2006 Plan of Work

Annual Report of Accomplishments

MICHIGAN
AGRICULTURAL
EXPERIMENT STATION

MICHIGAN STATE
UNIVERSITY

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Guide to Acronyms in this Report

AFEX	Ammonia Fiber Expansion
AFID	**A**dvanced **F**rontiers **i**n **D**rug, Design, Discovery, Development and Delivery
AoE	Area of Expertise
CAFTA	Central American Free Trade Agreement
CANR	College of Agriculture and Natural Resources
CSA	Community Supported Agriculture
DCPAH	Diagnostic Center for Population and Animal Health
DEQ	Michigan Department of Environmental Quality
DNP	Diversified Natural Products
EBT	Electronic Benefit Transfers (food stamps)
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FDA	Food and Drug Administration
GREEEN	Generating Research and Extension to meet Economic and Environmental Needs
IPM	Integrated Pest Management
IR-4	Interregional Research Project No. 4
LTU	Lulea University of Technology (Sweeden)
MAES	Michigan Agricultural Experiment Station
MSU	Michigan State University
MSUE	Michigan State University Extension
NIH	National Institutes of Health
NSF	National Science Foundation
PFID	Partnerships for Food and Industry Development
POW	Plan of Work
SARE	Sustainable Agriculture Research and Education
SOF	Student Organic Farm
TB	Tuberculosis
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
USDOE	U.S. Department of Energy

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Goal 1

An Agricultural Production System that is Highly Competitive in the Global Economy

Executive Summary

Agriculture is one of Michigan's top two industries. The state's agricultural/food system -- including agriculture, leather, food, floriculture/ornamentals/turfgrass and biomass energy industries -- accounts for $60.1 billion in total economic activity (direct and indirect) and more than one million jobs. Agriculture generates more than $35 billion in direct economic activity and more than 727,000 direct jobs. In total, the agricultural/food system employs nearly a quarter of all people working in Michigan. The system is likely second only to the auto industry in importance to the state's economy.

Michigan, with its 10.1 million acres of farmland, produces over 200 commodities on a commercial basis, making the state second only to California in agricultural diversity. From field crops such as corn, wheat and soybeans to fruits such as cherries, apples, grapes and blueberries; to horticultural crops such as ornamental trees and flowering plants; and livestock, honey and fish, Michigan grows just about anything one can think of except citrus.

Michigan leads the nation in production of 20 commodities (including tart cherries, blueberries, Niagara grapes, pickling cucumbers, 13 floriculture categories, and three varieties of dry beans) and ranks in the top 10 of 29 other commodities.

Michigan Agricultural Experiment Station (MAES) researchers from a range of disciplines are working to foster a globally competitive agricultural production system. From understanding the genes that control how plants fuel themselves to create better bioeconomy crops to managing/controlling insects and disease in plants to breeding more productive varieties to conducting research on the viability of new products, MAES researchers provide the research underpinnings to many of the state's agricultural success stories.

Allocated Resources

	FY 2006
Hatch Funds	
Hatch Regular	2,334,044
Multi-State Funds	526,450
Other CSREES Funds*	7,419,901
Other Federal Funds*	13,329,250
Total Federal Funds (est.)	23,609,645
State Match for Hatch Funds	2,860,494
Remaining State Appropriations	16,192,315
Self Generated Funds*	2,322,260
Industry Generated Funds*	2,557,935
Other Non-Federal Funds*	2,451,926
Total State Funds (est.)	26,384,931
Total Estimated Funds	49,994,576
Scientist Years	87.1

*Values extracted from Fiscal Year 2006 Funds and Manpower Report

1) Protecting Agricultural Profitability Through Disease Management

Key Themes: agricultural profitability, adding value to agricultural products

A. Brief Description: A deadly fungal disease – downy mildew – was first confirmed in Michigan in summer 2005 on cucumbers and yellow squash. The disease showed up again in 2006, and as harvesting time wound to a close for the year's crop, the disease was confirmed on cucumbers and cantaloupe in 28 Michigan counties.

The downy mildew threat is particularly important to Michigan, which is the leading producer of processing cucumbers in the United States, accounting for one-third of the nation's pickle cucumbers. Once introduced to a field, uncontrolled downy mildew can kill a crop within seven to 10 days. And once the disease hits an area, the only way to control crop damage is to apply fungicides. Products that historically worked against other diseases didn't work against downy mildew. Without clear direction on which products to use, Michigan cucumber growers would incur additional expense and suffer further crop losses.

For this reason, Mary Hausbeck, MAES plant pathology scientist was provided funding through Project GREEEN (Generating Research and Extension to Meet Economic and Environmental Needs), Michigan's plant agriculture initiative at

MSU, to identify which products were effective against downy mildew and develop fungicide application recommendations to protect this vitally important Michigan crop.

B. Accomplishment Statement: Choosing not to treat Michigan's pickling cucumber crop in 2005 had the potential of decreasing the state's yield from 182,400 to 1,900 tons and reducing the crop value from $30.6 million $319,196. Yields of untreated cucumbers in 2005 field trials were reduced by 99 percent compared with those treated with alternating combinations.

   Because of fungicide the trials conducted in 2005, Hausbeck was able to respond quickly to growers with control recommendations when the first outbreak was confirmed in June 2006. The partnership between her lab, MSU Extension, processors, scouts, crop consultants and growers helped get the word out about the disease so that growers knew what to do to protect their crops and avoid extensive crop losses. In 2006, growers spent upwards of $8 million on fungicides to successfully combat the fungus.

   Additional funding from Project GREEEN is being used to support three fungicide trials in southeastern Michigan and to purchase and set up spore traps in six counties across the state to monitor movement of the fungal pathogen.

C. Source of Funding: MAES, Project GREEEN, private industry/growers

D. Scope of Impact: MI

2) Improving Disease Resistance in Plants

Key Themes: agricultural profitability, diseases and invasive species, food quality and safety

A. Brief Description: The secret weapon of bacteria – the way they get a foothold in plants to launch an invasion – is now less secret, thanks to research published by Sheng Yang He, MAES plant biology and micro biology and molecular genetics researcher. Under study is the bacterial pathogen *Pseudomonas syringe*, better known as the disease agent of bacterial speck, which can cause serious tomato crop damage. The secret weapon: a bacterium's protein targets a plant that serves as a line of defense against illness. The bacteria target and disable a plant's defense protein so they can get in and multiply. Molecular studies such as this one may help develop novel disease control measures in the future.

B. Accomplishment Statement: The laboratory of Sheng Yang He has changed the textbook description of a plant's surface terrain and is unveiling new knowledge of how bacterial pathogens invade plants and take hold. This revolutionary

research redefines the role of the plant's pores in defense against invading bacteria and how some bacteria can overpower plants. It also outlines a better understanding of how bacteria set up camp and destroy the plant's ability to fight infection.

Experimenting on *Arabadopsis*, Maeli Melotto, a research associate, and Bill Underwood, a graduate student, in He's laboratory, shed light on the behavior of one the plant's first lines of defense against disease. It has been assumed that pores on the plant's surface – known as stomata -- were busy with their photosynthesis business and were merely unwitting doorways to invading bacteria on a plant's surface. However, experiments with *Arabadopsis* revealed that stomata are actually an intricate part of the plant's immune system, can sense danger and respond by shutting down. These mechanisms could be universal across all land plants. Having identified a key in bacteria's attack, researchers can learn much more about disease resistance.

The research also has useful human health implications. Understanding that animal pathogens, like dangerous E. coli, cannot easily gain access inside the plant helps scientists know how best to combat bacteria that cause food borne illness.

C. Source of Funding: MAES, U.S. Department of Energy, National Science Foundation, National Institutes of Health

D. Scope of Impact: MI, national

3) Controlling the Codling Moth, Protecting Michigan's Apple Industry
Key Themes: agricultural productivity, disease/pathogen management, food quality and safety

A. Brief Description: Michigan is the nation's third leading producer of apples, with over 40,000 acres yielding an annual production value of approximately $100 million. Topping the list of pests that directly attack the apple is the codling moth. Codling moths bore into apples, leaving the orchard full of holey, unmarketable apples. Up to 80 to 90 percent of a fruit crop can be damaged if a control program isn't in place to manage this pest. To address this problem, MAES scientists – working in cooperation with growers -- have been targeting the codling moth using an areawide management approach aimed at driving down codling moth populations on all of the contiguous apple acreage located in as large an area as possible.

The backbone of the program is pheromone mating disruption, which turns the insect's own communications system against itself. Codling moths rely on a

chemical signal – a pheromone – released by females to attract males for mating. Placing sources of synthetic pheromone throughout an orchard disrupts mating. No mating means no larvae, and no larvae means no wormy, blemished apples.

Traditionally, pheromones have been applied by hanging polyethylene ropes in tree tops. This approach, while relatively successful, must be done by hand and costs more than $100 per acre. MAES scientists have recently developed a more efficient, cost-effective method to control the codling moth.

B. Accomplishment Statement: The areawide control project has grown from its origins in 2004 on eight farms (800 acres) in Sparta, Michigan to approximately 3,000 acres on 31 farms in three separate regions of the state, including southwest Michigan and the Old Mission Peninsula north of Traverse City. Results have been very positive. In blocks deploying pheromone disruption for three years, captures of male moths in pheromone-baited traps were reduced 74 percent.

The overall number of insecticide applications on the farms declined from 10.1 to 6.3 from 2004 to 2006, and the average application of organophosphorous insecticides targeting the codling moth dropped from 5.8 in year one to 3.8 pounds by the third year. Fruit injury attributed to codling codling moth infestation decreased by 70 percent from 2004 to 2006, and was 96 percent lower in areawide blocks than in non-mating disrupted blocks located outside this program.

