MAFES • RESEARCH

Highlights

Spring 2001

MISSISSIPPI AGRICULTURAL AND FORESTRY EXPERIMENT STATION

CONTENTS

FRONT COVER: Scientists regard agricultural biotechnology as the best hope to feed an ever-growing world population. Find out how MAFES is using biotechnology to develop vaccines that will protect livestock and aquaculture (story on page 16) and to address other important agricultural issues.

from the DIRECTOR

Agriculture was born around 8,000 B.C. Since that time, people have selected the best-performing plants and animals to use in future growing seasons. While they didn't know it then, they were engaging in the earliest form of genetic modification.

By choosing and cultivating plants with superior agronomic traits, Native Americans transformed teosinte, a wild grass, into corn over several thousands of years. The early genetic improvements to teosinte and the ability beginning in the 1920s to produce hybrid seeds from crossbreeding plants were instrumental in enhancing corn's value as a food source.

Today, breeders can apply the tools of biotechnology to more precisely and quickly introduce beneficial characteristics into crops. The use of biotechnology together with traditional breeding practices in "marker-assisted selection" may facilitate our efforts in animal and plant variety improvement. At the same time, this technology could further our understanding of the factors affecting the health and quality of our crops and livestock, and it could enhance current methods of pathogen surveillance to ensure that our food is safe.

Agricultural biotechnology has the potential to provide sustenance for an ever-growing world population and may hold the key to developing a more sustainable, environmentally friendly way of farming.

MAFES is committed to using biotechnology to solve problems in agriculture. We have coordinated efforts to establish the Life Sciences and Biotechnology Institute on the Mississippi State campus that will add to our ability to address Mississippi's agricultural needs and serve to increase bioscience-based economic development in our state.

We are proud of our strides toward developing plants with built-in pest resistance and our work in improving animal health and food safety. Biotechnology has given us some of our success in these areas and has presented us with new research possibilities.

There is risk associated with any technology, and MAFES is bound to its responsibility as a public institution to carefully assess biotechnology's benefits and potential risks. We will continue to work with agencies like the U.S. Department of Agriculture, the Environmental Protection Agency and the Food and Drug Administration to use biotechnology in a responsible fashion that will protect our environment and ensure the safety and quality of our food.

Crops enhanced using biotechnology are not new to producers in Mississippi. About 75 percent of the cotton planted in this state has Bt-supplied pest protection. We are working to protect our farmers' investment in this technology by evaluating resistance management strategies and consumer attitudes toward genetically enhanced foods.

We invite you in this issue of Highlights to find out more about the biotechnology research conducted at the Experiment Station. We hope you will visit us at one of our branches and experience firsthand our commitment to the state of Mississippi.

Vance H. Watson
Director

Volume 64, Number 2
Spring 2001

Highlights

MISSISSIPPI AGRICULTURAL AND FORESTRY EXPERIMENT STATION

Vance H. Watson, *Director*

Malcolm A. Portera, *President*

J. Charles Lee, *Vice President*
Mississippi State University

EDITOR

Charmain Tan Courcelle

ASSISTANT EDITOR

Robyn Hearn

GRAPHIC DESIGN & LAYOUT

Mary Howell

WRITERS

Cliff Bice
Bonnie Coblentz
Terry Hanson
Dawn Luthe
Wallace Killcreas
Allison Matthews

PHOTOGRAPHY

Jim Lytle
Marco Nicovich
Tom Thompson
Fred Faulk

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

HIGHLIGHTS
Office of Agricultural Communications
Box 9625
Mississippi State, MS 39762-9625

Available on the World Wide Web

msucares.com/pubs/highlights

MAFES Works Toward Turning Biomass Waste into FUELS

By Charmain Tan Courcelle

Gas prices getting you down? Wish there were alternative fuels?

Biobased fuels have been in use from the time humans first set fire to wood for heat. Today, however, biofuels account for less than 1 percent of energy generated worldwide due to the cost of production and the need for improved manufacturing processes. MAFES has joined Oklahoma State University in an initiative to make production of biofuels more efficient and economically feasible.

"Our goal is to develop technologies that will make plant-biomass-derived fuel competitive with conventional fuel and to produce crops designed for greater energy efficiency than fossil fuels," said Nancy Cox, MAFES associate director.

Biobased fuels are derived from biomass, which includes wood, plant material, agricultural residues, animal waste and solid municipal waste. Examples of biofuels are ethanol, methanol and biodiesel.

Current U.S. ethanol production exceeds 1.5 billion gallons every year. Low petroleum prices have limited widespread use of ethanol as a fuel in the past, but pressing environmental concerns and the need for energy self-sufficiency have stimulated the search for a more cost-effective means to produce biofuels.

"The most common way we make ethanol for fuel is by traditional fermentation of corn. It's a very simple and well-known technique," said Mark Zappi, MSU chemical engineer and a key partner in MAFES research. "However, of the whole crop of corn, we only use parts of the kernel for ethanol production. The protein, fiber and oil present in the kernels, leaves and stalks of corn cannot be fermented, so you can imagine how much of the plant is actually wasted. Also, more than 70 percent of the earth's biomass is not amenable to direct fermentation techniques."

In addition to traditional fermentation of crops, there are four primary ways to make ethanol. MAFES researchers will use biotechnology and engineering advances to optimize the conversion of synthesis gas into ethanol.

Synthesis gas, or "syngas," a mixture of hydrogen, carbon monoxide and carbon dioxide, is made when feedstock is combusted at a high temperature. These gases are bubbled into a fermenter, or bioreactor, containing bacteria that are able to convert the gas to ethanol. One area of research supported by the initiative examines the impact of the type of feedstock on the composition of synthesis gas.

"We know from the literature that different materials that are used as feedstock can yield different syngas compositions," said Jerry Gilbert, MAFES agricultural and biological engineer. "We need to know the gas composition that's going into the bioreactor because it can affect the conversion efficiency of gas to product.

"MAFES scientists will evaluate biomass from waste streams that are common to Mississippi, such as wood waste, cotton gin trash and poultry waste, as potential sources of feedstock for ethanol production. We're also going to look at cultured grasses, such as switchgrass and other tall grasses, for biomass feedstock production," Gilbert said.

Gilbert added that these sources of feedstock have the potential to lower the cost of ethanol production because they are relatively inexpensive. Using waste biomass would also help solve the disposal problems facing Mississippi agricultural and forestry industries.

"The configuration and design of a gasifier is another important factor affecting syngas composition," Gilbert said.

A gasifier is a high-temperature furnace used to combust feedstock. Engineers involved with this project will identify gasifier technology and fine tune it to match the type of feedstock and fermenter that will be used.

Another aspect supported by the biofuels initiative is a detailed look at the fermentation process. Factors that can affect fermentation include the population of microorganisms found in the fermenter, the composition of synthesis gas, and fermenter operation.

MAFES researchers will search for new microorganisms that may have increased fermentation capabilities over previous isolates.

"A good production coming out of fermenters now is 40 grams of ethanol per liter of liquid recovered, but that is not stable or long-term production. Most of the people we know who are doing long-term studies are getting between 20-30 grams of ethanol per liter," Zappi explained. "We would like to find bacteria that can give us up to 70 grams of ethanol per liter or higher."

