest threat to Delta water quality" said Gwin. "If the water flows off too fast, it erodes the soil; if it moves too slow, the standing water kills crops and keeps farmers from working in the fields. "

Robert Seyfarth, chief of the Water Quality Management Branch of the Department of Environmental Quality in Jackson, said efforts are made to monitor erosion and the nutrients attached to the soil particles entering lakes and streams.

"Our job is to monitor the amount of pollutants that can enter the water and it still support its use, such as fish and wildlife habitat, municipal water, or recreation uses, " Seyfarth said. "Preventing soils from entering lakes will re duce the muddy water as well as the amount of chemicals entering the lakes."

"DEQ has been encouraging farmers toward practices that would reduce non-point source pollution, but until now, there has not be much data to verify the effectiveness of these practices, " he said.

Project developers chose three lakes in the heart of Mississippi's agriculture surrounded by farms using conventional tillage methods. The lakes are located in the southern portions of Sunflower

and Leflore counties between the Yazoo and Big Sunflower rivers.

- **Thighman Lake** - Size: 20 acres - Sunflower County
  No changes were intentionally made by the researchers, but since research began in 1994, surrounding farmers have elected to grow more corn and soybeans which require less intensive soil work than cotton. Some growers also have begun using no-till met hods, which benefits the lake as well.

- **Beasley Lake** - Size: 60 acres - Sunflower County
  Researchers added new structural practices such as filter strips and slotted board risers to minimize sediment entering the lake. Conventional tillage practices continued around the lake. Monitoring stations have been established around Beasley Lake to tr ack the breakdown of pesticides and nutrients, especially in a riparian buffer zone. This research may lead to recommendations concerning the use of vegetation and structural practices as a best management practice.

- **Deep Hollow Lake** - Size: 20 acres - Leflore County
  The most intense agricultural changes were proposed for Deep Hollow Lake. Farmers agreed to structural additions and to follow best management practices to improve the quality of the lake water. BMPs included conservation-till cotton and no-till soybeans with a winter wheat cover crop, hooded pesticide sprayers, and weed sensor technology.

All three lakes went through a renovation and were re-stocked with comparable fish populations. Water quality changes are monitored over the course of the project. Dissolved oxygen, acidity, conductivity, and temperature are measured hourly at thr ee sites on each lake. An automated sampler takes daily water samples for sediment analysis and plankton.

Gwin said the greatest improvements have occurred in the Deep Hollow Lake, where the most aggressive efforts have been made to help water quality. However, all three lakes show improvement since the research began.

"These are some of the most innovative farmers in the Delta. They are very interested in gathering this scientific data for future policies, " Gwin said. "Even without the project, they would be working to improve the water quality of th e lakes. "

One of the major factors in whether or not some of the new technologies are accepted is cost. For example, Gwin explains the new hooded sprayer with sensors being used at Deep Hollow costs about $40,000; the global positioning system adds another $10,0 00. With the price of most major crops just above the break-even mark, that sort of commitment is difficult to make.

Don Linn of Sunflower County is one of the Beasley Lake farmers who have volunteered for the project. He has two goals for the research: to establish science-based data for future policy decisions and to discover the best, most economical ways to impro ve water quality.

" We want policies to be formed out of good science. This project offers a real opportunity for some accurate scientific data to be gathered and used, " Linn said. "As future policy is formulated for non-point source pollution or agricul tural runoff, this will be the background for a good, strong scientific basis for those decisions. "

Linn said farmers involved in the project already have learned techniques they weren't aware of 4

years ago.

"We learned that some simple practices could be as effective, or almost as effective, as the more exotic options, " Linn said.

Duane Gill of the Social Science Research Center at MSU is surveying Delta farmers to determine the likelihood of their adopting some of the best management practices being studied in the MSEA project.

"Apparently, farmers with land near an oxbow lake are more likely to use BMPs, such as grass strips around crops. We're trying to learn more about why farmers choose whether to use best management practices, " Gill said. "Economics will be an important issue, but other factors enter into the decision as well. We also want to see what it might take to persuade more farmers to incorporate best management practices on their farm. "

"This is the only MSEA water project located on lake watersheds in the country, " said Snipes. "Other projects are on streams and/or on significantly different soils. Results from this research will be important across this region of the United States and around other lakes near active agricultural lands. "

Charlie Cooper, Research Leader and Ecologist with the Agricultural Research Service's National Sedimentation Laboratory in Oxford, said cooperation has been the key in this MSEA project.