Armed with successful results from the areawide research, attention was turned to the development of a more efficient, cost effective way to apply pheromones to trees. MAES scientists developed a method to embed pheromones in wax droplets and then developed a spray mechanism that can apply the wax drops to the apple trees. Applying the pheromone in wax saves growers about $35 per acre, which totals more than $4 million in savings per year and allows greater flexibility in application, timing changes and the amount of pheromone applied.

The success of this program could lead to more cooperative pest management efforts in the form of areawide control of the codling moth around the state, as well as the addition of other pests, such as the obliquebanded leafroller and the Oriental fruit moth.

C. Source of Funding: MAES, Project GREEEN, U.S. Department of Agriculture private industry

D. Scope of Impact: MI, national

4) Developing Tuber Moth-Resistant Potatoes has International Impact

Key Themes: diversified/alternative agriculture, agricultural profitability, plant production efficiency

A. Brief Description: As the world's No. 4 food crop, the potato nourishes people from Ecuador to South Africa and all points in between. MAES researcher Dave Douches has collaborative projects with researchers around the globe to keep Michigan's potato industry (10th largest potato grower in the country) thriving. The goal is to create varieties that have high yield potential, good appearance, excellent processing qualities, bruising tolerance and pest resistance.

Because potatoes are not native to North America, Douches has developed a number of international collaborations to exchange genetic material and information. His current project is working with South African and Egyptian researchers to develop tuber-moth –resistant potatoes. The potato tuber moth is the most serious potato pest worldwide. It damages growing plants in the field by feasting on leaves and can reduce yield by 30 percent. Insecticides are available to control the moth, but they're highly toxic and expensive to use.

While there are no tuber moths in Michigan, they are becoming an emerging problem in the Pacific Northwest. Since the process of getting insect resistance into a plant is the same, regardless of the insect being fought, the expertise being developed with tuber moths has definite benefits for Michigan potato growers as well.

B. Accomplishment Statement: Because potatoes have a narrow genetic base and reproduce asexually, it's difficult to introduce desirable traits, such as pest resistance, by conventional breeding. Through his research, Douches has found that genes from the natural soil bacterium *Bacillus thuringiensis* (Bt) can be introduced into potato plants to protect them from tuber moths. As a result of this research, two lines of Bt Spunta potatoes (as the tuber moth-resistant varieties were named) with commercial potential were identified.

Douches then began working with researchers in Egypt and South Africa who were interested in the tuber moth-resistant potatoes. Results from field trials of the Spunta lines in Egypt and South Africa show complete control of potato tuber moth.

Because the Bt Spunta potatoes are transgenic – they have a gene from another organism entered into them -- extensive regulatory and safety data must be gathered and evaluated before the crop can be released commercially to growers. So Douches and his collaborators began collecting the necessary

data for commercial approval of a Spunta variety in South Africa. The long-term goal is to deregulate a transgenic Bt potato variety in South Africa and then release an insect-resistant variety through the public sector.

The benefits of Bt potatoes to farmers and consumers are reduced input costs (less insecticide used), increased marketable yield, improved quality, reduced postharvest losses, reduced human exposure to pesticides and less pesticide residue on potato tubers.

This research is helping both South Africa and MSU build the infrastructure and capacity to deregulate a transgenic crop, ultimately building a "deregulation package" that can be used for other crops and projects. Douches' global partnerships and interactions with foreign industry officials have also opened doors for further discussions about exporting Michigan potatoes to other countries.

C. Source of Funding: MAES, U.S. Agency for International Development, U.S. Department of Agriculture

D. Scope of Impact: MI, national, international

Goal 2

A Safe and Secure Food and Fiber System

Executive Summary
The responsibility for safe and nutritious food is shared by all players in the food system, from farm to table. Sustaining a safe, secure food and fiber system and keeping people and animals healthy is a large and important part of the MAES mission. MAES researchers are continuously discovering new and more effective ways to help protect and enhance the nutritional quality, safety and availability of our food and fiber supply.

For example, testing for deadly pathogens in air, water and food is also critical to food security and human health and safety. To address this concern, a team of MSU researchers have developed a hand-held pathogen testing device that will minimize health threats significantly due to its ability to test for multiple pathogens simultaneously in a highly portable, effective and cost-effective way.

Significant headway is also being made by MAES researchers in balancing science-based food safety and risk analysis with social, ethical and environmental concerns. For example, while genetically engineered crops produce a plant that is more disease and insect-resistant, they can also cause allergic reactions in certain people. Thanks to the research efforts of a MAES scientist and his students, a model has been developed to determine the allergenic potential of genetically engineered crops before they're released into the human or animal food chain. If successfully validated, the testing could be available commercially in about five years.

Critical research also continues on the reduction and elimination of bovine TB in Michigan. MSU's Diagnostic Center for Population and Animal Health (DCPAH) protects Michigan's people and animals from disease and potential biological attacks or outbreaks. MAES scientists, working with DCPAH, continue to play a pivotal role in reducing bovine TB rates in Michigan. In 2006, significant progress was made in the development and testing of improved vaccines, increasing knowledge related to vaccination status of cattle and enhancing risk assessment models that can be taken directly to farms to estimate the risks and costs of various TB prevention programs.

MAES scientists are also working quickly to develop rot-resistant cherry rootstocks to safeguard Michigan's $65 million per year cherry industry from *Armillaria,* a soil-borne fungal disease. This research is creating management tools that growers can use to control *Armillaria* and identifying new biological controls that will help stop the growth of this troublesome fungus, ensuring the continued security and quality of this valuable fruit.

Allocated Resources

	FY 2006
Hatch Funds	
Hatch Regular	264,235
Multi-State Funds	108,346
	0
Other CSREES Funds*	7,253,044
Other Federal Funds*	13,329,250
Total Federal Funds (est.)	20,954,874
State Match for Hatch Funds	372,580
Remaining State Appropriations	18,680,229
	0
Self Generated Funds*	2,322,260
Industry Generated Funds*	2,557,935
Other Non-Federal Funds*	2,451,926
Total State Funds (est.)	26,384,931
Total Estimated Funds	47,339,805
Scientist Years	87.1

*Values extracted from Fiscal Year 2006 Funds and Manpower Report

1) **Developing a Hand-held Pathogen Testing Device**
Key Themes: pathogen protection, food/homeland security, food safety

A. Brief Description: Testing for deadly pathogens may get a lot easier and cheaper, thanks to the work of a team of MSU researchers who are developing a portable, hand-held device capable of detecting up to 50 microbial threat agents in air, water and food. The researchers were awarded $966,608 from the 21st Century Jobs Fund to develop and commercialize the device.

To date, testing air, water or food for pathogens that cause diseases such as cholera and dysentery have been done one pathogen at a time. Testing for each pathogen singly is dangerous, expensive and time-consuming. Simultaneous testing simplifies the process, making it safer and more cost effective.

B. Accomplishment Statement: Significant progress is being made with this technology, which gives the ability to measure pathogens in a manner and at a price that really matters for human health. Screening for all pathogens together can minimize health threats significantly. Unlike current technologies, the device

analyzes lots of marker genes in lots of samples, together with significantly lower false positives. It can be used anywhere that cost-effective testing of food, water or air for a number of pathogens is needed. Because of the lower cost, there will also be applications in countries where fewer resources are available for drinking water safety.

Looking toward the future, the researchers have been in touch with several organizations that are interested in the device. AquaBioChip, LLC, a Lansing-based company is testing the device under field conditions.

C. Source of Funding: MAES, State of Michigan (21st Century Jobs Fund)

D. Scope of Impact: MI, national, international

2) Testing Genetically Engineered Foods for Allergy-Causing Potential
Key Themes: food safety, animal models, food quality and its availability

A. Brief Description: Genetically engineered crops are created by inserting a protein from a different organism into the original crop's genome. This is usually done to create a plant that is more resistant to insects or diseases. While there are clear benefits to these crops in terms of agricultural productivity, profitability and food availability, the potential of genetically engineered foods to cause allergic reactions in people is a big reason why many people oppose them. Though protocols are in place through The World Health Organization and the United Nations Food and Agriculture Organization to ask questions about the allergy-causing possibilities of genetically-engineered foods, there has been no test that offers definitive answers.

To address this issue, MAES food science and human nutrition researcher, Venu Gangur, was awarded a $447,000 grant from the U.S. Environmental Protection Agency (EPA) to test the allergy-causing potential of genetically engineered foods.

B. Accomplishment Statement: Gangur and students in his lab have developed a mouse-based model – the first of its kind – to examine whether such a model works on a variety of proteins. To date, research using two allergenic foods – hazelnut and sesame seed protein – produced allergic responses similar in feature to human allergic reactions. The mice exhibited systemic allergic responses when exposed transdermally (passed across/through the skin) to the proteins. Clinical signs of allergic reaction were also observed when the mice were given the proteins orally.

This mouse-based system will be a valuable tool, because it can determine the allergenic potential of genetically engineered crops before they're released into the human or animal food chain. Researchers plan to further refine the model make it more economical to use. If successfully validated, the testing could be available commercially in about five years.

C. Source of Funding: MAES, U.S. Environmental Protection Agency

D. Scope of Impact: MI, national

3) Reducing Michigan's Bovine Tuberculosis Rates

Key Themes: disease/pathogen control and management, food safety, food quality and its availability

A. Brief Description: In 1994, a beef cow in Alpena County, Mich., tested positive for bovine tuberculosis (TB). The situation spiraled downward, and in 2000, the USDA revoked Michigan's TB-free status. The decision restricted movement of cattle and reduced out-of-state demand for Michigan beef and dairy products. The disease has cost the state tens of millions of dollars during the past decade.

MAES researchers continue to make progress in research on bovine tuberculosis, caused by the *Mycobacterium bovis* bacterium. Researchers, in conjunction with state and federal agencies, are working to eradicate this disease.