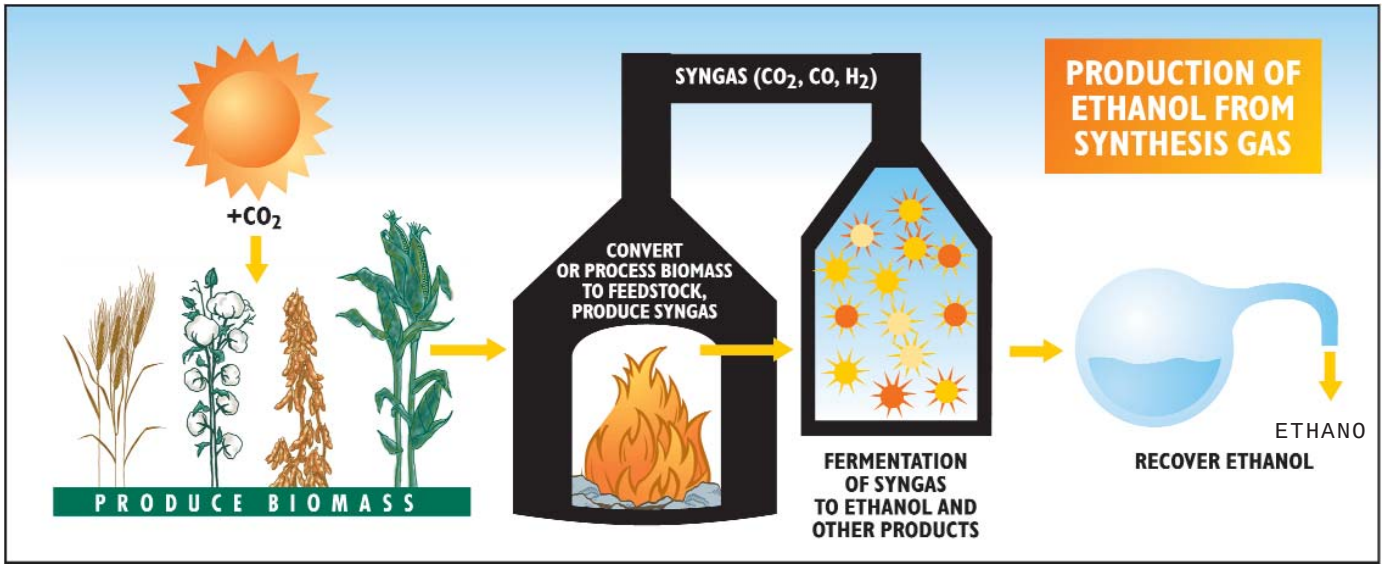
In addition to looking for better ethanol-producing bacteria, Zappi and others will look for ways to improve current fermenter design and operation. With Rakesh Bajpai of the University of Missouri in Columbia, Zappi has developed a modeling tool that allows researchers to determine how the efficiency of ethanol production is affected by changing individual aspects of the fermentation process – synthesis gas composition, type of bacteria and fermentation conditions.

Gilbert and Zappi both noted that the technologies developed for conversion of biomass and waste biomass to ethanol could also be used for producing other valuable products. Synthesis gas can be combined to produce at least eight chemical compounds.

"A second product that we will be looking at is acetic acid, which can be used as a 'seed' compound to produce other chemicals, for example methane. The production of ethanol and other products from 'waste' biomass sources allows for the beneficial use of these resources and the development of a new industrial base in Mississippi," Zappi said.

The U.S. Department of Agriculture is funding the MAFES-Oklahoma State University biomass-based energy research initiative. This initiative will complement an ongoing consortium effort supported by the Department of Energy (DOE) at MSU, the University of Southern Mississippi, the University of Mississippi and Jackson State University. The DOE-sponsored work has a focus on the development of the acid hydrolysis technique of ethanol production and on the improvement of fermenter design and ethanol separation from other products of fermentation.

"The exciting thing about the biofuels initiative is that it will bring people with different kinds of expertise and from different disciplines together into a group," Cox said. "The overall impact of using biomass and other renewable resources as fuel is that these are more environmentally friendly than coal, natural gas and petroleum. At the same time, development of biofuel technology has the potential to provide Mississippi farmers an alternative source of income for their crops and to be of economic importance to companies that are already established in this state."



Counting Electrons to cut Seafood Analysis

By Allison Matthews

A lack of uniform freshness standards in the seafood industry and an intriguing visit to Dauphin Island, Ala., led MAFES food scientist Douglas Marshall to brainstorm methods of improving seafood testing.

Although consumers who enjoy seafood expect their meals to be safe and fresh, the industry has employed a rather subjective means of measuring the quality of ocean harvests.

NICOWICH

MAFES food scientist Douglas Marshall prepares a sample of shrimp for bacterial analysis using impedance technology.

Processors have relied on sensory methods to measure characteristics such as aroma, texture and color. Chemical and microbiological testing methods have long analysis times and only seem to verify the sensory tests.

Marshall said the lengthy analysis time of chemical or microbiological tests wastes product shelf life and requires highly trained analysts to interpret results. He recognized the need to speed up seafood testing and eliminate subjectivity. He developed new tests that give fast results using impedance technology, which measures the flow of electrons through food.

"We've tried to use objective measurements of quality so that any inspector administering these tests will get the same results. This data correlates to results of sensory testing, but impedance eliminates the subjectivity of the processor's perspective," Marshall said.

Standard chemical and microbiological testing can take up to 24 to 48 hours, but impedance technology allows testing to be finished in as little as 30 minutes.

Marshall thought of impedance as an effective tool for the seafood industry after he met with scientists at the Food and Drug Administration's Fisheries Research Branch at Dauphin Island in 1990. The FDA scientists were trying to find more reliable indicators of seafood freshness.

Testing for quality and safety is very important, both to meet federal standards and to ensure consumer satisfaction and health. About 5,000 people in the United States die each year from food-borne illnesses. Seafood causes a large number of outbreaks, but it is not responsible for as many individual cases of food poisoning as other foods.

Impedance technology, using different applications, allows rapid testing of crustacean shellfish and mollusks. Crustaceans include seafood with an exoskeleton or soft shell, such as lobsters, crawfish, shrimp and crabs. Mollusks are those without skeletons that live in hard shells, including oysters, clams, mussels and scallops.

Marshall's rapid impedance tests can detect spoilage indicators in crustaceans and safety indicators in mollusks. Marshall explained the importance of testing safety of seafood such as oysters — which are the primary

Time

Testing for quality and safety is very important, both to meet federal standards and to ensure consumer satisfaction and health.

mollusks Americans consume — because they are often eaten raw.

Oysters are known to sometimes transmit a few serious pathogens. Marshall's tests are designed to quickly detect and count pathogens present so seafood that is safe may be supplied to consumers more quickly, without wasting freshness time. The tests also reliably indicate foods that violate FDA safety standards and should not be passed to consumers.

"These pathogens are primarily associated with the consumption of raw oysters. They are not a problem when seafood is cooked," Marshall said.

The pathogens, specifically *Vibrio parahaemolyticus*, which is most common in the United States, are present in all raw oysters. Scientists believe the pathogens are dangerous only when the number present exceeds a certain level established by the FDA. Impedance also can test for *Vibrio vulnificus*, a rare but deadly pathogen associated with oysters harvested off the Gulf Coast.

"The FDA has a regulatory limit for molluscan shellfish of less than 10,000 *Vibrio* bacteria per gram," Marshall said.

To test the food samples using impedance technology, processors place specimens into a well of a testing module. Each module contains 16 wells, and within each well is a pair of electrodes. The modules are placed in a Bactometer Processing Unit and tested with a few simple computer commands. The Bactometer counts the number of bacteria so processors can determine whether the samples meet safety standards. Marshall said up to 128 food samples can be tested simultaneously.

Before reaching the consumer, processors may conduct food safety and quality checks at a variety of points along the processing chain. Seafood is tested as soon as boats bring their harvests to the docks, again by processing plants and then by clients, such as supermarkets, who buy from the processing plants.

"Lastly, consumers do their own quality checks at the supermarket counters," Marshall said. The FDA also may double-check for quality and safety at any point in the food processing and distribution line.

NICOVICH

The Bactometer Processing Unit counts the number of bacteria present in a food sample. The unit allows the safety standards of up to 128 food samples to be determined simultaneously.

NICOVICH

Raw oysters carry *Vibrio* bacteria and other pathogens that can pose a threat to consumer health.

ing electrons to cut seafood analysis time

improved CATFISH STRAIN *distinguishes itself from the pack*

By Charmain Tan Courcelle

NICOVICH

NWAC-103 broodstock is harvested for distribution to the catfish industry.

Catfish growers were given a boost with the release of a new, faster-growing channel catfish strain.

MAFES and the U.S. Department of Agriculture's Agricultural Research Service (USDA/ARS) made the channel catfish variety, NWAC-103, available to the catfish industry on Feb. 6, 2001.

