MAFES RESEARCH

HIGHlights

Volume 65, Number 3

Summer 2002

ANNUAL REPORT 2002

Mississippi Agricultural and Forestry Experiment Station

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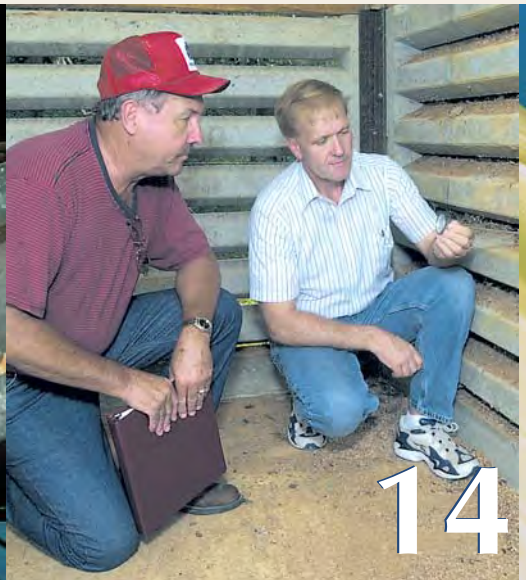

On the Cover:

MAFES research keeps Mississippi's $4.39 billion food and fiber industries competitive in a world economy. A sample of research areas includes, clockwise from top left, poultry, which accounts for nearly $1.7 billion; America's third highest sweet-potato production volume; a $270 million livestock industry; and pest control through breeding resistant plants for the state's nearly $1 billion row crop industries.

Back Cover:

Mississippi's trademark state flower is part of a $74 million horticultural industry.

from the DIRECTOR

Travel Mississippi's highways and byways and you'll find yourself in the midst of some of the world's highest technology. No, it's not just in the telecommunications industry, nor in our space industry, or not even in our growing automotive industry.

It's in the state's fields and forests.

That's right. High-tech Mississippi can be found in the world's oldest industry — agriculture.

Consumers owe the American farmer a debt of gratitude because it takes only about 40 days for most Americans to earn enough to pay for their year's food supply. In 1950, each farmer produced food for 27 other people. Now one farmer feeds more than 130 others around the world. That increased efficiency is due in large part to the nation's emphasis on agricultural research. In the Mississippi Agricultural and Forestry Experiment Station, we take that responsibility seriously.

This MAFES annual report highlights the work of the nation's fifth-best-funded agricultural research program. And, we're climbing the resource ladder among the world's research institutions by taking less than half a penny of every state-appropriated dollar and enhancing it with federal funds and competitive grants and contracts to make Mississippi a leader. In recent months, we have been refocusing our research priorities to gain efficiencies in a slowed economy and have leveraged the state resources in other sectors.

This issue of *Highlights* summarizes new poultry research efforts, describes a way to focus our Division-wide food research and outreach programs, and outlines two high-tech approaches to producing the old-time commodities of corn and sweetpotatoes.

Summer is a busy time at all of our Experiment Station sites. We hope that you, as important stakeholders in our research programs, will take time to attend one of our many field days or visit with individual scientists on specific program emphases. We value your input and judgement concerning all of our programs.

Vance H. Watson

Vance H. Watson
Director

Volume 65, Number 3
Summer 2002

MAFES RESEARCH
HIGHlights

MISSISSIPPI AGRICULTURAL AND FORESTRY EXPERIMENT STATION

MAFES Research Highlights, a quarterly publication of the Mississippi Agricultural and Forestry Experiment Station, is available free to Mississippi residents upon request.

Requests for this, other MAFES publications, or change-of-address notification should be addressed to

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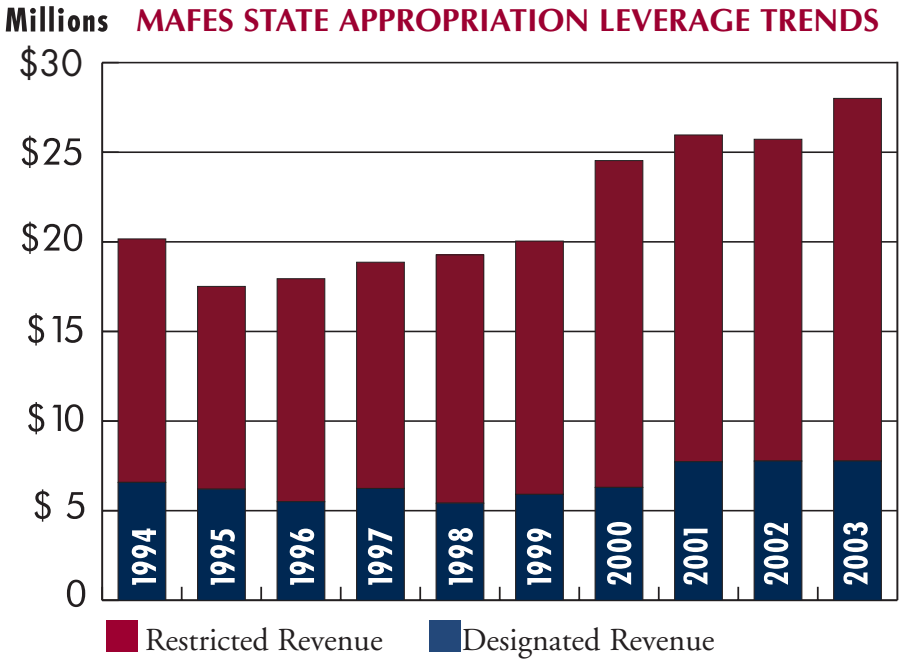
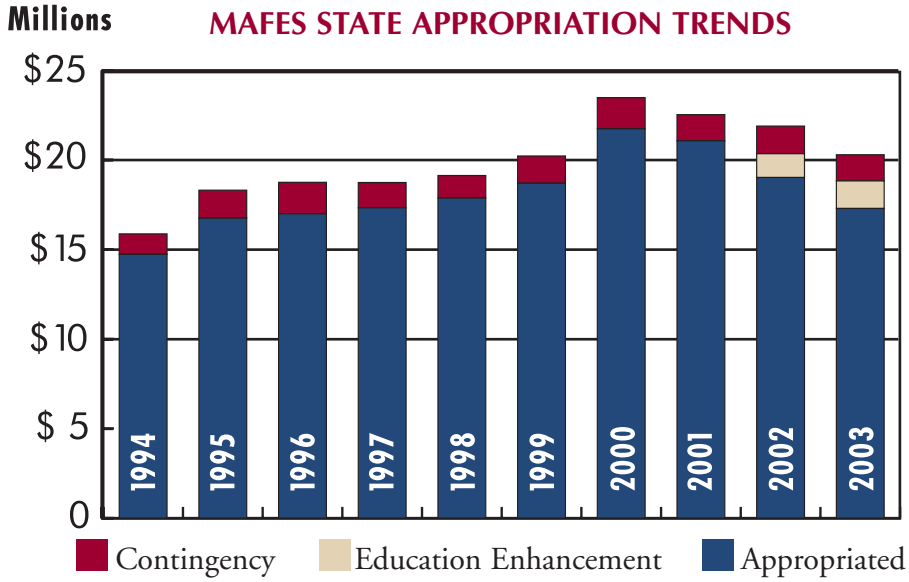
Financial REPORT

