



Project GREEN 2011 Legislative Summary



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Project GREEN



VISION

Founded in 1997, Project GREEN (Generating Research and Extension to meet Economic and Environmental Needs), Michigan's plant agriculture initiative housed at Michigan State University, is a cooperative effort by plant-based commodity groups and businesses in cooperation with AgBioResearch, Michigan State University Extension and the Michigan Department of Agriculture and Rural Development to advance Michigan's economy through plant-based agriculture.

MISSION

- Develop research and educational programs in response to industry needs.
- Ensure and improve food safety.
- Protect and preserve the quality of the environment.



LETTER FROM THE DIRECTORS

You've heard the number: the agri-food industry contributes \$71.3 billion to the state's economy. And now, Michigan's leaders would like to grow that number to more than \$100 billion. How do we do it? It all starts with plants.

Plants are the basis of the food chain. Their symbiotic relationship with animals is the foundation on which agriculture is built. Without plants and animals, there is no agri-food industry.

The bottom line? Plant agriculture matters. A lot.

That's why Project GREEN (Generating Research and Extension to meet Economic and Environmental Needs) is so important to the state's economy. With a relatively small investment from the state legislature, Michigan State University scientists and MSU Extension educators have constantly and consistently provided problem-solving research that has helped farmers, turf managers, greenhouse operators and others make science-based decisions that move their businesses forward.

This funding, combined with the work of a dedicated cadre of MSU researchers, Extension educators and 43 partner organizations, makes Project GREEN the envy of the nation. This unique program has never been successfully replicated anywhere else in the country.

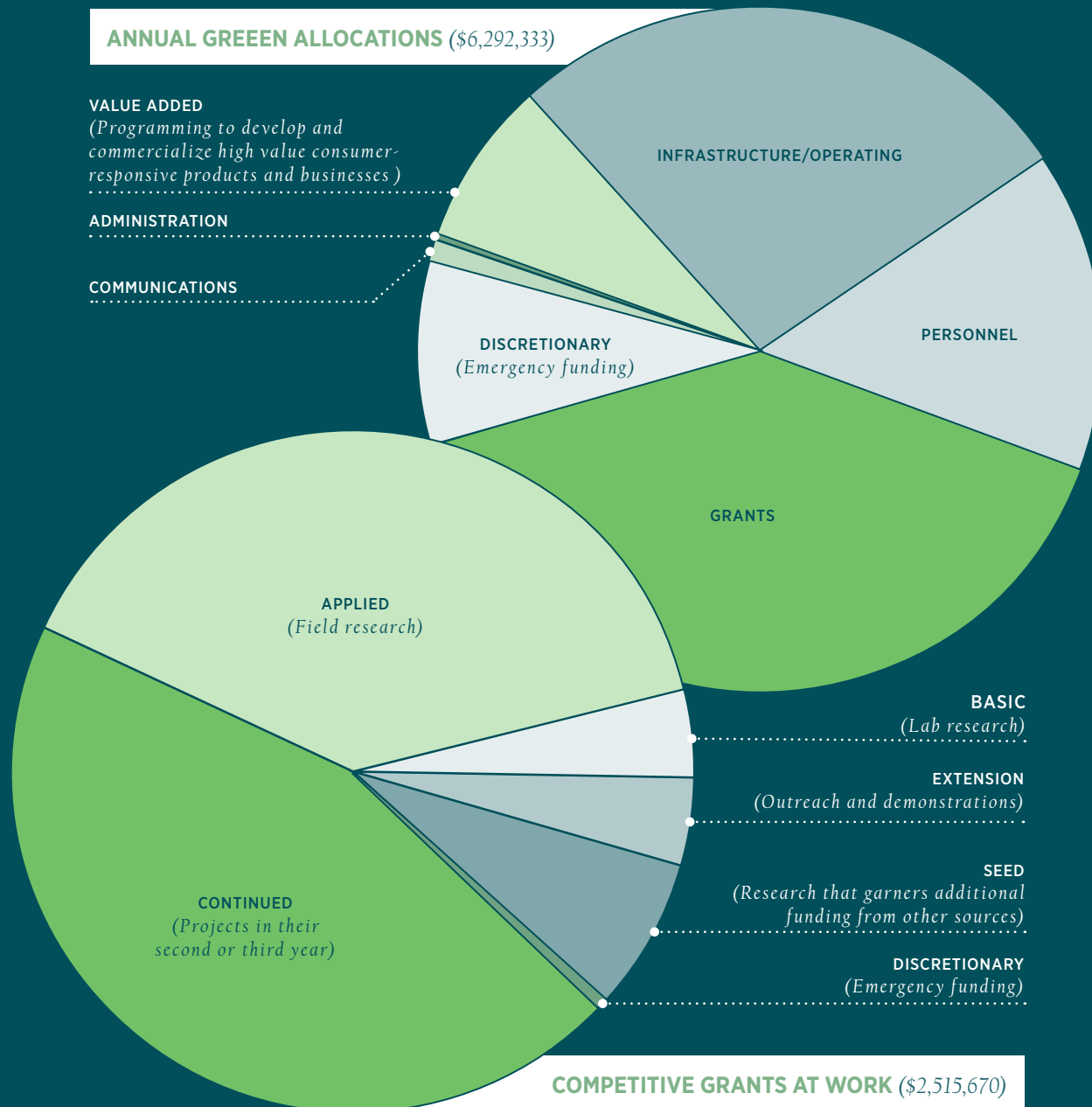
We hope you'll take the time to review the successes outlined in this 2011 legislative summary. Thank you for partnering with us to help create jobs, increase exports and provide healthy foods through the Michigan plant agriculture industry.

Sincerely,

*Ray Hammerschmidt
Chair, MSU Plant Pathology
Interim Director, Project GREEN*

*Steve Lovejoy
Associate Director, MSU Extension
Interim Director, Project GREEN*

2010-11 FISCAL YEAR



Project GREEN engages all plant agriculture commodity groups in Michigan. Housed on the Michigan State University campus, Project GREEN is led by AgBioResearch, Michigan State University Extension (MSUE) and the Michigan Department of Agriculture. Administration costs make up a small portion of Project GREEN's annual expenditures—a feat only possible because GREEN dollars primarily fund projects. Project GREEN researchers are AgBioResearch- and MSUE-funded, all allowing GREEN funding to supply the materials, labor, travel and collateral funds to conduct research and Extension programs. But the big ideas—the ground-breaking, world-changing, people-feeding work—is possible because of our partnerships in research and Extension.



COMPETING FOR GREEN

“THE DISCOVERY OF
AGRICULTURE WAS THE FIRST BIG
STEP TOWARD A CIVILIZED LIFE.”

Arthur Keith, Scottish scientist, 1866–1955

Competitive grants are the
foundation of Project GREEN.

Strong partnerships with
plant commodity groups and
the Michigan Department
of Agriculture and Rural
Development help Project
GREEN organizers set
priorities. From there, Michigan
State University researchers
develop funding requests for
research projects that reflect
those priorities. A panel of
university, state government
and industry professionals
review the proposals and make
recommendations. This annual
process allows for flexibility
and nimbleness to address
the changing needs of plant
agriculture in Michigan.





Competitive Grant Summaries: **Cross Commodity**

DETROIT'S FOOD DESERT: DETERMINING THE REAL EFFECT OF FOOD ACCESS OVER DECADES

Dave Weatherspoon

Detroit is one of our nation's worst food deserts, or area with limited access to affordable, healthy foods. Detroit also has a high obesity rate. To help inform future policy and improve the health of Detroit residents, researchers aimed to better understand the barriers to fruit and vegetable consumption and obesity risk among Detroit's female, African-American population – a group that is experiencing an increase in obesity and diet-related diseases. Preliminary results demonstrate how consumers living in urban food deserts face environmental and financial barriers to healthy food consumption.

MICHIGAN FOOD PROCESSORS SUMMIT

Thomas Kalchik

Michigan's food processing industry represents \$25 billion and 134,000 jobs in the state, and these numbers are growing. However, the industry needs to address several issues to maintain this growth, most notably waste water from processing facilities. With funding from Project GREEN, MSU researchers started the Michigan Food Processor's Summit. The event brought together food processing companies, economic development agencies, researchers and consultants, regulators and associated groups to specifically address the industry's waste water disposal issues to ensure that the industry remains compliant with environmental regulations in an affordable manner. The summit was also a chance to report on the full economic impact of Michigan's food processing industry and to plan for future events.

TOXICITY OF VARIOUS PYRETHROID INSECTICIDES TO VARROA MITE

Zachary Huang

Varroa mite is a devastating pest that threatens the honey bee industry worldwide. Most beekeepers rely heavily on insecticides to control varroa mites; however, the mite has developed insecticide resistance in many countries. For 10 years, two MSU laboratories have worked together to study how the varroa mite develops resistance to a class of pesticides called pyrethroids. With Project GREEN's support, this collaborative research group aimed to determine how toxic five pyrethroids are to the varroa mite. They determined that at least one of the pyrethroids was extremely toxic. If a new pesticide can be registered, it will benefit beekeepers and growers in Michigan and around the world.

