Mississippi State University

MAFES Research Highlights

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Contents

From the Director
Vance Watson

Change has always influenced agriculture.

Advancements in technology have enabled agriculture to survive, endure and progress by increasing production and reducing labor costs.

In the 1700s, the average farmer harvested only a small plot of ground, and did most of the work manually, a system that by today's standards seems cruel, wasteful and inadequate.

His plow was clumsy and inefficient, and the pace was slow. In one day and using two teams of oxen, he could plow an acre of land to a depth of about three inches, and so plowed only once every three or four years. Farmers sowed seeds by hand, and cult ivated and harvested their crops manually.

By the late 1800s, technological advances made it possible to farm more land. Cyrus McCormick's reaper revolutionized wheat production, and John Deere's steel plow facilitated planting operations. From 1876 to 1880, several beneficial agricultural impl ements appeared: the spring-tooth harrow, twine binder, centrifugal cream separator, gangplow, and mechanical tools for shucking and binding corn.

By the end of the 1800s, agriculture had become big business. Cultivated acres grew from 500 million to nearly 900 million.

In the 1920s, clothing styles changed and the use of synthetic materials decreased demands for cotton, dietary changes reduced consumption of wheat and beef, wagons gave way to trucks, and tractors replaced horses and mules, decreasing demands for oats and other grains.

Franklin Delano Roosevelt established the Agricultural Adjustment Administration (AAA) to increase farm income by making cash payments to farmers for reducing their crop production. In 1936, the Supreme Court declared the AAA unconstitutional, promptin g Congress to initiate a soil conservation program to pay farmers for planting crops to improve their soils.

Today, technology has further advanced and improved agriculture. In the transition from the Industrial Age to the Information Age, producers are using computers, the Internet, cellular phones, satellite imaging and other advances to bolster agriculture .

MAFES scientists are researching applications of these new technologies so producers can continue to produce higher quality products in a shorter amount of time.

MAFES Pedologist David Pettry researches and identifies soils in Mississippi. Learn more about the many types of soils in Mississippi, his research and the Soil Survey Centennial in MAFES is Part of Soil Survey Centennial.

Seafood aquaculture is relatively new in this area. MAFES scientists Ben Posadas and Custy Fernandes are approaching this industry from different perspectives. Read about their research in the story Coastal MAFES Researches Bigger, Saf er Catch.

Satellites and computers are making great contributions to agriculture. MAFES scientists came together this fall to tour several precision farming sites across Mississippi. Read about some of the research conducted through Advanced Spat ial Technologies for Agriculture in this issue.

I am proud of the commitment that MAFES scientists and staff make to keep Mississippi a leader in agriculture.

MAFES is Part of Soil Survey Centennial
By Rebekah Ray

"Older than dirt." A common adage that is full of meaning.

While soil may be many, many centuries old, the process of identifying and classifying soils through soil surveys celebrates its centennial this year.

"Identifying and classifying soils is important to our state. The national soil survey has helped coordinate research in categorizing and cataloging soils in this country," said David Pettry, MAFES soil scientist.

Soil surveys initially investigated how soils related to climate and organic life and evaluated the texture and composition of soils in fields and laboratories. In 1899, the USDA completed field investigations and soil mappings in Utah, Colorado, New M exico, Connecticut and one county in Maryland. Since then, many soil surveys have been initiated, completed and published cooperatively with USDA and state and other federal agencies. The total effort is the National

Cooperative Soil Survey (NCSS).

Soil classification and mapping are integral to knowing the true nature and distribution of soils. A successful soil survey requires a good model of how soils form and fit within the landscape. Existing soil surveys need to be updated to provide a clea rer representation of the distribution of soils in the natural landscape.

Soil maps convey knowledge about soil and soil properties. A soil-mapping unit is a simplified representation of a complex terrain unit.

While early surveys investigated the use of soils for farming, ranching and forestry, modern soil surveys have broader applications. Modern soil surveys describe characteristics of soils in a given area, classify the soils according to a standard, plot the boundaries of soils on a map and predict soil behavior. Surveys determine soil suitability for crops, establish mining codes, identify wetland areas and identify unique soil compositions. Soil identifications assist with tax assessments, waste dispos al, forestry requirements and pipeline installations.

"Soil is our most important resource. It's formation occurs over many centuries," Pettry said.

Formation of Soil. Soil, or pedosphere, is the thin, critical interface between the earth and atmosphere that supports much of the terrestrial life on the planet. Soil is unconsolidated mineral and organic matter on the earth's surface that serv es as a natural medium for plant growth.

Soil formed many thousands of years ago through the erosion of solid rock. Soil characteristics depend on the material from which it was formed and upon the nature of forces that cause the breakdown and weathering of minerals.

Water seeps into crevices during the winter and freezes. Acids in the frozen water, as well as organisms such as lichen, bacteria and mosses, break down the rock, enabling organisms to invade and accelerate decomposition. The expansion of plant roots g rowing in the fissures also serves to break up rock formations.

Soils in Mississippi formed primarily in sediments, not bedrock, or solid rock. The deterioration of rock provides parent material for soil formation. Parent material is a mixture of decomposed rock of varying texture, living organisms and humus, a re sidue of partially decayed organic material. Topsoil and other distinct soil layers, or horizons, are often visible in vertical profiles where ground has been sliced for roadbeds.

Each horizon differs from the others. The surface layer is normally darker in color and contains the highest levels of plant roots and organic matter. The subsoil layer generally contains more clay and may be brighter in color. Ideally, a desirable sur face soil consists of about 50 percent solids and 50 percent pore space that may be evenly divided between air and water. Solids consist of about 95 percent mineral particles and 5 percent organic matter.

The nature of soil depends on five major independent soil-forming factors: climate, organisms, relief, parent material and time. Each differs from site to site.

Importance of Soil. Life would not be as we know it without soil. Soil is a major component in the production of food and fiber, and it impacts air quality and water storage.