The Mississippi Agricultural and Forestry Experiment Station was established through provisions in the Hatch Act of 1887, which provided federal funds for research and experiment stations at land-grant universities, and subsequent state legislation enacted in 1888.

Research revenues from multiple sources have enabled MAFES to address the changing needs of the state's agricultural industry. While state funding continues to provide a key component of base support for the Experiment Station, MAFES has also developed research partnerships that have leveraged these appropriated funds.

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





MISSISSIPPI BUDGET

MAFES ALLOCATION

Of every 100 Mississippi tax dollars appropriated by the State Legislature, MAFES gets 49 cents. Leveraging our state appropriations with external funds, MAFES has become one of the nation's top-funded agricultural research programs.

Other Sources of Support:

MAFES Partnership with Commodity Groups Provides Research Benefits

Every year, several commodity groups set aside a portion of their sales income to fund MAFES research.

Producer checkoff funds from the Mississippi Soybean Promotion Board, the Mississippi Rice Promotion Board and the Mississippi Cotton Incorporated State Support Committee provided support for more than 20 MAFES projects in 2001. Research funds were also provided through checkoff money from the sweetpotato and pork commodity groups.

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

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

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

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

Enhancement of Mississippi Soybean Variety Trials entry standardization.

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

Dynamic approaches to improve soybean yield in the Mississippi Delta.

Application of information technology systems for soybean production in Mississippi.

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

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

Rice breeding and variety development in Mississippi.

Winter rice breeding nursery in Puerto Rico.

On-farm fertility management in Mississippi rice production.

Red rice control in rice.

Rice weed control.

Studies on false smut and kernel smut of rice.

Evaluation of rice breeding lines for resistance to blast and efficacy of new fungicides for blast control.

Management and control of rice sheath blight.

Nitrogen management for optimum rice production in the Mississippi Delta on Sharkey clay soil, and nitrogen management considerations for advanced breeding lines.

Interaction of cultivars, N rates, seeding rates, and Icon® seed treatment for long-grain rice production.

Control of rice stink bug and cattail billbug.

Supplement for rice promotion seed stocks program.

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

Nitrogen and potassium management in cotton/corn rotations – rotation benefits and economic impact.

Effects of herbicides and/or fungicides on early cotton growth and yields.

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

Development of insect-resistant cottons for Mississippi.

Corn crop residue and reduced tillage influence on ground residue cover and cotton profitability.

Cotton breeding and genetics: continued development of cotton varieties and breeding lines for Mississippi with root-knot nematode race 3 resistance and excellent yield; and continued search for useful nematode resistance.

Investigations on novel methods to control the cotton reniform nematode and their effects on early-season insect control.

Transgenic and nontransgenic cotton tolerance to selected pesticides and interactions.

Mississippi cotton varieties and germplasm.

A whole farm systems approach to increasing cotton farming profitability.

Selected MAFES *Journal Pub*

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J. Agricultural and Applied Economics, 33(2):349-351

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Little, R.D., May, J.D., Simmons, J.S., Lott, B.D. 2001. Financial analysis of selected setpoints for broiler houses.
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Lusk, J.L. 2001. Branded beef: Is it "what's for dinner?"
Choices 16(2):27-30

Lusk, J.L., Fox, J.A., Schroder, T.C., Mintert, J., Koohmaraie, M. 2001. In-store valuation of steak tenderness.
American J. Agricultural Economics, 83(3):539-550

Lusk, J.L., Daniel, M.S., Mark, D.R., Lusk, C.L. 2001. Consumer willingness to pay for nongenetically modified corn chips.
J. Agricultural and Resource Economics, 26(1):40-57

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Theriogenology, 56:637-647

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Agronomy J., 93:944-948

the sum of all— EQUALS SAFER FOOD

By Eva Ann Dorris

It may look good enough to eat, but is it?

That's the question answered daily in dozens of ongoing research efforts into meat production and safety, food processing and human nutrition. This research helps fulfill the Mississippi State University Division of Agriculture, Forestry and Veterinary Medicine's mission to provide a safe and plentiful food supply. The area of food science, including food safety, is one of the division's five core areas of interest and a major component of MAFES research.

As the nation reeled from the terrorist attacks of Sept. 11, and people worried about threats of more to come, MAFES and the division assessed its own areas of expertise, advice and strategic planning that would continue to help keep food supplies safe and plentiful.

MSU's Food Science Institute was revitalized with the appointment of 31 researchers, nutritionists, dieticians, professors, animal scientists, economists, agronomists and MSU Extension Service educators from throughout the university system. Twenty-eight of these appointees have partial or full-time MAFES assignments.

"Food safety and food security are second only to national security in the defense of this nation. Some of us have forgotten where our food comes from, and we don't realize how little there really is if we had to depend on existing supplies on a long-term basis," said Vance Watson, interim vice president of the division and MAFES director. "We have always committed a major part of our resources and programs to food safety because we care about our clients and about future generations."

The restaffing of the Food Science Institute has created a pool of expertise that potential new food industries in the state can go to for help in determining economic potential, assessing availability of raw or processed products and recruiting graduates trained for their needs. These industries could in turn bring millions of dollars to the state's economy.

