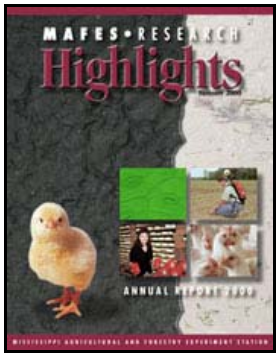
Mississippi State University Experiment Station

MAFES Research Highlights



Summer 2000
Volume 63, Number 3

Printable PDF version (24 pages)

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FROM THE DIRECTOR

On June 6, 1944, the Allied Forces began their attack of Normandy, France, with the largest invasion fleet in history — 1,200 fighting ships, 10,000 planes, and more than 150,000 soldiers. This marked the beginning of the end of Nazi Germany.

In doing their part on the home front, nearly 20 million Americans planted Victory Gardens and produced 40 percent of all the food consumed in this country. When the war ended in 1945, so did the call for Americans to supplement their food rations. This led to a brief period of food shortages as the agricultural industry resumed full production.

The war brought about many other changes at home. Agriculture adapted as small farms

gave way to large corporate operations, and mechanization replaced manual labor. More advanced chemical treatments became available and crop management systems, and genetic engineering modernized agriculture and increased production of commodities such as food.

Food production has been a prime focus of MAFES research. It has been estimated that if worldwide food production suddenly shut down, there would be only enough fare to last 45 days. This nation's overall security depends on an adequate supply of safe, nutritious food.

MAFES has been leading the way with agricultural research for Mississippi producers. Several research emphases are included in this annual report:

Environmental Monitoring - Global warming is a hot topic in agriculture. MAFES plant physiologist K. Raja Reddy has been keeping track of global warming and its effect on crop production.

Food Quality and Safety - Research focusing on the safety, development, quality and analysis of food is under way in the labs of MAFES researchers MaryAnne Drake, Zee Haque, Doug Marshall and Juan Silva.

Nutrient Management - Proper management of animal nutrients is a vital part of good agricultural management. MAFES soil scientist Billy Kingery shares his research on poultry litter management.

Remote Sensing - MAFES entomologists John Schneider and Scott Stewart and MAFES weed scientists Dan Reynolds and David Shaw are using remote sensing in new ways to help Mississippi producers.

Value-Added Product Development - MAFES researcher David Peebles is using scientific techniques to improve Mississippi egg production.

Legislative funding is enabling MAFES to continue helping Mississippi's producers meet the world's growing demands. Thank you for your support and confidence in Mississippi agriculture.

Vance H. Watson
Director

Agriculture Retains Economic Stronghold

By Linda Breazeale

Mississippi's total value of farm and forest production in 1999 held near the $5 billion* mark despite depressed market prices and a challenging growing season.

The state's total commodities, including poultry, forestry, crops, catfish and livestock, had a market value of almost $4.5 billion for 1999, a decrease of about 4 percent from 1998. Increased government payments brought total gross receipts to $4.9 billion.

"When all the indirect and secondary affects were taken into account, agriculture and forestry accounted for more than 26 percent of the Mississippi economy," said John Lee, MAFES agricultural economist. "No other sector in the state's economy claimed that much economic impact."

Lee said poultry products, timber and catfish combined to account for about two-thirds of the value of all agriculture and forest production in Mississippi.

According to figures released by MSU agricultural economists, the estimated value of Mississippi's poultry products totaled almost $1.5 billion and forestry was over $1.3 billion. Row and truck crops totaled over one billion dollars.

"Horticultural crops and livestock increased in value in 1999 while values of poultry and catfish decreased. The market values of cotton, soybeans, corn and rice were down sharply as a result of the lowest prices in recent history," Lee said. "Because of low prices, federal assistance to producers increased 44 percent over 1998."

Mississippi farmers received $405 million in government assistance in 1999.

MAFES agricultural economist Barry Barnett said Congress passed two one-time payment bills to help producers through the extremely low 1999 market prices and also provided some disaster assistance.

More drastic crop value changes occurred in corn and soybeans. Corn decreased 17 percent from 1998 to an estimated value of $72 million, which is below the 1997 value. Soybeans decreased 16 percent from 1998 to an estimated value of $227 million.

As Mississippi's number 1 crop, poultry had an estimated value of $1.48 billion in 1999, down 3 percent from 1998. Because of lower market prices, poultry value declined slightly despite an increase in broiler weight and numbers.

The No. 2 crop, forestry, was estimated at $1.33 billion, down 3 percent from 1998's record year and still above the 1997 value.

Cotton was estimated at $439 million, with depressed market prices forcing the value down 9 percent since 1998. Mississippi acreage increased to 1.18 million acres from 940,000 the previous year to help increase total production figures for the year, despite a drop in average yield.

Economists estimated the value of catfish at $294 million, down 4 percent from 1998.

On a bright note, livestock, including cattle/calves, milk and hogs, showed a 6 percent increase, with estimated values totaling $331 million.

**All figures are of June 20, 2000, and were provided by MAFES agricultural economist John Lee and project coordinator in the Division of Agriculture, Forestry, and Veterinary Medicine vice president's office Bob Williams.*

Estimated Value of Ag & Forestry Production 1998 and 1999

Commodity	1998	1999	Change (%)
Crops, Total	**$1,176,644,000**	**$1,046,570,000**	**-11%**
Cotton (Lint/Seed)	$483,720,000	$439,524,000	-9%
Soybeans	$270,240,000	$227,715,000	-16%
Corn	$87,720,000	$72,540,000	-17%
Rice	$139,741,000	$95,813,000	-31%
Hay	$73,865,000	$67,830,000	-8%
Wheat	$16,133,000	$19,800,000	+23%
Grain Sorghum	$4,469,000	$9,257,000	+107%
Sweet Potatoes	$23,765,000	$29,849,000	+26%
Other Hort, Crops	$76,991,000	$84,242,000	+9%
Poultry, Total	**$1,534,998**	**$1,488,348,000**	**-3%**
Broilers	$1,369,663,000	$1,323,180,000	-3%
Eggs	$158,092,000	$158,207,000	NC
Forestry, Total	**$1,362,000,000**	**$1,325,000,000**	**-3%**
Catfish, Total	**$307,229,000**	**$294,103,000**	**-4%**
Livestock, Total	**$312,544,000**	**$331,672,000**	**+6%**
Cattle/Calves	$158,772,000	$180,996,000	+14%
Milk	$93,798,000	$89,976,000	-4%
Hogs	$40,908,000	$41,700,000	+2%
Commodities Total	**$4,693,415,000**	**$4,485,623,000**	**-4%**

	Govt. Payments	$281,899,000	$405,300,000	+44%
Grand Total		**$4,975,314,000**	**$4,890,993,000**	**-2%**

Source: The 1998 figures are, for the most part, published data by the Mississippi Ag Statistics Service, the Farm Service Agency and the MSU Forestry Department. The 1999 estimates are a combination of published data from the same sources. **The data of this report are June 15, 2000.**
Note: Some sections may not add to the total since complete data are not shown.

NMREC Hosts PAC *Listening to the customers*

By Errol Castens, *Tupelo Daily Journal*

Nearly 300 producers gathered at the Lee County Agricenter on Feb. 22 to help set priorities for the North Mississippi Research and Extension Center at its annual Producer Advisory Committee meeting.

Producers represented 11 commodity categories on which research is done at the Verona center or one of its satellite stations in Holly Springs, Pontotoc or Prairie.

"Producers are what this is all about," said Dickie Rhea, extension ag program director at NMREC. "You have a chance to give your input."

The worst of times ...

Producers suggested priorities for research.