**UNDERSTANDING FACTORS FOR
THE SUCCESSFUL DEVELOPMENT
OF SACHETS FOR THE DELIVERY OF
BIOACTIVE MOLECULES TO IMPROVE
PACKAGED FRESH PRODUCE QUALITY
AND SAFETY**

Eva Almenar

The packaging industry has invented many ways to keep produce fresh and safe after harvest. One relatively new approach being explored by MSU researchers is the use of sachets containing bioactive molecules. When added to packaged produce, these sachets release molecules that defend against spoilage and pathogenic microorganisms. With Project GREEN's support, researchers are investigating the molecules' release process to refine the development of these fresh produce sachets. This research will enhance both the safety and quality of various types of fresh fruits and vegetables that are important to Michigan's agricultural economy.



Competitive Grant Summaries: **Field Crops**

DEVELOPMENT OF FORECASTING SYSTEM FOR SOYBEAN WHITE MOLDS

Jianjun Hao

White mold is among the most important diseases threatening soybean production in Michigan. However, its occurrence is considerably variable – some years fungicide use is required while in other years, no control is necessary. The challenge is to predict the future and determine whether white mold will be prevalent late in the season, which is several weeks after growers would need to apply fungicides for them to be effective. Project GREEN funds were used to begin development of a risk forecasting model for soybean white mold in Michigan by investigating the relationship between weather conditions and disease development. This forecasting model will help growers determine whether fungicides need to be applied and if so, the best time for application.

IMPACTS OF PILOT PROJECTS TO INTRODUCE PLANTING FLEXIBILITY TO FARM PROGRAMS IN MICHIGAN

David Schweikhardt

Planting restrictions on fruits and vegetables were hotly debated during the 2008 U.S. Farm Bill debate. While the issue was not resolved, a pilot program was developed that allowed limited planting of processing vegetables in seven Midwestern states. The goal of this project was to assess the pilot program and determine whether producers in the pilot program areas would begin to plant fruits and vegetables on existing acres, whether that change in planting would result in altered supplies and if so, whether the change in supply would result in significant change in market prices. So far, the research suggests the pilot program has had a very limited effect on the planting of fruits and vegetables and, hence, the total supply of these crops. This research will contribute to the 2012 Farm Bill deliberations and could result in policies that resolves the fruit and vegetable planting restriction issue.

TARGETED TILLAGE OF MANURE-ENRICHED PLANTING ZONES FOR PRIMING MANURE NITROGEN RELEASE IN LOW-DISTURBANCE CROPPING SYSTEMS

Tim Harrigan

Livestock-based cropping systems depend on efficiently recycling manure nutrients to help reduce commercial fertilizer use. In the low-tillage systems that are common in Michigan, 80 to 90 percent of the volatile nitrogen in manure evaporates or runs off before it can be used by growing plants. This project sought to identify ways to reduce the need to apply commercial nitrogen by strategically applying manure and planting cover crops to maximize nitrogen uptake by plants. In the study, the amount of nitrogen used was fine-tuned by planting an oil-seed radish cover crop and applying livestock manure. The nitrogen gap – the difference between nitrogen required and nitrogen delivered by the manure or cover crop – was closed, resulting in savings of between \$25 (manure only) and \$60 (manure and cover crop) per acre when growing corn. If a similar practice of using livestock manure applications and cover crops were to be followed on just 10 percent of the Michigan corn crop, researchers predict it would result in an annual economic benefit to Michigan corn growers of between \$1.25 million and \$3 million.



Competitive Grant Summaries: **Fruit**

BEST MANAGEMENT PRACTICES FOR WEED CONTROL IN BLUEBERRIES

Paul Jenkins

Weeds continue to be a major problem in Michigan blueberry production – in the field and during harvest. Several herbicides are currently being used for weed control; however, there is no “silver bullet.” For this reason, the blueberry industry’s top priority for 2009 was to develop management practices for improved weed control. This project specifically tested new herbicides and identified better application strategies for herbicides already on the market. Results have helped growers incorporate new herbicides into their management plans, and to more effectively use older ones. With good weed control practices, growers can realize a 10- to 20-percent increase in marketable yield, representing a \$10 million to \$20 million per year boost to the state’s economy.

DEVELOPMENT OF “ATTRACT AND KILL” TECHNOLOGIES FOR CONTROL OF MOTH PESTS OF FRUIT CROPS

Larry Gut

Michigan fruit growers need a new moth pest management approach, as resistance and new regulations are limiting insecticide use. Pheromone-based technologies, in which synthetic hormones are used to disrupt mating, are becoming quite popular. This project focused on improving the pheromone-based mass trapping technique known as “attract and kill,” which lures adult pests to an attractive source where they are captured and/or killed. Research achievements, which include a new MSU patent-pending microtrap, will help make Michigan fruit production more stable, sustainable and appealing to the public.

DEVELOPING A COMPREHENSIVE FRUITWORM MANAGEMENT PROGRAM FOR MICHIGAN BLUEBERRIES

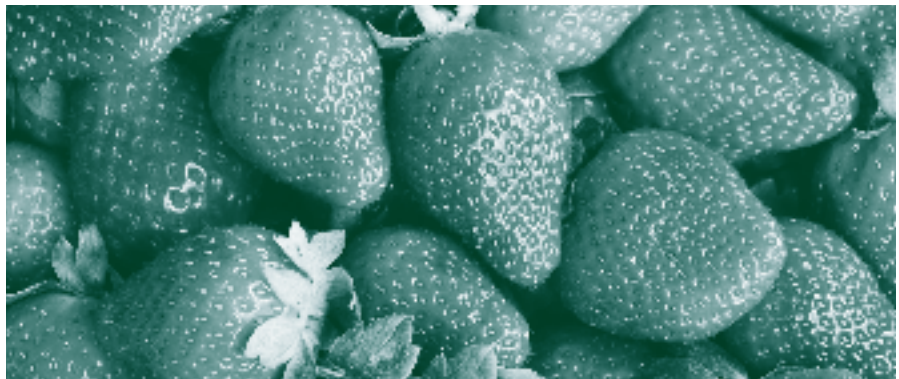
Rufus Isaacs

The cranberry fruitworm and cherry fruitworm have significant economic effects on blueberry growers in Michigan. Larvae infest fruit clusters and cause substantial loss to growers if discovered by customers. Some fields have as much as 80 percent fruit cluster infestation, reducing yields as well as profits. This study aimed to create a growing degree days model to better predict fruitworm populations, test alternative insecticides that could result in lower residues, and develop, implement and demonstrate an optimal fruitworm control program. A comprehensive integrated pest management (IPM) plan for controlling fruitworms in Michigan blueberries has been developed based on this project. The plan was introduced to more than 300 Michigan growers and consultants and will be implemented on about half of blueberry acreage throughout Michigan during the 2012 growing season, resulting in a nearly 10,000-pound reduction in the insecticides applied to that acreage. Additionally, data from this project provided preliminary information for a USDA Crops at Risk grant from Rutgers University totaling \$544,558.

CONTROL OF PARASITIC NEMATODES WITHOUT FUMIGANTS IN STRAWBERRY PLANTINGS

Annemiek Schilder

The environmental risks, cost and availability of fumigants have strawberry growers looking for a better way to control nematodes – microscopic worms that feed on roots and can cause serious damage in strawberry fields. For many, the solution may be in rotating strawberries with crops that limit nematode reproduction. This project evaluated a number of nematode-suppressing rotation crops to help growers choose the right one for their needs. So far, the project has identified several good rotation crops, including sweet corn, broccoli and pumpkin, which have the added benefit of being cash crops. Researchers expect crop rotation will have a significant economic impact as more growers adopt the approach and realize improved strawberry plant establishment and longevity.





EARLY DETECTION RAPID RESPONSE FOR SPOTTED WING DROSOPHILA, A POTENTIAL NEW PEST FOR MICHIGAN SPECIALTY CROPS

Rufus Isaacs

A new invasive pest has arrived in Michigan. In 2010, researchers detected the spotted wing drosophila – a small vinegar fly that could economically damage Michigan's strawberry, raspberry, blackberry, cherry, blueberry and grape industries. Given the significant economic impact this fly has had in western United States, MSU researchers formed the Michigan Spotted Wing Drosophila Response Team. The goal of the team, comprised of research and Extension personnel, regulatory agencies and interested stakeholders, is to develop and implement an early detection-rapid response plan. With funding from Project GREEN, the team deployed more than 300 monitoring traps around the state and delivered pest biology and management information to Michigan growers, pest scouts and consultants.