B. Accomplishment Statement: The MAES research continues to play a pivotal role in reducing bovine TB rates in Michigan. Disease prevalence has been reduced more than 65 percent since 1995. Minnesota reopened cattle trade with pats of Michigan deemed lower risk by the USDA. Michigan's Upper Peninsula was declared free of bovine TB by the USDA at the end of 2005 – the first part of the state to regain TB-free status since 2000.

In 2006, researchers developed and tested an improved vaccine to prevent bovine TB in mice. This vaccine reduced the number of lesions and deaths in vaccinated mice compared with unvaccinated mice, which is promising for developing a vaccine for deer or cattle that doesn't interfere with current TB testing methods.

Research efforts also revealed that Johne's disease (a chronic gastrointestinal disease of cattle caused by *Mycobacterium avium* subspecies *paratuberculosis*) does not affect the reliability of skin tests for *M. bovis* in cattle, but does affect the reliability of the whole-blood gamma interferon test for *M. bovis*. This information is now taken into consideration when cattle from herds affected with Johne's disease are tested for bovine TB. Scientists also found that vaccinating cattle for leptspirosis has no effect on skin or blood tests for *M. bovis*, but a

respiratory virus vaccine affects the reliability of the whole-blood gamma interferon test. Knowing the vaccination status of cows undergoing blood tests for TB is critical to proper interpretation of test results.
In addition, MAES scientists discovered that *M. bovis* can survive for six to 10 weeks in the environment in cool weather. This information will help the state control bovine TB on farms and in wildlife.

Researchers are currently configuring a version of the bovine TB risk assessment model that can be taken directly to farms to estimate the risks and costs of various TB prevention programs. This program will be a valuable tool for farmers who want to reduce their future risk of TB by improving their farm management practices.

C. Source of Funding: MAES, MSUE, MSU, State of Michigan

D. Scope of Impact: MI, national

4) Guarding Michigan Fruit and Nut Trees Against Root Rot
Key Themes: Food safety, disease/pathogen protection, food quality and its availability

A. Brief Description: MAES researchers are working to find long-term and sustainable solutions to *Armillaria* root rot, a soil-borne fungal disease that threatens Michigan's $65 million per year cherry industry. The scientist's goals are to develop rot-resistant cherry rootstocks and to create management tools that growers can use to control *Armillaria*.

B. Accomplishment Statement: MAES scientists developed the first lab test for *Armillaria*. In the lab, researchers culture the root rot fungus to develop tools to distinguish between various species of the fungus. These tools will help determine the prevalence of the pathogen in new or established orchards. Biochemical studies of pathogenic and non-pathogenic *Armillaria* species are providing information on the genetic differences between the two types.

The locations of various *Armillaria* species were mapped throughout Michigan by surveying orchards and forests in 12 counties. *Armillaria ostoyae* was the only pathogenic species found in northwestern Michigan; *A. mellea* and other species were found in the southwestern and central parts of the state. Knowing which species are present and their relative virulence can help farmers make planting decisions.

New biological controls for the fungus continue to be evaluated. MAES researchers have found that *Actinomycetes*, a type of soil bacterium, effectively stops the growth of *Armillaria.* By controlling the fungus with naturally occurring bacteria, MAES scientists hope to provide a long-term means of control and protect rootstocks planted in *Armillaria*-infected soil.

C. Funding Source: MAES, MSU, U.S. Department of Agriculture

D. Scope of Impact: MI

Goal 3

A Healthy, Well-nourished Population

Executive Summary
MAES work promoting a healthy and well-nourished population ranges from research in the basic sciences to providing nutrition research information and access to and availability of healthful, affordable food. The scientists' work targets issues that are important to all Michigan residents.

For example, in the last two years, supplies of flu vaccine have run short because of excess demand. Only four companies currently make vaccine for the U.S. market, and recent years have seen several serious shortages of the supply. U.S. health officials recently issued guidelines designed to speed development of new vaccines to fight seasonal influenza as well as a feared avian flu pandemic that could circle the globe quickly. Flu vaccine is difficult to make using the current egg injection manufacturing process. Among other things, recommendations encourage the development of new technologies that shorten the time it takes to make immunizations. An MAES researcher has developed a new cell-culture-based technology that reduces the cost, space and time needed to produce the vaccine. Efforts are under way to secure Federal Drug Administration approval to produce the vaccine commercially in the next several years.

A healthy, well-nourished population is more productive and has a higher quality of life. Key to achieving an optimal level of health and well-being is access to quality food and the provision of nutrition and healthy lifestyle information so that people can make informed decisions about their eating habits and preferences. Fewer than four percent of Michigan adults maintain a healthy weight, eat at least five servings of fruits and vegetables per day, and are regularly physically active.

MAES scientists are hard at work to create healthy choices for farmers, consumers and communities. For example, MSU has created the C.S. Mott Group for Sustainable Food Systems that focuses on equal access to healthful, safe, culturally acceptable food options at reasonable prices. In addition, work being done at MSU's Student Organic Farm (SOF) is teaching students and community members about the challenges of farming, the value of healthy, nutritious local produce and the viability of organic farming.

Meat quality is also important to the health and well-being of consumers. Scientists are at the forefront of research to explore the molecular genetics of pigs and beef cattle, seeking to parse out the suite of genes responsible for controlling meat quality. The ultimate goal is to provide producers with a simple blood test that would predict meat quality and allow them to make much more informed decisions about breeding and culling. Understanding the genes that control animal health can also lead to better human health.

Allocated Resources

	FY 2006
Hatch Funds	
Hatch Regular	176,387
Multi-State Funds	79,055
	0
Other CSREES Funds*	834,028
Other Federal Funds*	5,206,987
Total Federal Funds (est.)	6,296,456
State Match for Hatch Funds	255,442
Remaining State Appropriations	1,324,528
	0
Self Generated Funds*	64,342
Industry Generated Funds*	261,768
Other Non-Federal Funds*	658,644
Total State Funds (est.)	2,564,725
Total Estimated Funds	8,861,181
Scientist Years	15.5

*Values extracted from Fiscal Year 2006 Funds and Mnapower Report

1) **Protecting People Against Flu Viruses Becomes Faster and Cheaper**
Key Themes: human health, human safety

A. Brief Description: For the past 50 years, flu vaccines have been made by injecting 11-day-old fertilized chicken eggs with a flu virus strain. The virus grows in the eggs and is then killed and purified to make the vaccine. Each egg is injected with only one virus strain (a typical flu vaccine contains three strains) and produces enough virus for one or two doses. This means that huge numbers of fertilized eggs are needed – 270 million or more – to produce a sufficient vaccine supply for the United States. The process is time-consuming and inflexible because vaccine makers have to order eggs months ahead of time. If there are any problems with the eggs, such as infection by another virus, the entire lot of flu vaccine is lost. Also, anyone with an egg allergy can't have the vaccine.

Technology developed by an MAES researcher promises to produce new vaccines that will protect people against strains of flu. Known as cell-culture-based vaccine production, scientists infect cells with flu strains and then grow the virus in large vats or bioreactors. The virus is then killed and purified to make the vaccine. This process reduces the cost and time needed to produce the vaccine. Much more vaccine can also be grown in a smaller place, and the virus

that is grown is more pure. People with allergies to eggs are likely to benefit the most because they will be able to have flu shots without the threat of allergic complications.

B. Accomplishment Statement: Building on work done by other researchers at MSU, Paul Coussens, MAES animal science and microbiology and molecular genetics scientist and director of the MSU Center for Animal Functional Genomics, and his collaborators found a cell line that will grow almost every type of flu virus: avian, swine, equine and human. This research has led to five MSU patents on the use of cell lines for vaccine growth and production.

MAES researchers can be growing the cell-culture-based virus within a year, but Food and Drug Administration approval is needed to produce the vaccine – a process that could take some time. It is anticipated that a cell-based vaccine could be available in three to five years.

Hepa Life Technologies, Inc., a Vancouver, B.C. – based biotechnology company has licensed the technology from MSU and plans to produced cell-culture-based flu vaccine.

C. Source of Funding: MAES, MSU, royalties

D. Scope of Impact: MI, national, international

2) **Creating Healthy Choices for Farmers, Consumers and Communities**
Key Themes: sustainable agriculture, agricultural profitability, food quality and its availability

A. Brief Description: The C.S. Mott Group for Sustainable Food Systems at MSU focuses on developing sustainable, community-based food systems in the U.S. with a focus on marked expansion of farmer and consumer linkages at the local level. It currently has three areas of focus: encouraging the viability of small- and medium-sized family farms; ensuring all members of a community have equal access to healthful, affordable food; and promoting the use of pastures and outdoor environments to raise animals and their products (meat, poultry, dairy and eggs).

B. Accomplishment Statement: The Mott Group is involved in a research project developing the efficacy of unheated hoophouses as vehicles for expanding the market season for those selling at farmers' markets. Hoophouses have been constructed on nine farms across the Upper and Lower Peninsula,

production is in process, and data is being collected to determine the ability of these relatively low-cost structures to expand market opportunities. Mott Group members, along with others at MSU, have also been instrumental in development of the Michigan Farmers Market Association this past year.

The group is also actively engaged in making electronic benefit transfers (EBTs) -- aka., food stamps -- available at all Michigan farmers' markets. In addition, 2006 saw emergence of Youth Farmstands in Kalkaska and Detroit -- six additional youth farmstands will be added across Michigan in 2007. These are increasing nutrition education for food stamp eligible population as well as expanding their access to fresh fruits and vegetables while providing an entrepreneurial learning experience for Michigan high school youth.

More broadly, the Mott Group has identified a group of 300 K-12 school food service directors interested in getting Michigan products into school lunches. A new hire, beginning June 4, 2007 is charged with developing strategies and initiatives to capitalize on this interest among school food service directors. In addition, members of the Mott Group have been hired by the W.K. Kellogg Foundation to provide nationwide food system technical assistance for their new Food and Fitness Initiative, which began in late 2006.