- Grain growers cited a need for increased research into transgenic crops suited to Mississippi as well as better communication of seed law changes.
- Beef producers asked for help in marketing their products more effectively and more research on electronic animal identification and grading.
- Cotton farmers requested more research into the unique demands of raising the fiber crop in hill country. No-till production research and better arbitration with seed companies were high priorities. Low prices, high costs and bad weather have hit cotton and some other commodities hard in the past several years.
- Dairymen were even less optimistic. James Howard Robinson of Lee County noted, "We're really looking at whether we can maintain the dairy industry in the South." Milk producers asked for more research into reducing heat stress and into farming in a more "consumer-friendly" way, using fewer antibiotics and other artificial inputs.
- Fruit growers urged research on frost protection, while vegetable growers sought experimentation with no-till vegetable crops. They also asked for help in getting federal crop insurance and in finding ways to control deer and welcomed news that Tupelo will have a new farmers' market this spring.
- Sweetpotato growers' needs centered on insect control research.
- Swine producers asked for help in such diverse topics as niche marketing and odor control.

... And the best of times.

While some commodity growers are in survival mode, a few areas are doing quite well.

- In the fast-growing ornamental horticulture industry, producers said they would welcome more research into using native plants in landscapes.
- Equine producers' needs also centered on sharing information. With the growing popularity of trail riding, the horsemen requested an inventory of such facilities and vendors in the state. The group also urged a stronger equine research program at MSU.

"This is not just a growing industry," said Bobby Billingsley of Tate County. "It's ... exploding."

- The latest commodity group added to the NMREC event is for turf growers.

  Construction of new homes and golf courses is a factor behind that industry's precipitous growth, and producers urged more varietal trials as well as research into compaction problems and alternative fertilizer sources.

The assembly as a whole emphasized the need for more help for producers of all commodities.

"We need to pull together and save agriculture," said Jackie Courson, MSU Extension Service administrative project coordinator.

"We need to change the public perception of farming," added Keith Morton of Ripley. "We produce the most abundant and safest supply of food and fiber in the world."

PACs Bring Together Producers, MSU Personnel

By Rebekah Ray

MAFES and MSU Extension Service personnel are simply a phone call, fax or e-mail away from Mississippi's producers, but Producer Advisory Councils brought the two groups together this past winter.

The North Mississippi Producer Advisory Council met on Feb. 22 at the North Mississippi Research and Extension Center in Verona, and the Central Mississippi Advisory Council meeting took place March 7 on the Hinds Community College campus in Raymond.

"We're here to help you. It's essential for us together to lay out a program to move Mississippi forward. And, we need to know what you think is important so we can continue what we're doing," said Marty Fuller, MAFES assistant director.

Commodity groups for beef cattle, dairy cattle, row crops, fruits and vegetables, ornamentals and forestry met at both sites. Both in Verona and Raymond, producers expressed concerns over rising production costs, low market prices and the need for assistance to make agricultural production profitable.

Additionally, extension and research personnel learned what producers need to stay in business.

Council Forms For New Producer Group

By Rebekah Ray

Mississippi has traditionally been known as an agricultural state, yet many of the state's producers do not fill traditional roles.

The more than 3,000 nontraditional producers in the state include women, minorities, part-time producers and those with gross sales of less than $15,000 or who operate on limited resources. To help meet the needs of this segment of producers, MAFES and the Mississippi State Extension Service hosted New Producers' Advisory Council meetings on March 18 at the North Mississippi Research and Extension Center in Verona and on April 1 at the Central Research and Extension Center in Raymond.

"MAFES and MSU Extension devised a unique method to target underrepresented producers with the New Producers Advisory Council that serves as a special outreach to the group," said Clifford Hampton, MAFES/MSU-ES Special Projects Coordinator. "The meetings aimed to help MAFES and MSU-ES better understand and connect with the needs of new producers in an effort for better utilization of our programs and services."

The council focused on developing strategies to enhance outreach efforts to these nontraditional producers, Hampton said.

MAFES and MSU-ES set up the new council utilizing the framework of the two advisory councils already in operation. The new council's intent is to gain a better idea of the needs and barriers faced by nontraditional producers, as well as enhance their participation in MAFES and extension programs.

At its initial meetings this spring, the new advisory council offered producers information on research efforts; MSU-ES programming, functions and technologies presently available; and additional outreach work. The council also gleaned information from producers on their needs and offered recommendations to overcome production difficulties. Future plans include engaging new producers into commodity advisory groups, which are already functioning, as well as emulating the programming effort into other locations.

"We've received very positive feedback from those who attended and are planning to host future new producer groups," Hampton said. "We're using data gathered from these meetings to set up a data base, develop baseline information and to strengthen programming for these valued customers."

Local MSU Extension county agents identified at least two nontraditional producers from their counties who were not already participating on extension and research boards and councils. Attendance at both NMREC and CREC was good, with producers from 21 counties at each.

"We were interested in identifying participants who aren't already involved in extension and research groups so we could hear their suggestions," Hampton said. "Getting an accurate count of nontraditional producers is difficult, although targeted numbers were obtained from the USDA Agricultural Census," Hampton said. "The USDA has implemented a volunteer registry to identify underserved producers, which should provide information on many producers for the new group."

The idea of a group for new producers originated when MAFES and MSU-ES saw a need to more effectively serve all agricultural populations.

SPAR MEASURES GLOBAL CLIMATE CHANGE

By Rebekah Ray

The Sunbelt is ideal for agriculture because of the abundance of sunny days and moderate temperatures, but changes from global warming could greatly influence crop production.

For the past 15 to 20 years, MAFES plant physiologist K. Raja Reddy and now-retired MAFES agronomist Harry Hodges have tracked the temperature of the earth's atmosphere through soil-plant-atmosphere-research (SPAR) units. The U.S. Department of Agriculture built the units to evaluate the impact of global warming on crops.

"The SPAR facility is enabling us to conduct global warming research that can help producers deal with temperature changes. We are able to study canopy and small-plot responses to several combinations of limiting variables in controlled field-like environments and also study plants under near-natural levels of radiation," Reddy said.

Located on MSU's North Farm, the state-of-the-art SPAR facility consists of 10 naturally illuminated completely enclosed plant growth chambers equipped with tools to control environmental factors like temperature, water, nutrients and carbon dioxide. By emulating authentic field conditions on a very small scale, the SPAR units allow MAFES researchers to electronically control variables around the clock.

The Situation.

Climate has changed naturally throughout geological time, but many theorize that industrial influences have now affected weather processes. Over geological time, changes in temperatures, levels and patterns of rain and snow, and the frequency and severity of storms and other extreme events have occurred.

Solar energy affects weather and climate on earth and heats the earth's surface, which in turn radiates thermal energy back into space.

According to Reddy, atmospheric gases, known as "greenhouse gases," trap and reflect this heat like a greenhouse. This "greenhouse effect" has kept the earth's temperature at a hospitable 60° F average, but human activities since the beginning of the Industrial Revolution in the mid-18th century have increased atmospheric levels of carbon dioxide (CO_2) and other greenhouse gases like methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs).

The air we breathe contains about 365 parts per million (ppm) of CO_2, an increase of 100 ppm, or nearly 40 percent, from the pre-industrial concentration, and an increase of 50 ppm from 1958, when continuous monitoring of atmospheric CO_2 began at Hawaii's Mauna Loa peak, Reddy said.

Annual Atmospheric CO_2 Concentrations
Mauna Loa, HI

Through Global Circulation Models experts project concentrations of CO_2 may rise up to 560 to 825 ppm by the year 2100.

"We study canopy and small-plot responses to several combinations of limiting variables in controlled, field-like environments, and also study plants under near-natural levels of solar radiation. The SPAR facility is enabling us to conduct global warming research to help identify the basic crop processes vulnerable to changes projected in climate and to develop enough insights on how to manage, model and breed crops for a changing environment," Reddy said.

Increases in greenhouse gases have come from population growth, combustion of fossil fuels like coal, oil and natural gases, and burning of enormous quantities of wood from deforestation. In 1994, the U.S. emitted about one-fifth of total global greenhouse gases.

The six largest developing countries - China, India, Mexico, South Africa, Saudi Arabia and Brazil - emit approximately 22 percent of global emissions.

"The increasing world population puts pressure on agriculturists and sets new challenges for crop scientists to help meet the larger population's food and fiber needs. The world's population is forecast to increase to 8.1 billion by 2025, with about 84 percent of the growth occurring in developing countries," Reddy said.