The NWAC-103 catfish strain is the direct result of genetic research and evaluation conducted by USDA/ARS and MAFES scientists at the Thad Cochran National Warmwater Aquaculture Center. Using traditional breeding methods, researchers selected NWAC-103 fish out of a "closed population" of catfish for their increased growth performance and food consumption.

"The NWAC-103s have a six-year breeding history and give an improved growth rate of up to 20 percent," said Marty Fuller, associate director of MAFES. "Growth evaluations were performed on several different strains of catfish, and it turned out that NWAC-103 consistently outperformed its counterparts.

"The impact of this new variety of fish over an extended period of time is extra crops of catfish, which will add significantly to the producer's bottom line," he added (see accompanying story).

The faster growth rate of NWAC-103 appears to be due to higher feed consumption and vigorous feeding behavior.

"This new fish also has good reproductive traits compared with the catfish currently being used by producers," said Bill Wolters, USDA/ARS geneticist and breeder of the new fish. "Some NWAC-103 females

The impact of this new variety of fish over an extended period of time is extra crops of catfish, which will add significantly to the producer's bottom line.

– Marty Fuller

improved catfish

spawn at 2 years of age, which is a year earlier than other catfish. Overall, this variety shows good spawning success and fecundity."

In addition to its growth and reproductive traits, NWAC-103 also meets another producer need – the ability to easily identify and manage channel catfish strains and to keep them pure. The Aquaculture Center research has laid the groundwork for using DNA fingerprinting technology to help catfish growers keep close track of NWAC-103 fish.

"One unique thing about this release is that we'll have the ability to follow the NWAC-103 catfish once they are on commercial farms," noted Geoff Waldbieser, USDA/ARS geneticist.

The catfish genome is made up of 1.1 billion letters, or bases, that spell out each fish gene. Scattered throughout this code are tens of thousands of genetic markers called microsatellites that are passed down a family line.

"Microsatellites are short DNA sequences of bases (A, T, C, G) – for example, AAT or GATA – that are repeated several times in tandem," Waldbieser explained. The number of times a microsatellite sequence repeats itself within a given region of catfish DNA can vary between individuals. "We use the number of repeats as a marker to show if a random fish is 103."

Waldbieser and Wolters tested fish from 20 catfish fingerling operations in Mississippi, Louisiana, Alabama and Arkansas to see what genetic markers were out in the catfish industry and which of these markers could be used to distinguish NWAC-103 from other catfish varieties currently produced.

"Out of the 300 or so markers that we initially developed, we selected 10 that were more precise for discriminating 103s from other catfish," Waldbieser said. "With 10 markers spaced at different points in the genome, the probability is very low that a fish which gives a marker profile like a 103 is not a 103."

A small piece of catfish whisker, or barbel, is all that is required to pick NWAC-103 out from a crowd. Scientists collect the genetic material carried in whisker cells and analyze it using DNA fingerprinting. With the help of a sensitive laboratory test called the polymerase chain reaction (PCR) and different-colored fluorescent dyes, researchers are able to differentiate NWAC-103 fish from different strains of catfish that otherwise have the same physical appearance.

"We use PCR to make a short piece of DNA with the same starting and ending points. The sequence repeats, or microsatellites, are found in the middle of this DNA we've made. Different lengths of PCR products are obtained based on the number of repeats that are present in the DNA and we use this to identify 103s," Waldbieser explained.

NICOVICH

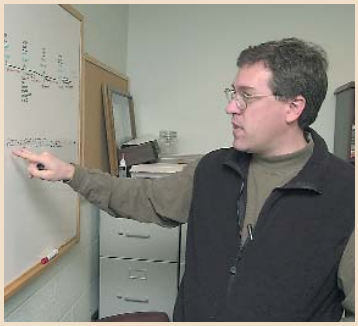
Even now after this new fish variety has been released to the catfish industry, research to enhance this popular food fish continues at the Thad Cochran National Warmwater Aquaculture Center.

"The next thing we want to do is to take NWAC-103s and try to improve multiple traits at the same time. Some of the traits include increases in dress-out percentages, disease resistance and growth rate," Wolters said.

Waldbieser and Wolters have mapped the addresses for 263 genetic markers that may help them locate the general vicinity of genes controlling desirable catfish traits. The researchers said they hope to extend this map to 1,000 markers to assist them in their studies.

"Some traits, such as disease resistance, are difficult to improve, and having genetic markers will increase our ability to enhance these characteristics," Wolters said.

The Mississippi catfish industry accounts for 70 percent of catfish produced nationally. Catfish research at the National Warmwater Aquaculture Center should benefit the farm-raised catfish industry, which produces two-thirds of the annual aquacultural products in the United States.



NICOVICH

Genetic markers in the NWAC-103 genome allow producers to distinguish this catfish strain from other commercial strains. USDA/ARS geneticist Geoff Waldbieser explains the laboratory test that makes this possible.

h strain distinguishes itself from the pack

economic comparison of NWAC-103 *and normal channel* CATFISH *strains*

Charles Manning, pond manager at the Thad Cochran National Warmwater Aquaculture Center, loads a truck with NWAC-103, a new, faster-growing strain of catfish.

For fingerling producers, the faster-growing NWAC-103 catfish strain would result in having larger fingerlings to sell at the end of the first growing season.

NWAC-103 channel catfish may help producers reap in extra crops of fish and additional profit.

By Terry Hanson and Wallace Killcreas,

MAFES agricultural economists

Broodstock of the NWAC-103 strain of channel catfish, formerly known as USDA-103, was released Feb. 6, 2001. You may have heard about its improved growth characteristics, but what does this mean to the producer's bottom line?

Research showed that NWAC-103 fish would consume 13 percent more feed than other channel catfish strains and convert the added feed to more pounds of fish. However, it is believed NWAC-103 has the potential to increase feed consumption by 20 percent. Will NWAC-103's ability to consume more feed translate into additional profit compared with non-NWAC-103 fish? If increased appetite results in shorter production cycles, will there be increased total production over the long run? How will fingerling producers benefit from NWAC-103 fish?

Wallace Killcreas, MAFES agricultural economist and FISHY software developer, has developed a catfish growth simulation program known as GROW-CATS. Using this software, two catfish strains were "grown" over a 10-year period, with NWAC-103 catfish being fed 20 percent more feed than normal catfish. (Non-NWAC-103 fish are referred to as "normal" in the rest of this article.) Resulting simulation production data were used to estimate annual per-acre receipts, costs and net returns for the two strains of catfish. A 10-year period of production was simulated with net returns calculated each year. The net present value (NPV) was calculated to discount future net returns to present-day dollars. In other words, a

sum of money gained in the future is "discounted" to 2001 dollar amounts to determine a product's potential for economic return. The further into the future the revenue is earned, the less its net present value. And in this analysis, the strain with the higher NPV would provide better long-term results to the farmer.

Each GROWCATS simulation was set up as a multi-batch-stocking scenario. Commercial grow-out practices were used in the growth simulation runs: (1) daily feeding limit set at 120 pounds per acre; (2) harvest weight was 1.25 pounds per fish; (3) stocking rate was 7,500 fish per acre (3,750 fish at 4.5 inches and 3,750 fish at 5.5 inches); (4) ponds automatically restocked with same-sized fingerlings after each harvest; and (5) the feeding calendar was set to standards typically used in FISHY. The program also took into account a catfish mortality rate of 1.7 percent per month and seasonal temperature effects on growth. The simulation began on Jan. 1 of year one and ran for 10 years. The GROWCATS program feeds, kills and grows fish on a weekly basis.

Once fish reach the prescribed 1.25-pound harvest size, the program harvests the fish and restocks the pond with fish of the same size.

Over the simulated 10-year period, the normal fish had an average production cycle of 18 months (73 weeks), while the NWAC-103 cycle was shorter, averaging 15 months (61 weeks). Shorter production cycles for the NWAC-103 strain of channel catfish could lead to greater long-term production through additional batch harvests and reduced mortality. The GROWCAT analysis estimated food fish producers could gain an additional 1.5 harvests per pond over a 10-year period with this reduced growth cycle.