As a key ingredient in agriculture, soil also is a basic resource for all land use and development. It maintains nutrients, filters contaminants, provides a home to animals and insects, disposes wastes and serves as a foundation for civilization.

The study of soil is known as pedology. Pedologists use information from soil extractions almost like archeologists use excavation sites to learn about societies and cultures.

Soil is classified physically, chemically, mineralogically and by its location in the landscape. Soil also is evaluated morphologically according to its shape, appearance in the field, color, horizon, structure and drainage. In laboratories, pedologist s evaluate soils by determining pH levels, base saturations, acidity and solubility levels and clay characterization.

"Mississippi is blessed with bountiful soil resources and can wisely use the resource for the future. Many other states are more populated and developed and don't have as many natural soil resources as this state does," Pettry said.

Soil Classifications. Soil has been classified into 12 soil orders:

Alfisols, fertile soils typical of the Brown Loam area that developed from wind-blown silty deposits, include Memphis, Natchez and Loring soils.

Andisols, or volcanic soils, have andic soil properties.

Aridisols are found in very dry, arid areas.

Entisols, recently formed soils that are typically found along streams and rivers and that lack significant profile development, include the Arkabutla and Robinsonville soils.

Gelisols are frozen soils of cold regions.

Histosols, organic soils found along the Gulf Coast region in swampy or marshy areas, include Croatan and Dorovan soils.

Inceptisols, or weakly developed soils found throughout Mississippi, include Ariel, Leeper and Natchez soils.

Mollisols have thick, dark surface horizons rich in minerals and organic matter and are located in some areas of the Delta and Blackland Prairie regions. Examples include Binnsville, Bowdre and Catalpa soils.

Oxisols are highly weathered soils with low fertility and are found in tropical regions.

Spodosols, or soils with subsoil accumulations of humus and sesquioxides, occur in acid, sandy, leached parent materials in the coastal areas. An example is Leon soil.

Ultisols, or low-base status soils, are highly weathered or leached soils with low fertility levels. Typically found in Coastal Plain regions, Ultisols include Smithdale, McLaurin and Savannah soils.

Vertisols, or clay soils, shrink and crack when dry, but swell when wet. Commonly called buckshot soils, Vertisols are typically found in the Mississippi Delta area and Blackland Prairie Region.

Examples include Sharkey, Alligator and Brooksvill e soils.

Of these orders, eight have been identified in Mississippi: Alfisols, Entisols, Histosols, Inceptisols, Mollisols, Spodosols, Ultisols and Vertisols. The dominant acreage in Mississippi is Ultisol.

"Mississippi has a rich history in soil science and surveying. One of the early fathers did much of his work here," Pettry said.

In the mid-1800s, Eugene M. Hilgard became one of the nation's first pedologists and spent the early years of his career in Mississippi, where he studied geology and soils. The German-born scientist also worked as Mississippi's state geologist and in 1 860, published his soil research and findings in *Report on the Geology and Agriculture of the State of Mississippi.*

MAFES soil research has played a key role in classifying and identifying several soil types in the state. More than 400 different soil types have been identified and classified in Mississippi.

"Soils are unique entities. They are named after the region where first recognized," Pettry said.

Mississippi's state soil, Natchez, is found in the Brown Loam Region.

Working with the Natural Resource Conservation Service, MAFES soil scientists have characterized the following Mississippi soils: Okeelala Soil in Prentiss County; Caledonia, Columbus, Steens and Annamaine Soils in Lowndes County; Daleville and Vimvill e Soils in Lauderdale County; Petal Soils in Forrest County; Vancleave Soil in Jackson County; Natraqualfs in eastern Mississippi; Spodosols in Jackson County; and Vertisols in the Jackson Prairie area.

Anthropic Epipedons, or surface horizons impacted by earlier civilizations, were first characterized in Itawamba County.

Research on Mississippi Delta and Blackland Prairie soils has resulted in reclassification of major soils as Vertisols.

Over the next few years, Mississippi will have a completed soil survey after mapping is completed for Greene, Wayne, Scott, Leake and Wilkinson counties. Many counties were mapped before the advent of modern technology.

In 1940s and 1950s, several Delta counties were mapped before the adoption of the soil taxonomy classification system currently used. Recent developments in land leveling, aquaculture and precision farming need modern soil survey information.

"As soil scientists, we hope to map soils for the entire nation. Once we get maps of soils done, we can learn even more," Pettry said.

Application of Pedology. A fragile resource, soil forms a thin layer on top of the earth's crust. This valuable top layer can be easily lost through erosion, poor farming practices such as overgrazing, loss of fertility, poor irrigation practice s and contamination with toxic substances.

In support of the cooperative soil survey, recent MAFES soil genesis research included the impact of imported fire ants on Mississippi soils, soil evaluations in Native Prairie Remnants in the Jackson Prairie Region, determination of heavy metals in so ils and parent materials, sodium soils in the state, expansive soils and soil morphology and hydrology.

"Demands for soil information are increasing each year," Pettry said.

"When casinos were first developing on the Mississippi Coast, many of the Spanish oak trees along the beachfront needed to be moved. Soil scientists were brought in to evaluate other soils in which the trees would flourish," Pettry said.

In the Mississippi Delta, following the Great Flood of 1927, levees were constructed to protect inhabited areas. These levees have also prevented flooding of the region by waters laden with fertile materials. Even though the land still has a large rese rvoir of nutrients, the soil is becoming more acidic. The Delta is now artificially drained, and over the last 70 years, there have been changes in the Delta soil structure, said Pettry.

As an important natural resource, soil is fragile, alive and diverse. An understanding of it is vital to good soil management and makes good economic sense. Modern soil surveys provide valuable blueprints for orderly growth and wise utilization of the resource.

Coastal MAFES Researches Bigger, Safer Catch

By Rebekah Ray

A different type of agriculture takes place on the Mississippi Gulf Coast.

In an area of the state where land is a premium and population is growing, the Coastal Research and Extension Center (CREC) is looking to readily available water resources for food crop production.