By 2050, experts estimate that 12.4 billion people will inhabit the Earth. Since there is no new arable land available for cultivation, the increased food supply must come primarily from more intensive cultivation of existing arable land.

"As agricultural production becomes more intensive, soil degradation will become a major concern and the world's water resources will be in greater demand as climate changes and population increases," Reddy said.

Agriculture contributes to the formation of radiative gases through the use of fossil fuels to drive equipment, tillage operations that release carbon from soil, livestock production and manure-handling operations, manufacture and utilization of nitrogen-based fertilizers, and production of crops. For instance, rice paddies produce large quantities of CH_4, as does lagoon storage of barnyard manure, while fertilization releases N_2O.

Because agriculture is so vital to our society, MAFES researchers are continuously investigating approaches to help Mississippi producers increase production and remain economically viable, yet not contribute to problems associated with global warming.

Greenhouse Gases.

Greenhouse gases such as water vapor, carbon dioxide, methane and nitrous oxide occur naturally in the atmosphere and have been augmented through human activities. Measurements have indicated that the greenhouse effect has warmed up the Earth's

atmosphere in the last 220 years, with the 20th century's 10 warmest years having all occurred since 1985. A domino effect has resulted from a warmer environment and includes increased temperatures and rising water levels as ice caps melt.

Carbon dioxide makes up about 50 percent of greenhouse gases. Major sources of CO_2 emissions include burning of fossil fuels, tropical deforestation and production of cement, so that industrial countries account for more than two-thirds of global annual carbon dioxide emissions. Additionally, microbes produce CO_2 in soil and free up carbon molecules from organic matter, and tillage speeds the release of CO_2 from soil. Any production practice that reduces tillage operations slows the degradation of soil organic matter.

Methane is an odorless, colorless gas released from production and transportation of fossil fuels, decomposition of organic wastes in solid waste landfills and production of livestock. Methane is released from rice paddies, ruminant fermentation, landfills, gas production and coal mining. Methane absorbs infrared radiation much more strongly than carbon dioxide and has a shorter atmospheric lifetime.

Nitrous oxide, the greenhouse gas most strongly associated with agricultural activities, is emitted from feed lots, fertilized soils used for crop production, biomass burning and industrial processes. It is produced naturally and artificially due to microbial processes in soil and water. When producers add nitrogen-containing fertilizers to crops, bacteria decompose the substance into nitrous oxides and other chemicals.

Chlorofluorocarbons result from use of foam agents, refrigeration, solvents, aerosol propellants and air conditioning. Even though production of CFCs was banned in 1996, the gases may reside in the atmosphere for a century or more after release, and are the most heat absorbent.

Higher levels of these gases may impact agriculture. Because agriculture is more sensitive to weather changes and extremes like floods, droughts, storms and seasonal variabilities than many other human endeavors, increased temperatures may alter yields.

"Understanding implications of weather changes on agriculture is essential, particularly as greenhouse gases increase, and linkages between agriculture and climate are quite pronounced, often complex and not always well understood," Reddy said.

Historical Trends.

Cotton yields before 1940 were approximately 200 kilograms per hectare and were relatively stable until 1940, when yields began increasing and reached 800 kg per hectare in the mid-1990s. The increase resulted from improved weed and insect control, increased use of fertilizers, irrigation of sizable acreage and development of improved varieties.

Between the mid-1930s and early 1950s, cotton acreage decreased dramatically as lowest producing lands were removed from production, low-cost fertilizer became available and crop production research increased following World War II. During this period, levels of atmospheric CO_2 also increased dramatically as fossil fuels were used more and more.

Observations.

Historically, cotton has been the state's top row crop. *Carbon dioxide* is an important factor in cotton yields and in its SPAR units, MAFES has focused on how CO_2 impacts cotton production. The SPAR facilities at Mississippi State were the first in the world.

Cotton crops grown in future environments will be subjected to climatic changes for which they were not bred. In SPAR, experiments have provided detailed insight into how cotton will respond as the environment changes, so that new guidelines and cultivars can be developed.

- **Carbon Dioxide.** In a controlled environment, boll production in five temperature conditions averaged 44 percent more in 720 ppm than in 360 ppm CO_2, with excellent nutrient and water conditions maintained throughout the season.

  More carbon was fixed in plants grown in high CO_2 at all levels of water and nutrient-deficient conditions and across a wide range of temperatures.

  Floral initiation, flowering, boll opening and leaf initiations were relatively insensitive to high levels of CO_2. High levels of CO_2 favored more vegetative and reproductive growth across a wide range of conditions.

- **Temperature.** Cotton is grown worldwide in a relatively narrow temperature range, varying from a minimal temperature of 12° to 15° C (55° to 60° F) and a maximum temperature that depends on duration of exposure. Optimal temperature is 26° to 28° C (80° to 82° F).

  The MAFES SPAR unit showed that boll (fruit) production increased as temperatures increased to 29° C (82° F), but boll production declined rapidly above that temperature.

  "Because young bolls of cotton cultivars are particularly vulnerable to heat, increasing crop tolerance to high temperatures and short-term heat shock would be useful to sustain crop tolerance in a warmer world," Reddy said.

  Reddy's research provides detailed insight into how cotton responds to potential global warming. The importance of altering agricultural practices and engineering techniques will continue to be urgent in a thriving human community.

Editor's note: On May 27, strong winds damaged two SPAR units at Mississippi State.

Global Warming Checked at Coastal Plain Branch

By Suzanne Berry

Work at the MAFES Coastal Plain Branch Experiment Station in Newton includes more than research on dairy cattle, forages, cool-season perennials and broiler waste management. Researchers there also monitor global warming with a system installed by the USDA Natural Resource Conservation Service (NRCS).

Coastal Plain is one of 10 sites in the country and perhaps the world to have a global warming monitoring system. There are seven such sites in the state of Mississippi.

"One of the reasons the Newton station was chosen is because we had worked with the NRCS on another project. The USDA was familiar with our facilities and personnel and were comfortable working with us again on this long-term project," said Joey Murphey, MAFES researcher and superintendent at Coastal Plain. The weather station will participate in a 30-year project, which began in 1994 and ends in 2024.

The site also had to meet additional criteria established by NRCS: totally undisturbed ground from the surface to more than six feet down; easy access from the highway; very low probability for vandalism; and location at least a one-quarter mile from the nearest electrical source so that satellite transmissions would not be interrupted.

A complete soil profile was conducted by taking core samples from a trench eight to 10 feet deep before installing the monitoring system. A total of 12 probes are surrounded by a chain link fence. Two probes are placed at each of six levels between two and 80 inches down into the ground to monitor soil temperature, moisture content, electrical conductivity of the soil and salinity. These measurements are needed by the instruments to convert raw data into useful information. Other instruments measure cumulative annual rainfall, wind speed, relative humidity and air temperature.

"Information gathered by the various instruments and probes is beamed up to a satellite each hour. This can be found on the Internet, so that anyone at anytime can look to see exactly what the weather is doing at the research station in Newton or in the other

locations of the global warming monitoring stations," said Murphey.

The website address is http://www.wcc.nrcs.usda.gov/scan/mississippi/2010.html

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A Primer on Photosynthesis

By Rebekah Ray

Plants grow through photosynthesis using solar energy to combine carbon dioxide with water to make carbohydrates and oxygen. The carbon dioxide (CO_2) for photosynthesis enters a leaf through stomata (the pores on the leaf surface), where water loss is regulated, and the Calvin cycle (the second stage of photosynthesis) then regenerates CO_2 into sugar before it leaves the cycle.

Plants have been categorized according to mechanisms used for photosynthesis. On hot, dry days, most plants close their stomata to conserve water. When stomata are partially closed, CO_2 concentrations begin to decrease within the leaves, photosynthesis yield is reduced and more O_2 is released during photo-respiration.

C_3 Plants. About 89 percent of the 250,000 higher plants are C_3 plants, which produce a three-carbon compound. Cotton, wheat, rice, soybeans, potato and most trees and grasses are C_3 plants. Higher levels of CO_2 stimulate photosynthesis and have shown increased yields in C_3 crops, as well as an increase in plant water-use efficiency due to partially closed stomates.