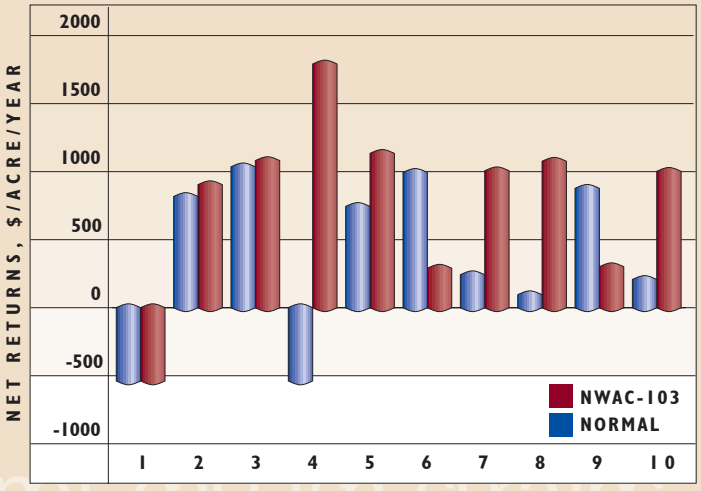
Slower growth in the normal fish resulted in greater divergence between the 4.5- and 5.5-inch fingerling batches as the simulation continued over time. These widening gaps resulted in four occasions when there would not be two batches of normal fish harvested, but only one or no harvests in a calendar year. In contrast, every NWAC-103 simulation year past the initial year had at least one batch of harvestable-sized fish, and net returns from production of this strain of catfish were greater than returns from the currently used channel catfish strains.

While research showed that NWAC-103 fish consume more feed than normal catfish, the additional feed costs used in producing the new strain of fish were offset by greater increases in production and associated receipts. On a per-acre basis, the extra production cycles would amount to an additional $387 per acre per year for NWAC-103 fish over the long-term. The net present value from a 10-year stream of returns was greater for NWAC-103 fish than for normal channel catfish, which implies that NWAC-103 fish would provide better long-term economic results for the producer.

For fingerling producers, the faster-growing NWAC-103 catfish strain would result in having larger fingerlings to sell at the end of the first growing season. NWAC-103 catfish could produce more fingerling inches per unit of time than normal catfish. More inches of fish could translate into greater returns to fingerling producers.

Actual fish performance may vary significantly from results presented here. Specific values calculated from the simulation may reflect "best" case scenarios and will definitely differ for each producer's operation. The GROWCATS software does not specifically account for some very important real-world conditions that could overshadow the positive growth of both NWAC-103 catfish and normal channel catfish. For example, the software does not simulate the effects of off-flavor delays or direct losses caused by disease, oxygen problems, bird predation, marketing constraints and poor management. Nevertheless, increases in overall NWAC-103 catfish production and profitability from greater feed consumption should be evident over a period of years.

COMPARISON OF NORMAL AND NWAC-103 CHANNEL CATFISH NET RETURNS OVER 10



MAFES *is measuring* Consumer Opinions *on modif*

By Bonnie Coblentz

Researchers at Mississippi State University's Agribusiness Institute are in the process of determining consumer attitudes to genetically modified foods.

Genetic modifications of food are typically done to make the item easier for the farmer to produce or to make it more desirable for the consumer because of new or enhanced traits. For example, tomatoes have been modified to stay fresh on the shelf longer, a benefit to consumers, and soybeans have been developed to be resistant to a common weed killer, a benefit to farmers.

The MSU researchers have completed one preliminary study in Mississippi to determine whether consumers feel differently about genetically modified foods if the change was made to develop a better product for them.

Jayson Lusk, MAFES agricultural economist, conducted the first survey for the Agribusiness Institute and is working on future surveys. These surveys will measure U.S. and European opinions on the subject of genetically enhanced foods.

"We want to find out if people change their opinions about genetically modified foods if there are different reasons for making the modification," Lusk said. "Will someone who opposes a genetic modification that aids the producer still oppose genetic engineering if it gives them a better product?"

This survey was conducted among Mississippi consumers, and the results have been compiled. Results indicate that consumers are more accepting of corn chips that have been genetically modified to increase shelf life rather than modified to increase farmers' crop yields. Results also showed that factors such as brand name are more important in determining consumer choice than the type of corn used in chip production.

A nationwide survey this summer will seek to gather 1,000 responses from U.S. consumers.

Bruce Trail from the University of Reading in England visited the Agribusiness Institute in March to discuss European issues. The MSU team will work with him to design research programs for Europe and the United States that will test for similarities and differences in consumer attitudes.

"Having this information should give ag producers, processors and all those involved in the chain bringing a farm product to the grocery store shelf an idea of the long-term potential for consumer acceptance of their products and the long-term demand for genetically engineered foods," Lusk said. "If we find this is going to be an issue that consumers will be increasingly concerned about, perhaps producers should consider alternative methods."

The research team is also interested in determining the factors that influence consumer acceptance of genetically modified foods. Knowing what consumers think of a product before it makes it to the grocery store shelf can help producers tailor products to consumers. If producers know in advance that consumers will accept modifications that provide a higher-value product, companies can save money by not investing resources into unnecessary efforts to control consumer backlash.

"This research should help agricultural producers and agribusiness firms that use genetically engineered products effectively promote and sell their products," Lusk said. "This survey information also can help estimate the number of people who may not wish to purchase genetically engineered foods. Determining the size of this niche market can identify an alternative market for producers."

John Lee, MAFES agricultural economist and head of MSU's Agricultural

> If we find this is going to be an issue that consumers will be increasingly concerned about, perhaps producers should consider alternative methods.
>
> — Jayson Lusk

fied foods

Economics Department, said results of this study have a lot of implications for U.S. trade policies and farmers.

"If it appears that European consumers are genuinely averse to genetically modified foods, U.S. producers can consider alternative products rather than spending effort and energy trying to overcome trade barriers," Lee said.

This research is just one project under way at the Agribusiness Institute. Lee said the institute has operated since 1990 and is a joint venture between the College of Business and the College of Agriculture and Life Sciences. It offers an academic program leading to a master's of agribusiness management.

"The Agribusiness Institute exists to be a place for the agribusiness community to get access to academic programs and students trained in agribusiness, and it serves as a focal point for research dealing with all aspects of the food chain linking producers to consumers," Lee said.

Molecular Research will Benefit the Touch of Cotton

LYTLE

By Charmain Tan Courcelle

LYTLE

Within the genes of the cotton plant lie the secrets to longer, stronger cotton fibers. MAFES biochemist Din-Pow Ma is using biotechnology to unlock these secrets and apply them to building a better cotton plant.

Physical attributes of a cotton fiber, including length, length uniformity and fiber strength, affect the quality and value of finished cotton products. They can also determine the efficiency of the manufacturing process.

Cotton breeders have traditionally relied on lengthy, trial-and-error methods to breed cotton varieties with high-quality fiber. Ma believes a molecular understanding of cotton fiber synthesis will take some of the guesswork out of developing new, high-fiber-quality cotton varieties.

"Nobody knows what contributes to the length and strength of cotton fibers," Ma said. "We're looking at the molecular level to identify the genes controlling fiber synthesis and development, and to understand their function. If we can find genes that are specific to fiber, we can potentially use these genes or parts of these genes to introduce beneficial traits into cotton fibers."

Cotton fibers develop in response to signals given by plant hormones. Each cotton fiber begins as a single cell within the epidermis of a developing seed. Genes controlling the four phases of fiber synthesis dictate how long a cotton fiber grows and how thick the fiber gets. Ma's group has found one gene that seems to play a role in fiber elongation. Lipid transfer protein 3 (LTP3) is a gene found only in elongating cotton fiber cells.

"We've found that LTP3 is developmentally regulated and is specifically expressed at high levels during the elongation phase of fiber synthesis," Ma said. "This makes it a possible candidate for cotton genetic engineering to incorporate novel traits into fiber."