C. Source of Funding: MAES, FACT, W.K. Kellogg Foundation

D. Scope of Impact: MI, national

3) **Growing Organics Promotes Health, Nutrition and Learning**
Key Themes: human nutrition, human health, nutrient management/education, food quality and its availability

A. Brief Description: Michigan State University's 10-acre Student Organic Farm (SOF) – which operates year round -- offers students the opportunity to plan, grow and harvest a wide variety of food crops, as well as participate in community-supported agriculture (CSA). CSA is a method of direct marketing that reduces the farmer's risk and increases the connection between the farmer, the food purchaser and the land used to produce the food. Community members who get food from the SOF support the students and learn about the challenges of farming, the value of local food, the availability of more than 40 nutritional vegetable crops, and the merits of organic farming.

Because most of Michigan's vegetable production happens between the middle of May and the end of September, most students are away from campus and miss the opportunity to gain hands-on field experience. Since education is one of

the SOF's goals, MAES researcher John Biernbaum has spent the last several years working with staff and students to produce crops in the winter in unheated greenhouses, providing students with the opportunity to experience organic farming during the academic year. A 12-month organic farming and specialty crop production program was developed and launched in January 2007.

This work is also helping Michigan farmers expand their production and marketing options. The greenhouses allow warm-season crops, such as tomatoes, peppers, eggplant, zucchini and basil to be grown a month earlier and a month later than they are grown in the field.

B. Accomplishment Statement: Research efforts using coldframe greenhouses at the SOF have been extremely successful, resulting in a unique 48-week model that allows for three 16-week CSA memberships (vs. the 20- to 25-week memberships offered by most other Michigan CSAs). Over a three-year growing period (May 2003 – April 2006), 93,000 pounds of produce were harvested, 25 percent of which was generated from the greenhouses throughout the winter. In year three, 55 memberships (over 200 people) were provided with fresh, local, organically grown produce during the 48-week period. The produce brought an average of $1.75 per pound, with a total farm income from membership over a three-year period of $136,500.

The extended growing season also increases student opportunities to learn. MAES researchers will continue to test and develop production schedules and methods for the 40+ greenhouse crops currently being grown under conditions of annual variation in light and temperature conditions, with an emphasis on winter production and harvesting.

When the SOF was started, one of the parallel goals was to offer a series of courses so students and current farmers could learn more about organic farming and year-round production using greenhouses. In January 2007, the College of Agriculture and Natural Resources Institute of Agricultural Technology Organic Farming Certificate Program began offering a 12-month, 40 credit program in organic farming and specialty crop production, including credit for a year of experience at the SOF and an off-campus internship the following year.

C. Source of Funding: MAES, MSU, USDA

D. Scope of Impact: MI, national

4) **Studying Genetics to Improve Meat Quality, Animal/Human Health**
Key Themes: animal health, human health/nutrition

A. Brief Description: Animal producers worldwide are at a disadvantage in rearing cattle and pigs that have consistently high quality meat year after year. Currently, quality can't truly be determined until after the animal is slaughtered and the meat is graded.

MAES scientists using functional genomics and genomewide genetic approaches to study meat quality, reproduction and health are partnering with scientists around the world to parse out the suite of genes responsible for controlling meat quality. Once the genes are identified, DNA could be extracted from an animal's blood sample and the genetic information and used to predict meat quality long before slaughter. Ultimately, MAES scientists would like to offer producers a simple blood test for meat quality. This would allow producers to make much more informed decisions about breeding and culling.

In addition, thanks to the work of MAES animal functional genomics scientists, biomedical researchers now are realizing that larger agricultural animals such as dairy cows or pigs (vs. mice, rats or other rodents) may be better models to decode the secrets of human gene function and health.

B. Accomplishment Statement: MAES researchers are currently studying the genetic makeup of pigs to identify those genes responsible for genetic variation in economically important traits such as flavor, juiciness and tenderness. Because there are so many genes to look at, international collaborations have been and continue to be invaluable to this research. To date, MSU scientists have worked with scientists in Ireland, Sweeden, Germany, South Korea, Brazil and Thailand on pork quality, and are investigating a potential collaboration in China.

Researchers expect that a draft sequence of the pig genome will be available by the end of 2007. Efforts are also under way to develop a beef cattle resource population for identifying meat quality and other economically and nutritionally important traits.

Because of MSU's international reputation in this field, it was the site of the 2nd International Symposium on Animal Functional Genomics in May 2006. The Symposium brought together leading thinkers in this field from around the globe. In recognition of the quality of the research presented and potential for agricultural animals, fish and wild animals to serve as biomedical models, the

journal Physiological Genomics published a special issue following the conference on animal functional genomics showcasing 12 papers presented at the symposium.

C. Source of Funding: MAES, MSU, USDA

D. Scope of Impact: MI, national, international

Goal 4

Greater Harmony between Agriculture and the Environment

Executive Summary
Understanding links between farm economics and the use of natural resources is key to fostering greater harmony between agriculture and the ecosystems that support life on the planet. Research is critical to identifying ways in which agricultural competitiveness and economic development can coexist with the natural resource base and enhanced environmental quality. Policies, practices and science-based knowledge must constantly evolve to promote stewardship in light of new opportunities for increased productivity, resource-saving technologies and threats to biodiversity.

For example, while ethanol shows great promise as an alternative to gasoline and adds fewer greenhouse gases to the environment, its production must be managed carefully for maximum environmental benefits. Producing ethanol from corn grain can release large amounts of nitrous oxide -- a greenhouse gas that is 300times more potent than carbon dioxide – into the environment. MAES scientist Bruce Dale is working with a team of researchers to compare and analyze various methods of producing corn for ethanol, as well as exploring the efficacy of other crops and a cost-effective, efficient way to turn plant leaves and stems – biomass – into ethanol.

Carbon sequestration – capturing and holding carbon in soil – is also an important component in reducing the negative effects of greenhouse gases. MAES soil biophysics scientist Alvin Smucker is working with scientists around the world to develop new management practices that improve soil health and carbon storage.

Industrial waste sites – also known as brownfields -- continue to pose economic and environmental threats. Researchers, working in collaboration with affected communities and industry are exploring ways to repurpose land that is unsuitable for commercial or residential use. MAES scientist Kurt Thelen is conducting field trials using biofuel crops on a former dump site to determine whether the sites can produce viable crops for biodiesel/ethanol production and if the crops can clean up the contaminated soils.

By the late 1950s, early 1960s, drawbacks to the extensive use of intensive, long-term pesticide use became apparent. This was the beginning of Integrated Pest Management (IPM) – a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools that minimizes economic, health and environmental risks. Thanks to the efforts of MAES entomologist Mike Brewer -- who heads up the MSU IPM Program -- and other IPM staff, grower awareness and use of IPM techniques have increased significantly in Michigan.

Allocated Resources

	FY 2006
Hatch Funds	
Hatch Regular	864,121
Multi-State Funds	166,288
	0
Other CSREES Funds*	187,486
Other Federal Funds*	3,805,727
Total Federal Funds (est.)	5,023,621
State Match for Hatch Funds	1,030,409
Remaining State Appropriations	418,497
	0
Self Generated Funds*	46,663
Industry Generated Funds*	296,940
Other Non-Federal Funds*	128,118
Total State Funds (est.)	1,920,626
Total Estimated Funds	6,944,247
Scientist Years	10.5

*Values extracted from Fiscal Year 2006 Funds and Manpower Report

1) Detoxing Our Oil Addiction

Key Themes: agricultural biotechnology, agricultural production technology, environmental protection, natural resources management

A. Brief Description: The United States currently uses more than 140 billion gallons of diesel fuel annually. More than 60 percent of the petroleum we use is imported, and the percentage is rising. As petroleum prices rise and concerns flare over dependence on imported oil, biofuels may be the antidote to the country's incessant craving for crude oil – but even this technology requires careful management for the greatest environmental benefit.

For example, compared to gasoline, producing and using corn ethanol adds fewer greenhouse gases (about 13 percent lower emissions) to the environment. However, if not managed properly, producing ethanol from corn grain can release large amounts of nitrous oxide, a greenhouse gas that is 300 times more potent than carbon monoxide, into the environment.

The ultimate success of biofuels will be determined largely by the ability to manipulate plants at the genetic, seed and field level. As the foremost university worldwide in the field of plant metabolism and biochemicals, Michigan State University is the premier place for this work to be done.

B. Accomplishment Statement: A team of researchers, led by MAES chemical engineering scientist Bruce Dale, are hard at work to compare and analyze various methods of producing corn for ethanol in 38 counties in eight states. To date, research shows that using cover crops reduces oxide emissions and boosts levels of organic matter in the soil, making for more fertile soil. Harvesting the corn stalks or cover crop to make cellulosic ethanol also reduces nitrous oxide emissions and overall greenhouse gas levels because ethanol is used instead of gasoline.

Other crops are also being studied to determine their use as viable biofuel sources. Currently, about 400 gallons of ethanol can be produced from an acre of corn grain. Research to develop technology for making ethanol from switchgrass, when fully developed, will allow about 1,000 gallons to be made from an acre of switchgrass, more than doubling the production from corn grain.

Scientists have also been looking at ways to turn plant leaves and stems – biomass – into ethanol in an efficient, cost-effective way. MAES scientist Bruce Dale has developed a process -- ammonia fiber expansion (AFEX) to pretreat biomass with ammonia -- making the breakdown of cellulose and hemicellulose much more efficient. Using enzymes alone, about 15 percent of cellulose and hemicellulose are broken down into simple sugars; when AFEX is used before adding the enzymes, more than 90 percent of the cellulose and hemicellulose are broken down into fermentable sugars. This process, once refined and enhanced, will fundamentally change biofuel production. An Article in the January 2006 issue of *Science* reports that production and use of cellulosic ethanol gives off about 90 percent less greenhouse gases than gasoline.