C_4 Plants. Tropical crops like corn, sugar cane, sorghum, millet and many pasture and forage grasses are C_4 plants and account for 3.2 percent of higher plants. The C_4 plants incorporate CO_2 into four-carbon compounds. These C_4 plants evolved when atmospheric carbon dioxide concentrations were low, and plants had to adopt CO_2 concentrating mechanisms to saturate enzymes that fix CO_2 into sugars.

CAM Plants. Crassulacean Acid Metabolism (CAM) is found in succulent plants, many cacti and pineapples. During the day, these plants close their stomata to conserve water and prevent entrance of CO_2 into leaves. At night when their stomata are open, these plants take up CO_2 through increased CAM during carbon fixation, or the incorporation of carbon into organic compounds.

"High productivity of certain cultivated CAM species and the high water use efficiency of CAM plants warrants increased use of such plants or incorporation of CAM characteristics into other species through modern genetic transfer technology," said K. Raja Reddy, MAFES plant physiologist.

MAFES Researchers Publish Text on Global Warming

By Rebekah Ray

Warm weather, sunlight, nutrients and moisture are essential to plant growth, but how do increasing temperatures from rising greenhouse gases impact agricultural production?

Worldwide climates are getting warmer and are causing major changes in crop production. To address the impact of global warming on agriculture, MAFES plant physiologists K. Raja Reddy and Harry F. Hodges recently published "Climate Change and Global Crop Productivity." Hodges retired from MSU in 1999.

"This book was written by a team of international experts on climate change and global warming and is the first comprehensive examination of the potential effects climate change could have on crop production systems. It also reviews the effects such systems have on climate change itself," Reddy said.

Current and predicted worldwide climatic changes have raised concerns about potential crop yields and production systems. These concerns include the ability to accommodate uncertain effects to ensure an adequate food supply for an increasing population, Reddy said.

Agriculture produces food needed for human existence, but agricultural activities are contributing to climate change. Different management practices could reduce the possible negative effects of agricultural production.The book explores solutions that include traditional breeding, management and biotechnology techniques.

The book is available at local bookstores and on the Internet. For more information on global warming research, call MSU's Department of Plant and Soil Sciences at (662) 325-2311.

Environmental Monitoring Research

- The Economic and Environmental Impacts of an Alternative Agricultural Conservation Practice: Case of Mississippi Soybean Rotations—W. Intarapapong, D. Hite, L. Reinschmiedt
- Developing and Pricing a Rainfall Contingent Claims Contract—S. Martin, B. Barnett, K. Coble
- Evaluation of New Risk Management ToolsÑM. Zuniga, K. Coble, R. Heifner
- Comparison of Agricultural Productivity and Efficiency of Russia and Ukraine—O. Murova, K. Coble, M. Trueblood
- Soil Chemistry and Nitrogen Fertility in Precision-leveled Rice Fields—T.W. Walker, W.L. Kingery, J.E. Street
- Willingness to Pay for Precision Application Technology to Reduce Agricultural Nonpoint Pollution — D. Hite, D. Hudson, D. Parisi, W. Intarapapong, S. Meerangruang
- An Analysis of Taxing Agricultural Chemicals and Environmental Implications—S. Meerungruang, W. Intarapapong, D. Hite, D. Hudson

This is a partial list of MAFES research in Environmental Monitoring.

Drake Develops Cheese Language

By Rebekah Ray

Nutty, sour, salty and sweet are mouth-watering descriptions for a flavor loved by many.

Americans are consuming more cheddar cheese than ever before, and MAFES food researcher MaryAnne Drake recently developed an objective test for determining its flavor.

"A standard descriptive language for evaluating cheese has not existed, so researchers in industry and academia have used their own descriptors. This has made communication difficult and replication of test results almost impossible," Drake said.

Drake has developed a more exact method for rating cheddar cheese, as increased consumption demands a more accurate rating and grading system for cheddar cheese than the human subjective methods that have been used to date in the dairy industry.

For more than 50 years, the dairy industry has evaluated flavor and texture quality of cheeses through a grading process and American Dairy Science Association scorecard judging. Both techniques involve skilled evaluators who generate an overall quality score or grade for a cheese while noting its deficiencies. While these techniques provide expert opinions, they may not match up with consumer opinion. And, using statistical analysis with grading is not possible.

Sensory analysis involves two categories of tools, discriminative evaluations and analytical tests.

Discriminative tests measure general differences in products, are simple, require little or no preparation, are easy to interpret, and provide qualifiable information.

Analytical, or descriptive, tests provide qualifiable (what's there) and quantifiable (how much is there?) information, without making evaluations of "good" or "bad." The test identifies attributes and then quantifies intensity so that data can be analyzed statistically through instrumental measurements.

Both aroma and taste make up flavor, a critical component in cheese application and marketing, and although flavors have been analyzed through instrumental analysis, sensory evaluations provide the best assessment of cheeses.

A panel of 15 cheese experts from industry, government and academia evaluated 250 cheddar cheeses and selected 70 representative cheeses of varying ages and from different geographic locations. The experts tasted samples and generated a Cheddar Language of 23 words to describe cheese flavor. The language was then fine-tuned to become standard references for flavor profiling to identify and quantify flavors of cheese.

A U.S. Department of Agriculture cheese grader used grading to evaluate two three-month-old cheddar blocks according to the Cheddar Language. The cheeses received the same grade, even though the two had vastly different flavors.

Cheese grade results

Cheese 1	A	sl bitter, sl flat
Cheese 2	A	sl bitter, sl flat

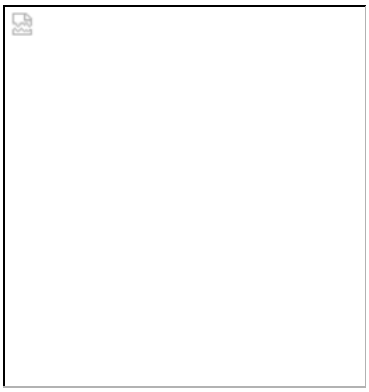
Use of Drake's descriptive language denotes vast differences in types and flavor intensities (Figure 1).

"It's essential to determine consumer preferences to develop cheese types or to sell the right cheese to the right market. Combining market segmentation data and descriptive sensory analysis with a universal language will enable us to determine preferred flavors for geographic areas," Drake said.

The Dairy Processing Plant at Mississippi State University is the only cheese production site in the state. In 1999, one million pounds of milk went into cheese production in the state.

"Last year, Mississippians consumed almost 80 million pounds of cheese," said Bill Herndon, MAFES dairy economist.

Figure 1.



Haque's Research Is Whey Good for Mississippi

By Rebekah Ray

Calcium-fortified orange juice is a functional food found on many Mississippi breakfast tables.

"Most foods have some degree of functionality that occurs naturally. Calcium-fortified orange juice is considered a functional food because calcium is added to help strengthen bones, whereas milk is a natural source of calcium," said Zee Haque, MAFES food chemist.

Functional foods are modified foods or food ingredients that may provide a health benefit

beyond the traditional nutrients it contains.

Functional foods research is one of the hottest areas in food science. Food researchers, nutritionists and food developers are exploring how traditional foods and new food formulations may improve the quality of food available, Haque said.

Haque is researching whey, a functional byproduct of cheese. In 1999, the state's milk production generated $105 billion. Haque's research can boost value of the Mississippi's milk as he tests various methods to extract whey protein concentrate so that the chemical composition of the byproduct is not adversely affected.

His research involves the use of various methods of dehydration, including freeze-drying, vacuum evaporation (VE) and ultra-filtration through a very fine wire mesh.

"Whey quality depends on the process of dehydration and the source of the milk. We're also looking for a way to increase yields and maintain the quality," Haque said.

Whey from various breeds doesn't vary much, but dehydration processes greatly impact its quality, Haque said.

Haque's research showed that the VE method increased yield by 12 percent and the whey had a better texture.

"To export whey, the quality has to improve. Many foreign countries are interested in exporting whey produced in the United States," Haque said.