In a preliminary study, Ma linked the LTP3 gene promoter to a reporter gene — a genetic marker that allows easy detection of gene expression — to determine what genetic elements give LTP3 its fiber-specific activity. Gene promoters regulate where a gene is expressed and how much gene product is made. Using the reporter gene system, Ma defined the regions within the LTP3 promoter that are important for its fiber-specific nature. Ma and his group are now looking at the proteins that interact with LTP3 promoter to see if they can control the length and strength of cotton fiber.

Ma's results suggest that LTP3 promoter can actually be used to transfer new traits into a cotton fiber. Because LTP3 promoter can induce reporter gene expression in the same type of cells that produce cotton fibers, Ma hopes to eventually use it to import new traits, such as disease resistance, into cotton fiber cells.

"Once you understand the molecular mechanisms of fiber development and synthesis, you can begin to think about making modifications to cotton fiber," Ma noted.

Cotton enjoys a 56 percent market share in the U.S. textile industry. Work in the area of fiber improvement could help cotton keep its competitive edge.

taking the bite out of

COTTON BUGS


LYTLE


LYTLE


LYTLE

By Charmain Tan Courcelle

Few – if any – Mississippi cotton producers have forgotten 1995. It was the year that tobacco budworms wreaked havoc on cotton, destroying 145,000 cotton bales worth millions of dollars. In 1999, tobacco budworms and cotton bollworms inflicted damage on 62,000 bales of Mississippi cotton. This reduction in cotton pest activity appears to be, in part, the result of high rates of Bt cotton adoption by producers in this state.

Bt cotton carries a gene from the soil bacterium Bacillus thuringiensis, or Bt. The gene directs Bt cotton plants to produce an insecticidal protein that is effective against certain insects, including the tobacco budworm and cotton bollworm. The Bt toxin gene has also been introduced into other crops, such as corn and potatoes. The toxin attacks the gut membrane of insects that feed on Bt-bearing plants, depriving them of food and eventually killing them.

While the original version of Bt cotton has been very effective in eliminating tobacco budworm populations, it is somewhat less effective on cotton bollworms. It also has limited activity on occasional caterpillar pests, such as fall armyworms, said Scott Stewart, MAFES entomologist.

There are several different strains of Bt bacteria, and each produces one or more Bt toxins, or Cry-proteins. Researchers have identified more than 60 Cry-proteins and have shown that these target a wide range of insects; for example, Cry1Ac is effective against tobacco budworms, and Cry3A kills Colorado potato beetles. Commercial lines of Bt cotton, which were first available in 1996, contain Cry1Ac.

Stewart and graduate research assistant Scott Akin have tested a new line of Bt cotton containing two Bt toxins, Cry1Ac and Cry2Ab, for field effectiveness against bollworms and occasional pests (armyworms and loopers). At several locations in 1999 and 2000, they planted three types of cotton: non-Bt cotton; original Bt cotton, which contains Cry1Ac; and Bollgard II, the new experimental line of Bt cotton. The MAFES scientists then monitored insect populations in each field plot to determine how efficient the different cultivars were in controlling these pests.

"We have preliminary results showing that Bollgard II is better than non-Bt cotton and original Bt at reducing cotton bollworm numbers," Stewart said. "Our results also show that while original Bt cotton controls between 0 and 40 percent of occasional pests, the new version of Bt cotton gives 90 percent or better control of these pests."

Bollgard II is not currently available for commercial use. Because experimental and commercial Bt cotton lines may have different agronomic qualities, Stewart plans to repeat his studies with commercial varieties of two-toxin Bt cotton.

"We've worked on experimental lines for now, but the Bt dual-toxin technology will eventually be moved into commercial varieties of cotton. Our big emphasis will be to test these commercial lines as they become available to see if they are as

LYTLE

MAFES entomologists Scott Stewart, foreground, and Mike Caprio discuss the effect of a Bt dual-toxin insect diet on cotton pests.

effective against these pests as the experimental lines," Stewart said.

The effectiveness of Bt proteins as insecticides depends on the amount of toxin that cotton pests eat. Different parts of a cotton plant can express different amounts of Bt toxin, so Stewart and Akin are also examining the effect of varying toxin expression levels on insect survival.

One example of this effect is seen with cotton bollworms, Stewart noted. Bollworm larvae feeding on certain flower parts were "sneaking through" on Bt cotton, presumably because of lower toxin levels in these plant parts. Understanding the relationship between insect feeding behavior and the levels of Bt toxin present in different plant parts may help growers better manage their cotton crop.

But the magic bullet that Bt cotton and other crops present to producers will only be useful if insects remain sensitive to Bt toxin. Scientists have already documented examples of several insects that have developed resistance to the spray insecticide (foliar) version of Bt, and there is concern that tobacco budworms and cotton bollworms may evolve resistance to Bt cotton.

Cotton pests have already developed resistance to several classes of spray insecticides used to control them – a factor contributing to the heavy tobacco budworm infestations seen in 1995. The Environmental Protection Agency (EPA) has established and required insecticide resistance management programs to delay Bt resistance in insects as long as possible.

"With insecticide toxin

LYTLE

Bud/Bollworm Larvae

expressed in all parts of Bt plants and throughout the growing season, there is the potential that resistance to Bt toxins could evolve rapidly," said Mike Caprio, MAFES entomologist.

Caprio is identifying ways to delay or prevent insects from developing resistance to Bt toxin. Using computer simulations and field studies, he has helped develop resistance management strategies based on the number of non-Bt plants that should be planted in refuge areas and on the arrangement of non-Bt acreage.

"We've found that how we put out a 4 percent refuge matters and has an effect on the evolution of Bt resistance," Caprio said.

Insects that are susceptible to Bt toxin carry two copies of the susceptibility gene (SS), while insects that are resistant to Bt toxin have two copies of the resistance gene (RR). Matings between susceptible and resistant insects produce heterozygotes that carry one copy each of the susceptibility and resistance genes (RS). Researchers have suggested that high-dose toxin production in Bt plants will kill almost all heterozygotes and eliminate most resistance genes (R) from insect populations.

"For a high-dose resistance management strategy to be effective, there has to be a high enough number of susceptible insects available to mate with resistant insects," Caprio said. "Our results show that an embedded non-Bt refuge is the best strategy for keeping the growth rate and number of susceptible insects up and delaying resistance. Using embedded refuges should make non-Bt acreage invisible to growers and they should not have to treat these crops differently from Bt crops grown in the same field."

Caprio has also joined researchers at the University of Nebraska in a study of Western corn rootworm insecticide resistance. Corn may soon benefit from Bt-supplied rootworm protection, and Caprio hopes to find the best way to prevent Bt resistance in this insect. He is receiving funding from the U.S. Department of Agriculture's Initiative for Future Agriculture and Food Systems for this project.

"Bt crops avoid a lot of the problems growers face with conventional treatments, such as pesticide drift and the destruction of nontarget, beneficial insects. It also reduces the need for pesticide use," Caprio noted. "We have to put in extra effort in the early phase to set down rules of use that will preserve this valuable resource."

taking the bite out of cotton bugs

Vaccine Work Aims to IMPROVE Animal Health

By Charmain Tan Courcelle

Vaccine and pharmaceutical combinations have been used in livestock and aquaculture production as the first line of defense against disease-causing organisms. In some cases, however, producers still lose some of their stock to disease because an effective treatment does not exist or resistance has developed to available drugs. Scientists at MSU's College of Veterinary Medicine (CVM), in association with MAFES, are using biotechnology to develop and test vaccines against several important animal diseases. The new vaccines may provide animal health benefits and increase animal productivity, which are two of MAFES' research goals.

THOMPSON

CVM scientist Mark Lawrence examines a petri dish for potential *E. ictaluri* mutants that have reduced capacity for causing ESC disease in catfish.

THOMPSON

Research assistant Michelle Banes prepares a mutant strain of *E. ictaluri* for growth and virulence assays.

HELP FOR A "HOLE-IN-THE-HEAD."

One control agent being developed is a live-attenuated vaccine for the bacterium *Edwardsiella ictaluri*, the cause of enteric septicemia of catfish (ESC). ESC is a major economic problem for the catfish industry. Nearly all catfish farms experience losses to ESC each year.

