



GROWING  
**GREEN**

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PROJECT GREEN 2012  
LEGISLATIVE SUMMARY



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### 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

**AGRICULTURE MAY BE AN ANCIENT OCCUPATION**, but it is key to Michigan's future. That was confirmed when the MSU Product Center released "The Economic Impact of Michigan's Food and Agriculture System" in April 2012. This updated version of a comprehensive study shows that the economic value of the food and agriculture system in our state has grown to \$91.4 billion—that's a nearly 50 percent increase since the initial study was released in 2006. The impact of Michigan's farms and the commodities they produce is 12 percent of that total, and their economic contribution has nearly doubled from less than \$7 billion to more than \$13 billion.

The major objective of Project GREEN (Generating Research and Extension to meet Economic and Environmental Needs) is to support economic development of Michigan's food and agriculture system. Project GREEN has been very successful in meeting and exceeding this objective, but now is not the time to stop and rest on our laurels. The desire and potential of increasing the contribution of the food and agriculture system calls for continued vigilance over the GREEN investment in research and outreach. We are grateful for the continued support of our stakeholders and the legislature for Project GREEN that will allow us to keep moving forward.

Project GREEN continues to be responsive to industry needs by using our network of production and commodity group professionals to keep us abreast of their research and outreach priorities. We have responded to a flat budget cycle by eliminating long-term projects and focusing on shorter-term, high-impact projects. Project GREEN investments in projects and departments ensure that scientists and outreach specialists can be both proactive and reactive, quickly responding to the needs of an ever-changing industry that is a vital part of our future.

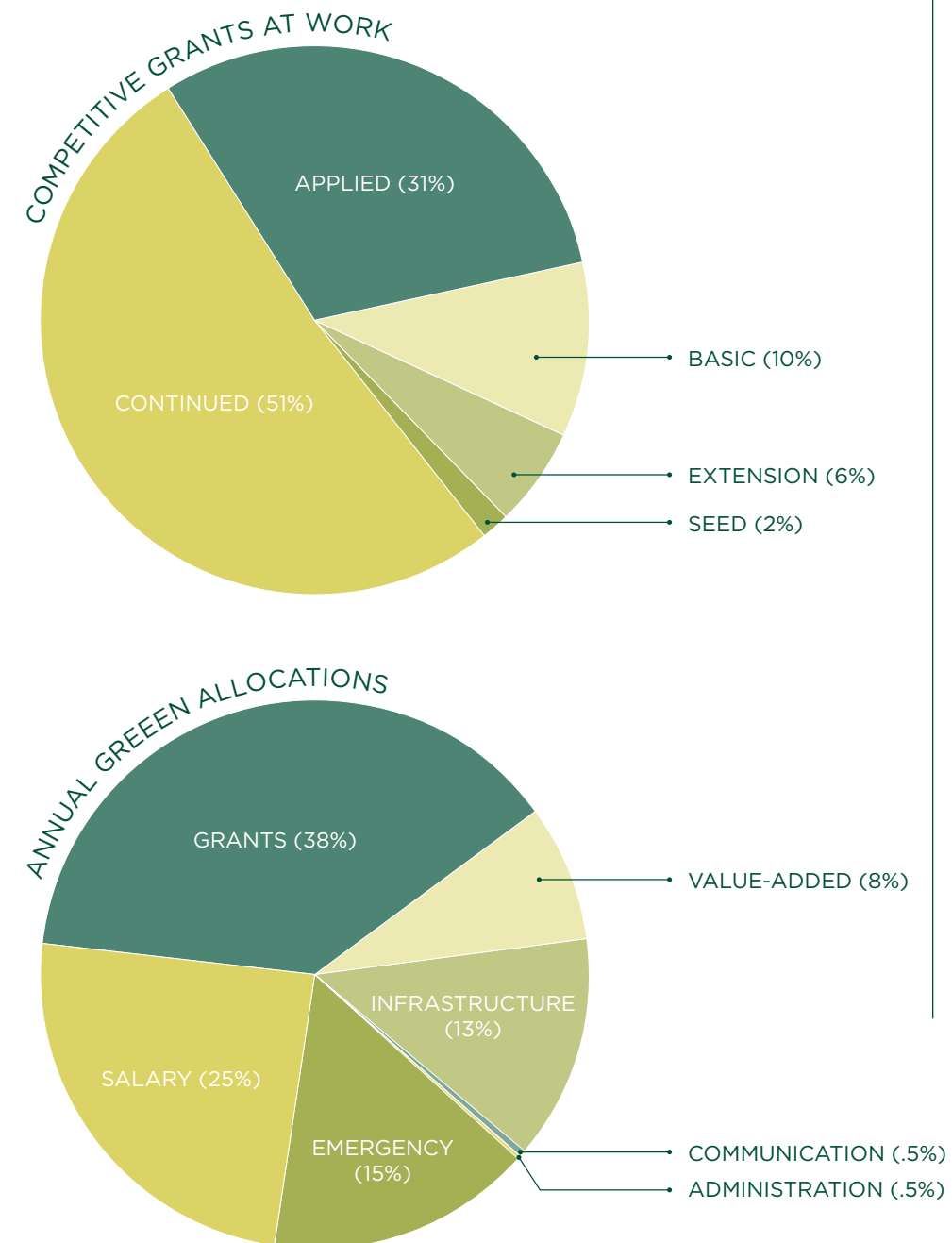
Project GREEN investments help ensure that Michigan fruit, vegetable and field crop growers, lawn care specialists, nursery operators, and others in agriculture and agribusiness have access to ongoing research and outreach so they can continue to help feed, fuel and beautify America.

Sincerely,

RAY HAMMERSCHMIDT  
Chair, MSU Plant Pathology  
Interim Director, Project GREEN

STEVEN LOVEJOY  
Associate Director, MSU Extension  
Interim Director, Project GREEN

## 2011-12 FISCAL YEAR



**TOTAL INVESTMENT: \$5.5 MILLION**

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 and Rural Development. Administration costs make up a small portion of Project GREEN's annual expenditures. 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.

MICHIGAN STATE UNIVERSITY | Extension

Michigan State University  
**AgBioResearch**

Michigan Department of  
**AGRICULTURE & Rural Development**

# COMPETING FOR GREEN

Competitive grants are the foundation of Project GREEN. Michigan State University administrators work closely with plant commodity organizations and the Michigan Department of Agricultural and Rural Development to set priorities that direct MSU researchers' funding requests. This ensures that scientists are connected with producers and responding to the needs of the industries.



— 1910 —  
6,366,000 farms in the United States, each averaging 138 acres. One farmer grew enough food to feed 2.5 people.