"In a day and age when budgets are shrinking and needs are increasing, partnering is paramount in research, " Cooper said. "No single agency could have pulled this research together by itself. "

Water Quality Headstart

By Jonathan Pote, co-chair Technical Steering Committee

The project was begun because we knew Mississippi farmers already were using many practices designed to protect the environment, but there were no large-scale projects to show how well these worked. Midwestern Management System Evaluation Area projects had shown that such practices as leaving behind corn stubble were positive, but even such well-accepted southern practices as winter flooding of fields had never been documented.

Near the beginning of the project in 1995, the Environmental Protection Agency had begun to release reports implicating agricultural non-point source pollution as a primary player in damaging rivers and lakes. We knew that agriculture had changed drama tically since the '60s, and we knew that many of the newer practices beginning to be accepted would have even more positive impact.

The MSEA Project is allowing us to: (1) find out how well these practices actually help water quality; (2) determine if they are economically feasible; and (3) find out how well they are generally accepted by the farmers.

In addition to showing how well existing practices work, farmers want to begin finding the next generation of management practices. These tend to be the ones which, in combined form, are called precision farming.

MSEA Glossary

BMP - best management practices; the optimum agricultural practices that ensure a balance of environmental and economic interests.

Filter strip - vegetation planted between cultivated land and a body of water.

No-till - seed planting without extensive disruption of the soil.

Oxbow lake - remnant of a meandering flood plain river.

Riparian zone - wooded bank of a natural body of water.

Slotted board riser - miniature dam-like structure used to control the flow of runoff water from a field.

Watershed - the drainage area that feeds a given stream or river.

Weed sensor - a device that senses chlorophyll and sprays pesticides precisely where weeds are growing.

To follow the MSEA Project on the World Wide Web, visit...

www.nal.usda.gov/wqic/wgwq/miss.html
U.S. Department of Agriculture's Working Group on Water Quality

www.agry.purdue.edu/agronomy/hua/us_hua.htm
USDA Water Quality Projects

Electronic Mail: Mdmsea@tecinfo.com

The Final Frontier Facilitates Farming

By Linda Breazeale and Rebekah Ray

Neil Armstrong's "one small step for man, one giant leap for mankind" on July 20, 1969, also was a step that one day would help Mississippi farmers make better use of their time, land, and resources.

Farm technology has made great strides over recent years, but now the sky is the limit with a new partnership. NASA, Mississippi State University, the USDA, and Spectral Visions, a unit of the Institute for Technology Development, have formed the Missi ssippi Coalition for Applications of Remote Sensing (MCARS) to incorporate satellite technology and farming. The MSU component of MCARS includes the Engineering Research Center, the Forest and Wildlife Research Center, the Extension Service, the Social Sc ience Research Center, and MAFES.

"The time and place is right to bring together expertise in agriculture, natural resources, social sciences and geospatial technology for commercial development, " said David Shaw, a weed scientist with MAFES and project coordinator for MCARS . "Through this, Mississippi can

become a leader in remote sensing research, an integral part of precision farming. "

In precision farming, satellite images precisely graph fields so farmers can determine proper application rates of fertilizers and herbicides. Satellite images plot fields into grids that range from 3 feet to 1 acre square. A global positioning system (GPS) is mounted either on the tractor or inside a crop-dusting airplane and will take actual readings of plant heights, weed infestations, or soil characteristics. This information forms a database in an onboard computer and will tell a variable-rate ap plicator how much fertilizer or herbicide to spray.

Precision farming involves collecting and analyzing data and then plotting a weed population map. Next, a herbicide population map is designed and programmed into sprayers so one or more chemical treatments can be administered. This process can save fa rmers money and protect soil from improper chemical treatments. The space age has entered agriculture as average farming turns into precision farming.

"Other universities are also conducting precision farming research, but MCARS will go beyond those, " Shaw said. "Having a NASA facility in Mississippi provides us with quick access to space technology, which we are using to help farmers produce better crops through precision farming. "

Located in Bay St. Louis, on the Mississippi Gulf Coast, the John C. Stennis Space Center is one of NASA's lead centers for commercial remote sensing and assists companies involved in land-use planning, environmental consulting, and natural resource ma nagement. One of 10 NASA field centers in the United States, Stennis is NASA's primary center for testing rocket propulsion systems for the space shuttle and future space vehicles. The center conducts continual research in science, mathematics, engineerin g, and technology.