EVALUATION OF ANTHRAQUINONE FOR BIRD CONTROL IN BLUEBERRIES

John Wise

Michigan ranks No. 1 in the nation for highbush blueberry production. Unfortunately, birds can damage up to 10 percent of a blueberry crop, and as yet, no highly effective bird control technique exists. With this in mind, MSU researchers evaluated the use of anthraquinone – a pesticide commonly used to repel birds from grass. They found that a high rate of application did provide some level of protection to the blueberry crop. This preliminary field research will ultimately be included in the EPA's review of anthraquinone as a bird repellent for food-use crops.

GENETIC MANIPULATION OF *VENTURIA INAEQUALIS* FOR CONTROL OF FORCIBLE ASCOSPORE DISCHARGE

Frances Trail

Apple scab, caused by the fungal disease, *Venturia inaequalis*, is one of Michigan's most destructive apple orchard pests. Year after year, this fungus threatens the quality of apples, and fungicide resistance is making management even more difficult. This project aims to discover how this fungus releases its spores since the presence of the spores is what begins the disease cycle in the spring. In doing so, researchers will be one step closer to eliminating or significantly reducing spores in apple orchards during the spring, which in turn will reduce disease and production costs for growers.



INTEGRATING NOVEL MECHANICAL, GENETIC AND HORTICULTURAL TECHNOLOGIES INTO AN EARLY-YIELDING, HIGH EFFICIENCY, GLOBALLY-COMPETITIVE TART CHERRY PRODUCTION SYSTEM

Ron Perry

The tart cherry harvesting equipment commonly used in Michigan requires that trees be planted in wide rows, resulting in low-density orchards with a maximum of 240 trees per acre. Some European orchards are now being planted at 1,150 trees per acre, which improves the yields and efficiency of these operations. These European improvements are forcing Michigan tart cherry growers to look at new harvesting technologies and production techniques to maintain their status as international leaders in the industry. This study tested over-the-row berry harvesters on tart cherries and established field research plots for both equipment and genetic testing. Researchers identified at least one current harvester that removes fruit efficiently and without damaging trees or fruit. For Michigan producers to use this machine, however, they will need smaller and more compact trees. Ongoing field research is seeking to address this challenge. The long-term impact of this project could be increased cropping and yields from a current rate of 121 trees per acre that produce 12,000 pounds of fruit up to 622 trees per acre that could produce more than 36,000 pounds of fruit.



INHIBITION OF BIOFILM FORMATION AND FIRE BLIGHT DISEASE CAUSED BY *ERWINIA AMYLOVORA*

George W. Sundin

Michigan apple growers need new methods to control fire blight disease caused by the *E. amylovora* bacteria. Unfortunately, one of the most effective means of controlling fire blight, the antibiotic streptomycin, has recently lost its effectiveness to resistance, prompting the Michigan Apple Committee to designate the control of this disease as a top priority. With Project GREEN's support, researchers are investigating how *E. amylovora* colonizes apples and establishes disease. In the long run, researchers hope to develop disease inhibitors that can be used to control fire blight. Funds have supported data collection and the establishment of a collaborative research group to seek additional funding from external agencies such as the USDA.



INVESTIGATING RESISTANCE INDUCERS FOR CONTROL OF BACTERIAL CANKER (*P. SYRINGAE*)

Nikki Rothwell

Michigan is one of our nation's top cherry producing states. One of the most structurally devastating diseases of cherry trees, particularly after a stressful event such as a spring frost or pruning, is bacterial canker. To maintain the economic vitality of Michigan's cherry industry, successful control of this disease is essential. Researchers are evaluating the use of two synthetic compounds that may make cherry trees more resistant to the disease. This project demonstrated how difficult it is to control bacterial canker and suggests that these compounds may curb bacterial populations and provide some level of disease control where none currently exists.

MANAGEMENT PLANS FOR EMERGING BLUEBERRY INSECT PESTS: PUTNAM SCALE AND BLUEBERRY TIP MIDGE

Rufus Isaacs

Two new pests are on the rise in Michigan blueberry fields: the blueberry gall midge and Putnam scale. These secondary pests have not been a significant problem before; however, their populations have increased in the last few growing seasons. So are these pests actually a problem? In an effort to determine the severity of infestations of these two pests, MSU researchers surveyed blueberry farms and nurseries within the major blueberry growing region of southwest Michigan. Researchers found that both pests are not significantly affecting fruit production, which means growers can avoid the cost of spraying insecticides to control them – a savings of \$120,000 a year for the Michigan blueberry industry.

PREPAREDNESS FOR THIRD-PARTY GAP AUDITS

John Wise

Most large-scale fruit producers in Michigan are Good Agricultural Practices (GAP) certified. This means they've been trained on how to safely grow, handle and store produce, and have been successfully audited by an outside entity to prove it. Currently, GAP certification is not required by law; however, many produce buyers and retailers will not purchase from growers who are not GAP certified. Because certification is costly, small-scale Michigan growers are getting left behind in the marketplace. With Project GREEN's support, a team of experts at MSU developed and conducted a GAP certification training program to help small fruit producers, as well as small packers and shippers, understand GAP requirements and write their own food safety manuals to prepare for the GAP certification process.

REDUCING ECONOMIC LIMITATIONS FROM MAXIMUM RESIDUE LIMIT REGULATIONS FACED BY MICHIGAN FRUIT INDUSTRIES

Suzanne Thornsberry

Maximum residue limits (MRLs) are the maximum level of a pesticide compound allowed to remain on a food or feed product in order to gain market entry. Most, if not all, nations regulate MRLs, but limits vary. Recently, several major U.S. trading partners revised their MRLs, and it is important that Michigan fruit growers are aware of and understand these changes. In this project, researchers created a list of compounds currently used by Michigan cherry, apple and blueberry growers, and identified MRLs, inspection processes and regulations for these compounds among major U.S. trading partners. As a result of this study, more than 3,000 fruit industry members from Michigan, 34 states and nine Canadian provinces have learned about recent changes in MRL regulations from four US trading partners, the U.S. standard and the international organization (CODEX) standard. Additionally, a user's guide was developed to help individuals actively monitor regulation updates.

REDUCING THE RISK OF NEW AND INVASIVE VIRUSES IN MICHIGAN BLUEBERRIES AND CRANBERRIES

Annemiek Schilder

A number of viruses, new and old, threaten Michigan's blueberry industry each year, and since there is no cure for an infected blueberry plant, investigations into their cause and effects are imperative. This project studied two relatively new Michigan blueberry viruses – blueberry shock and blueberry scorch – and continued monitoring of an unidentified pest plaguing blueberry fields for the last five years that is currently referred to as blueberry bronze leaf curl. Additionally, this project directly helped the Michigan blueberry industry by providing free diagnostic support and recommendations for growers with suspected virus problems in their fields.

REESTABLISHMENT OF BLUEBERRY PLANTING AT THE MSU TREVOR NICHOLS RESEARCH CENTER

John Wise

In 2009, six acres of highbush blueberries at MSU's Trevor Nichols Research Center (TNRC) in Fennville had to be destroyed because blueberry shock virus was detected in them, bringing a halt to more than 40 years of vital blueberry research. Blueberries were replanted in 2011 with Project GREEN's support. Although it will take several years for the bushes to grow enough to be ready for full-scale, active research, the successful reestablishment of the TNRC blueberry planting will have a significant impact on MSU's ability to address important pest management challenges to Michigan's blueberry industry.

SOLID-SET CANOPY SPRAY DELIVERY SYSTEMS FOR RESOURCE-EFFICIENT, ECOLOGICALLY SUSTAINABLE FRUIT PRODUCTION

Gregory Lang

In fruit production, too many rainy days can be too much of a good thing. Pest populations and disease can explode, leading to a loss in quality, production, income and even tree survival. When such weather events occur, growers often use tractor-mounted sprayers to apply pesticides. However, there are risks to doing so. Most notably, wet or saturated orchard soils may prevent timely, effective use of tractor sprayers, heavy equipment can cause soil compaction and erosion, and broadcast spraying in windy conditions can result in pesticide drift and potential nontarget contamination. Recognizing that another approach is needed, MSU researchers are developing stationary, in-row systems for growers to quickly and more accurately deliver agrichemical solutions and other inputs after inclement weather and as needed – all without stepping foot (or tractor tire) on wet orchard soils. Project GREEN's support enabled researchers to develop the first prototypes and ultimately secure a \$2.4 million federal grant to further develop and refine their novel systems.