In one project at the Coastal Aquaculture Unit (CAU) in Gulfport, MAFES scientists are conducting novel research in aquaculture, the commercial production of marine fish in a controlled setting.

Additionally, MAFES scientists at the Experimental Seafood Processing Laboratory teach Hazard Analysis Critical Control Point (HACCP) procedures and help processors sustain a safe supply of seafood.

"Seafood research is part of Mississippi State's long-term mission to foster economic development and utilize renewable natural resources. Actually, we're extending the type of research and development that agronomy has practiced for years. We're applying the same techniques to a crop new for the Experiment Station but old to Mississippi," said David Veal, head of CREC.

MAFES researches issues pertinent to the seafood industry at the three coastal centers. Research focuses on processing at the Pascagoula laboratory, on seafood safety in Biloxi and on the growth and harvesting of freshwater prawns and catfish in Gulfpo rt.

"Seafood aquaculture has not been very lucrative yet in Mississippi, but we're researching ways to raise the threshold of earnings for farmers," said Ben Posadas, MAFES marine economist at CREC.

Posadas is conducting experiments at CAU on the culture of larger prawns and on viable partnerships between wetlands and aquaculture.

Prawns. Freshwater prawns usually grow larger than saltwater shrimp. Prawns grow better on pond bottoms and need safe areas to hide during molting seasons when they've discarded their protective shells.

Similar in appearance to shrimp, prawns help lower cholesterol levels and are less prone to diseases. By developing more cost-efficient methods of production, continued MAFES seafood research can develop prawns as a new type of seafood.

"With about three prawn farms, Mississippi produces many small prawns and only a few large ones. Naturally, larger prawns draw greater market prices. We're testing to see how using artificial substrates will increase the weight of prawns," said Posadas.

The crustacean's growth depends on available bottom space. In three of the six research ponds, Posadas installed artificial substrates, or second "bottoms," to evaluate growth rates and weights of prawns. He constructed inexpensive portable substrates by bending plastic mesh into 10-foot waves to increase surface area by 50 percent. The substrates also provided shelter to protect smaller, younger or molting prawns from larger, more aggressive prawns. The other three ponds were the control pa rt of the experiment.

The quarter-acre ponds were stocked with 9,000 45-day old post-larvae (PL) on July 6, 1998, and were harvested November 4 through 6, after 120 culture days. At stocking, each PL weighed .01 gram and was less than one inch long.

Prawns were fed twice daily with 32 percent "sinking" catfish feed, based on the feeding schedule determined by MAFES scientists at the MSU Leveck Animal Research Center in Starkville. Dissolved oxygen and temperature were monitored daily, wh ile total ammonia, nitrites, salinity and pH were measured bi-weekly for management purposes.

Substrates were removed before prawns were harvested in early October.

To harvest, researchers seined the ponds by stretching a net from side to side across the pond to filter water through it as they walked the length of the water. Then the pond was "scrapped," which included draining the water so researchers c ould wade through the mud to manually harvest prawns hidden in crevices and low spots.

Harvested weight was 17 prawns per pound at an average weight of 26 grams each. Ponds with substrates yielded 347 lb/pond, or 1,388 lb/acre, while ponds without substrates yielded 291 lb/pond, or 1,164 lb/acre.

"This is good. We had been shooting for at least 125 pounds per pond, and we harvested more than 300 pounds per quarter-acre pond. I had been hoping for 300 pounds of prawn from the subscreened ponds," said Posadas.

Although the results of using substrates were positive, several problems appeared, such as predators and costs of substrates.

Predators including cormorants, raccoons and snakes accounted for some loss of the product.

Also, substrates may not be financially feasible for farmers.

"We need to compare the added costs of substrates to the increase in revenues." Posadas said.

"Building the 10-by-200 foot substrate was rather labor intensive. Six people built and installed the screen so another type of substrate may be tested next year," Posadas said.

Another problem included the approach of cooler weather. The growing season for *Macrobrachium rosenbergi* is mid-May to the first of November. Prawns die when water temperature drops to 60 degrees Fahrenheit.

"If we could have left them in the water for another 30 days, we might have hit 12 prawns per pound, but we had to harvest now because the water was getting too cold for this species," said Posadas.

In spite of these problems, results were good.

"Our numbers were great. They're better than we had anticipated," Posadas said.

Part of the harvesting process included sorting prawns by size as well as by sex. Harvesting at this point in species development, females were more easily detected because of their large orange egg sacks.

Crustacean research in seafood aquaculture is significant. Between 75 and 80 percent of shrimp are imported to this country from Central America and Southeast Asia. About 100 species of shrimp are traded worldwide.

Saltwater shrimp aquaculture in Asia and the Americas had been beset with disease problems.

Shrimp diseases include Taura Syndrome Virus, White Spot Virus, and Yellow Head Virus. These affect cultivation numbers. Chances are great that prawns bought in grocery stores have been infected with one of these viruses, but the viruses have no effect on humans.

"Although we can't really compete with the lower labor costs in these countries, we can produce a higher quality product. Strict requirements and regulations set by the Food and Drug Administration, Environmental Protection Agency and other federa l and state regulatory agencies help keep our fish clean and disease-free," Posadas said.

Another plus for raising farm-produced shrimp and prawns includes using animal byproducts as animal foods and fish oils.

"Freshwater shrimp farming has not yet taken off in Mississippi, but there is a renewed interest. It surely holds regional promise," Posadas said.

Wetlands. In addition to its research ponds, the CAU has 13 wetlands adjacent to its experimental ponds that are the focus of another major research effort.

Wetlands are areas covered by water, or where water is present either at or near the surface of the soil all year or for varying periods of time during the year, including the growing season. Water saturation is a major component in soil development an d the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species.

Wetlands are categorized as coastal or tidal wetlands and inland or nontidal wetlands. Tidal wetlands are located along the Atlantic, Pacific, Alaskan and Gulf coasts, and are closely linked to estuaries, where seawater mixes with fresh water. Inland w etlands are commonly found on floodplains along rivers and streams.