Fingerlings infected with *E. ictaluri* have a characteristic "hole-in-the-head" lesion that appears as a red ulcer between the eyes. Other external ESC symptoms include large red or white skin lesions, a distended abdomen, bulging eyes and pale-colored gills.

ESC reduces catfish feeding, and once fish are sick, there is no way to treat them with oral antibiotics. Because ESC-infected catfish are more vulnerable to other diseases, prevention through vaccination and improved management is preferred to treatment.

"The first vaccine that was developed against ESC was a killed vaccine," said Mark Lawrence, CVM researcher. "This treatment gave inconsistent results using mass vaccination procedures such as bath immersion or oral feeding, so it never gained acceptance among producers."

Catfish treated with killed ESC vaccine developed antibodies to a membrane sugar found on *E. ictaluri*. However, *E. ictaluri* lives part of its life cycle inside a type of host catfish cell called a phagocyte, where it is hidden from these antibodies. Thus, even when catfish produce high antibody numbers against the bacterium, they are not always protected from ESC, Lawrence said.

Defense against pathogens that live within cells relies on the activity of T-cells (a type of white blood cell), Lawrence explained. Antigens — proteins from invading bacteria or viruses — are presented on the surfaces of infected cells. T-cells recognize these antigens and cause a chain of events clearing the host of infection. Once an animal has been exposed to a pathogen, its body develops "immunological memory" that protects against later infections.

Unlike killed vaccines that rely on dead microorganisms, live-attenuated vaccines mimic the natural infection course of a virulent pathogen and stimulate T-cell immunity without actually causing disease, Lawrence said. This type of vaccine strategy may help to control ESC.

In order to develop a live-attenuated vaccine, Lawrence is first identifying and characterizing

THOMPSON

A channel catfish virus carrying *E. ictaluri* DNA is under study as a potential ESC vaccine. CVM researcher Larry Hanson, left, and research assistant Terrence Greenway use DNA vaccination techniques to screen ESC DNA fragments for their ability to induce protective immunity in catfish.

THOMPSON

some of the genes responsible for *E. ictaluri* virulence. He has used information from some of his studies to develop a mutated form of *E. ictaluri* with a reduced capacity for causing ESC disease in catfish. This less-virulent mutant could serve as a potential live vaccine.

"We've tested one mutant of *E. ictaluri* — a strain with a mutation in a membrane sugar component — in catfish and observed that it is highly attenuated," Lawrence said. "It takes 100,000 times more bacteria to cause ESC death using mutant *E. ictaluri* compared to wild-type (normal) *E. ictaluri*."

Lawrence is now working to further define how certain genes contribute to the ability of *E. ictaluri* to cause disease. These studies will help researchers make better selections in *E. ictaluri* vaccine design, he explained.

TWO-FOR-ONE PROTECTION.

CVM scientist Larry Hanson is taking a different approach in the fight against ESC. He is using channel catfish viruses to deliver pieces of *E. ictaluri* that may induce immunity in catfish.

"Our big focus has been to identify protective antigens (proteins that cause a good immune response) of *E. ictaluri* and move these into channel catfish virus," Hanson said.

In 1996, Hanson and then-visiting graduate student Nathalie Vanderheijden built a channel catfish virus with reduced virulence. They were able to genetically modify this avirulent virus to express a gene responsible for the production of a bacterial enzyme. When introduced into catfish, this modified virus produced protective immunity to both channel catfish virus and the bacterial enzyme. These findings encouraged Hanson to test the channel catfish virus as a possible vaccine vector.

"By carrying a small fragment of *E. ictaluri* DNA in with channel catfish virus, we may be able to express bacterial proteins that stimulate T-cell immunity," Hanson said. "This form of immune response is important for clearing this bacterium."

Hanson has developed a genetic tool to screen for potential protective antigens that could induce an effective immune response against ESC. He has completed a proof-of-concept experiment that shows the method works with a human protein. Now he hopes to apply the technique to find candidate antigens scattered throughout the 6 million bases, or letters, of the *E. ictaluri* genome.

WORM VACCINE WORKS FROM THE INSIDE OUT.

The search for an economical means to produce a parasite vaccine for livestock led CVM researcher Cody Coyne to look at the guts of the problem. Coyne has developed a method for growing intestinal cells from nematode parasites for use in vaccines.

Haemonchus contortus, known commonly as the barberpole worm, infects the true stomach of cattle, sheep and other ruminants. Infection with this worm can decrease animal productivity and is potentially fatal. Left unchecked, parasite infestations can lead to great economic losses in the livestock industry.

"In the past, anthelmintics were used to kill parasitic worms," Coyne said. "But in some areas of the world where there is intensive use of these drugs, there is a serious problem with drug resistance."

Coyne said he thought the use of vaccines would be a good alternative to drug use if a suitable immune target could be identified. He explained that protective immunity against internal parasites depends on direct contact between the host

ccine work aims to improve animal health

continued

animal's immune system and a vital organ system in the parasite.

"Some antibodies produced by the immune system cannot exert a protective effect because they are unable to move across the worm's external cuticle layer," he said.

An Australian team's success with a vaccine preparation harvested from the digestive tract of living ticks led Coyne to consider a cell-based vaccine for *H. contortus*.

CVM researcher Cody Coyne uses molecular biology to examine the protein composition from candidate vaccine cell populations. The protein banding patterns in the gels tell him the origin of the cells.

"To use this approach, we had to develop the technology for isolating and growing parasitic cells," Coyne said. "This meant that we had to isolate a source of purified, living parasites from a ruminant's stomach contents and design growth conditions to select for intestinal cells."

Once he had candidate cell populations, Coyne used biochemical and molecular biological tests to identify the cells and determine whether they came from the barberpole worm's digestive tract. These tests enabled him to confirm that he had isolated *H. contortus* intestinal cells, which have shown efficacy as a vaccine in livestock.

Coyne said that one target for the host animal's immune system appears to be aminopeptidase M, an enzyme involved in worm digestion. Parasites feeding on a vaccinated animal ingest antibodies to aminopeptidase M. The antibodies prevent the function of the barberpole worm's digestive system, causing the worm to starve.

The parasite vaccine could help the livestock industry protect animals from barberpole worm infections, Coyne said. An additional benefit from the vaccine is prolonged protection from worm parasites that can be passed from mother to offspring at the time of birth.

Coyne received a patent for his technique for growing nematode parasite intestinal cells in a laboratory environment. His group has isolated cells from 14 different species of internal parasites that affect multiple breeds of domestic animals.

PERSPEC

Agricultural

an inval

By Dawn Luthe

Over the last century, science has made amazing advances — many beyond what we may have believed possible. Technology has affected almost every aspect of daily life, and its impact is particularly evident in the field of agriculture. Today, biotechnology and genetic engineering are revolutionizing the way we farm and feed a growing world population.

Research and other indicators show that biotechnology is an invaluable tool for the benefit of all humanity. U.S. consumers benefit from improved product quality and food costs that are 53 percent lower today than they were in 1961. Likewise, farmers will prosper through the use of more economical and efficient production practices, millions of malnourished people could benefit from genetically enriched food supplies, and the world's natural resources could be sustained despite its ever-growing population.

Farmers benefit from biotechnology because it improves yields, eases their workload, reduces the need for pesticides, and conserves soil quality by reducing tillage. Many of these benefits are as good for the environment as they are for the farmer. For example, Bt cotton and corn with built-in pest control have significantly reduced insecticide use. Roundup Ready soybeans allow more efficient weed control. Crops that are more tolerant of environmental stress and that can more efficiently use fertilizers will further reduce production costs. Research is being conducted that will lead to the development of plants resistant to fungal and viral diseases.

Biotechnology and genetic modification of foods seem the best hope to feed the world's growing population and sustain environmental resources. Malnutrition affects more than 800 million people, 40,000 of whom die each day. Biotechnology has helped produce such promising developments as golden rice, a vitamin-A-enriched crop that may help prevent blindness in malnourished children. Plants with increased iron content

agricultural biotechno

CTIVE

Biotechnology

luable tool for all humanity

FAULK

will alleviate iron-deficiency, one of the most prevalent nutritional disorders. Using genetic engineering, it will be possible to improve the quality of starch, protein and oil in seeds that are used for human and animal consumption.