C. Source of Funding: MAES, MSU Foundation (Strategic Partnership Grant), USDA/DOE Biomass Research and Development Initiative, National Science Foundation, DuPont Biobased Materials, Inc.

D. Scope of Impact: MI, national, international

2) Improving Biomass Production While Reducing Greenhouse Gas
Key Themes: environmental protection, conservation/natural resources management

A. Brief Description: MAES soil biophysics scientist, Alvin Smucker, works with scientists around the world toward a common goal – improving biomass production and carbon sequestration by soils. Carbon sequestration – capturing and holding carbon in soil – is an important component in reducing the negative

effects of greenhouse gases. Europe is nearly a decade ahead of the U.S. in the bookkeeping of carbon sequestration in soil – important in reducing the negative effects of greenhouse gases in the atmosphere. Smucker studies the microspores inside soil aggregates using a synchrotron – a billion-dollar piece of equipment that emits high energy x-rays.

This is the first time any one has been able to look at the interior porosity of soil aggregates, allowing the opportunity to develop new approaches to study how the connections among pores modify the flow rates of bacteria, ions and water as they control carbon retention, keeping it from being released as carbon dioxide.

B. Accomplishment Statement: Declining soil structure, losses of soil organic matter, and increasing concentrations of atmospheric carbon dioxide can be overcome by sequestering more carbon in soils. Research has shown that farmed soils initially had 40 to 50 percent more carbon in them than they do today. Production techniques such as using cover crops and no-till and other conservation tillage practices that disturb the soil as little as possible mean more soil aggregates are left intact and more carbon is stored.

Preliminary findings demonstrate that this understanding of the biogeochemical mechanisms of carbon storage can be used to develop new management practices that will achieve about 50 percent more carbon storage in soils over and above that achieved by conservation tillage alone.

Smucker has also created a Web-based soil aggregate pore image analyzer similar to the one he and MSU computer scientists developed to analyze plant root systems geometries. Scientists from six continents use the online system. The results are used globally to analyze root growth and death rates and to compare carbon contributions to the soil by roots managed under various agricultural techniques.

C. Source of Funding: MAES, MSU, U.S. Department of Agriculture, U.S. Department of Energy

D. Scope of Impact: MI, national, international

3) **Producing Biofuels Crops on Brownfields**
Key Themes: environmental protection, land use, value and management, agricultural productivity/efficiency

A. Brief Description: On a two-acre parcel that is part of a 110-acre former industrial waste site, small plots of potential biofuel crops are being grown as part of a new

partnership between Diamler-Chrysler Corporation, MSU and Next Energy, a non-profit organization.

Funding was obtained to establish a pilot project investigating the feasibility of growing biofuel crops on an abandoned industrial dump site (brownfield) Township, Oakland County. A second research site, replicating plots of the same biofuel crops was established on the MSU Agronomy Farm as an experimental control. Kurt Thelen, MAES crop and soil sciences researcher, is growing these crops to determine whether: 1) the sites can produce the quality and yield for biodiesel or ethanol production, and 2) if the biofuel crops can help clean up the contaminated soil.

B. Accomplishment Statement: The focus of the research in 2006 (first year of the project) was to compare how the various crops grow on the brownfield site and evaluate their yields and the quality of the biofuel produced from each. Biofuel crops grown in the study include soybean, canola and sunflower as feedstock crops for biodiesel; corn as a starch-based ethanol source; and, switchgrass as a cellulosic ethanol crop. Background soil samples were acquired, biofuel crops were planted and harvested, and data was collected on crop yield and quality.

Preliminary yield data from the first year of the project was consistent between the brownfield site and the experimental control. The pilot project provided preliminary established that a brownfield site could logistically and economically be used for biofuel crop production. However, more than one site-year of data is required to make conclusive recommendations. Continued work and the collection of multiple years of data at the Oakland county and East Lansing site are proposed. Additionally, research will be scaled-up to include other marginal soils (low fertility, course-textured, droughty) and northern latitude soils in Michigan's Upper Peninsula. According to the Michigan Department of Environmental Quality, Michigan has some 300 other brownfield sites.

In addition to biofuel crop yield and quality, scientists are interested in monitoring system sustainability parameters including carbon budgets and soil quality indicators. If the results are successful, similar plots will be planted across the state and country on sites unsuitable for commercial or residential use.

C. Source of Funding: MAES, MSU, Project GREEEN

D. Scope of Impact: MI, national

4) **Controlling Pests, Conserving the Environment**
Key Themes: pest management, environmental quality

A. Brief Description: As agriculture became more mechanized, allowing profitable farming to be done in less time and with less labor, single-crop operations became hugely popular. Besides being profitable for farmers, these so-called monocultures were tremendously attractive to disease pathogens and insect pests. To combat the pests that were reducing crop quality and yield, growers and chemical companies formulated pesticides to address this legitimate concern.

By the late 1950s, early 1960s, drawbacks to intensive, long-term pesticide use became apparent. This was the beginning of Integrated Pest Management (IPM) -- a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks. The MSU Integrated Pest Management (IPM) Program has a 30-year history of studying innovative techniques to combat pests while preserving the environment. MSU's IPM Program focuses on strategies to heighten interest in IPM and increase the number of growers using IPM techniques.

B. Accomplishment Statement: MAES entomologist Mike Brewer coordinates the MSU IPM Program. Under his leadership, research in this area has resulted in the development of a comprehensive toolbox of options for growers, as well as information on how they can implement research-based IPM techniques. Toolbox tactics include practicing no-till, using cover crops, improving soil fertility, employing thoughtful crop rotation, encouraging natural enemies and physically removing pests – in addition to applying chemicals to produce a healthy crop with no negative effects on the environment.

Information is given to growers through a variety of channels: the IPM Resources Web site (averages 50,000 hits a week), crop-specific Web sites, demonstration projects, conference calls, newsletters, scouting guides and other publications. The launch of a new IPM Resources Web page has increased the links to MSU IPM resources throughout campus and doubled the number of hits received on the old site.

IPM staff members have also been helping farmers participate in the USDA-administered Environmental Quality Incentives Program (EQIP) that seeks to increase the number of Michigan growers using IPM techniques. Five pilot counties were targeted for increased EQIP enrollment. As a result of this effort, grower awareness of EQIP incentives increased from 25 to 75 percent, with the number of growers indicating they knew how to participate in the program

increasing from 18 to 45 percent. This outreach work is also translating into money for Michigan growers. In 2002, Michigan was given $75,000 to support IPM implementation; in 2005, this amount increased to $460,000. In 2006, $858,000 was devoted to IPM implementation by growers, a 10-fold increase since 2002 and an almost two-fold increase between the 2005 to 2006 program years.

C. Source of Funding: MAES, Project GREEEN, Michigan IPM Alliance, USDA Cooperative State Research, Education and Extension Service, Michigan Commodity groups, private industry

D. Scope of Impact: MI, national

Goal 5

Enhanced Economic Opportunity and Quality of Life for Americans

Executive Summary

The past several years have been very difficult for Michigan's economy. The slumping auto industry has deeply affected the state's finances, and downturns in other manufacturing sectors and record-high crude oil and gasoline prices have pushed the situation from bad to worse. Many state and federal legislators have recognized that the bioeconomy may provide Michigan with a way out of its economic doldrums.

In her 2006 State of the State address, Governor Jennifer Granholm acknowledged Michigan State University's (MSU) importance to the state's economy and announced plans to invest in alternative energy research through the 21st Century Jobs Fund. Eleven MSU research projects – from basic research to applied research already spinning off Michigan companies – received funding, several of which are MAES projects. These grant awards represent the breadth of applicable research positioned to benefit Michigan's economy, especially in terms of the state's diversification.

Designing processing plants that can produce a full complement of bio-based chemicals, fuels and other products results in a diversified operation that isn't subject to the ups and downs of a single market. In an area hard hit by business closings and layoffs, Kris Berglund, MAES chemical engineering and materials science researcher, helped start Diversified Natural Products (DNP), a Scottville, Michigan-based company that is using MSU biotechnology research to make new bio-based products, including fuels and chemicals and gourmet and nutritionally enhanced foods. Berglund also helped launch Working Bugs, a Webberville, Michigan-based company that identifies microbes that could be used to make products from renewable resources.

The identification of cost-effective and efficient processing techniques for new food products can provide new economic development opportunities while providing alternative food sources that are nutritious and safe. MAES researcher Kirk Dolan and graduate student George Nyombaire have developed an extruded bean product that not only provides a new market for Michigan bean growers by offering higher value uses for their crops, but may also help ease some hunger and nutritional deficiency issues in Rwanda.

Genetic research continues to play a critical role in improving human health and quality of life. A team of MSU scientists, led by MAES physiology and animal science researcher Joes Cibelli, have identified genes unique to the human egg, opening the way to understanding these genes' functions, which may lead to solving problems ranging from infertility to degenerative diseases.

Allocated Resources

	FY 2006
Hatch Funds	
Hatch Regular	176,951
Multi-State Funds	43,633
	0
Other CSREES Funds*	4,720,862
Other Federal Funds*	8,613,952
Total Federal Funds (est.)	13,555,398
	0
State Match for Hatch Funds	220,585
Remaining State Appropriations	7,759,552
	0
Self Generated Funds*	711,649
Industry Generated Funds*	3,729,244
Other Non-Federal Funds*	6,330,676
Total State Funds (est.)	18,751,705
Total Estimated Funds	32,307,103
Scientist Years	57.2

*Values extracted from Fiscal Year 2006 Funds and Manpower Report

1) **Boosting Michigan's Economy through Diversification**
Key Themes: economic development, jobs and employment, new technology/product development

A. Brief Description: Eleven MSU research projects – from basic research to applied research already spinning off Michigan companies – are among the winners of the state's 21st Century Jobs Fund awards. Topics range from ethanol fuel engines to laser-based molecular scalpel technology to ways to increase efficiency in pharmaceutical drugs. Several projects are led by MAES scientists.