According to the U.S. Dairy Export Council, China is in great demand for whey because it has no domestic whey industry. China imported 86,000 tons last year and of that total, about 30 percent came from the U.S., by far the largest single-country supplier to China. Over the last three years, U.S. exports of whey to China have increased 42 percent.

Once thrown away, whey is now considered beneficial, Haque said.

"It's abundant, very inexpensive, and quite healthy and is being used in everything from baby food to high-protein body building bars," Haque said.

Silva Focuses on Blueberries

By Rebekah Ray

They may reverse memory loss, help fight urinary tract infections, promote visual acuity and fight aging, cancer and heart disease, and they are a tasty part of a healthful diet. What are these miracles?

Blueberries are convenient, require no peeling or seeding, and are high in vitamins A and C, dietary fiber, caretenoids, antioxidants and anthocyanins. They are low in calories and can be eaten fresh, dried or in various processed items.

The U.S. Department of Agriculture recently ranked blueberries as number one in antioxidant activity among 40 fruits and vegetables. MAFES food researcher Juan Silva is investigating this fruit to identify its value as a source of "nutraceuticals," powerful food-derived antioxidants that show great promise in fighting disease.

"Daily intake of fruits and vegetables is part of a healthy diet and is recommended by the USDA. My research is determining the chemical compounds in blueberries that make them so beneficial," Silva said.

Health benefits of blueberries come in part from anthocyanins and phytochemicals, which are responsible for the intense blue and red pigments in the fruit. Silva is working to extract blueberry anthocyanins to determine chemical content and antioxidant activity. In addition, Silva is assisting commercial processors in developing methods for producing blueberry products for export.

Blueberries are one of Mississippi's many truck crops, and their production contributed $3 million to the state's economy last year. About 85 percent of blueberries are grown in the southeast quarter of the state; the top five counties for 1999 were Lamar, Wayne, Covington, Pearl River and George.

"Blueberry production is one of the bright spots in agriculture right now because of exports to Asian countries, growing markets for dried blueberries and the development of value-added foods. New varieties have recently come on the market that produce earlier and extend the season," said John Braswell, MSU Extension Service horticulturist at the South Mississippi Branch Experiment Station in Poplarville.

Marshall Studies Oyster Pathogens

By Rebekah Ray

Eating raw oysters and taking an antacid may be dangerous, according to MAFES food researcher Doug Marshall.

An estimated 20 million Americans eat raw oysters. Considered a delicacy, raw oysters may cause serious illness or death due to *Vibrio vulnificus*. A cousin of cholera, the bacterium lives in warmer marine waters like the Gulf of Mexico. Marshall has examined raw oysters for contamination by this organism.

Eating raw or undercooked seafood may result in acute septicemia, or blood poisoning. While not threatening to most healthy people, *V. vulnificus* can cause sudden chills, fever, nausea, vomiting, blood poisoning and death for those with certain medical conditions. The organism cannot be seen, tasted or smelled, yet is easily killed by cooking.

"*V. vulnificus* is a virulent pathogen and has the highest fatality rate of food-borne infectious diseases in the U.S, killing about 40 percent of those it affects," Marshall said. *V. vulnificus* is usually prevalent from April to November, with highest concentrations typically from June to October.

Marshall's gastrointestinal model simulated GI survival of *V. vulnificus* and the effects of antacid on survival of the bacterium. Antacids neutralize stomach acidity and are frequently used for gastric relief, but their presence in the GI system may play a key role in promoting oyster-related, food-borne diseases.

"The stomach is the body's primary defense against *V. vulnificus* and other food-borne infections. People who take antacids after eating raw oysters may be at a higher risk for infections from *V. vulnificus*," Marshall said.

Antacids remain active only for a short duration; acid blockers reduce acid secretion for a longer period. Reduction of stomach acid substantially increases the survival of common food-borne pathogens, and may favor increased survival and subsequent growth of *V. vulnificus*.

Marshall investigated two active antacid ingredients (692 milligrams of aluminum hydroxide hydrate and 400 mg of magnesium hydroxide) on three strains of *V. vulnificus* on shucked raw oysters. Viability of the bacteria was quickly lost when normal gastric juices were used in the model, yet results showed significant bacterial survival when antacids were used.

Consuming raw oysters early in a meal can also increase chances of *V. vulnificus*-related illnesses, Marshall said. Eating oysters on an empty stomach allows the bacteria to get into the digestive system faster, reducing exposure to protective gastric acids.

By eating oysters with a meal or afterwards, instead of as an appetizer, people might reduce their risk of illness by increasing the exposure of *V. vulnificus* to gastric juices.

"Playing it safe with fresh and perishable seafood is easier today than it has been, but there are still outbreaks of food poisoning that result from eating contaminated oysters and other shell fish. *V. vulnificus* and *V. parahaemolyticus* are affecting oyster beds around the world. It's a huge problem and a solution is important, especially for Mississippi's oyster production," Marshall said.

In 1998,* Mississippi oyster landings totaled $2.55 million; total economic impact of oyster harvesting, processing and distribution amounted to $26 million, said MAFES ag economist Ben Posados.

** Most recent figures available*

FOOD QUALITY & SAFETY RESEARCH

- Copper Sulfate and Reducing Off-Flavor in Catfish —T. Hanson
- Effects of Dietary Fat Supplementation of Swine Diets and Subsequent Packaging and Storage Conditions on Rancidity Development and Sensory Ratings of Bacon— R. Rogers amd D.E. Etzler
- Albumen Quality and Yolk and Embryo Compositions in Broiler Hatching Eggs During Incubation— E.D. Peebles, C.W. Gardner, J. Brake, C.E. Benton, J.J. Bruzual and P.D. Gerard
- Factors Affecting Metabolism of Commercial Channel Catfish Ponds as Indicated by Continuous Dissolved Oxygen Measurement— J. Hargreaves and J. Steeby
- Heart Growth in Broilers— J. Thaxton
- Survival of *Escherichia coli* 0157:H7 in Buttermilk as Affected by Contamination Point and Storage Temperature— S. McIngvale, X. Chen, J. McKillip and M. Drake
- Effect of Continuous and Pulsed High-Frequency Ultrasound on Physical-Chemical Properties of Orange Juice—T.J. Kim, R.S. Chamul, J.L. Silva, P. Ma
- Effects of Recombinant Bovine Somatotropin (rbST) and Nutrition on Growth and Carcass Traits in Early-weaned Beef Steers—K.E. Moullton, T. G. Althen, A.R. Williams, L.R. Jefcoat
- Impact of Drying Method on Functionality of Jersey and Mixed Cheddar Whey Powders and Their Effect on Quality of Dairy Products—T. Ji, Z. Haque
- Evaluating Factors That Affect Shelf-life of Chocolate Milk— C. White
- Use of Beneficial Bacteria to Improve Flavor of Low-Fat Cheese— C. White

This is a partial list of MAFES research in Food Quality & Safety.

Research Traces Broiler Health to Hen Diets

By Bonnie Coblentz

Better eggs mean better broilers, and one MAFES researcher has looked at what a hen must eat to lay eggs.

Mississippi's $1.5-billion poultry industry is the state's largest agricultural commodity. Even a small improvement in this business results in millions of dollars.

MAFES poultry science researcher David Peebles studied how different breeder-hen diets affect the eggs they lay and ultimately the broilers that hatch.

"The research deals mostly with the fat we add to poultry diets," Peebles said. "We checked corn oil, poultry fat and lard to hens in different concentrations, and then looked at its effect on both the egg and the broiler."

Fat is added in breeder diets to increase their levels of energy. The level and type of fat in the diet have separate, recognizable effects.

"Previous work didn't really separate out the effects of types and amounts of dietary fat, but we identified their individual effects." Peebles said.

Peebles researched how the hen's diet affected egg quality, the newly hatched chick's health and viability and the ready-for-slaughter broiler.

"Hens fed higher levels of fat and higher added-levels of saturated fats produced eggs with thicker shells that allowed less movement of gas through the shell than those hens fed diets with lower levels of added fat and higher amounts of unsaturated fat," Peebles said.