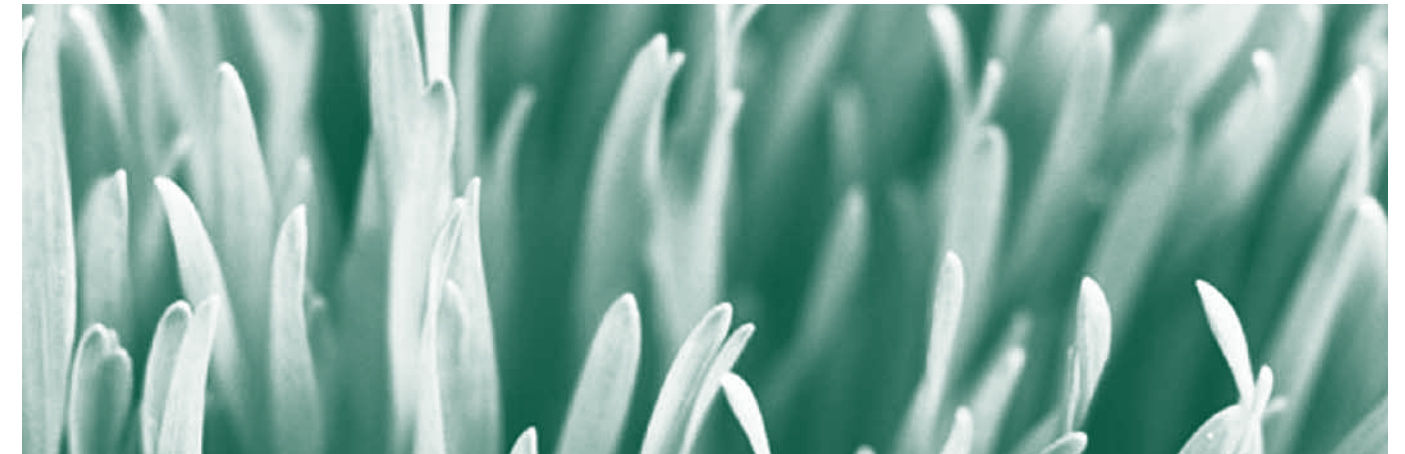
— 1960 —  
3,711,000 farms in the United States, each averaging 303 acres. An estimated 25.8 people were fed by one farmer.

— 2012 —  
2,200,000 farms in the United States, averaging 420 acres each. With advancements in farm technology, a farmer can now feed 155 people.

**SOURCES:** USDA Farm Census, Growing a Nation, the Story of American Agriculture, Agrium, Sustaining a Growing World and Farmers Feed US



## COMPETITIVE GRANT SUMMARIES: Bioenergy and the Environment



### Environmentally Protective Land Application Strategies for Food Processor's Wastewater

> STEVEN SAFFERMAN

AWARDED: \$25,000 for one year  
LEVERAGED: \$150,000  
PENDING LEVERAGE: \$337,000

Wastewater irrigation systems are essential to many plant-based food processors. Using wastewater for plant irrigation is highly efficient, because it not only removes impurities from the water, but also replenishes aquifers, all while watering the plants. Unfortunately, this system can sometimes lead to groundwater contamination. MSU researchers used Project GREEN funding to study the soil involved in these irrigation systems, to develop a clear irrigation model that processors can follow to prevent pollution.

### Establishment of Perennial Warm Season Grasses for Biofuels

> KURT THELEN

AWARDED: \$43,000 over two years  
LEVERAGED: \$499,400

The Energy Independence and Security Act of 2007 mandates that 36 billion gallons of renewable fuels must be available by 2022. And 21 billion gallons of fuel must be derived from cellulosic feedstocks. Meeting these standards will take a concerted effort of research and outreach to ensure farmers have access to best management practices for biofuels and know how to plant, grow and harvest these crops. Thanks to Project GREEN's investment, MSU scientists and Extension professionals compared the yield, tillage practices and chemical control needs of various switchgrass varieties, and shared that information through educational meetings with growers throughout the state. Researchers also identified one grass, miscanthus, as a potentially profitable new crop for greenhouse growers to propagate. Investigators considered varieties and specific cultural practices that could be successful in the Upper Peninsula, where it is challenging to grow some traditional food and feed crops. If successfully introduced, warm-season perennial grasses could contribute more than \$83 million to Michigan's economy.

### Quantifying Carbon Sequestration in Woody and Herbaceous Nursery Systems

> ROBERT E. SCHUTZKI

AWARDED: \$42,000 over two years  
LEVERAGED: \$59,250

The idea of curbing greenhouse gas buildup through carbon sequestration is growing in popularity. This method of reducing carbon in the atmosphere through underground storage or absorption in plants is often used with trees. What has not been explored is the carbon sequestration potential of decorative nursery plants. Until now. With Project GREEN support, MSU researchers studied nursery plants, calculated their carbon storage and determined the long-term carbon storage potential of each plant from the time it enters a nursery to when it reaches maturity. The researchers are combining these data with existing information on trees to create fact sheets on the environmental benefits of complete landscapes—trees and plants—for consumers and industry professionals. These fact sheets will also be offered to municipalities, so that, when creating ordinances requiring a minimum numbers of trees to be planted in an area, they can now add ornamental plants for consideration. This information could increase nursery sales, earn communities better environmental quality and enable municipalities to claim more environmental benefits in their towns.

### Quantifying Carbon Sequestration of Landscape Systems

> BRAD ROWE

AWARDED: \$60,000 over two years  
LEVERAGED: \$37,376

According to the Intergovernmental Panel on Climate Change, carbon dioxide levels have increased 36 percent in the last 250 years, and half of the growth has occurred since 1970. Excess carbon emission is a serious concern that is being approached in different ways. One method is carbon sequestration, or reducing carbon levels through underground storage or absorption into plants. With GREEN funding, MSU researchers are exploring a yet untapped resource for carbon storage: landscape plantings. Scientists specified the carbon sequestration potential of landscape systems by studying planting arrangements in varying levels of complexity and found an increase in carbon material within all of the landscape types. Carbon-sequestering landscapes could reduce not only carbon levels, but, if planted to absorb heat from buildings, could also cut energy costs.

### Reducing the Cost and CO<sub>2</sub> Emissions of Fruit Processing in Michigan Through the Use of Discarded Fruit Trees as a Source of Heat and Electricity

> DANIEL KEATHLEY

AWARDED: \$15,000 for one year

When fruit trees become 10-20 years old, their yields decline, and farmers remove them from their orchards. Currently, those removed trees, along with other fruit tree waste, such as pruning leftovers and cherry pits, are simply burned. But, with Project GREEN funding, MSU researchers discovered an opportunity to turn this waste into energy and cost savings. By observing Michigan cherry farms, determining how much fruit tree waste is disposed of in Michigan every year and comparing different wood-powered energy production systems, they were able to calculate that farmers could use their fruit tree waste to supply approximately 80 percent of their fuel needs with wood boilers.



Photo courtesy of Michigan Apple Committee

## COMPETITIVE GRANT SUMMARIES: Fruit

### Accelerating Blueberry Plant Establishment

> ERIC HANSON

AWARDED: \$70,000 over two years

Blueberry growers are reluctant to replace low-yielding blueberry acreage with new plants because they take seven to nine years to reach full production. Shortening the establishment time by two years would increase gross returns to growers over the first nine years by nearly \$30,000 per acre. If establishment time could be reduced, growers would be more likely to replant with superior varieties. To speed up the process, fruit can be removed from young plants for the first couple of seasons, but this is a time-consuming and labor-intensive practice. Improving soil health may also boost early growth in young plants. The purpose of this project was to develop methods to reduce fruiting and promote vegetative growth on new plants to shorten the average establishment period from nine to seven years, and find ways to enhance soil quality and control pests and pathogens in the soil where replanting is to take place. Chemicals and growth regulators did not provide consistent reductions in flowering and fruiting on young plants in studies, but other growth regulators and application timings deserve further research. Two long-term studies were initiated to test soil treatments prior to planting, but full results will not be available for two or three years. In the near future, Michigan growers are expected to plant 300 to 500 acres per year (new sites and replanting existing sites). The added returns generated by shortening the establishment period on this acreage would range from \$9 million to \$15 million.