"All of the groups involved in MCARS bring something unique to global precision farming. NASA has the ability to generate the satellite images, but is looking for partners to help apply it to agriculture. ITD/Spectral Visions and MSU's Engineering Research Center can develop the computer programs, but need agronomists to collect and understand the field data, " Shaw said.

Roger King of MSU's Engineering Research Center described the joint effort as a "match made in heaven." He said the ERC was looking for new opportunities to use its computational tools. Multispectral information using visible and near-infrare d light is not unique, but NASA's hyperspectral information will provide a much more detailed view from the sky. Hyperspectral sensors identify plant species such as crop plants or weeds and recognize stressors such as insects, nutritional problems, and d iseases.

"We will be developing spectral signatures, or satellite photographs, of these characteristics of the various plants and conditions we are trying to identify, " King said. "This technology will help us determine more than just that a pla nt is under stress; we hope to know what is causing the stress. "

Jac Varco, one of several MAFES agronomists, works with other scientists to obtain detailed data from fields to compare with the satellite images. He focuses on plant nutrients.

"In the past, satellite images have enabled us to identify problems in general, but now we are using the images to establish specific signatures for individual problems, such as drought, disease, insect, and nutrition stresses, " Varco said. "With this type of imagery we can see problems up to 2 weeks earlier that we are able to with the naked eye. "

For instance, soil types can change in a single field. Precision farming enables farmers to treat these weed pockets effectively. One field looks pretty much the same on the surface. Yield maps show why plants grow and produce as they do. Yield mapping gives a picture of the field and shows what's under ground. The work helps scientist understand why things go right or wrong in various spots.

Even though researchers are working to determine reliable, consistent signatures of crops for various conditions, growers cannot depend solely on satellite images to produce their crops.

"Researchers cannot view the pictures and analyze situations accurately without using ground truthing, or personal examination. People will still need to go into fields and take samples to compare with the image. Eventually, we want to distinguish between weeds and crops, analyze soil conditions, and determine how plants respond to light while under stress, "said King.

Traditionally, farmers have treated entire fields with uniform amounts of agricultural chemicals, thus treating crops and undesirable plants equally. Remote sensing allows farmers to customize herbicide applications and reduce production costs, so it i s particularly useful to weed treatments.

"Farmers will be able to put the chemicals they need where they need to in the amount they need to, " Shaw said. They can isolate patches of weeds, treat them, and increase crop production, as well as effectively fertilize crop plants.

GPS technology can help determine projected crop output by analyzing the fertility of soil classifications. Using computerized maps that show more and less fertile areas, farmers use variable rate technology to control the level of fertilizer applied.

Farmers would be able to develop management plans based on satellite or aerial photos, and reduce their reliance on labor-intensive scouting for weeds. Remote sensing technology will enable them to avoid wasting chemicals, lower production costs, and a ddress environmental issues. The anticipated goal is to develop commercial uses for remote sensing in agriculture.

" Through remote sensing, farmers can transfer data from field computers to equipment, and produce their crops more efficiently. This technology can help them make better decisions to remain competitive in the global marketplace, " said Robe rt Merle, a private consultant whose company is trying to build a business based on this technology.

Global positioning also benefits the environment. Sprayers can be shut off in areas where there is a high potential for chemicals to enter a body of water such as a grass waterway. The total load on the environment would drop.

Research without market assessment and proper training would leave the job half completed. A recent NASA equipment grant to MSU has allowed for the development of the Southern Remote Sensing Center, which will be used to develop a training center for i mage analysis and interpretation. Market assessments and evaluations of the economic impacts of these new technologies is also underway.

"Although this technology has not yet become economically feasible to sell to customers, GPS has already been useful in determining drainage problems by showing where those problems are, " said John Tate, an entomologist and private consultan t.

Precision farming is being tested on the Kenneth Hood farm in the North Delta area. On fields where peanuts were planted for 3 years, cotton has now been sown. Satellite photos are showing that these cotton plants are different in color - they are gree ner - from the peanut plants.