Competitive Grant Summaries: **Green Industries, Bioenergy and the Environment**

IMPROVING WATER MANAGEMENT IN CONTAINER NURSERIES BY SCHEDULING IRRIGATION

Tom Fernandez

Water conservation continues to be an important consideration for Michigan nursery owners. Researchers used eight types of ornamental shrubs and four types of conifers to evaluate the effectiveness of three irrigation levels based on estimated daily water use (DWU). The study showed that scheduling irrigation based on DWU could reduce water use without negatively affecting plant growth. Scheduled irrigation can reduce the environmental effects associated with nutrient leaching to rivers, lakes and streams. Researchers also found that monitoring DWU allows growers to more easily group plants by water needs, which results in more efficient irrigation. The result? Lowers costs associated with pumping water such as energy use, system wear and construction of increased-capacity runoff containment structures. Researchers recommend that growers use soil moisture sensors to set up a need-based irrigation protocol that doesn't affect plant size.

OPTIMIZING THE EFFICACY AND ENVIRONMENTAL FITNESS OF A COMMERCIAL *PSEUDOMONAS* BACTERIAL BIOCONTROL PRODUCT FOR THE CONTROL OF TURFGRASS DISEASE

Joseph Vargas

Turfgrass managers across the United States battle a variety of diseases, and pesticides have played a major part in their management. However, biological control products are becoming equally effective and offer a more environmentally friendly approach to turfgrass management. One popular biocontrol product used to fight fungal diseases is *Pseudomonas aureofaciens* Tx-1 – a bacterium that is good at controlling low to moderate (but not high) levels of disease. With previous research indicating that ultraviolet radiation may be the problem when disease levels are high, researchers improved this commercial biocontrol agent by identifying the most UV-tolerant strain and adding a sunscreen to the mix. Not only did they demonstrate how the performance of *Pseudomonas aureofaciens* Tx-1 can be improved, but also how these additions might improve other biocontrol products used on turfgrass and in other crop systems.

REED CANARYGRASS AS A BIOENERGY CROP IN MICHIGAN'S UPPER PENINSULA

Doo-Hong Min

Bioenergy crops are gaining attention as alternatives to fossil fuels because these crops can yield cheaper, safer and more renewable energy. Another perk is their potential profitability in rural communities where landowners often deal with unproductive cropland. In Michigan's Upper Peninsula, where wet, heavy soils prevail, MSU researchers evaluated the use of reed canarygrass as a bioenergy crop. They also determined the optimal application rate of nitrogen fertilizer (125 lbs N per acre at green-up time) – one of the costliest inputs in crop production. Researchers identified a promising variety ('Winnebago') of reed canarygrass for bioenergy crop production in the UP region, and demonstrated how repurposing otherwise marginal cropland can generate extra income in rural areas.



Competitive Grant Summaries: **Alternative Crops**

BUSINESS PLAN DEVELOPMENT FOR HOOPHOUSES

David Conner

Hoophouses, or passive solar greenhouses, are helping Michigan growers overcome seasonal restrictions on growing food locally. However, a large barrier to production is access to credit to purchase hoophouses. This project aimed to create business plan templates and samples to guide people through decisions related to purchasing hoophouses, as well as to help them secure and organize financial information for loan applications. As a result of this project, two MSU Extension bulletins, five videos, three journal articles and a website were developed to help Michigan growers take steps toward hoophouse production. Additionally, this project played a large role in creating national recognition for MSU's work with passive solar greenhouses, and helped stimulate a \$25,329 project through the North Central Regional Sustainable Agriculture Research and Education Professional Development Program. The project played a role in the development of state-funded loans for passive solar greenhouses and supported a key portion of Implementing the Michigan Good Food Charter, a \$2.5 million grant to MSU from the W.K. Kellogg Foundation.

DETECTING AND ASSESSING POTENTIAL CAUSES OF INTERNAL CHESTNUT DETERIORATION

Daniel Guyer

The U.S. cultivated chestnut industry is growing and Michigan is leading the way in numbers of growers and amount of research conducted to support the industry. Researchers estimate that Michigan chestnuts can bring at least a 25 percent (or \$1 a pound) premium over imports by producing a consistent and high-quality product. However, chestnuts' thick peels make it difficult to detect defects that could lead to dissatisfaction at both the processor and customer levels. As a part of this project, researchers determined that computed tomography (CT) scanning allowed for successful sorting of defective from quality chestnuts. CT scanning identified healthy tissue 100 percent of the time and only misclassified the type of defective tissue 20 percent of the time. Researchers are also working to develop a prototype scanner for industry use. The impact of this research could extend beyond chestnuts to sorting challenges in the fruit, vegetable, nut and food industries, reaching much farther than initially anticipated.

SUSTAINABLE CROPPING SYSTEM FOR MICHIGAN CHRISTMAS TREE PRODUCTION

Pascal Nzokou

Christmas trees, which are grown in every county in Michigan, are quite demanding. In addition to pest, weed and disease control, their production requires growers to supplement the soil with a significant amount of nitrogen. In recent years, growers have been eyeing the use of groundcovers for their dual ability to supply nitrogen and suppress weeds. But which groundcovers work best? Researchers found that legume groundcovers, such as alfalfa and white clover, can add a significant amount of nitrogen to the soil while controlling weeds early in the growing season. By using legume groundcovers, growers can potentially reduce their fertilizer use by up to 50 percent, saving Michigan's Christmas tree industry up to \$450,000 per year.



SUSTAINABLE IRRIGATION AND WATER MANAGEMENT IN FRASER FIR CHRISTMAS TREE PRODUCTION

Pascal Nzokou

Fraser fir, Michigan's most valuable Christmas tree, requires a significant amount of water for proper growth and development – a need not naturally met by Michigan's climate. As a result, Christmas tree growers rely on various irrigation systems to provide water and support nutrient uptake in trees. This project aimed to improve the sustainability of irrigation and water management systems for Christmas tree farms in Michigan. Specifically, researchers evaluated the water and fertilizer requirements of Fraser fir and developed recommendations for more sustainable and efficient irrigation schedules. These recommendations could bring Michigan Christmas tree growers a savings of up to \$60 per irrigated acre.



Competitive Grant Summaries: **Vegetables**

BIOFUMIGATION AND COVER CROP MIXTURES FOR OPTIMIZING THE PERFORMANCE OF COVER CROPS IN COMMERCIAL VEGETABLE PRODUCTION

Mathieu Ngouajio

Many growers use short-term crop rotation to stay competitive in Michigan's \$200 million plus vegetable production industry. However, this approach requires high inputs of fertilizer and pesticides and can lead to poor soil conditions and an increase in weeds and diseases. Growers need to adopt more sustainable practices such as growing cover crops between growing seasons. This study identified two specific cover crop systems that Michigan vegetable growers can use to improve soil health, protect vegetable crop quality and yield, and reduce fertilizer and pesticide use. Specifically, researchers demonstrated how Brassica cover crops (relatives of broccoli and cauliflower) and a rye-vetch cover crop (a combination of grass and legumes) can improve vegetable production in Michigan.

EVALUATION OF TUBER HEALTH PREDISPOSITION PROGRAMS IN CONJUNCTION WITH REDUCED RISK FUNGICIDES AND BIOFUNGICIDES APPLIED POST HARVEST FOR THE CONTROL OF POTATO STORAGE PATHOGENS

William Kirk

Potato late blight and other pathogens attack potato crops during the growing season and after harvest during storage. This means that potato growers need to stave off disease in both periods to bring high quality potatoes to market. In the field, growers typically rely on fungicides to tackle disease. But in storage, disease control options are limited. With this in mind, researchers developed a disease management scheme for the major potato storage diseases by testing the use of fungicides or biofungicides during the growing season and in storage. A list of recommendations was developed that will help Michigan growers ensure that potatoes will both enter and leave storage in excellent condition.

MANAGING LATE BLIGHT IN MICHIGAN BY COMBINING WEATHER-BASED DISEASE RISK MANAGEMENT SYSTEMS

William Kirk

The development of late blight in potatoes is highly dependent on the right weather conditions - specifically cool and wet. If growers could get a heads-up that weather conditions were becoming favorable for late blight, they could take appropriate steps to controlling the disease. This is exactly what MSU researchers had in mind when developing the Late Blight Risk Management website in 2000. This online tool alerts growers when weather conditions are becoming favorable for the development of potato late blight. With Project GREEN's support, researchers are making this online tool even more useful by expanding the prediction area to the entire state of Michigan and extending the predictions to up to five days in the future. The improved online system is a significant advance and is helping growers to more precisely time their disease control efforts, which is saving time, yield and money.