The institute also serves as a liaison between producers of raw vegetables, fruits, dairy products and meats, and the food industries that further process and deliver these goods safely and economically to grocery stores.

"What we've done is brought our people and our resources together to form a united front," said Bob Rogers, recently appointed director of the Food Science Institute. "We know it's almost impossible for a single scientist to work alone and achieve timely results. This institute will provide a team approach to problem solving and will provide a stronger front as we pursue funding."

Rogers, a professor of food science and technology with MSU's animal and dairy sciences department, brings more than 40 years of professional experience in meat and food processing to the institute. Among his personal achievements is the development of the method to rapidly and efficiently skin commercial catfish for processing. He also led research into the development of the fat-free hot dog, which now accounts for millions of pounds of processed meat sold worldwide.

One example of ongoing research, which will now be carried out under the auspices of the institute, is to perfect a nonradioactive, post-package pasteurization system. The system will lower the risk of food-borne pathogen contamination in food products consumers don't always cook or fully cook, such as hot dogs and other sandwich meats.

The Food Science Institute has been designated the flagship for food processing in Mississippi.

Rogers said the Food Science Institute plans to secure $5 million of outside or leveraged funds for research, education and extension activities related to foods and food safety.

Researchers and other members of the institute hope their work will provide a safer food supply, more industries for the state, more education on nutrition, enhanced research into new products, marketing of those products and degree programs that produce graduates trained to carry on the tradition of providing a healthy food supply.

Bob Rogers

- MAFES animal and dairy scientist and Food Science Institute director
- Bachelor's, master's and doctorate degrees in animal science from the University of Kentucky
- Current manager of MSU's meats laboratory, an on-site teaching and research facility.
- Professor of food law, food packaging and food plant management

survey finds AMERICANS LESS PICKY *about beef*

By Bonnie Coblentz

A recent Mississippi State University study suggests that Americans don't mind eating beef treated with growth hormones or fed genetically engineered corn nearly as much as European consumers do.

Jayson Lusk, assistant professor in MSU's Department of Agricultural Economics and MAFES agricultural economist, helped conduct a survey of consumers in France, Germany, the United Kingdom and the United States. He worked with Jutta Rossen from the Louvain-la-Neuve in Belgium and John Fox of Kansas State University.

The researchers were trying to determine whether consumer preferences for beef cattle administered growth hormones or fed genetically engineered corn were different in Europe and America. They were trying to see how these different preferences impacted trade policies.

"Since the late 1980s, the United States and the European Union have been involved in a contentious debate over trade of beef from cattle that have been implanted with anabolic growth hormones. The Europeans have banned U.S. imports of beef since 1989," Lusk said.

"Because the vast majority of fed cattle in the United States are administered added growth hormones to improve weight gain and feeding efficiency, U.S. producers have suffered from the loss of a valuable market," he said.

Surveys found that French consumers were willing to pay significantly more for beef from cattle not given growth hormones than were U.S., German or British consumers. They also found that the European consumers were willing to pay premium prices for beef from animals not fed genetically engineered corn.

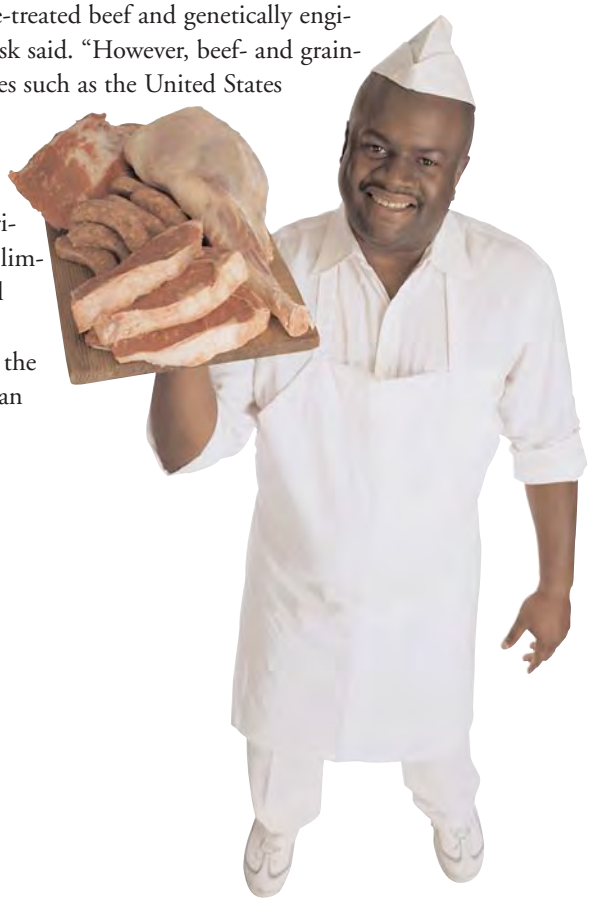
Results suggest American consumers are willing to pay an additional $3 per pound for rib-eye steaks from cattle not fed genetically modified corn. Consumers in the three European countries were willing to pay more than $6 a pound extra for the same product. Opinions on meat from cattle treated with hormones were not as divided.

"Although the level of concern for hormone-treated beef was high in both the United States and the European Union, it was surprising that Germany, the United Kingdom and the United States put the same value on this type of meat," Lusk said. "This suggests there is little support for the argument that differences in consumer preferences for hormone-treated beef justify the European Union import ban."

The fact that Europeans surveyed expressed a strong desire not to buy beef from animals fed genetically modified corn suggests U.S. exporters will encounter strong resistance to future efforts to enter these markets with genetically modified products.

Lusk said the survey results indicate the European Union is unlikely to open its markets to U.S. beef. This is despite the fact that the General Agreement on Tariffs and Trade does not allow nontariff trade barriers unless scientific evidence suggests a product is unsafe.

"The European Union claims that public health concerns constitute a valid basis for their trade restrictions on hormone-treated beef and genetically engineered crops," Lusk said. "However, beef- and grain-exporting countries such as the United States maintain that the European Union import ban protects domestic agricultural prices by limiting international competition and unfairly improves the welfare of European Union farmers."