B. Accomplishment Statement: MAES-related research includes mechanical engineering professor Harold Schock's project to develop ethanol fuel engines and chemical engineering scientist Dennis Miller's research on a continuous production process for biodiesel.

Other projects include research by Syed Hashsham in civil and environmental engineering and the Center for Microbial Ecology to strengthen air and water safety. Mitch Smith and Robert Maleczka, in chemistry, has developed a breakthrough with a patented chemical compound that makes drug synthesis more efficient and less costly.

Several awardees are start-up companies that use MSU technology. For example, Diversified Natural Products (DNP) in Scottville, MI has 15 patents that have

sprung from the research of MAES scientist Kris Berglund. DNP is a bio-based technology company that develops green products for manufacturers and for everyday living derived from renewable resources**.** DNP focuses on bio-based fuels and chemicals, nutraceuticals, gourmet and functional foods. And Lansing, MI – based AFID Therapeutics is the company of MAES biochemistry and molecular researcher Rawle Hollingsworth. AFID Therapeutics defines and delivers advanced chemical and biochemical technologies and strategies and employs them in the design, discovery, delivery, and development of new drugs.

These grant awards represent the breadth of applicable research positioned to benefit Michigan's economy, especially in terms of the state's diversification.

C. Source of Funding: MAES, MSU, State of Michigan (21st Century Jobs Fund)

D. Scope of Impact: MI, national

2) **Using Swedish Innovations to Grow Michigan's Bioeconomy**
Key Themes: economic development, jobs and employment, impact of change on communities

A. Brief Description: MAES biochemical processing researcher Kris Berglund works extensively with scientists at Lulea University in Sweden to identify products and processes that can play a crucial role in furthering Michigan's bioeconomy. Sweden has a national initiative to eliminate all uses of petroleum-based products by 2020 and instead use products from renewable resources. There are parallels between Michigan and Sweden. The population is roughly the same, as is the land mass of each. Also, neither Sweden nor Michigan has large amounts of investment capital. The goal is to use some of the innovative approaches that Sweden is developing to really push Michigan's transition to a bioeconomy.

Berglund is in a unique position to know. He's helping to develop some of Sweden's innovative approaches to creating bioproducts and processes. In addition to his MSU appointment, Beglund is also professor in the Department of Biochemical and Chemical Process Engineering at Lulea University of Technology (LTU) in Sweden. Berglund's collaborations have spawned enterprises in Michigan (in Scottville and Webberville), Sweden and France and raised tantalizing possibilities for diversified biorefineries that crank out bioproducts ranging from fuels to chemicals.

Designing processing plants that can produce a full complement of bio-based chemicals, fuels and other products results in a diversified operation that isn't subject to the ups and downs of a single market. If the ethanol market

experiences a downturn, the other products will keep the plant economically viable.

B. Accomplishment Statement: Diversified Natural Products (DNP), the Scottville-based company, uses Berglund's research to make new bio-based products. The company has two divisions – biobased fuels and chemicals, and gourmet and nutritionally enhanced foods. On the food side, one of the company's first products is exotic specialty mushrooms, including the morel. This is the first time morels have been mass-produced indoors. Other food products include a sodium-free salt substitute (invented at MSU) and a natural cholesterol-reducing product. DNP's bio-based fuels and chemical division produces succinic acid from natural sugars derived from sources such as Michigan corn. Succinic acid is used in everything from industrial solvents and biodegradable polymers to airport runway deicers. Fifteen of DNP's patents have sprung from Berglund's research. DNP also has a Swedish subsidiary and, at the beginning of 2007, announced plans to build a succinic acid plant in France.

   Working Bugs, the Webberville-based company, is a partnership between Spartan Technology Development based in East Lansing, and the Michigan Brewing Company, a Webberville-based brewery. Working Bugs identifies microbes that could be used in fermentation processes to make products from renewable resources, as well as intermediate chemicals that are then used to make bio-based products. The research to identify potentially useful microbes will be done in Sweden at LTU and the DNP subsidiary. The chemical catalysis and reaction research will be conducted at MSU, and the processes will be integrated, validated and commercialized through Working Bugs.

C. Funding Source: MAES, MSU, State of Michigan (21st Century Jobs Fund)

D. Scope of Impact: MI, national, international

3) **Enhancing Economic Opportunity and Health with New Bean Products**
Key Themes: enhanced economic opportunity, new product development, human health and nutrition

A. Brief Description: MAES researcher Kirk Dolan studies processing techniques for new food products. He and graduate student George Nyombaire have recently developed an extruded bean product that may help ease some of the hunger and nutritional deficiency issues in Rwanda, Nyombaire's native land. It will also provide a new healthy and nutritious product for Michigan consumers and a new market for Michigan bean growers by offering farmers higher value uses for their crops.

In Rwanda, 60 percent of the population lives below the poverty level. Developing more products that use beans is one of Rwanda's priorities because Rwandans eat more beans than anyone else – each person eats about 130 pounds of beans a year (vs. a U.S. consumption rate of 3.5 pounds per person per year).

But beans are also contributing to the country's environmental woes. Because Rwandans don't soak the beans before cooking, they have to be boiled for about five hours. To cook beans, people are stripping the countryside bare, chopping sown trees for firewood. Even though cutting wood has been outlawed, people continue to do it. They need to eat.

Storing the beans is also a problem. There's a huge weevil problem in Rwanda – about 40 percent of the beans are lost each year to insects, animals or spoilage. About 90 percent of Rwanda's people are subsistence farmers. Families have, on average, a half-acre of land on which to eke out a livelihood. Any crop loss means less for people.

B. Accomplishment Statement: Using an extruder modified for affordability and food use, researchers ran experiments to determine the viability of a dry bean product. Ground beans were run through an extruder where they were cooked and then pressed out through a small hole known as a die. This process takes much less money, energy and firewood to make the extruded bean product and mix up the porridge than it does to cook the beans as people do now. Using electricity is far cheaper and safer than using firewood. Using the extruder also reduces air pollution from the smoke and cooking fires.

The resulting bean product is a safe product – it's dry, fully cooked, resistant to microbial spoilage, and animals and insects can't get into it. It can be eaten as is or can be made into powder, which can be mixed with some warm water and a little bit of sugar to make a tasty porridge. The bean product is very nutritious, containing 22 grams of protein, one gram of unsaturated fat and 24 grams of fiber per 100 grams of product.

Taste tests were conducted in May 2006 on the bean porridge and the dry extruded bean product as a snack. The products were taken to the National University of Rwanda Hospital and given to women who had just given birth. The products were also taken to elementary and middle schools. The results were unanimous: everyone enjoyed them.

In addition, the relative affordability of the modified extruder ($20, 000 vs. $100,000 plus for a U.S. or European extruder) allows the opportunity for Rwandans to buy extrusion equipment. This will allow them to process and sell

the bean products themselves to make money to pay medical bills and school fees for their children. In doing so, they improve the nutrition of Rwandans and at the same time boost the economy of the country.

C. Source of Funding: MAES, Project PEARL (Partnership for Enhancing Agriculture in Rwanda through Linkages)

D. Scope of Impact: MI, national, international

4) **Understanding the Human Egg's Genetic Functions Can Save Lives**
Key Themes: enhanced quality of life, human health

A. Brief Description: The human egg's ability to transform into a new life, or into new stem cells that may someday save lives, is well documented. The mystery lies in the mechanics – in how a single cell can transform so nimbly. A team of MSU scientists, led by Jose Cibelli, MAES physiology and animal science researcher, have identified genes unique to the human egg, opening the way to understanding these genes' functions, which may lead to solving problems ranging from infertility to degenerative diseases.

Cibellli worked with researchers in Chile to obtain unfertilized human eggs from women seeking fertility treatment at a clinic in Santiago, Chile that were reproductively healthy and no older than 35, and the cause of the infertility must lie with the man. Cibelli and his group then teamed up with Beth Israel Deaconnes Medical Center at Harvard Medical School in Boston to work with sophisticated bioinformatics software to analyze the collected RNA.

B. Accomplishment Statement: To make a comparison that would show which genes were uniquely active in the human egg, researchers used RNA of all parts of the human body except that of the ovaries where the eggs are produced. Using bioinformatics software, researchers then conducted a computer analysis of thousands of genes. In a highly sophisticated matching game, every gene in the egg that was found in other tissues was eliminated so that only unique genes remained. The team identified 5,331 human genes that are over-expressed in the egg. Of those, 1,430 are mysteries – their function is unknown.

The group also compared the human egg genes with those of a mouse as well as human and mouse embryonic stem cells. On the final intersection, 66 genes were found to be common between the four sets of data. Armed with this information, scientists are poised to clone these genes and put them into cells to see if they have a role in the creation of stem cells – without fertilization or destruction of human embryos. This potential could be used to combat diseases.

Researchers believe some of these cells know the big secrets, such as when a cell should slow down and later become a cell that can grow into any cell of the human body. The results of this preliminary search will lead to further experiments.

C. Source of funding: MAES, foundations, private industry

D. Scope of Impact: MI, national, international

Stakeholder Input Process Section

As the state's land-grant institution, Michigan State University (MSU) is charged with generating research-based knowledge and educational programs so that people can make informed decisions to improve their lives. To accomplish this important mission, the Michigan Agricultural Experiment Station (MAES) and Michigan State University Extension (MSUE) are constantly evaluating and updating the areas they focus on to best meet the ever-changing needs of Michigan's people, industries and communities. As the state's priorities change, research and educational programs, research agendas and external relationships also must change.