Lower amounts of dietary fat with lower saturation allow the egg to sustain the growing chick. Peebles also noted hens fed higher fat diets produced fewer eggs.

Researchers also looked at the yolk, albumen and weight.

"High dietary energy decreased the percentage of albumen in the egg without significantly altering its ratio to yolk," Peebles said. "When you start altering egg components, you

affect the nutritional status of the developing chick."

Broilers had a poorer feed conversion ratio from 22 to 42 days of age. This ratio compares the amount of feed taken in to the weight gained.

At slaughter, the broilers' weight from the less saturated corn oil outperformed the lard. And, corn oil in breeder-hen diets, at an additional level of 1.5 percent, produces quality eggs and broilers that gain weight better.

1999-2000
APPLIED BIOLOGY
Seminars

As part of the developmental process for the Biotechnology Institute, MAFES and MSU hosted a series of seminars led by renowned researchers from around the country. The Hearin Biotechnology Project funded the seminars held on MSU's campus.

June 15-16	Quantitative Genetics in the Area of Genomics Populus as a Model System for Forest Tree Genetics *H.D. "Toby" Bradshaw, University of Washington*
June 16-17	Career Opportunities in Biotechnology Biotechnology Centers: A National and Regional Perspective *Stephen Dahms, California State University*
August 27	Bioinformatics and the Missouri Maize Project *Su-Shing Chen, University of Missouri-Columbia*
Sept. 13-14	Glyco-Biotechnology: Producing Mammalian-type Glycoproteins in Insect Cells AgriVirion Inc. A Biotechnology Company from Then and Now: Startup to the Present *Alan Wood, Cornell University*
Sept. 27-28	Implications of Modern Biotechnology for Biocriminality Biological Inspections in Iraq: Lessons for International Arms Control *Raymond Zilinskas, The Center for Nonproliferation of Monterey Institute of International Studies and Johns Hopkins University*
Dec. 8	Bio-based Economy of the 21st Century *Ralph Hardy, President* *National Agricultural Biotechnology Council*
Jan. 19	Selecting In-Vivo Models for Biomedical Research The Effect of Physical Stimuli on Connective Tissue: Implications for Healing, Remodeling, and Rehabilitation *Steven P. Arnoczky, DVM, Michigan State University*
March 17	What Makes a Good Anticoagulant? Mathematically Modeling Interventions in the Coagulation Cascade *Carolyn Cho, SmithKline Beecham Pharmaceuticals* Assisted Reproductive Technology and Human In-Vitro Fertilization: State of the Art *Sangital Jindal, Hackensack (NJ) University Medical Center*
April 13	The Life Sciences and High Performance Computing *Henry Gabb, Computer Sciences Corporation/ U.S. Army Engineer Research and Development Center, Vicksburg, MS*
May 1	Genetically-engineered angst: Public Discussions of Agricultural Biotechnology *Doug Powell, University of Guelph*

Poultry

Produces Profits, Higher Phosphorus Levels

By Rebekah Ray

Poultry is one of Mississippi's top agricultural commodities, but its production requires environmentally friendly ways to manage litter, a mixture of poultry manure and wood shavings that is commonly applied to pastures and forages.

Increased poultry production creates more litter, which means that more nutrients could enter the environment. Phosphorus is a major element found in litter, and several Mississippi State University researchers are investigating its impact on the environment. Researchers involved with the study include MAFES agronomists Billy Kingery, Michael Cox and Joe Johnson, MAFES statistician Pat Gerard and MSU Extension Service specialist Larry Oldham. Other scientists involved in the investigation are researcher Geoff Brink of the USDA Agricultural Research Service and agricultural engineer Keith McGregor of the National Sedimentation Lab in Oxford. "

Poultry litter is one of the better organic fertilizers available, but the high levels of phosphorus in it may harm the environment if not managed properly. Additionally, poultry litter could supply a considerable portion of the nation's nitrogen, phosphorus and potassium requirements for crop production," Kingery said.

Poultry litter is estimated to weigh 31 pounds per cubic foot and is about 4 percent nitrogen, 2 to 3 percent phosphate and 3 percent potash per dry ton. Additional elements include calcium, magnesium, zinc, copper, iron and manganese.

"These nutrients are good for plant growth but can be problematic if found in excessive quantities. Nutrient management plans (NMP) include characteristics of soil so we'll know how much chicken litter can be put out before it becomes a potential environmental problem," Kingery said. "Producers need a maximum amount of flexibility so they'll know how much excess the soil can tolerate."

As part of a more comprehensive conservation plan, NMPs must consider nitrogen, phosphorus and potassium and all potential sources of nutrients, including animal manure, organic byproducts, treated wastewater, commercial fertilizer, crop residues, and irrigation water, Kingery said.

Poultry litter is a good soil additive that builds up soil organic matter, increases soil water-holding capacities and enhances structural stability. But, applying poultry litter excessively to land may lead to phosphorus runoff in some watersheds. When poultry wastes are applied to meet nitrogen requirements of growing crops, surface soils can amass higher phosphorus levels.

With proper utilization and management, poultry litter is valuable in sustainable agricultural systems.

"Because poultry production is usually concentrated in four to eight houses in a relatively small land mass, there is a potential for large amounts of nitrogen and phosphorus to enter groundwater and streams. Our research checks for increasing levels of runoff phosphorus," Kingery said.

To evaluate tillage effects on phosphorus movement, researchers studied water and sediment runoff movement on poultry and litter-amended soils at MAFES' North Mississippi Branch Experiment Station in Holly Springs.

Initially, poultry litter was added to small watersheds twice a year so that three agronomic practices could be evaluated.

Six of the 18 research plots were tilled and planted in ryegrass on the same day. Another six were tilled and planted in ryegrass approximately one month later. The remaining plots were planted in ryegrass with no tilling.

After rainfall, runoff from soil was collected, and both water and sediment measurements showed whether the phosphate came from inorganic or organic sources. Because phosphorus is closely attached to the soil and moves by erosion, measurements of sediment losses showed how much phosphorus moved.

"Soils that have received animal byproducts may lose phosphate to surface waters and increase the growth of desirable algae. This would be detrimental to the surface water ecosystem, which is the interaction of plants, animals and the environment within a certain physical area," Oldham said.

Nutrient Management research

- The Feasibility of Recycling the Sands-solids Mixture from a Solids Settling Basin for Use as Bedding Material in a Dairy Free Stall Barn — J. Meriweather, R. Moore, M. Boyd, J. Tomlinson, T. Burcham
- Evaluation of a commercial bioreactor at a Prestage swine facility —T. Burcham and J. Bonner
- Nutrient utilization of steers when fed broiler litter that has been treated with aluminum sulfate — B. Rude

This is a partial list of MAFES research in Nutrient Management.

Remote Sensing Reveals Insect Hiding Places

By Rebekah Ray

Tobacco budworms (TBW), cotton bollworms (CBW) and tarnished plant bugs (TPB) can wreak havoc on a season's cotton harvest. Because these insects have been found overwintering or building up in the spring in vegetation patches around cotton fields, several Mississippi State University researchers are on the hunt for them.

MAFES entomologists John Schneider and Scott Stewart, MAFES weed scientist David Shaw, and MSU wildlife and fisheries researcher Wes Burger are using remote sensing to identify the hiding places of these cotton pests before they can damage a season's crops. The research is funded by the Remote Sensing Technologies Center, directed by Shaw.

"Spatial technology shows where the insects overwinter. Because plants harboring insects show up as a different color from nonhost plants in aerial photography, remote sensing gives us a better idea of where infestations live during the winter months," Shaw said.

Remote sensing could be a particularly important tool as interest increases in natural resource conservation planning. Producers are using field borders, filter strips and riparian buffers to enhance environmental quality. While these practices help control erosion, retain herbicides and serve as enhancements for wildlife, they may be sites where insects overwinter.

"Vegetation adjacent to crops harbors weeds and insects, specifically TBW, CBW and TPB. These three pests have accounted for an average annual loss of about $50 million over the last three years, so we're using spectral reflectance to determine wild host plants where these pests overwinter and build up in the spring," Shaw said.