MANAGING POTATO AND TOMATO LATE BLIGHT EPIDEMICS THROUGH THE USE OF WEATHER-BASED IPM SYSTEMS TO PREDICT OVERWINTER SURVIVAL OF VOLUNTEER POTATO TUBERS

William Kirk

More often than not, potatoes unintentionally left in the field from a previous growing season sprout into new potato plants. While this sounds relatively harmless, these leftover potatoes, known as volunteer potato tubers, are actually a huge threat to the new crop. In Michigan, volunteer potatoes are the primary source of late blight – a mold disease that can devastate potato (and tomato) crops. To make matters worse, late blight is becoming increasingly tolerant of cold temperatures. When you mix this with warmer Michigan winters that fail to kill the host volunteer potatoes, you get perfect conditions for an epidemic. To help growers determine the risk of their crops developing this disease, researchers identified the temperatures at which volunteer potatoes fail to survive and used this information to build a web-based management tool that alerts growers to the low, medium or high risk of late blight. The result? Direct control of late blight, which can protect growers' profits and potentially reduce the need for fungicide applications.

TRANSCRIPTOME RESPONSE OF CUCUMBER TO THE DOWNY MILDEW PATHOGEN

Brad Day

Michigan is the top producer of pickling cucumbers in the United States. Cucumber sales generates more than \$30 million a year. However, downy mildew – a disease that has pretty much been kept at bay in Michigan through the use of mildew resistant cucumber cultivars – is making a comeback. In an effort to tackle this disease once and for all, MSU researchers are investigating how downy mildew infects cucumber plants at the genetic level. With Project GREEN's support, researchers have been able to bolster their genomic resources and come closer to identifying strategies for developing new mildew resistant cucumber cultivars.

UNCOVERING THE ROLE OF P450 GENES IN RESISTANCE TO NEONICOTINOID INSECTICIDES IN COLORADO POTATO BEETLES (CPB)

Mark Whalon

In North America and Europe, the number one insect pest of potatoes is the Colorado potato beetle. Their uncanny resistance to all known classes of insecticides make them the fourth most resistant insect species in the world. This resistance costs the Michigan potato industry \$1.4 million a year as the beetles chew their way through the potato crop. MSU researchers are exploring the genetic makeup of the Colorado potato beetle to uncover how it has developed resistance to certain neonicotinoid compounds (insecticides that act on insects' central nervous systems). The study results will be instrumental in identifying effective control methods.





FEATURED TEAM



Robin Buell, Brad Day and Mary Hausbeck (front) and their team are working to save Michigan's high-value cucumber industry.

PLANT PATHOLOGY RESEARCHERS WORK TO RESCUE MICHIGAN CUCUMBER INDUSTRY

Once they identify the creeping vines with little green cylinders trailing throughout a field, most Michigan residents think, “ah, just cucumbers.” But the impact of *Cucumis sativus* makes it more than “just a cucumber.”

With an annual economic impact of more than \$250 million in Michigan alone, the pickled version of the humble vegetable makes it a job generator. In 2008, cucumbers ranked fourth in the nation for total acreage planted among vegetable crops, with a total production of 28.8 million tons, and they’re a key component of the pickling industry.

But the industry is in serious danger.

Downy mildew is the most devastating threat to cucurbits (members of the gourd family such as cucumbers and melons) production today. Though Michigan had been free of the pathogen for decades due to resistance breeding in

cucumbers, downy mildew reemerged in the state in 2005 and has ravaged yields. The industry loses \$6 million a year on fungicide applications in an attempt to control the pathogen. Worse yet, downy mildew is becoming resistant to most chemicals applications.

MSU plant pathology assistant professor Brad Day wants to turn the industry around. Thanks to Project GREEN funding, Day’s laboratory team collaborated with the research team of fellow plant pathology professor Mary Hausbeck and plant biology professor Robin Buell. Together, they are studying the makeup of the pathogen and cucumbers, in hopes of understanding how cucurbits are susceptible to downy mildew and, eventually, preventing it.

This collaboration, as well as GREEN funding, kick-started his downy mildew research, leading him to a larger grant from the United States Department of Agriculture partnering with

researchers in Wisconsin and North Carolina.

In addition to discovering a way to prevent the pathogen through breeding or genetic engineering, Day hopes to develop more efficient diagnostic tools to identify downy mildew and share this information with the many other states that are heavily dependent on cucurbits in agriculture.

“At present, treating downy mildew is really boiling down to a lot of Hail Marys,” Day said. “They’re just throwing everything they can at it, meaning a lot of pesticide treatments that have a high cost, not only financially, but for the environment. What we’re doing is building resources to try to provide alternative methods to combat a downy mildew epidemic that is slowly crippling cucurbit vegetable production in Michigan and across the United States.”



INFRASTRUCTURE SUPPORT

“FARMING LOOKS MIGHTY EASY
WHEN YOUR PLOW IS A PENCIL AND
YOU’RE A THOUSAND MILES
FROM THE CORN FIELD.”

Dwight D. Eisenhower

To remain viable,
agriculture relies on research.
The work of scientists in the
laboratory and in the field is
vital to the long-term growth of
Michigan’s second largest industry.
That’s why Project GREEN
awards funding to Michigan State
University academic departments,
specialized programming
and MSU Extension.

This funding allows scientists and
educators to invest in equipment,
personnel and other vital areas
that are key to groundbreaking
scientific discoveries. In addition,
they participate in programming
that helps farmers, homeowners,
turf and landscape professionals,
and others maximize their
time and money.





Academic Infrastructure

The Department of **AGRICULTURE, FOOD AND RESOURCE ECONOMICS**

With their GREEN infrastructure funding, Department of Agriculture, Food and Resource Economics representatives traversed the state for the MSU Product Center. They led numerous meetings, creating two food cooperatives and conducting 70 counseling sessions with 39 clients to help Michigan agricultural entrepreneurs and businesses develop their product ideas. The Center put on two summits for food processors, one addressing wastewater issues and the other barriers to industry expansion. The wastewater summit triggered major changes in the Michigan Department of Natural Resources' process for licensing wastewater treatment systems. AFRE also dedicated GREEN funding to research in various subjects, including:

- *Discovering optimal temperatures and lighting in greenhouses to both increase efficiency and reduce energy consumption.*
- *Developing approaches to balance the tart cherry industry's supply with demand. Researchers created a strategy to deal with changes in cherry yields that are difficult to predict and plan for.*
- *Gathering cover crop data and agricultural statistics for Clinton, Eaton and Ingham counties through the Tri-County Economic Development Initiative. The project applies input from local food and fiber industry stakeholders to economic development plans. The project has sparked interest in other regions of the state.*

The Department of **BIOSYSTEMS AND AGRICULTURAL ENGINEERING**

Stormwater – the runoff from rooftops, streets and parking lots – is the leading cause of water quality impairment in the United States. White mold is believed to have destroyed more than 94 million bushels of soybeans between 1996 and 2002. What do these situations have in common? They're both being researched by members of the Department of Biosystems and Agricultural Engineering. BAE used Project GREEN investment to examine current stormwater practices. Researchers also worked to reduce white mold in soybeans by studying how environmental changes affect the crop's condition and the persistence of white mold.

In addition, BAE researchers:

- *Studied improvements in the cropping of Michigan hops by examining the balance of water and nutrients involved in growing a viable crop.*
- *Developed new technology to better identify the potential damage from cherry leaf spot, a disease that causes tart cherry tree leaves to fall from trees prematurely and prevents cherries from developing properly.*
- *Designed new technology for documenting oxidation reduction in soils.*
- *Adopted new leaf wetness sensors, which help anticipate agricultural diseases, fog or rainfall by monitoring the amount of precipitation on leaves.*
- *Mentored four students in instrumentation and project management.*

The Department of **CROP AND SOIL SCIENCES**

A portion of the Department of Crop and Soil Sciences' Project GREEN funding supports the operation of the agronomy research facility on the MSU campus and a wheat farm in Mason, where annual field research trials are held. In 2010–11, Project GREEN funding was also used to install an irrigation pump and drainage tile at the agronomy research facility. Additionally, GREEN funding:

- *Helped support equipment and supply needs for more than 20 research projects.*
- *Supported the MSU Extension crop and soil sciences advisory group that enabled faculty to be more responsive to the research, Extension and education needs of their clientele and industries.*
- *Allowed researchers and MSU Extension specialists to travel throughout the state to talk directly with farmers and other stakeholders, thereby ensuring more open communication and that faculty research activities remain relevant to Michigan's needs.*

The Department of ENTOMOLOGY

The Department of Entomology used Project GREEN funds to assist in research and educational training designed to address various insect and pest problems in both agriculture and natural resource environments by:

- *Reducing the amount of pesticides used in forests, organic and traditional agriculture and turf grass applications through the adoption of integrated pest management techniques, while educating various agriculture groups on the use and successful implementation of IPM.*
- *Continuing research and field trials of various codling moth controls using pheromones and parasitic nematodes.*
- *Progressing toward better management of colony collapse disorder, which can wipe out entire colonies of honeybees, devastating apiaries.*
- *Having the North American Blueberry Council adopt MSU's Good Agricultural Practices for Food Safety in Blueberry Production: Basic Principals manual as an NABC food safety checklist for the entire highbush blueberry industry in North America.*
- *Assisting MSU in a timely response to producers regarding two new blueberry viruses.*
- *Testing tree trunk injection as an alternative application method for tree fruit insecticides.*
- *Informing farmers about the spotted wing drosophila fly, a new invasive pest in Michigan that is potentially devastating to many fruit crops.*