Probiotics Yield PROHEALTH, ANTIODOR *Benefits*

By Charmain Tan Courcelle

Dietary supplements of certain species of good bacteria reduce the population of harmful microorganisms in chickens and provide environmental benefits as well.

MAFES poultry scientist T.C. Chen and his group have found that feeding poultry live lactobacilli cultures, a practice called probiotic treatment, can turn the tide against pathogenic bacteria, such as *Campylobacter jejuni*, both in the guts of chickens and in their fecal material.

Probiotics are feed supplements that contain living bacterial species found naturally in the intestinal tracts of healthy animals. One way these bacteria work to help their hosts is by occupying sites in the intestine that could otherwise harbor harmful microbes. This process, known as competitive exclusion, shifts the balance of microorganisms in the host's intestines toward friendly bacteria.

Chen said the concept of using probiotics to promote health has been around since the 1960s.

Marco Nicovich

Yusrizal, a doctoral candidate who works on the probiotics project, examines chickens used in the study.

Examples of probiotic food products include yogurt and sauerkraut. In the poultry industry, probiotics have been touted as performance enhancers, but consistent reports on the benefits of these supplements in chickens have not been available.

Chen's group set out to determine the effects of probiotics in chickens. They chose to use a mix of lactobacilli species as a probiotic because these bacteria are safe — they are found naturally in poultry intestines — and they survive passage through the chicken oral cavity and gut, which produce enzymes for digestion of food and neutralization of microbes.

Using a simulated chicken digestive tract, the team studied changes in the survival of *C. jejuni* in the poultry gastrointestinal system with probiotic treatment. They also compared the intestinal and fecal microbial content of broilers fed a control diet with birds on the control diet supplemented with lactobacilli cultures.

Results from these studies showed probiotics reduce *Campylobacter* loads in the simulated chicken digestive tract. The team observed a similar reduction in *Campylobacter* numbers in the intestines and fecal material of broilers treated with probiotics compared with control birds.

"The lactobacilli species that we tested had an antagonistic effect on *Campylobacter*," Chen said.

He added that probiotic products, such as the lactobacilli mix used in his group's studies, could be used to lessen the risk of *Campylobacter* contamination during poultry processing. *C. jejuni* is the leading cause of bacterial food poisoning in the U.S., and the U.S. Department of Agriculture has mandated a program to reduce contamination of meat and poultry products by this food-borne pathogen. Probiotics could help poultry producers and processors meet this goal by removing the chicken gastrointestinal tract as a source of this pathogenic bacterium.

in CHICKENS

Probiotic treatment was also effective at reducing pathogenic bacteria in excrement even when the waste came from animals that weren't treated with lactobacilli, Chen said. "Spraying probiotics onto fecal material reduced the population of *E. coli* by 99 percent and lowered *Campylobacter* and *Salmonella* numbers too. So, probiotics could be used to reduce potential contamination of water supplies from pathogenic bacteria found in poultry waste as well."

In another study, the researchers set out to verify claims that probiotics reduce bad odors from animal operations. The team fed two groups of chickens either a control diet or the control diet supplemented with lactobacilli.

"Most of the subjects on our sniff panel could tell a real difference in odor intensity and unpleasantness by the 38th day of probiotic treatment," Chen said. "Using various chemical assays, we found that the concentration of ammonia and other organic volatiles associated with malodor were reduced with treatment."

While Chen's group did not observe any long-term improvements in broiler performance following direct treatment with lactobacilli, their results with a product designed to stimulate growth of these bacterial species were more promising.

Fructooligosaccharide (FOS), a probiotic product, selectively stimulates the growth of lactobacilli species in the intestine. Lactobacilli use this molecule to grow and produce metabolites, which further acidify the intestinal environment. *Salmonella*, *E. coli* and *Campylobacter*, which are Gram-negative bacteria, are susceptible to these acidic conditions.

The team found that supplementing poultry diets with FOS improved broiler body weight gain, feed conversion, carcass weight and carcass percentage. Chen believes the improvement in broiler performance was related to the increase in the length of the birds' small intestines.

Marco Nicovich

One phase of the research involves measuring volatile ammonia from the collected fecal materials. Concentrations of these and other organic volatiles were reduced with probiotic treatment.

"The results indicate that a longer gut improved nutrient absorption in broilers and led to better performance in the birds," Chen said.

Other results from the study of FOS treatment suggest producers won't be the only ones benefitting from better performing chickens. Consumers may see benefits to their health from this type of treatment.

"Some of our observations suggest that FOS reduces serum cholesterol in broilers. This could translate to lower cholesterol levels in eggs, which would provide consumers with a healthier product," Chen said.

Chicken Model May Provide Clues for PROBLEMS

Marco Nicovich

Jeanetta Tankson, left, who recently earned her Ph.D. at Mississippi State, and Davis Wilbourn, a graduate student, harvest chicken hearts to screen for bacterial species in the organs.

Marco Nicovich

***Researchers weigh a heart as one measurement of pulmonary hypertension syndrome development after infection with* E. faecalis.**

By Charmain Tan Courcelle

Work conducted by a research team at Mississippi State University suggests that chickens and humans have more in common in matters of the heart than might first meet the eye.

MAFES poultry scientist J. Paul Thaxton and former MSU graduate student Jeanetta Tankson have found that *Enterococcus faecalis*, a common bacterial inhabitant of animal and human intestines, is a cause of pulmonary hypertension syndrome in chickens. The researchers also discovered that chicken and human sufferers of this disease share similar symptoms, leading them to believe they have an animal model that may provide answers to the development of this condition in humans.

Pulmonary hypertension syndrome is marked by a prolonged buildup of pressure in the pulmonary artery that results from an obstruction in the small blood vessels of the lung. The blockage leads to an increased resistance to blood flow from the heart to the lungs. To overcome this resistance, the right ventricle of the heart works harder to push enough blood through the lungs. Over time, the overworked right ventricle becomes weak and damaged, and eventually can fail, leading to death.

About 8 percent of chickens reared in the U.S. are affected by pulmonary hypertension syndrome every year. The annual cost to the industry worldwide due to this condition has been estimated at $1 billion. Chickens with pulmonary hypertension can develop ascites — an accumulation of fluid in the abdominal cavity, called "water belly" — and either die prematurely or are condemned at processing.