The USDA Natural Resources Conservation Service has encouraged agricultural producers to install buffer strips, and plans to install up to 2 million miles of strips over the next year. These conservation practices can only be implemented when producer concerns regarding weeds and insects are addressed, Shaw said.

Researchers are using remote sensing technologies to evaluate field border management, monitor insect infestations, weed populations and wildlife habitats. Schneider is investigating insect infestations and overwintering in field border vegetation at MAFES' Black Belt Branch Experiment Station near Brooksville and in field studies in Clay, Lowndes and Noxubee counties.

TBW and CBW. Called "the worms" by producers, TBW and CBW eat plants, then drop off and burrow into the ground for the winter. As the weather warms, they become moths and must emerge from the soil. Tillage disturbs the soil, making it impossible for the moths to escape.

"Remote sensing may let us census plants that serve as hosts for pests of cotton and

other crops. Insects that do major monetary damage to annual harvests overwinter in vegetation that surrounds fields. Spectral technology may allow us to estimate the relative importance of the several host plants of a given pest," Schneider said.

Schneider's research has focused primarily on the TBW. For the last five winters, he sampled cotton fields and uncultivated areas in Monroe County. A crew of 12 students manually estimated counts of TBWs overwintering in these sites.

The study showed overwintering in some years of many insects while at other times, population counts were close to zero. However, each year tillage of cotton fields destroyed the TBWs there so that insects did not come out of the ground.

"In some years, populations of pests doubled in the spring if tillage had been delayed or if no-till practices had been used in all fields. Plowing actually destroys overwintering of TBWs or prevents the moths from getting out of the ground, so producers need to be aware of this benefit of plowing," Schneider said.

No-till practices have started to increase, yet even modified or reduced tillage prevents moths from escaping. Schneider has also studied "rehipping" that is being used more often. This practice does not disturb old rows but deepens the middles to make rows higher. This extra soil appears to prevent the moths from emerging.

"Plant communities adjacent to crops serve as a reservoir for crop weeds and insects. By using remote sensing over large areas, we hope to determine which of several wild host plants like teaweed, smallflower morningglory and velvetleaf are most important in harboring TBWs in the fall. If a single wild host plant were causing most of the pest problems, we would have a lot of incentive to try to reduce populations of that plant and thus, reduce pest levels," Schneider said.

TPB. In conjunction with the above project, Stewart is using remote sensing to identify alternate hosts of tarnished plant bugs, a "sucking" cotton pest that overwinters as an adult by hiding in protected areas.

"Like TBWs and CBWs, TPBs have a fair number of weed and wild hosts that serve as an alternate food source for the pest populations to build and ultimately infest cotton and other crops. Remote sensing helps identify spring and summer hosts where TPB live before they move into crops," Stewart said.

Stewart is using remote sensing to identify breeding sites for TPBs to predict movement from or manage these areas to prevent pest infestations in crops, Stewart said.

Host plants for TPBs include curly dock, pigweed and other plants that typically grow near fields.

Stewart's research has been conducted at the Black Belt Branch and in Clay, Lowndes and Noxubee counties.

Remote Sensing Reveals Crop Readiness

By Rebekah Ray

The same spatial technologies used to identify weed infestations are also helping determine better application times for cotton harvest aids.

MAFES weed scientist Dan Reynolds is using identical strategies to help Mississippi's cotton producers increase their yields and harvest efficiency. Cotton remained Mississippi's top row crop last year and generated $4.39 billion.

"Remote sensing technologies used to identify weed infestations are also revealing when cotton crops are ready for harvesting. We're using identical techniques to determine cotton readiness for harvesting as are used to detect and control weeds," Reynolds said.

Cotton harvest aids are critical to maintain crop yields and quality levels, but field variability in crop maturity requires different rates and applications of harvest aids. Reynolds is monitoring harvest-aid applications through hyperspectral sensors mounted on both aerial and ground platforms to determine crop maturity.

Generally, cotton is mature and ready for harvesting when 50 percent of the bolls are open. Then, plants are sprayed with a defoliant/boll opener so that more bolls are open at the same time to enable a once-over harvest.

We are also doing manual ground truthing to count open bolls and cracked bolls, and to determine percentages of defoliation. These treatment maps will be compared to remote sensing analyses so that economic comparisons can be made between the two approaches, Reynolds said.

Bird's Eye View ID's Weed Infestations

By Rebekah Ray

Cocklebur, sicklepod, pitted and entireleaf morningglory, pigweed, Johnsongrass, broadleaf signalgrass and velvetleaf are some of the most bothersome plants faced by Mississippi cotton, corn and soybean producers.

MAFES weed scientist Dan Reynolds' work with remote sensing technologies is showing promising results in species-specific distribution for the detection and control of weeds. He is principal investigator on a MAFES project that's paired up with the NASA Stennis Space Center in Hancock County. The Remote Sensing Technologies Center funded the research.

"Remote sensing has been used for weed detection for a number years, mostly in rangelands where infestations cover several acres. With row crops produced in Mississippi, producers need better geo-resolutions to identify weed populations present in a smaller area," Reynolds said.

In determining weed infestations, this project has already shown a 70 percent efficiency in weed identification, Reynolds said.

Reynolds monitored two 20-acre cotton fields and two 40-acre soybean fields. In four-meter-square plots, Reynolds planted different densities of weed species with cotton and soybeans.

Because spectral images of different weeds vary, this project will enable researchers to compare manually generated maps with spectral images to develop a library of plant signatures. Reynolds said.

Signatures of weeds change as plants mature, so researchers are looking at reflectance patterns to develop a classification system to determine growth of weeds. Data from the reflectance patterns is given to the Engineering Research Center to develop algorithms for the database.

"We're breaking ground with new ways to use remote sensing to help Mississippi producers. As a new technology in weed science, this element of research offers a huge growth area for students," Reynolds said.

REMOTE SENSING RESEARCH

- Yield monitor design, soil parameters from remote data, creation of a new research and teaching lab in Remote Sensing, yield prediction of cotton from satellite data — F. To, A. Thomasson
- GPS and molecular studies in plant pathology — R. Baird
- Remote Sensing Weeds On Mississippi Farmlands — D. Shaw, D. Reynolds
- Remote Sensing Finds "Precise" Solutions to Agricultural Challenges — D. Shaw

This is a partial list of MAFES research in Remote Sensing.

Mini Cotton Gin Enhances Teaching

By Bonnie Coblentz

MAFES engineering fashioned a miniature cotton gin in late May that will help both

students and researchers in their study of cotton.

Jerry Gilbert, head of MSU's Agricultural and Biological Engineering Department and MAFES ag and bio-engineer, said work began three years ago to create a demonstration gin with internal operations that can be viewed. MAFES agricultural engineer, Eugene Columbus supervised the project.

"It will be a tremendous teaching aid and research tool that our students will have available to them on campus in a laboratory or lecture setting," Gilbert said. "They can have direct contact with a full-size gin and from that experience, become more familiar with ginning without having to leave campus."

The fully operational machine is outfitted with clear Plexiglas sides to allow viewers to watch the flow of cotton through the foot-wide gin. Unlike commercial gin facilities, the model is missing a drier on the front and a press on the back. It is housed in one room of MSU's Pace Seed Lab and will be used to strengthen the Gin Management and Technology emphasis in MSU's Agricultural Engineering Technology and Business major.

Gilbert also praised the gin's ability to accommodate producer and industry needs by processing cotton samples too small for a commercial cotton gin to process.

The Southern Cotton Ginners Association was one of the projects' financial supporters. Lee Todd, executive vice president of the association, was present at the dedication and said his organization has a vital interest in the success of the program.

"This year we anticipate a 19-million-bale crop that we will gin with about 1,000 gins throughout the Cotton Belt," Todd said. The cotton gin is part of the seed processing equipment in MAFES. It will be operated under the direction of the Department of Agricultural and Biological Engineering.

In A Different Light... Researchers Pass On Firsthand Knowledge

Many MAFES researchers share their firsthand lab and field experiences with MSU students. Several researcher/teachers have been recognized over the past year for their outstanding work... in a different light.