Posadas is investigating the use of constructed wetlands to improve water quality from aquaculture ponds. Poor water quality in catfish production ponds can lead to the direct loss of fish and cause off-flavor problems in the harvested product. Circula ting pond water through constructed wetlands helps clean the pond water, improves yield, reduces mortality and alleviates off-flavor in catfish.

The project tested use of a standard design for the pond-wetland system and evaluated variations in the design factors, such as size and flow rates of water through the wetlands.

In the ongoing projects, six quarter-acre ponds were stocked with 10,000 catfish per acre in May. Six additional quarter-acre ponds were stocked with 8,000 catfish fingerlings per acre in April.

Results of catfish yields for ponds with wetlands were about the same as for ponds without wetlands. Measuring the effect of using wetlands in conjunction with catfish ponds was difficult because predators such as cormorants could not be isolated, so e xpected levels of yield, anticipated revenues, mortality rates and off-flavor were not realized.

Constructed in 1987, CAU is located on the grounds of Mississippi Power Company's Plant Jack Watson in Gulfport. The center consists of a 2,200-square-foot research facility and 26 one-quarter acre research ponds for aquacultural, water quality, wetlan d and estuarine-related research. The facility has also conducted research in nutrition, stocking densities, disease reduction, breeding habits, genetics, cage culture and the quality of wetland water. Aquaculture research has been conducted at the center since its inception.

Sustained Seafood Safety. MAFES scientists ensure the sustained safety of processing seafood by updating processors on safer methods for improving and maintaining the quality of the seafood products.

"We're working to sustain a safe, wholesome supply of seafood available, while at the same time, extend the shelf life of what's being harvested," said Custy Fernandes, MAFES food fisheries scientist.

Fernandes and MAFES food scientists Doug Marshall and Juan Silva teach HACCP methods to seafood processors.

Along its coast, Mississippi has more than 100 seafood companies that process primarily shrimp, oysters and crabs. HACCP includes identifying hazards at each processing operation and identifying critical control points (CCP) to monitor, eliminate and r educe biological, chemical and physical hazards. Critical limits are established at each identified CCP where processors monitor activities and use corrective action to return the process to normal.

Since December 1997, seafood production and the aquaculture processing industry have followed HACCP regulations for better management of processing facilities. Using a system of checks and balances, processors provide regulators with records to verify safety of products.

Fernandes updates local and state seafood processing companies by providing guidance in their

HACCP program. Currently, he serves on the sanitation standard operating procedures (SSOP) technical committee of the National Seafood Alliance. The goal of t he National Seafood Alliance is to develop a national and international curriculum for SSOP.

MAFES research looks at the microbial quality of seafood before and after the implementation of HACCP to see if treatments have been effective. Research has shown that seafood microbial quality has been sustained because processors follow good manufact uring practices (GMP) and SSOP. These procedures avert temperature abuse, reduce levels of microbial spoilage and extend shelf life.

During harvesting, shrimp may develop melanosis, or black spots, from biochemical reactions and become "cooked" on the boat deck. Although these "Halloween shrimp" are harmless, black and orange shrimp reduce quality and the shrimp never make it to the market.

To preserve the quality, shrimp are treated with the preservative $NaHSO_3$, or sodium bisulfite, a preservative generally regarded as safe. While still on deck, the seafood is iced down. Harvested shrimp are soaked or immersed in $NaHS0_3$, a common practice.

Economic Impact. Built on the harvesting and processing of oysters, Biloxi was once nationally known as a seafood processor and claimed to be the Seafood Capital of the World. Presently, money may be rolling in from increased tourism, but the co mmunity is losing its leadership role in the seafood industry because of labor losses and man-made intrusions on the environment.

Fernandes is researching how this change is affecting Biloxi's seafood industry, particularly the mechanization of shucking oysters. His research evaluates a freeze-and-heat method of facilitating oyster shucking.

MAFES aquacultural research is paving the way for Mississippi to become a leader in the seafood industry.

ASTA: Applying Satellite Technology to Mississippi Agriculture

By Rebekah Ray

Now that the Cold War is over, the Iron Curtain has fallen, and the Space Race has eased, NASA is using its satellite technology to help farmers improve crop yields, reduce production costs and protect their land resources.

Through a USDA-funded grant referred to as Advanced Spatial Technologies for Agriculture (ASTA), MAFES scientists are researching how Mississippi farmers can benefit from applying space-age technology to an earth-bound profession.

"We're about to begin our third year using ASTA funding to conduct accurate, valid research for Mississippi producers. Our main goal is to help producers make better decisions concerning crop production," said Nancy Cox, MAFES assistant direc tor.

"The ASTA technology is a cornerstone of the university-wide remote sensing center that's being formed now. This project provides lots of ground-based validation for remote sensing systems," Cox said.

The ASTA project has enabled scientists to focus their research on production of several crops, study soil characteristics, identify stressors in plants, evaluate critical equipment needs of Mississippi farmers and examine environmental issues related to animal waste, Cox said.

"A unifying theme for the ASTA project has been how MAFES can help Mississippi farmers manage spatial information to produce better crops more economically and with positive impacts on the environment," Cox said.

Also known as site-specific farming or precision farming, ASTA uses the most advanced technologies such as computers, electronic sensors, and remote sensing to manage soil and crop production effectively. These technologies match conditions specific to every location in an agricultural field or tract of land.

"With the market's declining prices for agricultural products and increasing farm production costs, we must help find ways for farmers to improve profit margins. We're looking at ways that the technology available today, including precision-farmin g techniques, can help producers compete in today's economic climate," said David Laughlin, MAFES agricultural economist and ASTA coordinator.

Laughlin organized an ASTA tour this fall for 15 scientists and administrators from MAFES' departments and branch stations. The group visited research sites at Mississippi State University, Brooksville, Pontotoc, Perthshire and Stoneville.

Each scientist focuses on research projects in a specific area of his or her expertise. The tour took ASTA team members to other research sites in the program, to see a more complete picture of ASTA activities and to share their research with other sci entists.