"A number of theories have been put forward to explain the cause of this condition," Thaxton said. "Some people said it results from birds being fed too much and selected for rapid growth. Others said it's due to inadequate ventilation and exposure to ammonia. We don't disagree with any of these explanations;


Marco Nicovich


Marco Nicovich

OF THE HEART

however, we propose that another cause of pulmonary hypertension syndrome is bacterial invasion."

Working with MAFES poultry microbiologist Yvonne Vizzier-Thaxton, the team isolated bacteria from the heart and lungs of chicks from early embryonic stage to three weeks of age. They then analyzed the samples for the types of bacterial species present and their numbers.

"Of the 41 different bacterial species we identified in the hearts and lungs of chicks, only one, *Enterococcus faecalis*, was present at every single sampling time in either the heart or lungs, or both organs simultaneously," Thaxton said.

Overall, the scientists found that the heart and lungs of young chicks only transiently harbored bacteria, including *E. faecalis*. But they chose to focus on *E. faecalis* as a possible cause of pulmonary hypertension syndrome because it can become pathogenic under the right conditions.

"*E. faecalis* can cause endocarditis (inflammation of the innermost layer of the heart's valves) if it inadvertently enters the circulation and infects the heart," Thaxton said. "That made this bacterium a logical candidate for a cause of pulmonary hypertension in chickens."

The researchers tested this theory by looking for the incidence of damage to the right ventricular wall — cavity formation — in chicks infected with three doses of *E. faecalis*.

"About 90 percent of birds challenged with *E. faecalis* in this study developed visual signs of pulmonary hypertension syndrome, including a depression in the external wall of the right ventricle," Thaxton said.

The study confirmed that *E. faecalis* is one cause of pulmonary hypertension syndrome in chickens. In other experiments, the scientists wanted to gain a better understanding of pulmonary hypertension by studying the changes to the heart and lungs of birds experiencing this condition.

Thaxton and his colleagues assessed the physical characteristics of the heart and lungs of chickens infected with *E. faecalis* — weight, length and diameter of the heart; the thickness of right and left ventricular walls; right and left ventricle weight and right and left lung weight — and compared them with heart and lung measurements from control birds. They also evaluated the cellular and tissue structure of the heart and lungs.

The group found *E. faecalis*-induced pulmonary hypertension caused the right ventricle to increase in size (hypertrophy). They also observed changes to the structure of the lung's blood vessels in chickens infected with *E. faecalis*, including epithelial cell injury and death and pulmonary congestion, which together with hypertrophy are common hallmarks of primary pulmonary hypertension in humans.

In humans, primary pulmonary hypertension is a diagnosis of exclusion, meaning other lung and heart diseases are ruled out before this condition is confirmed. Because of this, diagnosis of pulmonary hypertension often comes too late, when severe or fatal symptoms are present.

Thaxton said he hopes the chicken model of pulmonary hypertension syndrome will provide an understanding of disease progression in humans.

In addition, his group is working to develop a detection system for pulmonary hypertension syndrome in live chickens. The scientists have found decreases in the levels of protein and cholesterol in the serum (the liquid portion of blood) and increases in percentages of certain immune cells (monocytes and basophils) are good indicators of pulmonary hypertension syndrome caused by *E. faecalis*.

These results could eventually lead to a diagnostic tool for pulmonary hypertension syndrome, which would go a long way in helping the poultry industry limit losses to this condition, Thaxton said.

COMPOSTING
Solves a Smelly Problem

By Eva Ann Dorris

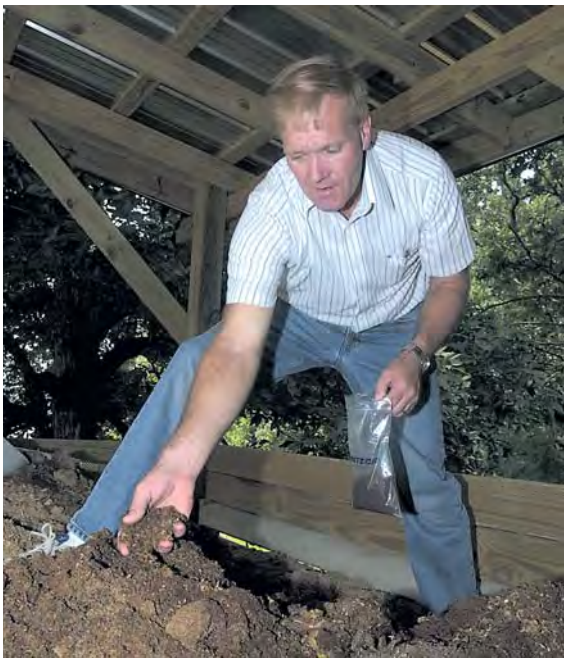
Composting may be a big part of the solution to waste disposal on hog farms.

MAFES research has found composting eliminates much of the odor associated with manure and is an efficient means of disposing of dead hogs.

Wayne Frank, assistant professor in waste management with MSU's animal and dairy sciences department, led a team that developed an alternative waste disposal system that keeps odor levels down and provides a value-added product for additional on-farm revenue. The three-year research project was funded in part by the Mississippi Farm Bureau Federation.

Under intense public pressure over the odor associated with swine production, the Mississippi Legislature issued a moratorium four years ago prohibiting the construction of any swine facilities. More specifically, the law was aimed at the waste management lagoon systems that go along with these animal production facilities. The legislative action allowed existing farms with traditional lagoon systems to continue in production, but no new facilities could be built.

Jim Lyrle



Wayne Frank collects a sample from a compost bin.

In traditional waste management systems, swine waste is collected into lagoons and diluted with water. The effluent is then applied to surrounding pastures as a fertilizer. The ban on new construction of waste lagoons meant a new method of waste management and disposal was needed.

Frank's team's answer to that need is a modified deep-litter system. The system consists of a two-inch layer of sawdust maintained on solid, sloped concrete pen floors. As the pigs move around the pens, the sawdust is mixed in with the animal waste and moves down the slope where it is collected in a pit. The litter is then composted and can be used for row crop and horticulture production.

"We can provide the expertise and information needed to any grower who wants to convert to this system," Frank said.