The Department of FOOD SCIENCE AND HUMAN NUTRITION

Forty-eight Michigan businesses and entrepreneurs were assisted with their product ideas through the Department of Food Science and Human Nutrition and the MSU Product Center. Project GREEN funding allowed FSHN to provide research and quality testing for many Michigan business and entrepreneur projects. It also supported the facilities, computers, software licenses, and student and visiting faculty help needed to maintain these efforts. Product Center efforts included:

- *Providing nutritional labels to various Michigan entrepreneurs.*
- *Assisting the Michigan-based company Chelsea Milling with product testing.*
- *Providing pilot plant equipment for various groups and businesses' outreach and training activities. For example, drying chestnuts for the Michigan Chestnut Grower Group.*

The Department of GEOGRAPHY

Since its formation in 2006, the weather-based information system, Enviro-weather, has become a valuable source of location-specific data for plant, pest and natural resource management decisions to an average of more than 8,000 users a day – up from 4,200 a day one year earlier. The Department of Geography plays an integral role in ensuring that Enviro-weather users receive timely, accurate information by working closely with the Michigan Automated Weather Network (MAWN). In addition, Project GREEN infrastructure funding was used to:

- *Purchase a variety of sensors, dataloggers and related equipment for the operation of the weather network.*
- *Manage the Enviro-weather databases and maintain the 64 weather stations that are integral to providing top-quality and timely information to farmers.*
- *Extend the network's outreach into fruit-growing regions of eastern Wisconsin through a collaboration with the University of Wisconsin and a grant from the U.S. Environmental Protection Agency.*
- *Help cover the expenses of geography researchers as they spoke at meetings throughout the state to discuss developments in climate change research; crop simulators and local weather data gathering groups like the Community Collaborative Rain, Hail and Snow Network.*

Academic Infrastructure

The Department of HORTICULTURE

Funding from Project GREEN helps the Department of Horticulture maintain the MSU Student Organic Farm, which provides year-round organic produce at local farmers markets and in the MSU residence dining halls. The farm also offers the intensive Organic Farmer Training Program that focuses on diversified year-round organic production methods.

In addition, Project GREEN funding helps the department maintain the 180-acre Horticulture Teaching and Research Center located on the MSU campus. Projects there include:

- *Researching methods to improve post-harvest quality of fruits and vegetables.*
- *Increasing tree diversity throughout Michigan, replacing trees killed by the emerald ash borer.*
- *Improving reproductive development in cucumber and melon plants.*
- *Sustaining wholesale production nurseries and improving long-term profitability of vegetable production systems.*
- *Determining factors limiting grape vine growth and development in Michigan's cool climates and finding ways to overcome those issues in order to increase the state's grape production.*

The Department of PLANT PATHOLOGY

Project GREEN infrastructure funding helped researchers in the Department of Plant Pathology develop effective methods of plant disease control and detect the latest threats of disease outbreaks. Some examples of the myriad Project GREEN infrastructure-supported research conducted in Plant Pathology include:

- *Learning more about the causes of Stigmina needle cast, a new fungal disease in blue spruce that is spreading rapidly among Christmas tree plantations, tree farms and landscape plantings.*
- *Curtailing a substantial potato late blight epidemic through early intervention.*
- *Installing a new, free-to-users tool on the Plant Pathology website that forecasts late blight risk.*
- *Testing two new fungicides for the management of apple scab, an extremely debilitating fungal disease. Both fungicides will be registered and available to Michigan growers in 2012.*

The Department of PLANT BIOLOGY

Researchers in the Department of Plant Biology require advanced computational abilities to conduct their studies. Plant biology scientists work with bioinformatics, the process of analyzing biological data with computers, and genomics, the study of gene sequences in DNA, both of which require specialized software programs. Project GREEN infrastructure funding was invested into extensive information technology support to aid faculty in conducting this research.

MSU ACADEMIC DEPARTMENTS THAT RECEIVE ANNUAL INFRASTRUCTURE FUNDING FROM PROJECT GREEN

*Agriculture, Food and
Resource Economics*

*Biosystems and
Agricultural Engineering*

Crop and Soil Sciences

Entomology

*Food Science and
Human Nutrition*

Forestry

Geography

Horticulture

Plant Biology

Plant Pathology

Outreach and Education Through MSU Extension

MSU Extension educators put their Project GREEN infrastructure dollars to work disseminating information about the latest developments in pest management and crop development. Here are some examples.

MSU Extension educators made great strides in developing the bioeconomy industry in Michigan this year. Partnering with the Institute for Public Utilities, the Michigan Renewable Energy Program and the Michigan Corn Growers Association, educators assembled two years of applied research data on perennial biomass crops, spoke about biomass handling and access considerations at events such as the Saginaw Valley Research and Extension Center annual tour, and demonstrated to farmers how they could become biomass suppliers. The goal is to make Michigan farmers aware of more crop choices in bioeconomy ventures and how to increase their farms' net income. Extension educators also sought to increase the number and improve the success of bioeconomy project ideas in Michigan through workshops, conferences, and client counseling and educational programs.

MSU Extension educators spoke at many locations across the state to explain developments related to various tree-fruit diseases affecting Michigan, such as apple powdery mildew infection and a fire blight pathogen called *Erwinia amylovora*. Educators explained developments in the diseases, such as increased resistance to fungicides and the diseases' likely responses to current weather conditions, and offered information on the most affordable treatments. In addition, educators coordinated sessions on these topics at the Great Lakes Fruit, Vegetable and Farm Market Expo.

Educators conducted a summer meeting of Christmas tree farmers, bringing together 350 growers from Ohio, Illinois, Indiana, Minnesota, Kentucky, Missouri and Tennessee. At that meeting, growers indicated that MSU Extension's work with soil nutrition assistance and improved pest management increased the value of their trees by \$1,000 to \$1,500 per acre.



MSU Extension works to increase farmers' success while protecting the environment, ensuring food safety, reaching new markets and advancing agriculture through applied research.

www.msue.msu.edu

MSU Extension educators used weekly Crop Advisory Team (CAT) Alerts to inform Michigan growers of important developments in weather and crop conditions. The alerts keep growers informed of crop nutrient level changes and developments in tree fruit diseases and insects. The information served as a weekly update on pathogens such as bacterial canker in sweet cherries, a disease that challenged Michigan growers in the cool, wet spring weather.

Delivering science-based Extension information is an ever-evolving process. Established methods such as bulletins, workshops and fact sheets will continue to be an important method of communicating research results to growers, but Internet and social media communication is becoming increasingly popular among many Michigan farmers. In answer to this trend, Extension launched an online MSU Christmas Tree Channel. The channel currently offers more than 30 videos from MSU Extension educators and specialists on virtually every aspect of Christmas tree production. The videos can be found at youtube.com/MSUChristmasTrees.



PROGRAM SUMMARIES

"AGRICULTURE IS OUR WISEST
PURSUIT, BECAUSE IT WILL IN THE END
CONTRIBUTE MOST TO REAL WEALTH,
GOOD MORALS AND HAPPINESS."

*Thomas Jefferson, in a letter to
George Washington in 1787*

Michigan's diverse climate,
its wide variety of soil types
and the entrepreneurial spirit
of its residents make it the
second most agriculturally
diverse state in the nation.
More than 200 commercially
grown commodities dotting the
landscape make Michigan the
land of opportunity... and
the land of challenges.
Project GREEN helps fund
key research and outreach
programs to ensure that
entrepreneurs and others can
tap into world-class research
and outreach programs to help
grow the economy and keep
our land productive.



ENVIRO-WEATHER

ENVIROWEATHER.MSU.EDU

Unpredictable and uncontrollable weather has long been the bane of agriculture's existence. Thanks to Michigan State University's Enviro-weather information system, farmers have a resource that can help them predict weather events and pest outbreaks so they can better manage their crops. An intricate web of 61 weather stations strategically sprinkled throughout the state supply data to several predictive pest and weather models that give growers the information they need to make solid management decisions.

In 2010, this science-based decision-making tool got even better. A cooperative project between Enviro-weather and the University of Wisconsin-Madison has resulted in the placement of three weather stations in Wisconsin's Door Peninsula, with three more slated to be placed elsewhere in that state. Discussions with Wisconsin blueberry growers who are also interested in obtaining Enviro-weather stations to help predict pest infestations may soon result in stations near Michigan's Upper Peninsula. These additional stations, made possible thanks to grants from American Farmland Trust and the U.S. Environmental Protection Agency, help build a more robust, efficient system that will benefit all growers.