### The Development of Vineyard Models for the Maximum Production of Juice Grapes with Acceptable Quality under Michigan Growing Conditions

> THOMAS J. ZABADAL

AWARDED: \$50,000 over two years  
LEVERAGED: \$51,015

Stagnant yields and declining farm-gate prices have brought Michigan's juice grape industry to a crossroads. Given the marginal profitability of the crop, little acreage has been committed to new Concord grape vines, and hundreds of acres of overgrown and unproductive vineyards have been abandoned. In order to reverse this trend, Michigan growers need new management strategies for increasing yields and reducing the per ton cost of growing juice grapes. Researchers developed a prototype device to mechanically position the shoots on a model Concord grape vineyard at the MSU Southwest Michigan Research and Extension Center near Benton Harbor. Though further evaluation of this device is needed, this project has brought the state's juice grape industry closer to being able to successfully convert overgrown Concord grape vines into productive vineyards.

### Development and Delivery of an Effective Organic Pest Management Tactic for Michigan Organic Apples using Entomophagous Nematodes

> MATTHEW GRIESHOP

AWARDED: \$60,000 over two years  
LEVERAGED: \$176,000

Though the majority of insect pest management strategies used in Michigan fruit production focus on controlling insects during their above-ground life stages, insects spend at least 25 percent of their lives in the soil. In this project, which focused on developing new and sustainable insect management tools for Michigan's organic apple growers, MSU researchers demonstrated how small parasitic worms called entomophagous nematodes, which are known for feasting on soil-dwelling insects, could be used to manage codling moth and similar pests. Entomophagous nematodes are a nontoxic control option compatible with organic production and would reduce the potential for negative effects on workers, the environment and harvested fruit. The nematode species applied, *Steinernema feltiae*, effectively infected and killed codling moth larvae in a variety of in-ground locations where they are commonly found overwintering in Michigan orchards. More research is needed, however, to determine the factors preventing *S. feltiae* from infecting CM larvae on the orchard floor, another common overwintering location.



Photo courtesy of Michigan Apple Committee



WE INTERRUPT THIS MATING  
*to improve control of insect pests*  
**IN MICHIGAN'S**  
**TREE FRUIT INDUSTRIES**

**RECALL THE SAYING, “WATCH AND LEARN?”** MSU researchers applied this philosophy in their bid to expand the environmentally friendly and sustainable insect pest control methods available to Michigan’s apple, cherry and stone fruit industries. As organophosphate and chlorinated hydrocarbon insecticides are permanently phased out by the U.S. Environmental Protection Agency, growers need more cost-effective and efficient pest control alternatives at their disposal. Identifying economical and effective control tools ahead of the final phase-out period will help growers transition with little interruption to successful pest control.

Because of the impending phase-out, pheromone-based pest management technologies, such as mating disruption and attract-and-kill, are becoming increasingly important. Using synthetic sex pheromones to interrupt the natural mating cycle of insects is considered a sustainable control tactic that can be used by both conventional and organic growers. Mating disruption technologies are implemented on nearly one-third of the state’s apple acreage, or on about 15,000 acres. Even though it has helped growers eliminate three to four applications of broad-spectrum insecticides from their annual insect pest control programs, growers still rely on insecticide applications to achieve maximum control. Employing attract-and-kill tactics can help further reduce the need for insecticides and banish the negative side effects of insecticide use, such as exposing workers and the environment to chemicals.

Researchers have focused their efforts on two economically important insect pests for the apple industry, codling moth and the Oriental fruit moth, and three wood-boring pests: lesser peachtree borer, peachtree borer and dogwood borer. Infestations by these wood-boring insects in cherry, peach and apple trees can result in reduced crop yield and, in a worst-case scenario, inflict enough damage to kill a tree. The moth species are problems every year and have, up until now, been effectively controlled by

insecticides. Achieving control of wood-boring pests has relied upon spraying insecticides on the trunks of the trees, but determining the exact coverage needed is difficult depending on the age and size of the tree.

The first step to building the perfect killing trap was for researchers to record and observe how the two moth species approach traps in the orchard. Because the biology of codling moth is similar to that of Oriental fruit moth, the hypothesis was that the two would react similarly to the test traps. What researchers found, however, was surprising. CM was trapped relatively easily. OFM, on the other hand, spent a lot of time in the vicinity of the trap, but it was difficult to trap. Current research for OFM is focusing on the development of insecticidal killing stations (pieces of cloth covered with insecticide) to take advantage of this behavior.

“It’s all about figuring out and taking advantage of the weak points in a pest’s life cycle,” explained MSU organic pest management specialist Matthew Grieshop. “If you want to develop the most effective pest-control practices possible, you have to put the time in to watch and learn. You never know what you’ll discover.



“In essence we have been shooting in the blind up until this point,” he added. “We actually invested time upfront to record and learn the insects’ mating behavior patterns to help us customize control efforts to fit their behavior.

As far as controlling the wood-boring pests lesser peachtree borer, peachtree borer and dogwood borer, attract-and-kill tactics were found to perform superior to mating disruption. With the upcoming commercial release of products to control dogwood borer, lesser peachtree borer and peachtree borer, rapid adoption by Michigan growers is expected, especially since data collected by MSU researchers show that hanging as few as 75 dispensers per acre provides effective mating disruption. (Beginning of paragraph says attract-and-kill is superior to mating disruption, but the new solution is mating disruption? I thought they were two different things.)

“Making these mating disruption products available for use on Michigan’s 34,500 acres of stone fruits could result in the total elimination of trunk spraying programs,” Grieshop said.

**> MATTHEW GRIESHOP**

**Development and Implementation of Mating Disruption for Environmentally Sound Management of Sesiid Borer Pests in Cherry and Apple Orchards**

AWARDED: \$66,000 over two years  
 LEVERAGED: \$80,499

**Evaluating the Importance of Visual Cues for Fruit Pest Attraction to Pheromone Dispensers and Attract-and-Kill Devices**

AWARDED: \$61,500 over two years  
 LEVERAGED: \$123,000\*

\*Since initiating this project, researchers have submitted three successful grant proposals to two outside funding groups and started collaborating with a private company to explore commercialization of attract-and-kill devices.

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**Early Leaf Removal to Improve Crop Control, Cluster Morphology and Berry Quality in Vinifera Grapes**

> PAOLO SABBATINI

AWARDED: \$51,000 over two years  
LEVERAGED: \$41,000

MSU grape experts are constantly working to improve Michigan's viticulture industry. Thanks to Project GREEN, university scientists were able to investigate whether removing wine grape leaves early in the season could help growers regulate grapevine growth. Their work proved early leaf removal not only can help grapevine yield, but it can also improve the quality of the fruit. What's more, early leaf removal reduces the incidence of a grape-infecting fungus called grape rot. This work could reduce grower labor, enhance grape quality and improve profitability for Michigan's grape growers.

**Evaluation of Strategies to Achieve Sustainable Production of Concord Grapes in Michigan**

> PAOLO SABBATINI

AWARDED: \$48,000 over three years  
LEVERAGED: \$13,000

Juice grapes are an essential crop for Michigan. Of the 14,000 acres of grapes planted in the state, 12,000 are used for juice. MSU researchers used Project GREEN funding to make Michigan's juice grape industry as competitive as possible. They calculated the best timing to cope with Michigan's unpredictable growing seasons and determined the number of grapes that should be removed for optimum fruit quality each year. They also met with growers and showed them vineyard management strategies that hasten fruit development. This research has helped growers, processors and extension educators improve the quality of Michigan's juice grapes economically and consistently.