Since the moratorium on new hog production facilities, another obstacle has fallen into the path of all livestock producers. Because of concerns about the potential transmission of animal diseases, restrictions have been placed on mixing rendered animal protein with animal feeds. Previously, rendering plants purchased dead poultry and livestock for use in feed production. The new restrictions mean producers have to find other mortality disposal methods. Incineration seemed the likely alternative, but that too has restrictions.

"About the only other approved method to dispose of animal mortalities is in a landfill," Frank said, "and that is a short-term solution, which is expensive to the producer. Plus, the mortalities have to be transported off-farm to the landfills."

Researchers found composting to be the answer to this challenge as well.

"Temperatures in a composter get to about 140 to 160 degrees. That's crock pot temperature," Frank said. "We found if you put the dead animals into the composter, they will break down very rapidly, and after three days, will completely disintegrate into the compost materials."

Jim Lytle

Houston swine producer James E. Blissard, left, and Frank check the temperature inside a compost bin.

Jim Lytle

Waste management starts with proper feed management. Frank analyzes feed flow to minimize feed waste.

Research at MSU has led to inexpensive but efficient methods of on-farm composting and opportunities for additional on-farm revenue.

Frank's team found in-container composting with some method of rotation is the best method for Mississippi's humid climate. Options are as simple as building a homemade composter from steel road culverts placed on house trailer axles or purchasing used asphalt- or cement-mixing trucks. Commercial composting containers are more expensive and can handle up to 50 tons of compost per day.

"Composting reduces the volume of waste by 50 percent, and it reduces odors as the finished product has a pleasant earthy smell," Frank said. "It also kills all known pathogens and stabilizes nutrients, which means there are no runoff concerns. Nutrient runoff from composted materials would typically only occur when there is so much water that the compost floats away with the flow."

Frank said manure-source compost can be sold in bulk for application to pastures, row crops and truck crops, or it can be bagged and sold through retail markets. Presently, compost produced using mortalities is not approved for sale, but it can be used on-farm.

"I know of some dairy farmers who are making more now from selling their compost than they are from selling their milk," Frank said. "There is a great potential in selling this value-added product, but we need to work on the public's perception of composting, and we need to convince consumers of how good it is.

"This coming year we will be working with soil scientists to determine the benefits of using compost commercially. If we can develop a market for commercial compost, we can sell all we can produce," he said.

The modified deep-litter compost system is one answer to reducing odors associated with swine production, but researchers continue to explore other methods as well.

Ongoing projects at the university include work by MSU Extension Service swine specialist Mark Crenshaw to reduce fecal phosphorus by manipulation of animal diets, and work by MAFES agricultural engineer Tim Burcham to determine the feasibility of using biofilters such as kenaf to suppress in-facility odors.

Corn Protein Puts FALL ARMYWORM *on Starvation Diet*

Courtesy of Tibor Pechan

Marco Nicovich

This electron micrograph (50x magnification) shows a caterpillar gut with the peritrophic matrix containing a food bolus (above left). An adult fall armyworm is shown in the photograph at right.

By Charmain Tan Courcelle

A protein made in certain strains of corn reduces weight gain by 50 percent or more. But this corn product is not the latest in miracle diet drugs for the weight-conscious consumer; instead, it's a promising new control agent for fall armyworm and other caterpillar crop pests.

MAFES biochemist Dawn Luthe, postdoctoral research assistant Tibor Pechan and Agricultural Research Service (ARS) corn breeder and geneticist Paul Williams were part of a team that first made the link between reduced larval growth and a 33-kDa cysteine proteinase produced in the leafy tissue of developing whorls from fall armyworm-resistant corn plants. The researchers recently completed a collaboration with ARS entomologist Allen Cohen that has revealed how the protein works to stunt fall armyworm growth.

The 33-kDa cysteine proteinase appears to be a novel type of plant insect-defense system, Luthe said. Unlike other plant proteins in its class, the 33-kDa cysteine proteinase acts by directly damaging a critical insect gut matrix.

"The 33-kDa cysteine proteinase causes the peritrophic matrix, which plays a role in insect digestion and nutrient

absorption, to break down," Luthe said. "Damage to the peritrophic matrix throws off the balance of nutrient absorption and recycling and is harmful to insects.

"The ability of this protein to cause peritrophic matrix damage represents a different form of insect resistance in plants that has not been identified before. It could add to our ability to develop crops that can defend themselves against insect attack."

In earlier work, Luthe and her colleagues found that the 33-kDa cysteine proteinase is mobilized within an hour of larval feeding from internal stores in resistant corn. It then accumulates at the wound site for up to seven days. The group also observed that fall armyworm larvae developed more slowly when they were fed tissue from resistant corn lines compared with a control diet or a diet of susceptible material.

"The physiological indices we used suggested that insects fed a diet of resistant whorl tissue are unable to use the nutrients found in this plant material to grow," Luthe said.

Based on this first clue of nutritional impairment, the researchers decided a possible target for the 33-kDa cysteine proteinase was the caterpillar peritrophic matrix.

The peritrophic matrix forms a "sock" around the ingested food bolus and provides the proper environment for digestion and nutrient absorption within the insect midgut. It functions as a filter that allows digestive enzymes to enter into the midgut and nutrients from digested food to exit out into the circulation. The peritrophic matrix also forms a physical barrier that protects the midgut cells from invading microbes and damage caused by chemical toxins.

The research team evaluated the structure of the peritrophic matrix from caterpillars fed resistant or susceptible corn tissue to determine the effect of the 33-kDa cysteine proteinase on this digestive lining.

"We found holes, tears and gaps in the peritrophic matrix of caterpillars that were fed on resistant plants, but no matrix damage in caterpillars fed on susceptible plants," Luthe said.

Because the peritrophic matrix also has a protective function, disrupting this lining could open the insect up to attacks from pathogens, such as bacteria and viruses, that would otherwise be filtered out by an intact matrix. Holes in this lining could also allow chemical toxins to pass through.

So, the 33-kDa cysteine proteinase may be acting by both disrupting nutrient absorption and increasing the insect's vulnerability to pathogens and toxins, Luthe said.

The researchers confirmed the 33-kDa cysteine proteinase, and not some other factor in resistant corn tissue, was responsible for this effect by moving the gene for this protein into susceptible plant material (Black Mexican Sweetcorn callus).