"Seeing other areas of precision- farming research can provide these scientists with a more complete picture of all the research being conducted, allow them to see how their research fits into the overall MAFES precision-farming research program a nd share ideas with other scientists," Laughlin said.

Precision farming, remote sensing, global positioning systems (GPS), geographic information system (GIS), yield monitors and mapping are tools of ASTA research.

Precision-farming techniques often involve mapping fields using GPS data. Fields are mapped electronically, and the information is stored in a computer. GPS receivers are mounted on farm equipment and are connected to on-board computers. Computers are used to collect site-specific data, such as yield, soil moisture or soil type, or to control implements, such as fertilizer applicators.

Major issues of precision farming include identifying factors that affect yield and production efficiency. Yield mapping is one of the tools used in developing appropriate recommendations for optimal management. Those recommendations provide informatio n for proper input use through variable rate technology.

Research with precision-farming technology includes site-specific fertilizer applications, weed control, soil mapping, wastewater tracking, environmental monitoring, soil variability analysis, soil testing and detection of plant stressors, including nu trition deficits, insect infestations and disease presence.

Key to MAFES's precision-farming research is the university's close proximity to and cooperation with the John C. Stennis Space Center in Bay St. Louis. As one of NASA's lead centers for commercial remote sensing, Stennis conducts continual research in science, mathematics, engineering and technology, and it provides MAFES scientists with access to remote-sensing technology.

"Not only does Mississippi State utilize NASA and its research capabilities at the Stennis Space Center, Mississippi State has received a $10 million grant over two years to study the application of this technology to Mississippi's agriculture, fo restry, and wildlife and transportation industries. The additional funds provide a real springboard for work using remote sensing in these areas," Laughlin said.

"Initially, ASTA focused on land management, but now we're integrating it with remote sensing from ground-, air- and space-based platforms to produce crops more economically," Cox said.

One tour site included Kenneth Hood's Perthshire Farm in Coahoma County, where MAFES scientists frequently conduct their real-world research.

"Traditional methods of farming are not as productive in today's global economy. Now, expenses have to be cut 25 percent or farmers won't survive," Hood said.

Tour demonstrations included:

Variable Rate Fertilizer Application. A global positioning system unit and on-board computer guide fertilizer applications at appropriate rates. The project tested mounting precision-farming equipment on an existing variable-rate fertilizer app licator, avoiding the high cost of specialized equipment.

Wastewater Tracking. A GPS mounted on spraying equipment helps monitor and improve the effectiveness and safety of applying nutrient-rich swine wastewater onto farmland. By tracking the exact location of a sprinkler-gun in a field, the correct a mount of wastewater can be accurately applied.

Ultimately, this system will document when, where and how much wastewater to apply to a portion of the field. Future versions of the system will provide variable application rate, further improving the environmental aspects of the system.

"I'm doing all I can to see that we have $1.99 bacon and still have clean water and air," said Tim Burcham, MAFES agricultural engineer.

Environmental Monitoring of Hazardous Materials. One of the key issues surrounding contemporary agriculture is the use of agricultural chemicals and their impact on the environment.

MAFES Social Scientist Frank Howell and several graduate students are combining new remote-sensing technologies and conventional GIS methods with existing public and private databases. Located in the Social Science Research Center at Mississippi State, this research monitors the relationship between potentially hazardous materials and the environment.

"The U.S. has been so productive in the world economy because farmers use lots of pesticides to control insect activity. We've also been leaders in the responsible use of pesticides, yet research has identified agriculture as one potential source of many pollutants and other hazardous materials in the environment," Howell said.

"Combining GIS data with remote-sensing imagery shows the effects such waste products have on the environment," Howell said.

Soybean Yield Fertility. NASA satellite images, used in combination with a backpack GPS unit and a combine-mounted computer yield monitor, allow researchers to produce information on factors that control soybean yields. Soybeans are notorious fo r not responding as predicted to fertilization. A GPS unit can map fields for pH levels, soil fertility, percentages of organic matter, soil texture and carbon matter, so scientists can relate the data to yield rates.

Effects of Soil Spatial Variability on Sweetpotato Yield. Using satellite technology, scientists subsampled many small areas of fields to investigate the relationship between soil spatial variability and sweetpotato production. Varying amounts o f micronutrients such as copper and zinc are present in soil and greatly affect yield and grade of crops. Scientists used GPS to map chemical compositions of soils at various locations.

"With grain crops, farmers can mount a monitor on combines to determine fertile and nutrient-weak areas, but farming sweetpotatoes doesn't allow that luxury. We're investigating using precision farming on a smaller scale," said Jeff White, M AFES research scientist.

GPS/GIS in Water Management. GPS has been used to plot turbidity and to map out Moon Lake in Coahoma County. GPS also can graph water boundaries lost during periods of extended rain or following flooding.

Spatial Technologies and Precision Farming to Monitor Agricultural Pests. Using spatial technology in agricultural pest control is still rudimentary, but satellite images and scouting techniques can give clues about insect populations.

"We're investigating the effectiveness of using remote sensing to detect insect pest populations. Remote images indicate patterns of plant health within the crop, which also influence the distribution of pests. We're using these images to guide ou r search for pests and to determine how insects influence growth patterns," said Scott Stewart, MAFES entomologist.

Physical and Chemical Properties of Alluvial Soils on Cotton Yield. Many fields consist of different soil types, each of which hold and move water differently. GPS technology measured physical and chemical properties of a one-acre grid of Missis sippi Delta soil. Remote sensing determines soil elevation, soil moisture and drainage patterns to gauge proper application amounts of nitrogen fertilizer using variable-rate technology.

By using GIS technology to visualize soil and crop variability, producers can delineate areas in fields that require management decisions and strategies that differ from the norm to optimize yields.

"Charts of soil let farmers see how to treat their land both physically and chemically. With these data, farmers can improve poor yields and determine strong, fertile pockets of soil," said Jac Varco, MAFES agronomist.