**Formation of a Multi-university Plant Enterobacterial Pathogen Group: Role of Biofilms in Colonization and Pathogenesis**  
**> GEORGE SUNDIN**

AWARDED: \$35,000 for one year

Fire blight is an economically important disease for the apple industry. Because the pathogen that causes fire blight (*Erwinia amylovora*) has become resistant to the main control agent, streptomycin, new, sustainable control options need to be developed. Data generated from this work furthered the understanding of the role biofilm formation plays in causing the disease and colonizing the xylem (transport tissue in plants). Researchers demonstrated that the regulatory molecule cyclic-di-GMP repressed motility and induced biofilm formation in *E. amylovora*. This is an important finding because chemically inhibiting cyclic-di-GMP from forming is one possible method for controlling fire blight. Data generated from this project was the foundation for a \$1.5 million research grant proposal submitted to the National Science Foundation.

**Genome Resources for *Venturia Inaequalis***

**> FRANCES TRAIL**

AWARDED: \$12,000 for one year  
 PENDING LEVERAGE: \$17,000

Apple scab is the most severe fungal disease affecting Michigan apples. The disease-causing fungus, *Venturia inaequalis*, can force farmers to apply fungicides up to 11 times in a single season. Worse still, the fungus is gradually becoming impervious to fungicides. With Project GREEN support, MSU researchers studied the fungus' genetic makeup to understand how it reproduces and how it has developed fungicide resistance. This information could limit fungicide applications, saving time and money for Michigan growers.

**The Impacts of Expanding Chinese Production on Michigan's Blueberry Sector**

**> MOLLIE WOODS**

AWARDED: \$7,600 over two years

Demand for blueberries continues to grow in the Far East, especially in Japan and South Korea. The purpose of this project was to determine the potential impact that expanded blueberry production in China might have on Michigan's blueberry industry. In the short term, China should be viewed as an export opportunity and not a threat. High-value products, such as dried blueberries, suit China's supply chain well because Chinese growers often don't have the ability to keep products chilled or frozen. Based on these findings, Michigan growers and processors could potentially establish a dried blueberry export program targeted at Japan and South Korea. In the long term, since North American growers are slow to make planting decisions based on price and it takes several years for blueberry plants to reach full production, there is a danger of oversupplying the market once it hits the saturation point. Though current prices indicate strong demand, the industry needs to be aware of pricing trends and respond accordingly.

**Increasing Sustainability for the Michigan Juice Grape Industry through the Development and Validation of Thresholds for Key Vineyard Insect Pests and Diseases**

**> PAUL JENKINS**

AWARDED: \$70,000 over two years  
 LEVERAGED: \$224,960

Michigan juice grape growers could greatly reduce their production costs by applying pesticides only as needed and not several times during a potential infestation period. Until this project, however, no economic thresholds had been developed for the major insect pests and diseases affecting juice grapes. In this project, researchers developed an economic threshold for grape berry moth. The GBM threshold has the potential to save growers from having to spray thousands of acres of vineyards, thereby saving money and reducing the pounds of active ingredient released into the environment. Even reducing insecticide application by a conservative estimate of 20 percent will save growers \$50,000 annually. Replicated field trials were conducted to determine the relationship between the amount of overwintering inoculum for two fungal diseases, black rot in Concord grapes (infected canes) and Phomopsis fruit rot in Niagara grapes (mummified fruit), and their effect on the following year's yield. Overall disease levels in the fungal disease trials were well below those seen in commercial vineyards, suggesting there are multiple inoculum sources. Though more research is needed over multiple years, the work highlights the importance of initial inoculum levels in determining black rot and Phomopsis fruit rot levels at harvest and suggests tentative thresholds to consider. Findings from this project are relevant for all juice grape growers in the state and will foster steps to developing more environmentally and economically sustainable management practices.

**Optimizing Grape Potential: Influence of Climate, Viticultural Practices and Vine Balance on Michigan Terroir**

**> PAOLO SABBATINI**

AWARDED: \$60,000 over two years  
 LEVERAGED: \$44,000

There is an idea among wine enthusiasts called "terroir," which means grapevines' development can be affected by the unique characteristics specific to their growing environment. Unfortunately, when it comes to Michigan's terroir, this can mean cool climates and short growing seasons. With Project GREEN funding, MSU researchers tested various viticultural treatments to improve the quality of grapevines grown in Michigan climes. Their work uncovered simple changes growers can make that could greatly improve the quality and ripeness of grapes grown in Michigan.



**Optimizing Management of Grape Berry Moth with Risk Assessment, Pest Phenology and Sustainable Controls**

**> RUFUS ISAACS**

AWARDED: \$68,000 over two years  
 LEVERAGED: \$229,500

Grape berry moth is an economically important pest to the juice grape industry. Commodity buyers are challenging growers to implement more ecologically friendly pest control practices, so new cost-effective, sustainable integrated pest management strategies are needed. Researchers were able to achieve cost-effective GBM control with decreased impact on the environment by using reduced-risk insecticides. Using reduced-risk insecticides in vineyard borders was found to reduce GBM damage by up to 60 percent compared to those vineyards treated with broad-spectrum insecticides. Using reduced-risk insecticides as border treatments was also 20 to 30 percent less expensive than applying a standard treatment of broad-spectrum insecticide to the entire vineyard. Growers that only apply insecticide to vineyard borders can expect to realize a \$20 per acre per year reduction in insecticide costs, in addition to reduced fuel and labor costs. If this practice is adopted by growers on 40 to 60 percent of the state's 12,000 juice grape acres, annual cost savings for insecticide alone could total \$96,000 to \$144,000. No difference in damage amounts was found between the two treatment programs in vineyard interiors, so growers should be able to reduce the amount of insecticide applied to these low-pressure areas. Based on the results of this study, researchers expect to see an overall decrease in the use of broad-spectrum, neurotoxic insecticides.



### Overcoming Biennial Bearing in Tree Fruits

> STEVE VAN NOCKER

AWARDED: \$40,000 for one year

One of the foremost challenges facing the Michigan apple industry is growers' inability to produce apples of consistent size suitable for tray packing. Facilitating production of even crop loads, which dictate fruit size, from year to year is controlled by the flowering phase. In many tree fruits, flowering and fruit production occur in an on/off cycle, known as biennial (alternate) bearing, with maximum flowering and fruiting occurring every other year. Limiting growth and profitability in several of Michigan's tree fruit industries, biennial bearing is of special significance to the apple and pear industries. This project generated preliminary data that will be used to apply for a U.S. Department of Agriculture—Agriculture and Food Research Initiative grant worth \$300,000 to \$500,000. More than 300 million DNA sequences expressed during flowering in apple were identified and catalogued. This is a 1,000-fold increase in data compared to the 300,000 DNA sequences previously available to scientists. The genomics-related data were transferred to the National Center for Biotechnology Information, where they will be accessible for the scientific community at large. This will also enable advanced genetic studies of flowering to be conducted by researchers at MSU and other universities to discover less expensive and more effective and consistent methods for controlling biennial bearing. Results of this work will appear in an upcoming scientific journal publication.

### Storage of Honeycrisp Apple Fruit

> RANDY BEAUDRY

AWARDED: \$26,000 over two years

Honeycrisp apples are one of the most popular varieties on the market. Their sweet, firm and tart qualities make them an ideal apple to eat raw, and the number of honeycrisp acres planted in Michigan is growing steadily. Project GREEN funded research to extend the honeycrisp marketing season in Michigan. MSU Researchers scrutinized the various storage disorders honeycrisp apples suffer, so that more apples can be preserved from the time they are harvested until they reach the consumer. Their preliminary work established some ultimate storage temperatures and conditions for honeycrisps depending on their duration of storage. These findings can help prevent harmful apple maladies like chilling injury and controlled atmosphere injury, and allow growers to greatly increase their honeycrisp market potential in Michigan.