The world's population is escalating more and more rapidly, but the amount of arable land will not increase. The use of biotechnology to develop crops that grow where poor soil and climate conditions limit production will be essential for those who rely on this marginal land for food production.

There are other health and economic benefits of agricultural biotechnology. For example, the vaccine for hepatitis B, a leading cause of cancer, is being produced in bananas so that it can be given orally at low cost to children in developing countries. In the future, other vaccines and pharmaceuticals may be produced in tobacco and other crops. Biotechnology could make possible the production of completely new products, such as plants that make biodegradable plastics or novel fibers.

Genetic modification is certainly not a new phenomenon. All organisms are genetically modified through the natural act of breeding. Intentional genetic modification through classical selective breeding techniques is as old as civilization. Conventional breeding brings a multitude of additional genes along with a single beneficial gene; these often include undesirable traits that require years to eliminate. Biotechnology, on the other hand, enables us to precisely insert a single gene to provide advantageous characteristics to a crop variety and is a much faster process than conventional breeding. For example, it has taken more than 20 years to develop high-lysine corn, an accomplishment that could have been achieved much quicker using genetic engineering.

Despite the benefits, no new technology is free of risk. We must weigh all the benefits of genetic modification against any possible drawbacks. To me, the risks are far outnumbered by the positive health, environmental and economic implications of biotechnology. Some concerns that have been raised include food safety, cross-pollination with nearby wild species and development of pesticide-resistant insects. Sound, science-based testing is essential to evaluate the levels of these risks and to address any significant problems identified. While science cannot rule out all possible disadvantages, it can be used to regulate and help prevent biotechnology-related problems.

Years of rigorous testing by the USDA, EPA and FDA indicates that genetically modified foods are as safe as conventional foods. In fact, one advantage of biotechnology is the ability to eliminate some food allergens and to more easily monitor food safety.

Despite the efforts of biotechnology advocates, the decision to use genetic modification is ultimately up to consumers. The demands of everyday people will determine how biotechnology is incorporated into agricultural practices. The key to earning and maintaining consumer confidence is careful testing and open communication. The role of scientists in this exchange is to provide accurate information that allows the public to make good, informed decisions.

Through this public exchange, the world will better understand that agricultural biotechnology has many significant positive implications. As more people learn about the science of biotechnology and weigh the benefits for themselves, I believe most will accept this technology and value its positive impact on their lives.

ology: an invaluable tool for all humanity

MAFES *Finds Potential in an Age-old Concern*

By Cliff Bice

MAFES is leading a statewide research effort to alleviate poultry farm byproduct use concerns associated with the Mississippi poultry industry, the state's number-one income producer with a farm gate value of $1.45 billion in 2000.

This extensive research will ensure that byproducts — primarily poultry house litter from the state's almost 2,000 poultry farms — are used in an environmentally sound manner. This will help permit future expansion of the industry while protecting all aspects of the environment. Another benefit of the research is to identify new ways to efficiently use poultry litter products.

"Most environmental concerns relating to the poultry industry are centered around correct use of poultry house litter, which contains nitrogen, phosphorus and potassium. Most litter is currently applied to farmland as fertilizer," said Yvonne Vizzier Thaxton, MAFES poultry scientist. "While poultry litter is an excellent fertilizer and organic material, if too much phosphorus is applied at one time, it will be absorbed by rainfall and transported to streams, lakes and rivers.

"Poultry production is concentrated in about 34 central Mississippi counties, which means there's not enough farmland to safely use all litter produced in that area," Thaxton explained.

The MAFES research has been under way for several months in cooperation with many local, state and federal agencies. However, the expanded research effort received a much-needed boost this year when Bonnie Hutchins, the coordinator of Southwest Mississippi Resource Conservation and Development District (RC&D), Inc., approached MAFES about a partnership to conduct more work on proper litter disposal.

The new project will identify alternative nutrient management strategies for using litter, help identify new litter products and uses, assess the quality and quantity of litter in Mississippi, and develop improved litter products and marketing strategies.

"We are especially interested in developing and marketing new litter products and discovering new uses for litter that will use large volumes of the material," said Larry Oldham, MSU Extension nutrient management specialist. "New potential uses being studied include fertilizer applications for forage, forestry, turf, and horticultural crops; cattle feed; potting mixes; pelleted litter products; and manufacturing many specialty products such as glue."

"Our long-term challenge is to develop environmentally and economically sustainable uses of litter byproducts," said Thaxton, who coordinates the RC&D project for MAFES. "In short, we will turn a potential liability into a valuable asset."

School Days on the Farm is a cooperative effort of MAFES, the College of Agriculture and Life Sciences, and other state and private agricultural organizations. This year's event took place April 10-12 at the MSU Agricenter. Donny Ray, swine unit manager, brings a piglet up for closer inspection.

MAFES Receives Money for Sweetpotato Research

MAFES sweetpotato researchers at the Pontotoc Branch Experiment Station recently received a $4,000 grant from the Mississippi Sweetpotato Council to continue plant spacing trials.

"Sweetpotato yields can be affected by plant spacing and this, in turn, can affect plant profits," said Paul Thompson, MAFES horticulturist and sweetpotato breeder. "The Mississippi Sweetpotato Council grant will allow us to determine the optimal spacing of sweetpotato plants within a row and distance between rows, and results from these trials may help producers get better sweetpotato yields."

The donation marks the first time the sweetpotato industry has committed funds for research.

"The Mississippi sweetpotato industry recognizes the good value of MAFES research and the need for more sweetpotato studies," said Benny Graves, a plant pathologist with the Mississippi Department of Agriculture and Commerce and treasurer of the Mississippi Sweetpotato Council. "There is not much nationwide sweetpotato research and MAFES' work in this area will have a much broader impact than just within state borders.

"We are proud to team up with MAFES to move the sweetpotato industry forward."

Molecular Workshop *Provides Learning Opportunity*

COURCELLE

Research assistant Sonya Baird loads an electrophoresis gel that will separate DNA samples into distinct profiles.

By Charmain Tan Courcelle

Law enforcement officials and forensics experts have long relied on fingerprints to identify criminals. Now, a week-long molecular biology workshop has provided a group of MAFES researchers the tools required to follow the movements of plant and animal disease organisms using their DNA fingerprints.

A group of 20 scientists, research associates and students attended the program. Participants learned two related techniques – DNA amplification fingerprinting and arbitrary signatures from amplification profiles – which allow rapid molecular identification of a disease-causing culprit from a lineup of possible suspects.

COURCELLE

CVM researcher Larry Hanson prepares a sample for DNA amplification fingerprinting.

"We wanted to reach a new level of understanding about the disease organisms affecting plants, animals and fish," said Rich Baird, MAFES plant pathologist. "Learning these molecular biology techniques will allow us to obtain information on a pathogen's genetic variability and the associated differences in disease symptoms."

Every individual, whether human, animal or plant, carries a unique set of genetic information. This particular identity is revealed by DNA fingerprinting as a series of bands, or DNA profile. Analyzing DNA profiles allows scientists to diagnose the cause of a disease or determine if two individuals are related to each other.

"There are bacterial isolates that cause disease in catfish that we can't readily identify through conventional methods. This is just one example of a situation where DNA fingerprinting can be used as a reliable diagnostic tool," said Larry Hanson, College of Veterinary Medicine animal scientist.

MAFES scientists will apply the molecular genetics techniques they have learned to diagnosing diseases in plants and animals. These methods will also be used to more precisely develop crops with enhanced growth and improved disease resistance.

Horticulturist Bob Trigiano and research assistant Malissa Ament, both of the University of Tennessee, served as course instructors for the workshop, which ran from Feb. 19 to 23 and was sponsored by the MSU Life Sciences and Biotechnology Institute through a grant from the Robert M. Hearin Support Foundation.