The potential for this research goes far beyond tomorrow. The technology seems expensive up front, but when spread across farmlands nationwide and over time, higher yields and reduced production costs will show how affordable this satellite technology is in the long run, said Shaw.

Outlooks for GPS and precision farming are phenomenal. Maximizing output for a given space of land has been a goal of agriculture through its existence. GPS is a very viable solution to meet today's economic realities in agriculture. Farmers, farmer c ooperatives, and crop input dealers are using GPS technology to determine which products will grow more and better.

"The technology is here to stay. It may be the saving grace for our farmers since it could result in lower production costs and also address environmental problems, " said David Laughlin, MAFES agricultural economist.

Words to Know

Geospatial technology -utilization of new tools (i.e. satellite, aerial, ground-based, and/or computational) to geo-reference and collect or disseminate information that can be used for management purposes.

Remote sensing research - detection of differences or changes in land, water, or vegetation through automated data collection methods; typically refers to aerial or satellite images.

Precision farming - management of small subsections of a field individually rather than as a collective average.

Global positioning system - a satellite-based system to determine the precise geographic coordinates at a given moment.

Multispectral information - data from two to five specific wavelengths in the visible spectrum.

Hyperspectral information - data from over 200 specific wavelengths (1-6 nanometer band widths each) from the visible and near-infrared spectrum.

Variable rate technology - application of varying rates of agricultural chemicals based on need, rather than blanket applications across an entire field.

Research That Works

By Robyn Hearn

Diagnostic kit to detect budworm and bollworm eggs

MAFES-supported research led to the development of a diagnostic kit to identify bollworm and tobacco budworm eggs rapidly, inexpensively, and reliably. A prototype of the kit, known as

Hel-**ID**, is being commercialized by Agdia, Inc., of Elkhart, Indiana. Adequate control of the potentially devastating cotton pests depends on selecting the right pesticide for each insect and timing applications to kill eggs and young larvae. However, there was previously no way to identify insect eggs with out expensive equipment and trained technicians. Each *Hel*-**ID** kit allows a farmer to test 96 eggs collected from the field. In less than 3 hours, *Hel*-**ID** identifies whether each egg contains a bollworm, a budworm, or neither. *Hel*-**ID** uses "monoclonal antibodies" that bind to specific proteins in the bollworm and budworm eggs.

Unique cotton yield monitor

MAFES engineers are developing a novel sensor to measure the yield of cotton as it is being picked. The sensor -- which monitors the amount of cotton picked by measuring the sound that the bolls make as they enter the harvester -- is designed to be clamped outside the picker duct. Unlike optical yield sensors, this technology is easy to install, and it is not impaired by debris that accumulates in the harvester. While the technology is being developed for use on cotton pickers, experiments are underway to adapt it for use in harvesting soybeans, rice, and corn.

New techniques to bioengineer soybeans, other crops

New genetic engineering techniques developed by MAFES plant scientists could take years off the time it takes to create new and improved varieties of soybeans, corn, rice, kenaf, and cotton. These quicker, more efficient processes are being used in efforts to produce root-knot-nematode-resistant corn, herbicide-resistant rice, herbicide-resistant and Bt kenaf, and soybeans resistant to the soybean mosaic virus and the bean pod mottle virus. After refinement of techniques being developed for cotton, they too will be used for crop enhancement. Overall, the process uses a commercial "gene gun" to introduce new DNA into plant cells, followed by unique regeneration systems to grow transgenic plants from the altered cells.

Enzyme to control major corn pests

Research continued on the Mir1 gene, which MAFES and USDA-ARS scientists found to produce an enzyme that makes some corn varieties resistant to the fall armyworm and other caterpillar pests. In efforts to find the switch that activates this gene, researchers discovered large increases in accumulation of the Mir1-generated enzyme in the whorls of resistant corn plants around areas of insect-feeding damage. Understanding how Mir1 functions could lead the scientists to develop techniques to increase a plant's concentration of this newfound insecticidal enzyme. If Mir1 can be successfully introduced into the DNA of nonresistant corn varieties, it could replace or augment the Bt gene.

High-yielding cotton variety

A high-yielding cotton variety developed at the Delta Branch Experiment Station was released in 1997 under an exclusive license to Deltapine Seed. The new variety, DES 607, will be tested in field-scale variety trials across the U.S. in 1998. Some seed may be available for Mississippi producers in 1999. MAFES trials showed that DES 607 produced yields similar to the industry standards Stoneville 474 and SureGrow 125. Tests also revealed that the fiber of DES 607 is longer than fiber from Stoneville 474 and similar to SureGrow 125. Its fiber is finer than fiber from both

industry standards.