### Trunk Injection of Pesticides for Disease and Insect Control in Tree Fruits

> JOHN WISE

AWARDED: \$25,000 for one year

LEVERAGED: \$15,000

Using trunk injection to deliver pesticides to fruit trees is an alternative to airblast sprayers, which have been criticized for inefficiently hitting their targets, wasting active ingredient and increasing pesticide drift. In addition to optimizing pest control, trunk injection will help eliminate the negative effects of pesticide drift, decrease nontarget pesticide contamination, reduce tractor and sprayer use, and reduce soil compaction and erosion resulting from the use of heavy equipment. Growers may also achieve significant cost savings, including having to purchase less fuel, reducing equipment wear and maintenance expenses, and saving as much as 50 percent on pesticide purchases.

### Validation of Disease Prediction Models for Anthracnose Fruit Rot and Mummy Berry in Blueberry

> ANNEMIEK SCHILDER

AWARDED: \$52,000 over two years

LEVERAGED: \$28,000

Global demand for blueberries continues to grow. Michigan produces more than 93 million pounds of fruit annually, of which one-third is for the fresh market and two-thirds are for processing. Growers contend with a variety of fungal diseases, including mummy berry (early season) and anthracnose fruit rot (late season). One missed or improperly timed fungicide spray can result in 10 percent yield loss to mummy berry, and losses up to 25 percent have been reported when no controls are applied. Processors, who have zero tolerance for mummy berry, will reject an entire load of fruit if one mummified berry is found. Preharvest yield losses of 10 to 20 percent and post-harvest losses of up to 100 percent can result from anthracnose fruit rot infection. Using Enviro-weather data, researchers successfully developed a disease prediction model for anthracnose fruit rot, the first of its kind in blueberries. This tool will help growers minimize unnecessary or poorly timed fungicide applications, thereby reducing production costs and reducing the amount of fungicide exposure to workers and the environment. Eliminating just one spray on half of the state's 20,000 acres of blueberries would save between \$500,000 and \$1 million annually in product and application costs. A mummy berry predictive disease model is under development.

## COMPETITIVE GRANT SUMMARIES: Landscape and Nursery



### Nursery Establishment and Physiology of Difficult to Transplant Ash Alternative Species

> BERT CREGG

AWARDED: \$50,000 over two years

LEVERAGED: \$37,800

For years, white and green ash were the trees of choice for Michigan's urban settings, subdivisions and parking lots because of their durability. But in the late 1990s, an invasive pest called the emerald ash borer emerged and has since killed over 40 million ash trees. Now, experts are recommending new hardy alternatives to ash trees, such as hackberry, oak and bald cypress, for urban areas. But while these trees are dependable once in the ground, they are particularly vulnerable during their early development in nurseries. So, with the help of Project GREEN, MSU researchers tested various preplanting treatments to help nursery growers produce these ash alternatives. They found that tree success depended on the species type, thus eliminating the need for time-consuming treatment practices becoming popular among nursery growers. The results they gathered will help nurseries better supply Michigan's cities with quality trees.

### Plant Defense Priming: Can Plant Growth Regulators or Fertilization Enhance Resistance of Native or Asian Ash Species to Emerald Ash Borer?

> DEBORAH MCCULLOUGH

AWARDED: \$60,000 over two years

The emerald ash borer is one of the most destructive forest insects in North America. The cost of handling infected trees in U.S. cities is expected to exceed \$10.5 billion by 2019. MSU researchers are investigating ways to stop this pest. Thanks to Project GREEN, researchers were able to prove the emerald ash borer prefers some species of ash trees to others, enabling tree owners to prioritize trees for treatment or replacement. They also found that use of a certain plant growth regulator, a chemical given to young plants in nurseries to keep them in manageable sizes until sale, altered trees' composition enough to consistently reduce the number of borers found and could possibly enhance plants' resistance to other pests as well. This research could lead to the efficient prevention of the emerald ash borer and thousands of dollars in savings for Michigan cities.

## COMPETITIVE GRANT SUMMARIES: Turf



### Development of an Alternative Granular Pesticide Application Technology and Prototype Applicator for Golf and Athletic Turfgrass

> JOSEPH VARGAS

AWARDED: \$30,600 for one year  
LEVERAGED: \$85,000

In the wake of the economic recession and shrinking labor and maintenance budgets, golf course superintendents are struggling to maintain the quality and playability of golf courses to the level expected by players. MSU researchers have invented a combination sand sprayer/sand top-dresser machine that combines two important maintenance operations for golf courses and athletic fields into one efficient step. By allowing the maintenance manager to combine the biweekly practices of sand top-dressing and applying fertilizer and/or pesticide sprays, labor costs, play disruption, fuel usage and carbon dioxide emissions should be reduced by approximately 50 percent. The machine also saves time, lowers equipment costs, and reduces operator and bystander exposure to pesticide drift, a current EPA priority.

### A New Approach to Grub Tolerance for Growing Healthy Lawns without Insecticides

> DAVID SMITLEY

AWARDED: \$70,000 over two years

Midwest homeowners can have low-maintenance, grub-free lawns. Researchers meshed findings from this project with previous recommendations derived from turf management research to develop these recommendations:

- Grow Kentucky bluegrass or red fescue.
- Water the lawn during dry periods.
- Apply a minimal amount of fertilizer (1 pound of nitrogen per year).
- Mow at a height of 3.5 inches, or the highest setting on the lawn mower.

Homeowners following these recommendations are unlikely to see lawn damage caused by grubs or wildlife searching for grubs, such as skunks and raccoons. Following these lawn tips could reduce the amount of insecticides used on Michigan lawns by more than 50 percent, saving homeowners an estimated \$10 million per year, and significantly reducing the risk for trace amounts of insecticides and other chemicals from appearing in groundwater or polluting neighboring streams and ponds.

### Soil Moisture Depletion Patterns, Water Use and Nutrient Fate on Creeping Bentgrass for Sustainable Golf Course Putting Greens

> KURT STEINKE

AWARDED: \$76,000 over two years  
LEVERAGED: \$21,500

Maintaining nonagricultural landscapes such as athletic fields and golf course putting greens during the summer months may increase water usage by up to 300 percent. Golf course putting greens represent only 3 percent of the total area maintained by golf courses, but they are the most input-intensive. Researchers evaluated three irrigation-scheduling strategies. They learned that implementing an integrated water management plan with deep and infrequent applications early and late in the growing season, in conjunction with light and frequent applications from June through August, would maximize water savings and the quality of the turfgrass. Nutrient loading would also be minimized. Researchers also discovered that if one irrigation strategy is desired for the entire season, light and frequent daily replacement of 80 percent potential evapotranspiration (the amount of evaporation that would occur if a sufficient water source were available) required less water, decreased water losses and improved putting green quality compared to the deep and infrequent irrigation strategies.