MSU *Receives Gift from* Biotech Company

By Charmain Tan Courcelle

Mississippi State scientists working in the field of biotechnology recently received a new resource — Monsanto's internal information network.

MSU's Life Sciences and Biotechnology Institute was granted access rights to Monsanto's Biotechnology Conservatory on May 2. Hosted on Monsanto's intranet, the Biotechnology Conservatory is a one-stop resource that the company uses to track primary scientific publications, issues and news coverage in the field of agricultural biotechnology. It also contains limited-release material previously restricted to Monsanto officials.

Monsanto is a major producer of agricultural products, including herbicides and seed products with insect- and herbicide-resistant technologies.

"The Biotech Conservatory offers scientific investigators, educators and administrators at MSU the ability to obtain biotech information quickly. It is a comprehensive online source for things that are happening in the industry and things that are happening in crop biotechnology," said H. Alan Wood, director of the Life Sciences and Biotechnology Institute.

The biotechnology institute was set up to facilitate biotechnology research in the areas of agriculture, forestry and animal health. MSU scientists will be aided immensely with access to this information tool, as it will place them on equal footing with researchers at other institutions nationwide, Wood said.

MSU is one of 12 universities that have received initial access to Monsanto's information network.

IN BRIEF

Marshall *Named Journal Editor*

MAFES food scientist Douglas Marshall was recently named a contributing editor for the scientific journal *Food Microbiology*.

The journal covers all aspects of the microbiology of foods, including research in the areas of food spoilage and safety, predictive microbiology, rapid methodology and the use of novel microbial processes to produce flavors. *Food Microbiology* is published by London-based Academic Press and has contributing editors in the U.S., Canada, France, Ireland and the Netherlands.

Marshall is an internationally recognized expert in food science and technology and was chosen for the high quality and quantity of his research in the areas of food safety and public health.

Lusk *Joins Agricultural Economics*

Jayson Lusk joined the Department of Agricultural Economics at Mississippi State.

He has a bachelor's from Texas Tech University in food technology and earned a Ph.D. from Kansas State University in agricultural economics. Lusk was a USDA Graduate Fellow at Kansas State, where he examined consumer demand for quality-differentiated beef and studied consumer attitudes to novel food products.

His current research will be focused in the areas of consumer demand and agribusiness marketing. Lusk also plans to determine how Europeans perceive genetically modified foods.

Smith *Is New Dairy Scientist*

Terry Smith recently joined the faculty of the Department of Animal and Dairy Science, where he will conduct research in dairy nutrition and physiology.

Smith comes to Mississippi State University following postdoctoral fellowships at Purdue University and Albany Medical College. At the latter institution, he examined the molecular interaction of growth hormone and insulin. One of his research areas at MSU will be a study of the effect of growth hormone on insulin signaling in cows. In addition, he will investigate the relationship between leptin – a hormone produced by fat tissue that affects food intake – and metabolism in dairy cows. He is also a member of a multistate dairy heat stress project.

Smith holds a bachelor's degree from California State Polytechnic University, Pomona, and a master's degree from Washington State University in dairy physiology. He received his doctorate from Iowa State University in dairy nutrition and physiology.

Coker *Is New Horticulturist at Coastal Branch*

Christine Coker has joined the staff of the Coastal Research and Extension Center as an assistant horticulturist. She will be conducting research at the Beaumont Horticultural Unit on vegetables and ornamentals.

Coker comes to MAFES from Auburn University, where she received a Ph.D. in horticulture. Her doctoral work focused on white-tailed deer feeding preferences and deterrent strategies for horticultural products. She earned a bachelor's in biology from the University of Tennessee, Martin, and a master's in biology from Austin Peay State University.

Coker is a member of the Southern Nursery Association, the American Society for Horticultural Science, the Florida State Horticultural Society, the Alabama Fruit and Vegetable Growers' Association and Sigma Xi.

Courcelle *Is New Editor of Highlights*

Charmain Tan Courcelle is the new editor of *MAFES Research Highlights*. Before coming to Mississippi State University, she was a science writer with The Stanford Daily and LongerLiving.com. She received a bachelor's degree in molecular and cellular biology from the University of California, Berkeley, and a Ph.D. in microbiology and immunology from Stanford University.

MSU names new biosciences institute director

By Charmain Tan Courcelle

A Cornell scientist will direct Mississippi State University's Life Sciences and Biotechnology Institute (LSBI).

H. Alan Wood assumed his duties April 2. Wood comes to MSU from the Ithaca, New York-based Boyce Thompson Institute for Plant Research, where his studies included development of biologically based pest management strategies.

"Dr. Wood brings national stature and an exceptional record of achievements to this critical leadership role," said J. Charles Lee, vice president for agriculture, forestry and veterinary medicine. "He has been very successful in developing resources for research and in the application of new scientific breakthroughs to agriculture and industry."

MSU is establishing the biotechnology institute with support from the Robert M. Hearin Support Foundation and Mississippi Technology Alliance to increase economic development in Mississippi based on the biological sciences. The program will build on MSU's existing biotechnology strengths in plant genetic engineering, waste bioremediation, animal health, and pest and disease control, as well as promote new areas of research.

"I'm very excited about the opportunities and challenges which come with being director of the Life Sciences and Biotechnology Institute," Wood said. "LSBI should be used as a focal point around which biotechnology can be expanded and nurtured at MSU.

"My goal is to facilitate bigger and better science at MSU and to work with faculty to help them do what they are trying to do to meet their goals," Wood added.

"We'll need to get core facilities up and running, to institute a competitive grants program and an educational outreach program," Wood said. "This should facilitate the intellectual growth and enhance financial support for biotechnology research and teaching at MSU."

Wood has experience moving scientific discoveries from the university into broad commercial application. He is a cofounder of AgriVirion Inc., which began as a company producing inexpensive, environmentally safe bioengineered pesticides.

A nationally recognized scientist, Wood has previously been invited by the U.S. Forest Service to head a research team with members from around the country to study the use of biological pest control agents in the forest environment. He has also collaborated with scientists from several disciplines.

H. Alan Wood

"Dr. Wood's ability to foster collaborations among researchers from different areas of science will be valuable in his lead role at the cross-disciplinary LSBI," said Vance Watson, MAFES director.

In 1994, Wood was appointed to the Agricultural Biotechnology Advisory Committee of the U.S. Department of Agriculture. As a member of this committee, he helped develop policies and rules related to the release of genetically engineered animals and plants. He also serves as a consultant to the Environmental Protection Agency on ecologically friendly field testing and release of genetically enhanced viral insecticides.

"Dr. Wood understands the importance of using biotechnology in a responsible fashion and is well-versed in the potential impact of biotechnology on agriculture and environmental quality," Lee said.

Wood holds a bachelor's degree in biology from Middlebury College in Vermont and a master's degree and Ph.D. in virology from Purdue University.

Efforts to establish the Life Sciences and Biotechnology Institute were coordinated by MAFES and involved major contributions from the colleges of Agriculture and Life Sciences, Arts and Sciences, Engineering and Veterinary Medicine at MSU, as well as the MSU Extension Service and the Forest and Wildlife Research Center.

"This teamwork reflects our commitment to solving complex problems; breakthroughs in biosciences are the key to the future of agriculture in Mississippi," Watson said.

CALENDAR OF UPCOMING EVENTS

June 23
Hay Day, Brown Loam Station

Aug. 15, 2001
Cotton Field Day,
Delta R&E Center

Aug. 16, 2001
Rice and Soybean Field Day,
Delta R&E Center

Sept. 29, 2001
North Mississippi Garden Expo, Verona

Oct. 12-13, 2001
Fall Flower and Garden Festival,
Truck Crops Branch

Nov. 7, 2001
Mississippi Entomological Assoc. Insect Control Conference, MSU

Nov. 15, 2001
MSU-MAFES Annual Production Sale,
MS Horse Park, Agricenter and Fairgrounds

Dec. 5, 2001
Cotton Shortcourse, MSU

Experiment Station

Mississippi Agricultural and
Forestry Experiment Station
Box 9625
Mississippi State, MS 39762-9625

LYTLE