MAFES Soil Scientist Frank Whisler used the crop simulation model, GOSSYM, in the same experiment to measure nutrient levels and organic matter in more than 200 individual sites by taking soil cores 39 inches deep.

"Producers can use this information to judge appropriate fertilizer inputs, irrigation levels, row spacing and plant populations. These data can help increase production yields, especially when used to locate the most productive areas in fields,&q uot; Whisler said.

Fertilizer and Lime Application. By using GPS/GIS testing, researchers can obtain a better means of identifying and understanding how soil variability influences soybean yield. Three fields were evaluated according to variability of elevation an d soil chemical and physical properties to determine which soil factors have the greatest impact on soybean yield.

"Mississippi soybean production is increasing for several reasons, but factors such as variability in soil chemical and physical properties can significantly influence crop yield. Our study evaluates soil properties to determine what management pr actices a producer can use to increase their soybean yields," said Mike Cox, MAFES agronomist.

Grid Site Selection for Soil Testing in Cotton. GPS can identify and map natural variabilities of soil nutrients. Soil samples are collected and geo-referenced for nutrients. Each nutrient is coded with a different color. Maps are then generated to apply variable rates of fertilizers.

"Grid sampling can be important when trying to delineate problem areas or in detecting problem areas in a field. The smaller the field sample unit, the better the variability picture," said Wayne Ebelhar, MAFES agronomist.

A field that has grown cotton for 30 years can be switched more easily to another crop when a concise picture of the field's nutrients is available. With this system, the producer can return to the same field area using variable rate applicators to cor rect problem areas.

Site Specific versus Conventional Potassium Fertilization. GPS/GIS technology is used to conduct soil tests to determine nutrient composition and its correlation to crop yield. This type of data management is critical to precision farming.

"Farmers have been very gracious for letting us use their fields, and we appreciate the real-world tests," said Bart Freeland, MAFES researcher in Stoneville.

Precision-farming technology provides farmers with a wealth of data.

"It is of utmost importance that we relate data to yield or it means nothing to farmers," said Gordon Tupper, MAFES agricultural engineer.

"This is the most exciting time ever in agriculture, with all the technology that's now available," MAFES Director Vance Watson said.

Crystal Springs Hosts Fall Garden Day

By Rebekah Ray

Garden beds bursting with pumpkins, eggplants, chrysanthemums and marigolds colored the landscape for the Truck Crops Branch Experiment Station's Fall Garden Day on Friday and Saturday, Oct. 16-17.

Cooler temperatures welcomed more than 3,200 visitors to the station's 175-acre research farm and 2.5 acres of vegetable, flower, butterfly and herb gardens. Visitors included home gardeners, school and church groups and the general public.

"The Fall Garden Day has become a tradition for Mississippi State University. Since the first one on Nov. 17, 1979, tens of thousands of visitors have come to the Truck Crops Station to see firsthand what vegetable production and horticulture are all about," said Rick Snyder, MAFES horticulturist.

Capturing the attention of many gardening enthusiasts were the Hyacinth Bean Tunnel, Corn Meal Man Buel Upton and his portable grist mill, Sammy Soil Conservation mascot and a large tent for Extension Service education displays on vegetable crops, home canning and insects.

Demonstrations included pond management, shade tree gardening, fruit tree grafting, ornamental grasses and the use of sculptured stone in the garden.

Wagon tours took visitors to backyard wildlife habitats, wildlife food plots, vegetable variety trials and persimmon, pear and pecan research sites. A four-foot-deep soil pit revealed several layers, or horizons, of soil types.

Master Gardeners and extension personnel presented yard and garden seminars every 45 minutes on various topics, including food safety, grilling vegetables, landscaping, shade gardens, seasonal arrangements, growing herbs and making muscadine vine baske ts.

The Master Gardener Program is an education arm of the Mississippi State University Extension Service that trains volunteers in horticultural skills. Master Gardeners aid extension agents in answering gardening questions and by encouraging participatio n in community projects.

MAFES, Mississippi State University Extension Service, the Truck Crops Branch Experiment Station, Central Mississippi Research and Extension Center and Mississippi State University sponsor Fall Garden Day.

In Brief

MAFES Jointly Releases Corn Germplasm

MAFES and the USDA Agricultural Research Service have jointly released the dent corn germplasm line Mp715 as a source of resistance to aflatoxin.

USDA-ARS Research Geneticist Paul Williams and Research Plant Pathologist Gary L. Windham developed the germplasm. New germplasms are used in crop breeding programs as sources of genetic material for introducing superior traits, in this case resistance to aflatoxin.

Aflatoxin is a chemical by-product of the growth of the fungus *Aspergillus flavus* on corn kernels. Grain containing aflatoxin is toxic to animals. Little hybrid research exists and few decontamination methods have been used successfully.

Mississippi has problems with aflatoxin infection in its corn production because the state's hot, humid climate is conducive to fungal growth. High levels of aflatoxin cause significant portions of harvested corn to be rejected at grain elevators.

Mp715 was developed from the variety Tuxpan in a selective breeding program aimed at selecting plants resistant to aflatoxin accumulation.

When crossed with other germplasm lines, Mp715 was highly resistant to aflatoxin accumulation following inoculation of ears with an *Aspergillus flavus* spore suspension. Mp715 is a tall, late-maturing line with yellow kernels and white cobs.

Corn production dominates American agriculture, and the United States is the world's largest exporter of corn, supplying 80 percent of the world demand. In 1997, Mississippi had an estimated value of $133 million in total corn production.

Off-flavor Catfish Cut Profit Margins

By Bonnie coblentz

Catfish is a major agribusiness in Mississippi, but fish that don't taste right at the pond won't make it to the dinner table until they do. This setback costs the industry millions of dollars a year.

Mississippi processed about 315 million pounds of catfish in 1997. The consistently mild, sweet flavor of pond-raised catfish is an important reason for the success of the industry.

Craig Tucker, MAFES fisheries biologist, researches catfish pond water quality management. He said off-flavor catfish increases the cost of production 5 to 20 percent and is a marketing problem.