## COMPETITIVE GRANT SUMMARIES: Vegetables



### Developing a Program of Accurate Detection and Enhanced Management of Cucurbit Downy Mildew

> MARY HAUSBECK

AWARDED: \$50,400 over two years  
LEVERAGED: \$432,600

Until the first downy mildew outbreak in Michigan in 2005, the state's \$103 million cucurbit crop was genetically resistant to *Pseudoperonospora cubensis*, the downy mildew pathogen. Growers have had to battle the disease, which causes catastrophic losses in a brief period of time, each of the last seven years. Repeated fungicide applications — which can total \$600 per acre (\$6.4 million statewide) and reduce already low profit margins — are needed to protect the crop. Spore traps have been established in Michigan to alert growers to the presence of *P. cubensis* to better time fungicide application. Field research identified two new highly effective fungicides, which the U.S. Department of Agriculture IR-4 Project has categorized as high priorities to ensure registration in the near future. Downy mildew has previously been a major problem on cucurbits grown in low tunnels in Michigan, but frequently applying fungicides is cost-prohibitive. Researchers have been able to show that Presidio, newly labeled for drip application, provides the same level of control (drip) as when applied as a foliar spray with less than 2 percent foliar disease symptoms and no crop defoliation. Applying fungicides through drip systems in low and high tunnels will be invaluable to the cucurbit fresh market industry by limiting the development of downy mildew disease from early inoculum.

### Combining Strip-Tillage and Cover-Cropping for Improved Insect and Weed Management in Michigan Vegetable Crops

> DANIEL BRAINARD

AWARDED: \$60,000 over two years  
LEVERAGED: \$191,853

Cabbage and sweet corn are grown on more than 10,000 acres of Michigan's farmland. In recent years, these growers have experienced an increase in extreme wind and rain events and are considering trying "strip tillage" to protect their soils. This practice is an alteration of current tilling systems, which entail agitating the entire top layer of soil on a field to aerate it and mix soil nutrients. Strip tilling disturbs only parts of the soil, leaving some crop residue. With Project GREEN support, MSU researchers discovered that strip tillage, combined with use of cover crops, conserves soil moisture, hinders erosion and reduces dependence on pesticides as more insect predators inhabit the new cover crops. Combine this with the reduced labor involved in tilling less, and this research could mean important savings for the cabbage and sweet corn industries.

### Cover Crop Benefits and Options for Celery and Onion Rotation Systems on Muck Soils

> MATHIEU NGOUAJIO

AWARDED: \$19,600 over two years  
LEVERAGED: \$384,931  
PENDING LEVERAGE: \$486,696

Michigan is ranked No. 2 nationally for celery production and No. 11 for onion production. Together, these two commodities contribute \$28 million annually to the state's economy. These crops are primarily grown on muck soils, which have high organic matter and nitrogen content, but cultivated muck soils may recede by as much as 3 cm every year because of wind erosion, soil compaction and the decomposition of organic matter. This project demonstrated the importance of using Brassica spp. cover crops in celery and onion cropping systems to improve crop yield, decrease input costs and sustain soil health. Results from on-farm trials led to a 60 percent increase in the usage of Brassica spp. cover crops by growers. Growers have reported an average 10 percent increase in yield, which corresponds to 150 more boxes per acre at a value of \$8 to \$20 per box, or an increase of \$1,200 to \$3,000 per acre. As an industry (1,900 harvested acres), this potentially represents additional income of \$228,000 to \$570,000 per year for growers.

**Iris Yellow Spot Virus, a New Threat to Michigan Onions**

> **WALTER PETT**

AWARDED: \$60,000 over four years  
LEVERAGED: \$101,538

Onion thrips are the most damaging—and the most difficult to control—pest in Michigan onions. These insects feed deep inside the onion, where insecticides can't reach them. They're known to develop resistance quickly to insecticides— insecticides that can cost more than \$100 per acre and still not offer full control. Plus, onion thrips are now spreading Iris Yellow Spot, a new virus that weakens the plant and makes it more vulnerable to other onion threats. With help from Project GREEN, MSU scientists identified two weed species that could spread the Iris Yellow Spot virus. Growers now have key information for thwarting the disease before it gets fully established in the area. Researchers also honed a thrips management strategy to reduce the number of insecticide applications per season. This work could save farmers approximately \$30 per acre and prevent the spread of a new virus in Michigan.

**Strip-Tillage and Planting Density Strategies for Improving Carrot Quality and Soil Health**

> **DANIEL BRAINARD**

AWARDED: \$63,000 over three years  
LEVERAGED: \$37,841

Michigan's carrot industry has faced many challenges in recent years. Higher energy costs, increased pests, declining soil health and restrictions on deer baiting are all causing farmers to search for better techniques. Enter Project GREEN. MSU researchers ascertained the best carrot varieties and carrot planting densities for increasing profits. They also proved that composting and the implementation of strip tillage can lead to higher returns, bringing innovative support to the Michigan carrot industry.



**CHANGING vegetable pests' BAD BEHAVIOR**

**MSU ENTOMOLOGY** assistant professor Zsofia Szendrei is a busy woman. She is researching pest management techniques that could help save money for farmers across the vegetable industry.

With Project GREEN funding, Szendrei researched two agricultural pests/diseases: the asparagus miner and the aster yellows disease, spread by the aster leafhopper insect.

The aster yellows phytoplasma is a disease that infects multiple species, including many important Michigan vegetable crops, like celery, carrots, potatoes and onions, crops that earned over \$200 million for Michigan in 2008.

The leafhopper insect that spreads aster yellows is often attracted to cover crops that farmers plant in their fields early in the season to protect their main crops from wind damage and soil erosion. When farmers kill the cover crops, the leafhoppers move onto and infect the main crop. Szendrei researched whether the leafhoppers preferred one cover crop to another and whether they preferred the leaves of weeds to those of carrots.

She found that there was no preference between the cover crops but that leafhoppers were more attracted to grassy-leaved plants, or cereals, and weeds in general than carrots and broad-leaved weeds.

"If you understand the leafhopper's preference for certain crops, you can use the crops themselves to change the insect's behavior," Szendrei said. "If you move your cover crops or remove them as early as possible and if you focus your weed

> **ZSOFIA SZENDREI**

**Development and Delivery of a Sustainable Asparagus Miner Management Program in Michigan**

AWARDED: \$64,800 over two years

**Sustainable Management Solutions for Control of Aster Yellows Phytoplasma and Associated Leafhopper Vector in Michigan**

AWARDED: \$64,800 over two years

management, you control these pests not by killing them with expensive pesticides but by changing their behavior."

Szendrei's other GREEN-funded focus is equally vexing for Michigan farmers. The asparagus miner creates mines in asparagus stems and opens up infection sites for a harmful fungus called *Fusarium* spp. At present, there are no registered insecticides or other control methods to deal with this insect. For a state that ranks second in the nation for asparagus production, that is a problem.

Many insects like the asparagus miner require certain temperatures at certain times to develop. Szendrei is monitoring the asparagus miner to find the connections between critical events in its life cycle and temperature. She is also testing the effects of various chemicals on the miner's population.

Szendrei believes that by better monitoring fields and timing insecticide applications to certain times in miners' development, farmers will be able to reduce damage to asparagus plants by 50 percent and extend asparagus longevity by three to five years.

In addition to research, Szendrei is highly focused on outreach. She has given numerous presentations to growers explaining both her asparagus miner and aster yellows leafhopper findings.

"These pests affect vital industries in Michigan agriculture," Szendrei said. "What I'm striving for is to develop new methods for controlling these problems through timing and behavioral management, saving farmers money in the process."

## COMPETITIVE GRANT SUMMARIES: Field Crops



### Diversity and Management of Streptomyces Species that Cause Scab on Potato and Sugar Beets in Michigan

> JIANJUN HAO

AWARDED: \$70,000 over two years

Researchers used a method of DNA sequencing to identify *Bacillus amyloliquefaciens* strain BAC03 as a novel biological control agent for suppressing plant pathogens and promoting plant growth. It shows potential as an alternative disease management tool for controlling common scab in potato. The patent on *Bacillus amyloliquefaciens* strain BAC03 is expected to generate \$78,000 per year in profit for MSU.