The MAES and MSUE worked together in 2005-06 to gather public input on the issues of greatest concern to Michigan citizens. [Note: See last year's annual report for specifics on the actual process.] This issues identification process, called Strengthening Michigan's Economy, will help ensure that relevant, research-based educational programming is available to address local issues. Both organizations will use this input to guide state-level decisions for research priorities and program support moving forward.

Summary of Findings

The involvement of nearly 10,000 people in the issues identification process helped MAES and MSUE define research and educational priorities for the future. For example, based on stakeholder input, the MAES has focused more sharply on bio-based products that can help boost the Michigan economy, including fuels, chemicals, neutraceuticals and food products, as well as youth and family issues, the environment, land use issues and biotechnology.

The strongest message, repeated by multiple audiences throughout the process, was that both organizations should work to strengthen Michigan's economy. Strengthening Michigan's economy encompasses more than creating jobs—it means enhancing quality of life. This theme emerged from detailed analysis in eight important areas:

- Encouraging economic diversification and sustainability
- Enhancing agricultural industries
- Sustaining Michigan's natural resources
- Promoting responsible land use
- Strengthening communities
- Promoting healthy lifestyles
- Building strong families
- Preparing youth for the future

To better direct the use of our strengths and capitalize on opportunities, efforts will be directed to five strategic priorities developed from the eight themes. These strategic

priorities are interdisciplinary, cutting across traditional programming boundaries to benefit the entire spectrum of Michigan residents. The five strategic priorities are:

- Developing entrepreneurs
- Promoting healthy lifestyles
- Preparing for the expanding economy
- Educating and supporting decision makers
- Building leaders for today and tomorrow

Selected activities that will be undertaken to address these priorities follow:

Developing Entrepreneurs

- Develop mentoring programs to help established entrepreneurs share experiences.
- Conduct research and education to improve the operations and business and financial management skills of agricultural and natural resources producers.
- Provide opportunities for youth to gain skills needed for entrepreneurship and progressive careers.
- Find ways to meet the educational needs of the increasing number of minorities owning Michigan food enterprises.
- Research and develop models for business startups in urban core neighborhoods.

Promoting Healthy Lifestyles

- Work to stay ahead of emerging diseases and pests that threaten the health of ecosystems, plant industries or environmental health and quality of life.
- Conduct focused research and develop targeted educational strategies for health issues in growing minority and senior citizen populations.
- Pursue research and extend education about genetically modified foods regarding their known benefits, risks and contributions to a safe, wholesome food supply.
- Identify internal and external assets important in the healthy development of children, families and communities.

Preparing for the Expanding Bioeconomy

- Help agricultural and forestry product developers adopt practices for creating new products in the bioeconomy.
- Develop improved methods to grow higher quality, higher yielding plants and cultivate new varieties to produce better raw materials to make bio-based products.
- Create new processing and production technologies, test new bio-based fuels and chemicals, and develop new products made from raw biomass.
- Collaborate with Michigan's colleges and universities to provide the education and training necessary to develop the workforce to propel the bioeconomy.

Educating and Supporting Decisionmakers

- Assist downtown development authorities, economic development corporations and other units in addressing local priorities and economic development strategies.
- Develop a new curriculum, Money Mentors, which will train community volunteers to be financial mentors for people with limited income and/or financial experience.
- Help 4-H build the next generation of financial wizards through programs such as Financial Champions, the High School Financial Planning Program and the new 4-H Millionaires' Youth Investment Clubs.

Building Leaders for Today and Tomorrow

- Develop new programs to help people acquire leadership skills and learn about public policy issues and processes.
- Conduct research to understand the orientation, training, support and recognition needs of youth volunteer leaders in community-based organizations.
- Offer programs and volunteer training to involve youth in making community decisions and developing local programs.
- Provide land-use policy education for a broad audience, including K-12 students, Michigan residents and policy-makers at the local and state levels, to improve residents' ability to serve in public roles and make private decisions.

Results to Strengthen Michigan's Future

Our strategic direction aligns with MSU President Lou Anna K. Simon's "Boldness by Design" initiative to position the university for the future. Our direction underscores the university's imperative to enrich community, economic and family life -- one of five strategic imperatives that will guide MSU in fulfilling its commitment. President Simon has called for "a new land-grant revolution, the next bold experiment—the land-grant university for the world." MSU Extension and the MAES are uniquely positioned to play key roles in this initiative.

The strategic priorities for MSUE and MAES also mesh seamlessly with the MSU College of Agriculture and Natural Resources (CANR) strategic plan, which focuses on three areas: food and health, ecosystems health and services, and development of the bioeconomy. MSUE and MAES contribute enormously to the fulfillment of the CANR mission to enhance the quality of life for the people of Michigan and the world by advancing knowledge for the management of communities and agricultural, natural resources and food systems to meet diverse human needs in a sustainable manner.

Though we will direct our efforts toward articulating our mission and strategic vision around five crosscutting priorities, we are also deeply committed to working at the

intersections of community, family and industry needs—what President Simon likes to call the "sweet spots" of our assets. For that reason, we are excited about the possibilities for research and Extension initiatives around these priorities.

The strategic priorities provide the framework around which MSUE and MAES researchers, educators, specialists and other professionals will build their plans. Faculty and staff members will want their research and educational program plans to reflect these strategic directions, which will guide MAES and MSUE as we allocate our resources at all levels. The priorities will be front and center as we establish and fill positions, determine the most efficient use of organizational resources, consider Areas of Expertise proposals and establish funding priorities for Project GREEEN.

The theme of working to strengthen the state's economy will guide our research and program delivery through 2011. We are committing ourselves and our resources to conducting research and educational programs that continue to make a positive impact on the lives of individuals, families, communities and businesses across Michigan.

Program Review Process

There have been no changes in the program review process since the MAES submitted its 2006-2007 Plan of Work Update.

Evaluation of the Success of Multi-state and Joint Activities

Multidisciplinary and Integrated Research/Extension Activity

1) Bringing New Pesticides to Light

Brief Description: The registration process for pesticide clearance from the Environmental Protection Agency is so strict, expensive and time-consuming that most chemical companies develop pest control products for only the most widely grown crops to recoup their investment. However, crops grown in smaller quantities – specialty crops – need pest control solutions too. And registration of biopesticides – those available for use by USDA-certified organic growers -- is especially crucial because they have a very small pool of pest control choices.

Since 1963, Interregional Research Project No. 4 (IR-4) has worked with growers and chemical companies to register existing products for use on specialty crops and reregister older products. MAES scientist Robert Hollingworth coordinates the MSU I-4 Lab. Since 1995, the IR-4 initiative has focused on registering reduced-risk and biopesticides.

Did the planned program address the critical issues of strategic importance, including those identified by the stakeholders? Yes. The IR-4 program has been very successful in addressing the critical issues of importance in the biopesticide research, registration and advocacy arena. New and reregistered compounds are developed to ensure that, while the new compound is killing plant pests, it's also safe for humans, animals and the environment. Further, sales of organic foods have increased by 20 percent each year -- demand is growing so quickly that it outstrips some supplies at times. To ensure Michigan growers continue to be a fundamental contributor to this $10 billion market, they need pest control methods that conform to organic standards and allow them to produce plentiful, pest-free crops.

Did the planned programs address the needs of underserved and under-represented populations of the state? Yes. The IR-4 Project is an advocate for biopesticides. Quite a few of the companies manufacturing these compounds are small. Many times, they don't have experience in dealing with the EPA, so they are unfamiliar with how to submit the data. Because the IR-4 Project works closely with the EPA and the USDA, as well as growers, they can help the agrochemical companies through the registration process. This in turn, increases the availability of reduced-risk pesticides needed by specialty crop producers, who are underserved by the larger agrochemical companies, because the size of the market did not justify the cost of registration and continued manufacture of the products they needed.

Did the planned programs describe the expected outcomes and impacts? Yes. Today, about 70 to 80 percent of IR-4 research focuses on reduced-risk pesticides. In addition to registration work, the IR-4 Program develops microbial and natural

products as pest controls for organic and other growers who would like to uses these products. It also promotes biopesticide research and has supported the growth of the Biopesticides Industry Alliance (BPIA), which registers biopesticides and furthers grower education and acceptance of these products.

Did the planned programs result in improved program effectiveness and/or efficiency? Yes. Since 1963, IR-4 has worked with growers and chemical companies to register existing chemical products for use on specialty crops and reregister older products. IR-4 was started in cooperation with land-grant universities and directors of state agricultural experiment stations to help producers of specialty crops maintain access to effective chemical pesticides. It is now funded by the USDA as a special grant program. Four regional labs participate in the program – at MSU, Cornell University, the University of California-Davis and the University of Florida. Twelve Midwestern states now run their registration projects through MSU, which then works with the other regional labs and IR-4 headquarters at Rutgers University to obtain national registration of products.

2) The New Agriculture Network: Farmers, Researchers and Educators Team up for Sustainable Ag Solutions in the Great Lakes Region

Brief Description: Organic farmers have a valuable tool courtesy of Purdue University, Michigan State University and the University of Illinois. The New Agriculture Network, launched in 2004, features a Web site and a newsletter that is published twice a month during the growing season.

Topics include the economics of organic vegetable production, the market for organic dairy, disease and pathogen management, weed management, grant information, research and survey findings, and reports from organic growers other specialists.

Did the planned program address the critical issues of strategic importance, including those identified by the stakeholders? Yes. To provide research and recommendations to organic field crop and vegetable growers, MSU has teamed up with Purdue and the University of Illinois, as well as other organic growers in all three states, to create the New Ag Network Web site (www.new-ag.msy.edu). The site features crop updates from organic growers and articles from university specialists about a variety of practices and new findings useful to organic growers.

Did the planned programs address the needs of underserved and under-represented populations of the state? Yes. The information serves those interested in transitioning to organic as well as those currently practicing low-input or organic agriculture.