"A very conservative estimate is that off-flavor costs Mississippi farmers an estimated $16 million a year," Tucker said.

Off-flavor in catfish is any objectionable flavors in the meat. Consumer satisfaction is jeopardized when off-flavor fish make it to market.

While substances causing the off-flavors in catfish are not toxic, the fish is unmarketable. Although the flavors do go away with time, the cost of production increases while the fish are being held over.

"Producers consider off-flavor their biggest production-related problem, and it's been that way since the industry began," Tucker said. "Holding fish in inventory while waiting for the off-flavor to leave increases the length of time needed t o raise a crop."

This interruption results in lost income from delayed harvest and in forfeited income from missed sales because the producer cannot restock fish and grow the new crop.

Harvesting fish on schedule is very difficult. Catfish ponds are tested for flavor twice before harvest, but many shipments still end up rejected at processing plants.

Much catfish off-flavor is due to the growth of algae in ponds. The algae *Oscillatoria chalybea* is the main cause of off-flavor. It produces two substances that cause an earthy flavor in fish when absorbed by the gills.

The problem of off-flavor dates back to a published account in 1550 of muddy flavor in certain fish. A centuries-old method of putting the fish in clean water to remove the off-flavor is still the most dependable method used today.

MAFES Comes Home for '98 Conference
By Rebekah Ray

With a "New Attitudes" theme, the 1998 joint MAFES and Extension Annual Conference drew 600 employees together in Bost Auditorium at Mississippi State University, Nov. 18-20.

"Our research in agriculture is as good as anywhere," MSU President Malcolm Portera said, as he presented his vision for the university's agricultural sector.

"Funding must be better because agriculture is the future," Portera said. "The agriculture division has done the best job of growing the economy of the state. It's the link to help the state's economy grow."

MSU Vice President Rodney Foil stressed the importance of quality in programs and services offered by MAFES and the MSU Extension Service. Both are measured by customer satisfaction. Researchers and extension personnel should know what their clients wa nt and need, and they should be ready to provide it and work as a team.

"Function as a team and let the quality of your product be your goal. In doing so, you will bring credit to your unit," Foil said.

Mississippi State's agricultural division distinguishes itself from similar institutions through the actions of its people, who make it a living, breathing organization to serve the people of the state, Foil said.

In another session at the second annual joint conference, Terry Nipp, president of AESOP Enterprises in Washington, DC, discussed the state of federal funding for research and extension programs. AESOP is an agricultural advocacy group.

"We're positioned to do better now than we've been in decades," Nipp said.

Funding for agricultural research and development is of particular interest to land-grant universities.

"We have to get out of our box and work with other agencies aggressively. We need to increase our financial resources from our communities," Nipp said.

Nipp also commended Mississippi for the seamless relationship between its research and extension programs.

Several Mississippi leaders responded to Nipp's remarks, discussing how events at the national level affect research and extension in Mississippi.

David Waide, president of Farm Bureau, said agriculture needs a safety net since it faces greater risks than in years past. Crop insurance will be an important part of that net as farm gate value diminishes, he said.

Chip Morgan, director of the Delta Council, recognized Mississippi State's role as one of the biggest contributors toward economic progress in northwest Mississippi. The university must speak and act boldly on behalf of agriculture in the state, he sai d.

Steve Corbitt, executive vice-president of the Mississippi Forestry Association, said many forestry decisions are based on research and extension. With a farm gate value of $12 million, forestry can't afford to make mistakes with 25-year crops, he said .

Updates

Respess is First Cochran Fellow

Sen. Thad Cochran continued his strong support of agriculture by establishing the MAFES Cochran Research Fellow in Agriculture.

Don "Wash" Respess, Jr., a graduate student in animal physiology, is the first recipient of the fellowship, to be awarded annually to graduate students who also receive partial funding from MAFES. Respess was awarded the fellowship at the 199 8 MAFES/ Extension Service Annual Conference.

Respess will spend this spring in Sen. Cochran's Washington, DC, office as a member of the senator's staff.

Respess grew up on a Quitman County farm that produces cattle, catfish and row crops. His undergraduate degree in biochemistry and molecular biology is from Mississippi State, where he also played on the Bulldog baseball team. He plans to graduate with a masters of science in animal physiology in spring of 2000.

Selection for the Cochran Fellowship is by a special committee appointed by the MAFES director.

Cooke Named MAFES Outstanding Worker

MAFES economist Fred Cooke has been named the 1998 MAFES Outstanding Worker.

Considered an expert on agricultural economics in the Mississippi Delta, Cooke has studied cotton irrigation, beef cattle production, pastures, the cost of cotton production, high-energy corn silage, the impact of banning DDT and large-scale boll weevi l eradication in Mississippi.

"No other researcher in agricultural areas within Mississippi State University has the vision and in-depth knowledge of the entire agricultural picture like Fred Cooke," said James Smith, head of the Delta Research and Extension Center.

Cooke has worked in agriculture for 42 years. He first worked as a production economist with the USDA Economic Research Service for 30 years, and for the last 12 years, as an agricultural economist with Mississippi State.

His research has involved some of cotton's deadliest pests: boll weevils and tobacco budworms. He has also worked with the Mississippi Boll Weevil Management Corporation to determine the cost of boll weevil control in various areas of the state.

The First Mississippi Chemical Corporation annually recognizes the MAFES scientist who has made significant contributions to the agricultural sector. Brent Langley, an MSU graduate and manager of field sales for Mississippi Chemical, presented Cooke wi th the award.

MAFES Turns over New Leaf in Greenhouses

MAFES horticulture has a new home at Mississippi State.

"For the last year, we've been enjoying new, more technically equipped greenhouses," said Richard Harkess, MAFES horticulturist.

To make way for the four 10,600-square-foot facilities, greenhouses built in the 1890s were demolished. The new facilities are equipped with more advanced technologies and are more space efficient, Harkess said.

Technical improvements include computerized automatic shade curtains to protect plants from too much sun, computerized climate controls instead of cooling vents, rolling plant benches and fans to create uniform air flows.