MAFES Researchers Renowned in Their Fields

By Rebekah Ray

As the state's premier agricultural research institution, Mississippi State University boasts seven MAFES scientists who over their careers have been named fellows in their academic disciplines.

Fellows hold distinguished positions in professional societies and are selected because of outstanding research and teaching, publications, contributions to the discipline, service and leadership. Usually few in number, fellows are leading thinkers in their disciplines.

"Recognition by one's peers as a fellow in a professional society is a special honor. Such recognition of our faculty is also an important asset in building the national reputation of our university," said Dr. Charles Lee, vice president of the Division of Agriculture, Forestry and Veterinary Medicine at MSU. MAFES is in this division.

MAFES researchers recognized as Fellows include agricultural economist John Lee by the American Agricultural Economics Association and animal and dairy scientist Robert W. Rogers by the American Meat Science Association.

The American Society of Agronomy has recognized MAFES agronomists Roy Creech, David Pettry, Glover Triplett, Frank Whisler, and Vance Watson. Pettry is also a fellow in the Soil and Water Conservation Society of America. Creech and Watson have been recognized by the Crop Science Society of America, and Watson, by the National Institute of Agricultural Botany in Cambridge, England.

NSF Selects MSU Students for Major Research Awards

By Bob Ratliff, University Relations

Two Mississippi State University biological engineering majors are National Science Foundation Graduate Research Fellows for 2000.

Allison P. Kirkpatrick of Gadsden, Ala., and Dana L. Nettles of Batesville each are receiving $16,200 annually for three years, plus up to $10,500 annually to cover tuition and fees. In all, the fellowships total nearly $80,000 apiece. Their research is partially supported by MAFES.

More than 4,600 students nationwide applied for the 850 NSF awards, which are based on academic records, Graduate Record Exam scores and the applicants' research proposals. Kirkpatrick's research involves the natural reduction of hog farm odors, while Nettles is working in the area of human cartilage replacement.

Working under MAFES agricultural engineer Tim Burcham, Kirkpatrick is developing a biological filtration system constructed with kenaf, a fast-growing plant native to Asia and related to cotton and okra. Kenaf is a cash crop in Mississippi.

Nettles is working on a tissue engineering project directed by MSU ag and bioengineering professor Steve Elder. Using chitosan, a natural substance found in the exoskeletons of shrimp and other arthropods, she is seeking to develop a material that can replace damaged human cartilage.

Both students are in their first year of graduate study after completing bachelor's degrees in biological engineering last year at MSU.

Filip To: The Joy of Teaching

By Jennifer Cason, *MSU Reflector*

Biological engineering classes can be fun. Just ask students of professor Filip To.

To is a MAFES agricultural engineer who also teaches undergraduate classes in agricultural and biological engineering. An MSU alumnus with a degree in electrical engineering, To has been at MSU for 16 years.

"He acts like he wants to be here more than we do," student David Yarnell said. "You can tell he enjoys what he's doing."

Getting away from theory is a main aspect of his teaching approach. He believes students learn best from lecturing, hands-on experience and in-class discussions. He also incorporates the Internet into his class. To said his main job is to keep his students on their toes and give them responsibility.

"Students are the biggest customers I have," To said. "They need to be up to snuff all of the time, but they also need to relax and release tensions."

Legislative Tribute Honors MAFES Researcher

By Sammy McDavid, University Relations

MAFES weed scientist G. Euel Coats was among 76 faculty and students receiving special statewide recognition by the Mississippi Legislature this spring.

Coats, recently joined the others honored for "outstanding achievement" as part of its 13th annual HEADWAE celebration.

HEADWAE, (Higher Education Appreciation Day/Working for Academic Excellence) was established by lawmakers in 1988 to spotlight individual academic accomplishment and the overall contribution of public and private institutions of higher learning. The state's business community and the Mississippi Humanities Council also support the annual recognition program.

MAFES Helps Center Promote Rural South

By Bonnie Coblentz

MAFES and the Mississippi State University Extension Service have teamed up on a center that will keep research and information on Southern rural development issues a top priority.

The Southern Rural Development Center (SRDC) based at Mississippi State University has used its resources to share research and information important in keeping rural development issues a top priority in the South for 25 years.

The SRDC works with 13 states and two territories. It serves Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, Virgin Islands and Virginia.

"The SRDC seeks to tap the talents of the region's land-grant universities to help address important rural development issues," said SRDC Director Bo Beaulieu. "We try to understand the rural South research needs and take steps to get that research conducted. We then make sure that research is delivered for application to the leaders and citizens of the region."

The SRDC's first priority is to keep the development concerns of the rural South in the spotlight. Once concerns have been identified, the center develops research to better understand these issues.

The SRDC then provides educational programs to communities and citizens to address these issues. It also seeks to inform policy-makers of the impacts federal and state policies are having on the rural South.

"We try to provide the most up-to-date information for rural communities to use to develop strategies to address such things as economic development, workforce preparation and strategic planning programs for its citizens. We do this through our links with each land-grant's extension service," Beaulieu said.

SRDC coordinated a recent four-state conference for Champion Communities. About 150 representatives gathered from communities in Alabama, Florida, Georgia and South Carolina.

Knowledge and information gained at the SRDC conference allowed Champion Communities to make even greater strides forward. One county was awarded a $3 million grant for a rural water system, and one of the cities involved was given almost $400,000 for rural health.

SRDC puts the strengths of the southern states to good use across the region. Where one state may not have the resources to find a solution to a rural development issue, SRDC can identify and recruit people from other universities to help that state accomplish the task.

Southern land-grant universities comprise the center's primary audience. SRDC works to keep land-grant personnel informed of critical rural development issues. Secondary audiences include organizations with significant interest in rural issues, such as state rural development councils, USDA Rural Development Offices and community-based grassroots organizations.

SRDC is one of four USDA-funded multi-state rural development centers organized as a result of the Title V Rural Development Act of 1972. Similar organizations include the Northeast Regional Rural Development Center, the North Central Regional Center for Rural Development and the Western Rural Development Center.

SRDC Receives $20,000 in Grants

By Rebekah Ray

The Southern Rural Development Center (SRDC), a regional organization based at Mississippi State University, recently received $20,000 in grants to continue improving

socioeconomic conditions in rural areas of the South.

SRDC obtained $15,000 from Pegasus Satellite Television and $5,000 from AmSouth Bank. Jointly administered by MAFES and the MSU Extension Service, SRDC is a primary facilitator of rural development research, education and policy dialogue in 13 southern states and two territories. The organization focuses on rural areas of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, Puerto Rico and the U.S. Virgin Islands.

"We are so pleased that both Pegasus Communications and AmSouth have committed financial resources for advancing the well-being of rural areas" said SRDC Director Bo Beaulieu. "Through their gifts, the Southern Rural Development Center will be better positioned to deliver technical assistance and educational programs that respond to the needs of rural people and communities in the South."

During SRDC's 25th anniversary observance, Pegasus Television presented the center with the funds. Pegasus provides DIRECTV programming to select rural areas throughout the United States and reaches more than 7.2 million homes in 41 states. It serves more than 1.1 million subscribers and is the third largest satellite service provider in the country.

AmSouth Bank is one of the largest financial institutions in the Southeast. Based in Birmingham, Ala., AmSouth has more than $43 billion in total assets and approximately 660 banking offices throughout Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, Tennessee, and Virginia.

Kudos

C. Watson Named Head of PSS

MAFES agronomist Clarence Watson has recently been named interim department head of the Department of Plant and Soil Sciences at Mississippi State University, following the retirement of MAFES horticulturist Richard Mullenax. Watson has been with MAFES for 24 years.

N. Cox Wins MSU Staff Award

Nancy M. Cox received a Zacharias Distinguished Staff Award in the executive, managerial and administrative catagory. She has been assistant director of MAFES since July 1, 1997. Previously, Cox taught animal science courses at Mississippi State University. The award is in named in honor of MSU's president emeritus, Dr. Donald W. Zacharias.