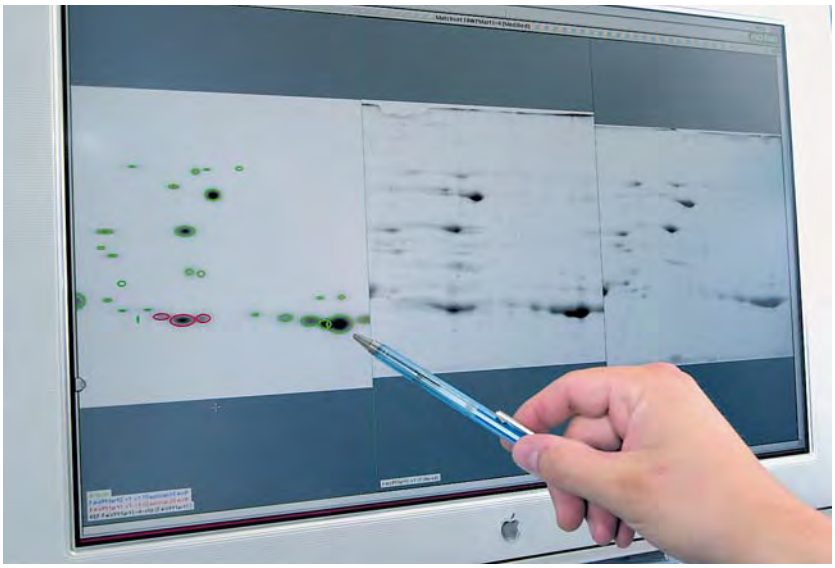
"Only the caterpillars fed on Black Mexican Sweetcorn callus transformed with the protein had damage to their peritrophic matrix and showed reduced growth," Luthe said.

The team's success with transferring the protective effect of the 33-kDa cysteine proteinase into another plant host suggests that the protein may eventually be used to provide enhanced insect resistance in other crops. Luthe said understanding more about how resistant corn plants regulate the 33-kDa cysteine proteinase will help make this a reality.

"We hope one day to be able to protect plants against insects. The 33-kDa cysteine proteinase may provide us one more way to do so," Luthe said.

Marco Nicovich

Marco Nicovich



Postdoctoral research assistant Tibor Pechan examines an electrophoretic analysis of larvae peritrophic matrix proteins. Spots on the screen represent individual proteins that are structural and functional components of the matrix.

Looking Out for "No. 1" from Above

REMOTE SENSING TAKES ON SWEETPOTATO PRODUCTION

By Charmain Tan Courcelle

A plane's eye view may one day help producers striving for higher yields of U.S. No. 1-grade sweetpotatoes.

MAFES agronomist Mark Shankle is leading a team that is exploring the use of remote sensing in sweetpotato production. The research aims to provide answers for growers faced with inconsistent yields of marketable, top-grade sweetpotatoes.

Mississippi is the third-largest producer of sweetpotatoes in the nation, ranking behind North Carolina and Louisiana. Sweetpotatoes grown in the United States are graded based on their size, shape and surface appearance. The roots are separated into U.S. No. 1 and 2 fresh market grades, canner and jumbo processing market grades and a cull grade.

"U.S. No. 1-grade sweetpotatoes are five to eight times more profitable than the other potato grades and represent most of the fresh market," Shankle said. "The processing market for canner and jumbo grades is much smaller than the market for U.S. No. 1's, and producers will let the canners and jumbos roll off the back of the digger with the culls if there is no market demand. They do this because storage and handling are costly and the profit margin is low in the processing market."

A good yield percentage for sweetpotato fields is 60 percent U.S. No. 1-grade roots. But yields of this top grade of sweetpotatoes are often inconsistent across a field.

Shankle said previous attempts to define factors influencing No. 1 yields, including fertilizer rates, have produced mixed results every time. He hopes remote sensing will remove the guesswork from sweetpotato production and allow producers to maximize their yields of No. 1 roots.

One question that Shankle's research will address is the utility of conventional versus unmanned aircraft for collecting spatial information. Shankle is working with Air-O-Space International and EMC, Inc., to monitor crop development with an unmanned aerial vehicle (UAV) and conventional airplane, respectively. The project is funded by the Mississippi Space Commerce Initiative and the Advanced Spatial Technologies in Agriculture program.

"The UAV seems to be a better fit for sweetpotato production because this crop is generally grown in fields lower in acreage (10 to 20 acres) than those used for other row crops," Shankle said. The unmanned craft also has the advantage of providing real-time data.

Shankle's team is assessing whether these positives will add up to better profits on the ground.

Both the UAV and conventional aircraft will be used to collect multispectral data across sweetpotato fields at 41, 65 and 85 days after transplant, which correspond to periods of root initiation, root elongation and preharvest, respectively. The information will then be processed to give a normalized difference vegetation index, which indicates crop health and vigor.

As part of this study, the team will collect "ground-truthed" data, including soil properties (macronutrient and micronutrient content, moisture, compaction and texture), plant leaf nutrient and chlorophyll content, the percentage and type of ground cover, insect populations and sweetpotato grade yield.

Results from the ground-truthing and aerial data collection will then be compared to determine the factors affecting sweetpotato yield variability across a field.

So far, the group has found that soil compaction has an effect on the shape and size of sweetpotatoes. U.S. No. 1 sweetpotatoes are two to three and one-half inches in diameter, three to nine inches in length, well shaped and free of defects.

"We've found that some compaction at lower depths is good because it prevents long roots from forming. On the other hand, compaction near the surface is bad because it causes roots to become misshapen and unattractive," Shankle said.

Other preliminary results from this study suggest soil pH and levels of zinc, boron and sulfur also affect sweetpotato yield variability in a given field.