The system's website underwent a major redesign that has allowed Enviro-weather to offer more applications and enhanced features. For example, users can now choose to compare rainfall amounts across a region, and over five years. It also added 11 new commodity-specific tools for producers, as well as a variety of new predictive models for 16 insect pests, which increases the system's usefulness for a range of commodities and users.

That's good news for growers who have been using the site more and more. Overall use increased by 270 percent between 2007 and 2010, and more than 50 percent of Enviro-weather users who responded to a voluntary survey reported using the website at least daily.



Abbey Jacobson, co-owner of Westview Orchards in Romeo, Mich., poses with an Enviro-weather station on her farm. The free-standing, solar-powered, 12-foot-tall weather station transmits information, via cellular technology, to Michigan State University. Detroit News photo.

Photo below courtesy of MDARD



MSU LAND MANAGEMENT OFFICE

Critical field research at Michigan State University depends on the MSU Land Management Office to keep research stations running and up-to-date. Professional farm managers also use Project GREEN funds to purchase critical farm equipment used in research trials. Some of the impacts resulting from this research are:

- Screening insecticides to provide baseline data to support spray recommendations for fruit producers.
- Successful elimination of Blueberry Shock Virus (BShV) infested plants, and the reestablishment of five acres of blueberries at the Trevor Nichols Research Complex in southwestern Michigan.
- Screening fungicides for resistance, and sharing the results with growers.
- Improving the ecological efficiency of Michigan sugarbeet production.
- Developing soybean germplasm with resistance to multiple biotypes of aphids and Japanese beetles.

PESTICIDE AND PLANT PEST MANAGEMENT (PPPM) DIVISION, MICHIGAN DEPARTMENT OF AGRICULTURE AND RURAL DEVELOPMENT

The PPPM Division of the Michigan Department of Agriculture and Rural Development uses Project GREEN funds to help support the division's export manager and a plant pest specialist. Thanks to this funding, professionals were able to survey stone fruit nursery stock producers in an effort to resolve Plum Pox Virus (PPV) trade issues, particularly the export of *Prunus* sp. nursery stock to Canada.

A review of phytosanitary requirements with the state's primary trading partners resulted in the continuance of detection surveys for pests of concern, including Japanese beetle, flag smut, light brown apple moth, red belted clearwing moth, golden variegated tortrix, Karnal bunt, Sirex wood wasp, soybean cyst, potato cyst and golden nematode.

The plant pest specialist cooperated with MSU Extension to train industry participants and maintain phytosanitary certification protocols for apples exported to Mexico. This specialist and the MDARD inspection staff also conducted inspections of soil and commodities before issuing certificates that documented producers' compliance with the requirements of the importing states and countries. Commodities certified included fruit, logs, lumber, beans, hay, grain and nursery stock, among other plants and plant parts.



THE PLANT BIOTECHNOLOGY RESEARCH AND OUTREACH CENTER

The MSU Plant Biotechnology Research and Outreach Center offers research support on specialty crops of relevance to Michigan, as well as outreach programs dealing with molecular breeding and environmental biosafety of genetically engineered crops. The overall goal is to facilitate the work of MSU researchers and other scientists involved with specialty crops. The PBROC also works to provide information on the safe deployment of biotechnology across the world.

A facility such as PBROC is well-placed at MSU. The university has long been on the cutting edge of technological advances, and Michigan is the country's leader in the production of numerous specialty crops, including bedding plants, blueberries, dry beans, cherries and pickling cucumbers, as well as a major producer of grapes, asparagus, herbaceous perennials, snap beans and strawberries. Among other activities, the center provides hands-on training to MSU students and visiting scientists, does contract work for MSU research programs, and conducts a short course on molecular plant breeding that is attended by university and international students and scientists.

The center has also provided an international outreach component, hosting visits from international scientists and one-month internships for students.

Core funding from Project GREEN allows PBROC to bring in grants and service contract dollars to provide services and fund projects.

THE MSU PRODUCT CENTER PRODUCTCENTER.MSU.EDU

Growing Michigan's \$71 billion agri-food industry takes dedication and expertise in business development. The MSU Product Center helps individuals and businesses launch new ventures by reducing the risks associated with new product and business development. Created in 2003, the Product Center strives to be the go-to place for venture development in the food, agriculture, natural resource and bioeconomy sectors in Michigan. The center has a network of resources to assist in the creation of new ventures. This network provides a bridge between entrepreneurs and support services, such as business, marketing, technical and scientific resources. It is a blend of expertise of MSU and external partners.

Since its inception, the MSU Product Center has assisted almost 2,000 Michigan residents. Its innovation counselors have conducted more than 15,000 individual counseling sessions. The center has helped Michigan residents launch 164 new ventures. Those ventures have created or retained 1,100 new jobs, invested almost \$230 million in the Michigan economy, and increased their first year sales by almost \$310 million.

Granting GREEN

Thanks to funding from Project GREEN, 94 plant agriculture research projects will receive more than \$2.5 million in grant funding for fiscal year 2011-12. The Project GREEN selection committee invested \$1,343,350 in 49 new projects and \$1,169,650 in 45 continuing projects.

New projects

Advancing native plants to support agriculture and the environment

DOUGLAS LANDIS

Analyzing the impact to Colorado blue spruce quality in Michigan landscapes, nurseries and Christmas tree industry from stigmia and rhizosphaera needlecasts

DENNIS FULBRIGHT

Caught you looking! What captures consumers' attention when they buy ornamental and food-producing plants

BRIDGET BEHE

Changing sensitivity of sugarbeet roots to decay throughout the storage campaign: Germplasm evaluation and symptom amelioration

RANDOLPH BEAUDRY

Combining strip tillage and dual cover crops to increase profitability

DALE MUTCH

A comprehensive approach to coning in Fraser fir Christmas trees

BERT CREGG

Control of berry maturation to improve total fruit antioxidant in concord vines

PAOLO SABBATINI

Cover crop susceptibility to herbicides

CHRISTY SPRAGUE

Critical invasive pests of Michigan tree fruit

LARRY GUT

Determining the potential of ground floor management to reduce disease pressure in Michigan vineyards: A bio-rational approach to management of downy mildew in Michigan

ANNEMIEK SCHILDER

Developing soybean germplasm with resistance to multiple biotypes of aphids and Japanese beetles

DECHUN WANG

Development and delivery of biologically based pest management for the apple flea weevil

MATTHEW GRIESHOP

Development and field evaluation of true fir genetic material for Michigan Christmas tree production

PASCAL NZOUKOU

Development of a spectral index to facilitate the efficient scouting of *Phytophthora capsici* in squash

MARY HAUSBECK

Development of an alternative granular pesticide application technology and prototype applicator for golf and athletic turfgrass

JOSEPH VARGAS

Development of genetic resources for improvement of American ginseng

ROBIN BUELL

Evaluation of binary mixtures of alfalfa and grass and their responses to supplemental nitrogen fertilization

DOO-HONG MIN

Fate of weed seeds when plants are terminated prior to maturity

KAREN RENNER

Formation of a multi-university plant enterobacterial pathogen group: Role of biofilms in colonization and pathogenesis

GEORGE SUNDIN

Genome resources for *Venturia inaequalis*

FRANCIS TRALL

Grower decision support tool for conversion to a high-efficiency tart cherry orchard system

MOLLIE WOODS

Grower initiated project to enhance the profitability of cucumber and tomato production with low tunnels

MATHIEU NGOUAJIO

Identification of oomycete and fungal species responsible for stand loss in soybeans and corn

MARTIN CHILVERS

Identification of pathogens responsible for potato dry rot and other skin-blemish diseases in commercial potato production and sugar beet root rot diseases and their sensitivity to fungicides

WILLIAM KIRK

Impact and social acceptance of selected sustainable practices in ornamental crop production systems

THOMAS FERNANDEZ

The impacts of expanding Chinese production on Michigan's blueberry sector

MOLLIE WOODS

Improving the ecological efficiency of Michigan sugarbeet production

KURT STEINKE

In plant analysis of resistance and susceptibility: The identification of missing responses in the cucumber-downy mildew interaction

BRAD DAY

Inheritance and mapping of resistance to anthracnose fruit rot in highbush blueberries for marker assisted selection

ANNEMIEK SCHILDER

Initiation of immediate and long-term management strategies for invasive genotypes of *Phytophthora infestans* on potato foliage and tubers

WILLIAM KIRK

Insecticide resistance management of the greenhouse pest: Western flower thrips

DAVID MOTA-SANCHEZ

Management strategies to alleviate winterkill on golf courses

KEVIN FRANK

Managing and using high-yielding corn residue in Michigan

TIM HARRIGAN

Managing gall wasp in Michigan blueberries

RUFUS ISAACS

Managing potato and tomato late blight epidemics through the use of weather-based IPM systems to predict overwinter survival