### Identification of Oomycete and Fungal Species Responsible for Stand Loss in Soybean and Corn

> MARTIN CHILVERS

AWARDED: \$40,000 for one year

LEVERAGED: \$9,541,694

PENDING LEVERAGE: \$2 million

Keeping corn and soybean crops healthy is the key to higher yields and increased profitability. Across 28 soybean-producing states from 2006 to 2007, disease was responsible for the loss of an estimated 89 million bushels of soybeans worth approximately \$890 million. According to a national survey, soybean seedling disease is the fourth-most-important factor influencing plant stand. A survey of certified crop advisers found that growers are likely to pay a \$2.50 per bag premium for seed rot- and/or seedling disease-resistant seed. Even if only 50 percent of the state's growers were willing to pay the \$2.50-per-bag premium, this means that growers place a minimum value of \$2.5 million on improving disease control in soybeans alone. Isolates collected as a result of this project will be used for screening fungicide sensitivity, pathogenicity and aggressiveness toward seedlings; as part of a multistate survey of seedling diseases; and for developing diagnostic disease markers. Other isolates will be used for developing and validating molecular diagnostic assays. Findings will help in determining the most effective and judicious use of fungicides and steering the direction of future soybean breeding programs for improving stand establishment, reducing root rot and increasing yield.

### In Planta Analysis of Resistance and Susceptibility: The Identification of Missing Responses in the Cucumber Downy Mildew Interaction

> BRAD DAY

AWARDED: \$32,000 for one year

LEVERAGED: \$317,224

PENDING LEVERAGE: \$700,000

A disease that scientists had thwarted in the 1950s has developed new resistances in recent years and returned to ravage one of Michigan's most important agricultural industries. Michigan is the No. 1 producer of cucumbers for processing in the United States, and the downy mildew pathogen has cost farmers more than \$6 million in pesticide treatments. With Project GREEN funding, MSU researchers analyzed the genetics of the disease to discover what traits cause downy mildew infection. This information can serve as a resource for growers to better detect the pathogen and prevent crop losses.

### Optimizing the Conditions and Developing New Tools for Controlling Soybean White Mold Using Cultural and Biological Means

> JIANJUN HAO

AWARDED: \$70,000 over two years

Treating soil can eliminate most of a pathogen from the soil, but any that remains can still germinate and cause infection. Researchers evaluated the efficacy of new biocontrol agents on reducing the soil population of *Sclerotinia sclerotiorum*, the pathogen that causes white mold, also called sclerotinia stem rot. They found that combining the biocontrol agent Contans (2 pounds per acre) with most common fertilizers saves growers time and money, enhances disease control, and provides growers with alternatives to chemical fungicides.

### Improving Biological Nitrogen Fixation in Dry Beans for Michigan

> JAMES D. KELLY

AWARDED: \$64,000 over two years

LEVERAGED: \$963,762

Dry bean breeding programs have primarily emphasized increasing yield and improving feed, grain and processing qualities, along with maturity rates and resistance to pests, diseases and stress. As a rule, little attention has been focused on enhancing the efficient use of nutrients. The agriculture industry as a whole uses more than \$100 billion worth of nitrogen fertilizer annually, but more than half does not get taken up by the plant and can potentially contaminate groundwater. Legumes are unique because they have the ability to fix, or convert, atmospheric nitrogen through the process of symbiosis with *Rhizobium*, a bacterium found in soil. Enhancing this process, called symbiotic biological nitrogen fixation, in dry beans through breeding and selection would provide growers with additional options for reducing fertilizer use and minimizing the potential for groundwater contamination. Organic producers face an additional constraint: the availability of organically produced bean seed is limited so they must rely on using conventionally produced untreated seed. Saving (organic)

MICHIGAN IS the second-leading producer of dry beans in the United States and ranks No. 1 in the production of specific varieties of dry beans: black, cranberry and small red beans. It is also the top producer of organic dry beans: Michigan accounts for 37 percent of the nation's acreage and 47 percent of the country's sales.

SOURCE: USDA Economic Research Service

seed from year to year is an option, but it runs the risk of disease buildup from seedborne pathogens that respond favorably to the state's climate. Achieving modest yield increases would be beneficial and exponential considering the average yield of organic dry beans was 15.2 cwt (hundredweight) per acre compared to 18.6 cwt per acre for conventionally produced dry beans in 2008. Organic dry beans sold for \$54.3 per cwt compared to \$35.9 per cwt for conventionally produced dry beans. Researchers found that bean varieties differ in their ability to fix nitrogen, and black beans specifically fix more nitrogen than navy beans and older commercial varieties. Improving biological nitrogen fixation through sources such as Puebla 152, a superior nitrogen-fixing bean line, increased yield in bean varieties adapted to Michigan when grown under low nitrogen levels or under organic management systems. Organic producers who cannot apply conventional fertilizers to increase yield would benefit from bean lines with enhanced BNF, higher seed partitioning and a desirable maturity range.

### Nematode Assemblage Analyses of Michigan Soil Groups across Ecosystems and Temperature Zones to Develop a Proof-of-concept

> HADDISH MELAKEBERHAN

AWARDED: \$25,000 for one year

Breakdown of soil quality is a global problem. Michigan's six major soil groups continue to degrade, in part from intensive crop production practices, especially those related to corn and soybean production. Determining how to restore and/or prevent further deterioration first requires an understanding of the direct (biological and physical) and indirect (anthropogenic, or human-caused) factors responsible. Researchers measured the population density of nematodes between three soil subgroups and across two temperature zones in the Lower Peninsula to generate evidence that nematode populations can be indicators of soil health. Their findings suggest that the same soil groups in different temperature zones differ in their biological structure and function. This project provided the background justification needed to apply for the Howard G. Buffett Foundation grant of \$525,000 for two years.



### Optimizing Row Width and Plant Populations to Improve Weed Management and Yield in Michigan Dry Bean Production Systems

> CHRISTY SPRAGUE

AWARDED: \$56,000 over two years  
LEVERAGED: \$20,000

MSU dry bean breeders have developed several upright dry bean cultivars. These new cultivars provide opportunities to Michigan growers since they can be planted in narrow rows. Decreasing row widths may help improve weed control, increase yield and improve harvestability. In order to determine the most effective weed-and pest-control strategies and optimize crop yield with these new cultivars, researchers evaluated how cultivar selection, row-spacing, plant populations and the timing of herbicide application affected weed populations. Recommendations resulting from this research project have helped Michigan dry bean growers adapt to using narrow row technologies and served to increase the profitability and viability of the state's dry bean industry. Since the start of this project, the number of dry bean acres grown in narrow rows has increased from 40 percent (72,000 acres) in 2010 to 75 percent (135,000 acres) in 2012. Implementing the recommendations has also helped to reduce soil erosion and compaction by eliminating the use of inter-row cultivation to control weeds. Four manuscripts are currently under peer review.