Biological control of destructive pine pest

A discovery by MAFES entomologists could provide the key to developing biological control of the southern pine beetle, the most destructive insect pest of pine forests in the Southeast. In adult populations of the beetle, researchers discovered viruses that are probably important natural regulating agents for the pest. After further study, one or more of these viruses could be used in spray formulations to manage the southern pine beetle.

High-efficiency, low-till plow

A low-till parabolic subsoiler designed by MAFES agricultural engineers can increase cotton profits by nearly $33 an acre over the best in-row treatment. Shaped like a deep-curved U, this deep-tillage subsoiler increases fuel efficiency and reduces soil surface disturbance erosion. Also, the subsoiler's shape allows tractors to pull it faster than other plows. Field tests showed that the improved plow increases field performance by 11.4 percent over another commercial in-row subsoiler.

New coccidiosis vaccine for poultry

Mississippi's billion-dollar poultry industry can lose up to $200 million a year from coccidiosis-related losses, but a new vaccine developed by MAFES poultry scientists should cut 75-80 percent of these losses. Disease control costs are reduced because the vaccine is delivered at the hatchery in one injection, along with all the other vaccines traditionally given to a chick. Unlike existing coccidiosis vaccines, which are mixed with feed, the new treatment does not cause losses in body weight, total growth, and feed efficiency.

Maximizing shrimp harvest in the northern Gulf

Gulf shrimpers will benefit from Coastal Research and Extension Center evaluations of exclusion devices that help sea turtles escape from commercial trawling gear. Inshore areas of the Gulf have more trash and natural debris on the bottom, which can cause turtle excluder devices (TEDs) to malfunction or become clogged. Fishermen reported that these problems reduced shrimp catches by up to 63 percent. Based on the TED research, scientists determined which TEDs are best for the various conditions of the northern Gulf and designed gear modifications that further reduce harvest losses. As a result, Gulf fishers can protect sea turtles while losing fewer than 6 percent of their shrimp catch.

Early termination of cotton insect control

Mississippi's cotton farmers could save up to $20 million a year thanks to MAFES entomology studies. Four years of research indicated that monitoring the number of nodes above the white flowers on cotton plants is a precise and reliable method to determine when cotton insect control can be stopped without reducing cotton yields. On-farm validation studies based on this rule showed that two insecticide applications can be eliminated. Besides the economic advantages, use of this method reduces the environmental impact of insecticides, and it reduces selection for

insecticide resistance in pests.

Kenaf-based product for wallpaper backing

MAFES textile researchers have developed a kenaf-based nonwoven material that could be used as a wall-covering substrate. Due to its texture and other properties, this material shows promise in promoting wallpaper adhesion, preventing bubbling in wall covering application, and controlling mildew. In addition, kenaf fibers could provide an environmentally friendly alternative to the synthetic materials traditionally used in wallpaper production. Kenaf, a fast-growing relative of cotton and okra, produces bark and core tissues valued for products ranging from paper to particle boards. This research could provide yet another value-added use for Mississippi-grown kenaf, as well as create new manufacturing opportunities for the State.

Improved food quality and safety of catfish

Efforts by MAFES food scientists to improve the safety and increase the shelf life of catfish could provide a major boost to marketing Mississippi's aquacultural products. Several natural organic acids were found to extend refrigerated shelf life of fillets by 6 days and to control *Listeria monocytogenes*, a potentially deadly human pathogen. Also, researchers demonstrated that exposure of whole catfish to steam for 120 seconds extends shelf life by 50 percent without harming fillet quality. Nutrition for young brood catfish

Nutrition for young brood catfish

MAFES aquaculture research could ensure the production of high-quality eggs and fry in the catfish industry. Researchers found that 2- to 3-year-old broodfish need high energy levels (2,500 kcal/Kg) and low to moderate protein levels (25 percent). Broodfish of this age spawned at lower rates and produced smaller eggs when fed lower energy diets. Older broodfish have accumulated sufficient body fat for good egg production and may not need high-energy feeds.