WILLIAM KIRK

MSU-conducted and -coordinated industry wheat evaluations for wheat quality testing of advanced lines

PERRY NG

Nematode assemblage analyses of Michigan soil groups across ecosystems and temperature zones to develop a proof of concept for a National Science Foundation proposal

HADDISH MELAKEBERHAN

New *Colletotrichum* diseases of Michigan onion and celery

MARY HAUSBECK

A new crop for a variable climate: intermediate wheatgrass biology and forage potential

STEVE CULMAN

Overcoming biennial bearing in tree fruits

STEVE VANNOCKER

Pest management technical information updates and state and federal committee service

MARK WHALON

Pesticide nosema interactions across developmental states of honey bees

ZACHARY HUANG

Pre-harvest sprouting resistance in elite wheat lines adapted to Michigan

JANET LEWIS

Reducing the cost and CO2 emissions of fruit processing in Michigan through the use of discarded fruit trees as a source of heat and electricity

DANIEL KEATHLEY

Responding to spotted wing drosophila's arrival in Michigan small fruit crops

RUFUS ISAACS

Teaching, researching and demonstrating encapsulated soil life techniques at KBS

JANE HERBERT

Transcriptome analysis of resistant and susceptible potato varieties to common scab
DAVID DOUCHES

Trunk injection technology for disease and insect control in tree fruits
JOHN WISE

Water management for container nurseries to improve irrigation efficiency and reduce runoff and offsite agrichemical movement
THOMAS FERNANDEZ

Continued Projects

Accelerating blueberry plant establishment
ERIC HANSON

Combining strip-tillage and cover-cropping for improved insect and weed management in Michigan vegetable crops
DANIEL BRAINARD

Cover crop benefits and options for celery and onion rotation systems on muck soils
MATHIEU NGOUAIJO

Developing a program of accurate detection and enhanced management of cucurbit downy mildew
MARY HAUSBECK

Developing LED photoperiodic lighting for specialty crop production (SCRI match)
ERIK RUNKLE

Development and delivery of a sustainable asparagus miner management program in Michigan
SOFIA SZENDREI

Development and delivery of an effective organic pest management tactic for Michigan organic apples using entomophagous nematodes
MATTHEW GRIESHOP

Development and delivery of sustainable, biologically based insect pest management for Michigan greenhouses
MATTHEW GRIESHOP

Development and implementation of mating disruption for environmentally sound management of sesiid borer pests in cherry and apple orchards
MATTHEW GRIESHOP

Development of polar plantations for treatment of food processing wastewaters
DAWN REINHOLD

The development of vineyard models for the maximum production of juice grapes with acceptable quality under Michigan growing conditions
THOMAS ZABADAL

Diversity and management of streptomyces species that cause scab on potato and sugar beets in Michigan
JIANJUN HAO

Early leaf removal to improve crop control, cluster morphology and berry quality in vinifera grapes
PAOLO SABBATINI

Effect of endoparasites (*Nosema* spp.) on honey bee behavior and physiology
ZACHARY HUANG

Enhancing cover crop selection and performance for field crop and vegetable farmers in Michigan
DALE MUTCH

Establishment of an expanded interdisciplinary entology research and development program at MSU
KRIS BERGLUND

Establishment of perennial warm season grasses for biofuels
KURT THELEN

Evaluating the importance of visual cues for fruit pest attraction to pheromone dispensers and attract-and-kill devices
MATTHEW GRIESHOP

Evaluation of strategies to achieve sustainable production of concord grapes in Michigan
PAOLO SABBATINI

Improvements to moth mating disruption by insights from comparative studies of oriental fruit moth versus codling moth
JAMES MILLER

Improving biological nitrogen fixation in dry beans for Michigan
JAMES KELLY

Increasing sustainability for the Michigan juice grape industry through the development and validation of thresholds for key vineyard insect pests and diseases
PAUL JENKINS

Investigating hop (*Humulus Lupulus*) varieties for Michigan production
ROBERT SIRRINE

Investigating horticultural methods for overcoming *Armillaria* spp. On cherry orchard sites
ERIN LIZOTTE

Investigation of potato plant resistance mechanisms to Colorado potato beetles and development of resistant varieties
DAVID DOUCHES

Michigan wheat initiative
MICHELLE RODGERS & MARTIN NAGELKIRK

A new approach to grub tolerance for growing healthy lawns without insecticides
DAVID SMITLEY

New tools for identifying resistance to potato common scabs and improving disease management
DAVID DOUCHES

Nursery establishment and physiology of difficult to transplant ash alternative species
BURT CREGG

Optimizing grape potential: Influence of climate, viticulture practices and vine balance on Michigan terroir
PAOLO SABBATINI

Optimizing management of grape berry moth with risk assessment, pest phenology and sustainable controls
RUFUS ISAACS

Optimizing row width and plant populations to improve weed management and yield in Michigan dry bean production systems
CHRISTY SPRAGUE

Optimizing the conditions and developing new tools for controlling soybean white mold using cultural and biological means
JIANJUN HAO

Plant defense priming: Can plant growth regulators or fertilization enhance resistance of native or Asian ash species to emerald ash borer?
DEBORAH MCCULLOUGH

Preparing Michigan plant industries for the changing physical and policy climates
CLAIRE LAYMAN

Quantifying carbon sequestration in woody and herbaceous nursery production systems
ROBERT SCHUTSKI

Quantifying carbon sequestration potential in landscape systems
BRAD ROWE

Scheduling bedding plants for energy efficient greenhouse production
ERIK RUNKLE

Soil moisture depletion patterns, water use and nutrient fate on creeping bentgrass for sustainable golf course putting greens
KURT STEINK

Soybean sudden death syndrome: Assessment of *Fusarium virguliforme* distribution, pathogenicity, genetic diversity and fungicide resistance in Michigan
MARTIN CHILVERS

Strip-tillage and planting density strategies for improving carrot quality and soil health
DANIEL BRAINARD

Sustainable management solutions for control of aster yellows phytoplasma and associated leafhopper vectors in Michigan
SOFIA SZENDREI

Upper Peninsula corn hybrid test trials
KURT THELEN

Validation of disease prediction models for anthracnose fruit rot and mummy berry in blueberries
ANNEMIEK SCHILDER

Western bean cutworm biology, life history and management under Great Lakes conditions
CHRISTINA DIFONZO

Plant Coalition

Directors' Action Team

The Directors' Action Team (DAT) is the decision-making body that establishes goals and strategic action plans for Project GREEN.

Douglas Buhler

MSU College of Agriculture and Natural Resources

Thomas Coon

Michigan State University Extension

Keith Creagh

Michigan Department of Agriculture and Rural Development

Ray Hammerschmidt

MSU Department of Plant Pathology

Stephen Lovejoy

Michigan State University Extension

Steven Pueppke

MSU AgBioResearch

Robin Rosenbaum

Michigan Department of Agriculture and Rural Development

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Industry Partners

Project GREEN was founded as a grassroots-driven initiative that was endorsed by 45 agriculture commodity groups when it was presented to Michigan legislators in 1998. Those grower-led organizations continue to help direct Project GREEN activities by submitting their research and Extension priorities to address critical and emerging issues affecting their industries. Scientists submit competitive grant proposals that directly meet those needs. The grower-led organizations that support Project GREEN include:

- Celery Research Inc.
- Corn Marketing Program of Michigan and the Michigan Corn Growers' Association
- Great Lakes Canola Association
- Growing U.P. Agricultural Association
- Michigan Apple Research Committee
- Michigan Asparagus Research Inc.
- Michigan Bean Commission and Michigan Bean Shippers' Association
- Michigan Blueberry Advisory Council
- Michigan Carrot Committee
- Michigan Cherry Committee
- Michigan Christmas Tree Association
- Michigan Cranberry Council
- Michigan Crop Improvement Association
- Michigan Farm Bureau
- Michigan Floriculture Growers Council
- Michigan Grape and Wine Industry Council
- Michigan Grape Society
- Michigan Hay and Grazing Council
- Michigan Integrated Food and Farming Systems
- Michigan Nursery and Landscape Association
- Michigan Onion Committee
- Michigan Organic Food and Farm Alliance
- Michigan Peach Sponsors
- Michigan Pear Research Committee
- Michigan Plum Advisory Board
- Michigan Potato Industry Commission
- Michigan Sod Growers Association
- Michigan Soybean Promotion Committee
- Michigan State Millers' Association
- Michigan Turfgrass Foundation
- Michigan Vegetable Council
- Midwest Nut Producers
- National Grape Cooperative
- Pickle Seed Research Fund
- Sugarbeet Advancement Committee
- Western Michigan Greenhouse Association

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