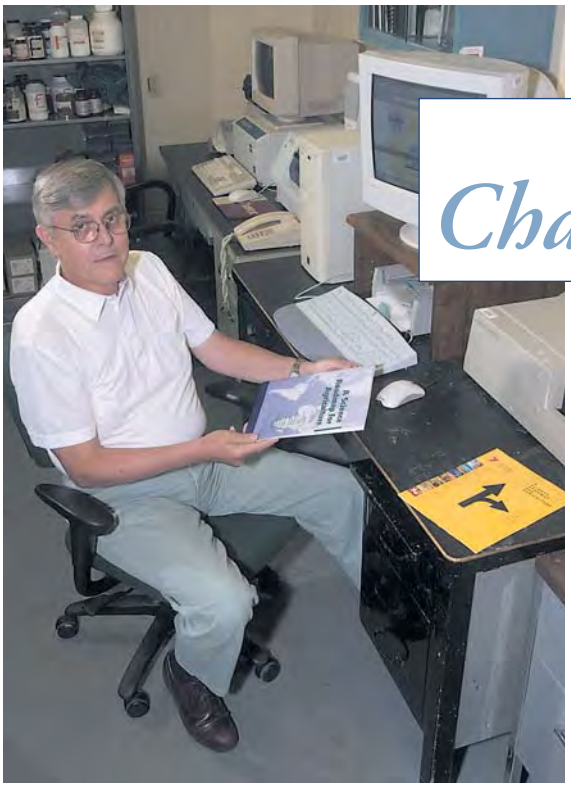
"Many of the factors that we've found to be important are soil characteristics that can easily be managed," Shankle said. "Using remote sensing technologies, we may be able to develop site-specific strategies that will help sweetpotato growers to manage variability in their fields and to maximize yields of U.S. No. 1 potatoes consistently."

Charmain Courcelle

Charmain Courcelle

Shankle, left, and Air-O-Space manager Skip Wright check out the UAV used to collect spatial information in the sweetpotato yield study (photo at left). Shankle collects ground-truthing data with research assistants Jeff Main, left, and Trevor Garrett.

Jim Lytle



SCIENCE ROADMAP
Charts Agriculture's Future

***Wilson displays a copy of* A Science Roadmap for Agriculture: Seven Challenges to Meeting our Nation's Agricultural Goals.**

By Eva Ann Dorris

The chapters in the history of American agriculture reveal a phenomenal success story. However, the most exciting chapters are yet to be written. Some of the nation's top research scientists believe there's even more potential for agriculture in what's ahead.

The scientists, an appointed task force of the Experiment Station Committee on Organization and Policy (ESCOP), recently published a handbook entitled "A Science Roadmap for Agriculture: Seven Challenges to Meeting our Nation's Agricultural Goals."

The handbook is a result of brainstorming sessions among 24 scientists from throughout the nation who collectively have hundreds of years of experience in agricultural research. One member of the elite group responsible for the roadmap is Robert P. Wilson, MAFES professor of biochemistry and molecular biology.

The scientists believe the rapidly evolving world of science and agriculture calls for a new approach to defining needs and setting priorities for agricultural research and education. The roadmap outlines seven challenges identified by the task force as areas that must gain the attention of the scientific research community.

Wilson's involvement in the group was a natural complement to responsibilities he recently completed for the National Research Council's Board on Agriculture and Natural Resources and to his more than 30-year career as an agricultural educator and researcher.

"Agriculture has been a success story, but where do we go from here?" Wilson asked. "We've improved the production and management side of agriculture. We've improved genetics. And now we have to use the new biotechnology to produce more or perhaps produce specialty or niche crops.

"I don't think anyone would question that the products we are producing are the best in the world, but we have to figure out how to be sure farmers are rewarded for doing that."

Wilson said the roadmap identifies the type of future research and manpower that will be needed 10 to 15 years from now.

The seven challenges identified by the scientists include developing new and more competitive crop products and new uses for diverse crops; developing new products and new uses for animals; reducing the risks of local and global climatic change on food, fiber, and fuel production; providing the information and knowledge needed to further improve environmental stewardship; improving economic returns to the producer; strengthening families and communities; and ensuring food safety and health throughout the food production chain.

The task force projects the national agricultural research system will need significant new resources — almost $6 billion in new funding — if the roadmap is to provide its intended direction. The funding could be provided from a variety of sources, but Wilson said the majority will come from the government through increased federal investment in the land-grant university system.

The publication, prepared by the National Association of State Universities and Land Grant Colleges (NASULGC) and ESCOP, is being distributed to assist decision makers and advocates as they plan for future program areas for the research and education system. Copies of the report are available upon request from NERA@umail.umd.edu.

CALENDAR OF UPCOMING EVENTS

August 14, 2002
Cotton Field Day,
Delta R&E Center, Stoneville

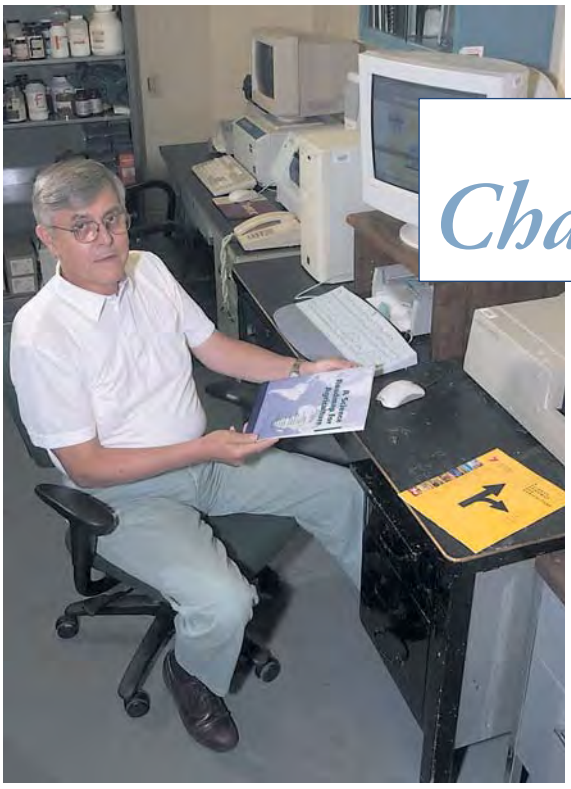
August 15, 2002
Rice and Soybean Field Day,
Delta R&E Center, Stoneville

September 28, 2002
North Miss. Garden Expo,
North Miss. R&E Center, Verona

October 18-19, 2002
Fall Flower & Garden Festival,
Truck Crops Branch,
Crystal Springs

November 21, 2002
MSU-MAFES
Annual Production Sale, MSU

Jim Lytle



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