New Rice variety available in 2000

A new rice variety developed at the Delta Branch Experiment Station could solve some disease problems facing rice producers. The new variety, Priscilla, is highly resistat to sheath blight disease, a widespread problem in Delta rice production. Priscilla is also resistant to lodging and has excellent yield potential, averaging 15-20 bushels an acre more than Lemont, the most popular rice variety grown in Mississippi. MAFES will harvest registered seed in 1998; certified seed should be available for sale in 2000.

Viability of freshwater shrimp farming

MAFES aquacultural research since 1984 has resulted in the development of management strategies designed to make production of freshwater shrimp, or prawns, economically feasible in Mississippi. Thorough economic analysis revealed it is possible, through niche marketing of whole prawns, to successfully supplement Delta catfish farming with freshwater shrimp production. Since the U.S. relies on imports for about 680 million pounds of the shrimp consumed by Americans each year, there could be a strong market for home-grown prawns.

Alternative dairy waste-handling systems

MAFES agricultural economists completed a two-year study to compare the labor and equipment costs of alternative waste-handling systems that allow Mississippi dairy producers to meet Federal "no discharge" wastewater regulations. Their findings indicated that total confinement of milking cows is the least expensive method of meeting the new regulations. Related studies showed that the nutrients found in dairy wastewater are valued at almost $38 per acre for each application on pastures or cropland.

Summer breeding of dairy cows

Dairy producers often have cows they want to continue breeding during the summer, but high temperatures make it difficult to detect when cows are in estrus and conception rates are very low when they are bred. MAFES dairy scientists have developed a system to improve the chances of success in summer breeding. Odds are improved when cows are kept under a shaded structure with fan cooling for several weeks before artificial insemination. Also, injection of GnRH (Factrel® or Cystorelin®) at the onset of estrus, followed by insemination 6-10 hours later resulted in a 10 percent increase in conception rate. Bulls should not be used in summer.

MAFES Researchers Help Farmers Manage Risks

By Linda Breazeale

Farming comes with many inherent risks, but MAFES researchers are working to help Mississippi farmers consider every alternative for minimizing financial risks.

MAFES agricultural economists Keith Coble and Barry Barnett analyzing the existing and potential risk management instruments available to farmers. Coble said there has been an increased push toward revenue insurance since governmental safety nets have disappeared.

"Government policy has changed a lot in recent years. Some of the old programs farmers used to manage their risks are gone," Coble said. "There are all kinds of new risk management tools looming on the horizon."

While risks cannot be eliminated from farming, they can be managed, but likely at some cost to the grower. Some risk management tools include various kinds of insurance, forward pricing/futures, or crop diversity.

"The best strategies will vary from one farmer to the next. They may use a single risk management tool or several tools in combination," Coble said. "Farmers can expect to face an increasingly complex set of choices."

Barnett said yield and revenue insurances provide farmers with ways to manage risks.

Crop insurance has not been an alternative many Mississippi farmers have considered in the past.

The Crop Insurance Reform Act of 1994 changed the government's role in crop disaster payments.

"The government used to come through with disaster payments, but since 1995, those payments

have reduced significantly. It has to be a pretty significant disaster for growers to see any government payments. Growers didn't even get relief from the most significant tobacco budworm damage in 1995," Barnett said.

"Federal catastrophic insurance is now available to farmers for a very low administrative fee. In the event of a total loss, a CAT policy will only pay about 30 percent of the expected revenue from the crop," he said.

Beyond catastrophic coverage, growers can purchase buy-up insurance to protect their investment. In 1997, USDA statistics indicated that Mississippi growers purchase less insurance than their counterparts in other states. Nationally, growers insure 47 percent of their cotton acres, 45 percent of their corn, and 37 percent of their soybeans. In Mississippi, growers insure 15 percent of their cotton, 11 percent of their corn, and 27 percent of their soybeans.

"We want to understand why Mississippi farmers insure a smaller percentage of their crop and suggest improvement to the program that will make it more attractive for our growers," the economist said.

Barnett explained that several factors will impact crop insurance costs. His research is comparing yield data with the prices charged for insurance.

"Some farms and farmers are riskier than others, just like some automobiles and automobile drivers are more risky than others," Barnett said.

"Decisions on crop insurance should be informed choices, " Barnett said. "Farmers should never neglect crop insurance because they didn't get around to it, but rather because they weighed their risk and felt safe with their decision.&qu ot;

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