Additional space in the $1.7 million greenhouses is used to house a potting room and a chemical area with separate storage for fertilizers, pesticides and herbicides. The room is designed with a fume hood, sloping floors and a drain for hazardous dispo sals.

Experimental transgenic plants are housed separately, according to government regulations.

Biotech Executive Relates Technology to Agriculture

By Rebekah Ray

The face of agriculture will change in the next century through the use of technology, increased knowledge and new methods of transferring that knowledge, according to Roger Malkin, president and chief executive officer of Delta and Pine Land Company in S cott, Miss.

Malkin spoke on agricultural developments at the 1998 Will Carpenter Adaptive Biotechnology Seminar hosted at Mississippi State University on Nov. 5 and 6.

"Change will happen at such a rapid rate that traditional methods of transferring knowledge will be outmoded," Malkin said.

A cottonseed breeding company and farm operations administrator, Malkin addressed challenges presented by the development of new agricultural technology, as well as the impact that technology will have on agriculture in the next century.

"Technology is worthless if farmers don't know how to use it. In the past, information was spread by word of mouth, which led to the development of the Extension Service, but now we need to look at sharing pertinent information in real time," Malkin said.

Malkin noted that using the Internet and on-line communication can help farmers keep up with current information and research.

"The technology developed at land-grant institutions such as Mississippi State has been given to farmers free of charge. Land-grants support agricultural technology," Malkin said.

Malkin noted that additional changes facing agriculture include new methods of communication and the transfer of information, production of value-added items from crops, the need for additional training for farmers, further environmental awareness and entrepreneurial farming.

"Farmers need to begin running their organizations as other businesses do with one-year and five-year plans," Malkin said.

Biotechnology will have a major impact on agriculture. By using living organisms or parts of organisms, biotechnology engineers products to improve human health or the environment. Examples include using hormones in cattle and disease- or insect-resist ant plants, which allow for better production.

"By the year 2007, we will be marketing seeds already treated with 75 percent of what is presently sprayed on them now," Malkin said.

Biotechnology will reduce the cost of production, enhance crop values and reduce production risks, noted Malkin.

The Delta and Pine Land Co. introduced the first Bt variety of cotton in 1996. The company is the largest non-government-funded cotton seed breeding, production and marketing company in the world. It also breeds, produces and markets soybean seed and o perates breeding and research programs in eight countries.

In addition to sharing views on farming in the next century, Malkin related the relationship of farming and technology to Mississippi State University and other land-grant institutions.

"Land-grant institutions who have welcomed change have redefined themselves by welcoming technology," Malkin said.

One issue concerning the rapid growth of technology is that farmers still want the assurance that comes with using time-tested seed, Malkin said.

Transgenic varieties allow for better production, but may not have been tested over time. Seed companies need to be responsible to farmers, yet help them optimize production yields.

"If you're in the seed business around the world, you probably either know Roger Malkin or know of him," said MAFES Director Vance Watson in his introduction of Malkin.

In its third year, the Will Carpenter Adaptive Biotechnology Seminar honors Will Carpenter, retired vice president and general manager of new products for Monsanto Agricultural Chemicals. Carpenter is a 1952 graduate of Mississippi State University and a former executive-in-residence at the university.

The lecture series recognizes leaders who provide executive leadership in biotechnology and have made outstanding contributions to the development of biotechnology products.

The Adaptive Biotechnology Committee organized the seminar.

Y2K Approach Calls for Preparation

By Rebekah Ray

When the millennium arrives, potential problems associated with processing dates in computer programs (software) and with how pre-programmed computer chips (hardware) function may affect agribusiness.

"Solving software problems will necessitate some reprogramming, but the move should not pose major problems for the agriculture industry," said Wallace Killcreas, MAFES agicultural economist.

Agricultural records have been stored in computers since the 1950s, in "flat" or "ASCII" files.

Even 10 to 15 years ago, engineers and programmers used only the last two digits of years to save space and memory.

The format needed for the year 2000 (Y2K) and beyond is MM/DD/YYYY, with four "year" digits, which affects both computer programs and data files that used MM/DD/YY format.

Flat files containing dates without century digits will need to be rewritten to include century digits. Database management files such as dBase, FoxPro, and Clipper are less of a problem, since date formats in those programming languages already contai n century digits.

Computer chips that were preprogrammed without century digits present problems for the agriculture infrastructure. Problems may occur in any machinery with operations based on dates, including computer systems, feed preparation equipment, automatic ele vator operations, irrigation systems, milking machines and production tracking systems. Input applicators for fertilizer, seed and other chemical treatments will also need to be programmed.

An interruption in computer-driven data could be detrimental to agriculture-support industries dependent on computerized processing. Banking systems, credit card companies and other computer-based industries are already preparing to move into 2000.

Microcomputer systems made before 1995, may need to be replaced. Some computers can re-boot and a year 2000-system date entered, while others systems will need to be replaced.

The U.S. Department of Agriculture suggests the following Y2K plan:

Awareness. Become aware of possible problems and ways to become Y2K compliant.

Inventory. Conduct an inventory of automated systems currently used.

Assessment. Contact equipment manufacturers to see if equipment is Y2K compliant. To make it compliant, upgrade to the latest Y2K version, replace systems that are not Y2K compliant or fix systems by scanning all systems and programs to check fo r date routines or date storage fields and fix them to create compliance.

Testing. Include time to test computer systems thoroughly. The system date should be reset to 01/01/2000 and then run for an extended period of time. Since 2000 is a leap year, be certain the system calculates leap years correctly.

Chips in other automatic systems need to be checked on a case-by-case basis. Contacting the manufacturer will be essential in these cases.

Contingency planning. Include ways to back up and protect business data, ensure continued production with minimum delay, ensure continued cash and product flow and delineate responsibilities of key employees during potential Y2K mishaps.

Mississippi State University and MAFES are providing farmers with software programs using dates with century digits.

For more information on preparing for Y2K, call the MSU Department of Agricultural Economics at (662) 325-2750.