Did the planned programs describe the expected outcomes and impacts? Yes. The network is a unique partnership designed to build collaboration among farmers and universities. It is an excellent way to make resources available to growers. It takes a regional approach so farmers can benefit from what others are doing, as well as from experts from three universities, broadening the information that's available and bringing more ideas to the table.

New information is posted twice a month during the growing season and less frequently in winter. Information for the Web site and newsletter comes from organic growers and Extension specialists. Twice each month, nine organic growers discuss, via teleconference, crop updates and other topics with Extension specialists. Extension specialists also write articles about a variety of practices and new findings useful for organic growers.

Illinois had the greatest participation in teleconference calls this year -- they consistently had four to five farmers on each call and submitted comprehensive reports on their activities. Michigan also had better participation from its organic vegetable producers this year as they've seen the value in the networking and online resources provided by the New Ag Network.

Did the planned programs result in improved program effectiveness and/or efficiency? Yes. The network had 15 farmers participate this year (MI=5, IL=5, IN=4 and IA=1), up from nine in 2004 and 12 in 2005. The Ag Network also received a $75,000 grant from NCR-SARE Professional Development Program (PDP) this year to work with these farmers to develop organic educational curriculum for Extension Educators.

Web site access has increased dramatically, from approximately 4,500 hits in 2004 to 60,000 hits in 2006. The number of online articles published increased from 42 in 2005 to 65 in 2006, providing users with more resources and information. Additional articles about the Network were also published in the Organic Research Foundation newsletter, on the MSU organic list-serv and Rodale's New Farm Web site.

The Ag Network partners also conduct research, the results of which are posted on the Web site. Thanks to the grant information posted on the Web site, three new Ag Network farmers – Steve Tiwald of Naperville, Ill.; Anthony Cinzori of Ceresco, Mich.; and Dale Rhoads of Nashville, Ind. – have received over $35,000 in USDA Sustainable Agriculture Research and Education (SARE) grants to investigate the various organic herbicides available. The research will examine vinegar and liquid propane flaming for weed control as well as the organic herbicides, and will use the herbicides and weed control strategies in the field to set up sterile seedbeds to assist in weed control. The project will also compare efficiency and cost effectiveness.

In the past year, the New Agriculture Network has expanded to include participants in Minnesota and Wisconsin.

3) Partnerships for Food and Industry Development (PFID) – Fruit and Vegetable Project in Nicaragua

Brief Description: Despite some economic improvements, Nicaragua is the second poorest country in the Americas. About half of the population lives in poverty, and 17 percent lives in extreme poverty. About 75 percent of Nicaragua's poor people live in rural areas and depend on agriculture for employment in addition to food. The Nicaraguan government would like to encourage economic growth in rural areas to reduce poverty as well as the potential for political instability.

The Central American Free Trade Agreement (CAFTA) with the United States has forced the Nicaraguan economy to globalize very quickly, which has created both opportunities and threats for Nicaraguan agriculture. For producers who can meet regional and global market standards, there are many opportunities. But these producers have to be prepared to meet the inevitable competition that will come because of lower trade barriers.

Started in 2001 at Michigan State University, Partnerships for Food Industry Development (PFID) works to increase the competitiveness of small- and medium-scale producers in developing countries around the world. By linking these farmers with local, national and international markets, PFID boosts their economic development. The program has the added bonus of creating new business opportunities for Michigan producers and processors.

Did the planned program address the critical issues of strategic importance, including those identified by the stakeholders? Yes. Since 2003, PFID has been helping Nicaraguan fruit and vegetable farmers become more competitive and to increase growers' access to high value markets. PFID scientists designed technical assistance programs tailored to participating producers' needs, with the ultimate goal of helping them consistently and efficiently produce high quality and safe produce for local, regional and export markets. In addition to PFID scientists, the partnership includes the following businesses, agencies and government organizations: Hortifruiti and La Colonia supermarket chains, Catholic Relief Services, Technoserve, Adventist Development and Relief Agency, Project Concern International, Save the Children, World Relief Corporation, and the Inter-American Institute for Agricultural Cooperation.

Did the planned programs address the needs of underserved and under-represented populations? Yes. The major activity of the PFID is promoting economic development and growth among farmers that are making less than $2 per

day. If these farmers can expand their operations, they'll have more money and be able to buy more and high quality food.

Typically, PFID begins helping fruit and vegetable farmers expand local markets by improving infrastructure, such as transportation, communication and production techniques. This leads to higher quality products and increased consumption, which improves the health of the local population. Then the farmers move on to regional and international markets.

For example, in Nicaragua, PFID scientists designed technical assistance programs to help them consistently and efficiently produce high quality and safe produce for local, regional and export markets.

Did the planned programs describe the expected outcomes and impacts? Yes. In addition to improved program effectiveness and efficiency, a number of key impacts were described in the Nicaraguan Fruit and Vegetable Project. For example, about a quarter of the program participants were single mothers and female heads of household. In Nicaragua, women make up 20 percent of rural workers who don't own any land. Off-farm jobs in transport, packaging and labor that were created as crops became more diverse and sales of fruits and vegetables increased were important sources of income for these women. Another key aspect of the program involves teaching at-risk youth how to grow fruits and vegetables and then how to market them. These youth are learning that you can make a living without resorting to crime.

Did the planned programs result in improved program effectiveness and/or efficiency? Yes. Phase I of the Nicaraguan project was completed in late 2005, and the results were impressive: sales of fruits and vegetables increased by $7.4 million, more than 11,000 jobs were created, and more than 9,000 acres went into production. Twenty-four alliances were formed and 26 market contracts between farmers and buyers were formalized. In addition, six associations improved their business practices. All the results exceeded targets set by the program.

To continue the momentum of the project, Phase II started in 2006. PFID scientists continue to provide technical assistance, as well as identify potential buyers and evaluate markets, and help build strong, lasting alliances between buyers and Nicaraguan suppliers. They are also working with public and private organizations to get rid of any supply chain constraints to fresh produce sales.

This project has also helped introduce Michigan agribusinesses to markets and cooperative opportunities in Nicaragua.

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Multistate Extension Activities and Integrated Activities
(Attach Brief Summaries)

Fiscal Year: 2006

Select One: ___ Interim XX Final

Institution: Michigan State University State: MI

	Integrated (Hatch)	Multi (Smith-Lever)	Integrated (Smith-Lever)
Established Target Percentage	4%	--	--
This FY Allocation (from 1088)	$ 8,811,115	--	--
This FY Target Amount	$ 352,445	--	--
Carryover Previously Reported	$ -0-	--	--
Title of Planned Program Activity	$ 352,445	--	--
TOTAL	$ 352,445	--	--
CARRYOVER	$ -0-	--	--

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

Director **5/23/07**
Date

Form CSREES-REPT (09/04)

2006 Summary of Accomplishments
Michigan Agricultural Experiment Station

Michigan Agricultural Experiment Station (MAES) researchers from a range of disciplines are working to foster a globally competitive agricultural production system by:

- understanding the genes that control how plants fuel themselves to create better bioeconomy crops.
- managing/controlling insects and disease in plants.
- breeding more productive varieties to conducting research on the viability of new products.

Significant headway is being made by MAES researchers in balancing science-based food safety and risk analysis with social, ethical and environmental concerns by:

- developing a hand-held pathogen testing device that will minimize health threats significantly due to its ability to test for multiple pathogens simultaneously in a highly portable, effective and cost-effective way.
- creating a model to determine the allergenic potential of genetically engineered crops before they're released into the human or animal food chain.
- studying ways to reduce and eliminate bovine TB in Michigan, including developing and testing improved vaccines and enhancing risk assessment models.
- developing rot-resistant cherry rootstocks to safeguard Michigan's $65 million per year cherry industry from *Armillaria,* a soil-borne fungal disease, ensuring the continued security and quality of this valuable fruit.

MAES scientists are constantly working to promote a healthy and well-nourished population by:

- conducting research in the basic sciences to providing nutrition research information and access to and availability of healthful, affordable food.
- developing and commercializing a new cell-culture-based technology that reduces the cost, space and time needed to produce flu vaccine.
- teaching students and community members about the challenges of farming, the value of healthy, nutritious local produce and the viability of organic farming.
- exploring the molecular genetics of pigs and beef cattle, seeking to parse out the suite of genes responsible for controlling meat quality.

Research is critical to identifying ways in which agricultural competitiveness and economic development can coexist with the natural resource base and enhanced environmental

quality. MAES scientists are contributing significantly to progress being made in this area by:

- comparing and analyzing various methods of producing corn for ethanol, as well as exploring the efficacy of other crops and a cost-effective, efficient way to turn plant leaves and stems – biomass – into ethanol.
- working with scientists around the world to develop new management practices that improve soil health and carbon storage.
- conducting field trials using biofuel crops on a former dump site to determine whether the sites can produce viable crops for biodiesel/ethanol production and if the crops can clean up the contaminated soils.
- Increasing grower awareness and use of integrated pest management techniques that combine biological, cultural, physical and chemical tools that minimize economic, health and environmental risks.

The past several years have been very difficult for Michigan's economy. The slumping auto industry has deeply affected the state's finances, and downturns in other manufacturing sectors and record-high crude oil and gasoline prices have pushed the situation from bad to worse. MAES scientists have responded to this challenge by:

- applying for and securing several 21st Century Jobs Fund grants from the state to conduct research positioned to benefit Michigan's economy, especially in terms of the state's diversification.
- designing processing plants that can produce a full complement of bio-based chemicals, fuels and other products, resulting in a diversified operation that isn't subject to the ups and downs of a single market.
- developing cost-effective and efficient processing techniques for new food products, providing new economic development opportunities and alternative food sources that are nutritious and safe.
- identifying genes unique to the human egg, opening the way to understanding these genes' functions, which may lead to solving problems ranging from infertility to degenerative diseases.