### Soybean Sudden Death Syndrome: Assessment of Fusarium virguliforme Distribution, Pathogenicity, Genetic Diversity and Fungicide Resistance in Michigan

> MARTIN CHILVERS

AWARDED \$55,000 over two years  
LEVERAGED: \$289,535  
PENDING LEVERAGE: \$5.5 million

Since soybean sudden death syndrome was first described in Arkansas in 1971, the disease has been spreading north. In 2009, 50 percent yield loss attributed to SDS was documented in one Michigan field. Researchers were able to conclusively demonstrate that *Fusarium virguliforme*, one of the causal agents of SDS, is present in Michigan, mapped its presence in 21 counties, and developed a rapid diagnostic tool for SDS. They were also able to show that *F. virguliforme* is capable of infecting dry beans under field conditions. An SDS-resistance greenhouse screening method developed by colleagues within the north-central region was modified for use in vetting breeding material. Isolates of *F. virguliforme* have been collected across the state. They are being assessed for fungicide sensitivity, aggressiveness and genotype composition, information useful for directing breeding and management efforts. Estimates from survey data collected from 500 commercial growers at outreach activities held in winter 2012 indicated that these growers either saved or increased profitability by a total of \$692,000 because of the information they learned on managing SDS. Findings generated from this project have been used to secure and apply for additional basic and applied research and outreach funding.

### Western Bean Cutworm Biology, Life History and Management under Great Lakes Conditions

> CHRIS DIFONZO

AWARDED \$30,000 over two years  
LEVERAGED: \$104,000

The western bean cutworm attacks dry beans and corn. It has been native to the western United States since it was first reported in 1915. Beginning in 2000, WBC started spreading rapidly outside its native range for unknown reasons. Crop damage was first reported in Michigan in 2007-2008. The biology of the WBC found in the Great Lakes region (Michigan, Canada and neighboring states) differed from its western counterparts, and management recommendations used successfully there didn't work well here, especially in dry beans. Researchers evaluated WBC under regional field conditions and found that scouting during the daytime in dry beans wasn't appropriate because larvae spend the day in the ground and feed at night. Instead, timing of insecticide applications should be based on trap counts and the amount of pod damage. To achieve WBC control in dry beans, they learned that a single well-timed insecticide application is as successful as multiple applications, thereby saving growers time, money and equipment wear. In corn crops, growers should base their management decisions on cumulative egg mass numbers over a period of several weeks and not on a single week of scouting. In the Great Lakes region, the 8 percent threshold used in the West is too high; instead, a 5 percent threshold was adopted regionally based on ear damage, reduced quality (mold) and yield loss. According to reports from processing facilities in central Michigan in 2010 and 2011, it's estimated that by following the blanket spray recommendations, growers averted approximately \$600,000 in crop loss (25,000 acres x \$24 per acre crop loss for 2 percent WBC damage).

## COMPETITIVE GRANT SUMMARIES: Cross Commodity



### Pollinator-Focused Gardening for Sustainable Urban Agriculture

> JULIANNA TUELL

AWARDED: \$10,000 over two years  
LEVERAGED: \$2,000

Urban and natural gardens are a growing trend in Michigan. Beyond the commonly-known benefits—like reclaiming neglected urban spaces or improving neighborhood relations—urban gardens have another, lesser-known benefit: attracting and conserving bees. With funding from Project GREEN, researchers created a pollinator-friendly Vegetable and Insect Pollinator (VIP) Garden within the MSU Horticultural Gardens. The demonstration garden is designed to educate the public about Michigan pollinating bees. Educators also created a new free, annual event called the MSU Bee-Palooza, which offered interactive demonstrations on Michigan bee varieties and their various benefits for urban gardeners. Their work is now serving as models for other demonstration gardens throughout the state.



## SAVING *Michigan pollinators*

### > ZACHARY HUANG

#### Effect of Endoparasites, *Nosema* spp., on Honey Bee Behavior and Physiology

AWARDED: \$30,000 over two years

#### Pesticide *Nosema* Interactions across Developmental Stages of Honey Bees

AWARDED: \$12,000 for one year  
LEVERAGED: \$200,000 for both projects

**HONEY BEES ARE** the principal pollinator for millions of dollars' worth of fruit and vegetable crops in Michigan. Honey bees have been plagued in recent years by a number of threats, including parasitic mites, bacteria that cause diseases, and fungi such as *Nosema apis* and *Nosema ceranae*. *Nosema* are microsporidian parasites that attack the epithelial mid-gut cells of honey bees. *N. apis*, originally described in 1909, affects protein digestion, shortens the longevity of worker bees, forces queen bees from the hive, and affects colony productivity. It was originally thought that only *N. apis* affected Western honey bees, and that *N. ceranae*, first described in 1996, only infected Asian honey bees, but recently *N. ceranae* was found extensively in Western honey bees. An analysis of bees from the Colony Collapse Disorder original crisis showed that virtually all bees from CCD-positive colonies had four pathogens: two viruses and two species of microsporidia, *Nosema apis* and *Nosema ceranae*. In this project, researchers sought to compare the pathology of the two *Nosema* spp.; characterize the pathogenicity and effects of *N. ceranae* on honey bee workers in colonies; determine whether *N. ceranae* through competition replaces *N. apis*; and whether there is a correlation between nutritional status and *Nosema* disease. Researchers learned:

- All tested concentrations of *Nosema* increased bee mortality, and as concentration levels increased, mortality levels increased.
- *N. ceranae* was significantly more deadly than *N. apis*; mixing the two infections resulted in higher mortality rates than any other tested infections.
- It appears that *N. ceranae* was not more virulent than *N. apis* in field conditions.
- Mixed infected bees consistently foraged earlier than other bees and also died earlier.
- *N. apis*-infected bees always outcompeted *N. ceranae*-infected bees, at a ratio of 8:1; this suggests that mixed infected bees died earlier, perhaps because *N. ceranae* was immune-suppressing the honey bee hosts, and then *N. apis* reproduced faster resulting in the earlier death of the mixed infected bees.
- There is an interaction between pollen nutrition and type of *Nosema* infection.

Findings from this work have appeared in five publications, with more forthcoming, and five MSU Extension talks.

In the second research project, also focused on *Nosema* spp., researchers studied whether adult bees previously exposed to sub-lethal levels of pesticides showed increased susceptibility to *Nosema ceranae* (all previous studies had been conducted in young bees). Traces of chemical residues have been found in beeswax and honey, and exposure to chemicals decreases bee vitality and survival, which leads some to question if chemical exposure is a potential cause of Colony Collapse Disorder. They discovered there were no interactions between pesticide exposure and infection in honey bees in the four different pesticides tested.

## GROWING LOCAL ECONOMIES with agriculture

**WHY HAVE A DISCUSSION** about economic development and leave out a major part of the economy?

This often is the case in communities that get a big economic boost from agricultural-based businesses. These local food systems contribute significantly to the health and vitality of many local economies, but when it comes time for planning, officials and policy makers tend to overlook agriculture's prominent role.

Through this project, an economic development plan was created for the Clinton, Eaton and Ingham tri-county region that takes into account the essential requirements agricultural businesses need to grow and thrive. Public and private buy-in were leveraged through a series of baseline assessments, listening sessions and surveys to identify the barriers and opportunities facing agriculture-based businesses and create action steps for expanding the profitability and viability of this sector moving forward. The tri-county project also serves as a case study for regions both inside and outside Michigan contemplating the pursuit of similar economic development planning.

As a takeaway from the discussion and analysis process, the project team crafted a regional economic development plan that included 11 strategic recommendations:

- Include agriculture in local economic development planning.
- Develop zoning that supports innovative farming activities.
- Encourage development of nonagricultural areas.
- Attract agriculture processing facilities to the region.
- Encourage agricultural entrepreneurship.
- Link agricultural activities to community development efforts.

- Advocate for government support.
- Market (our) region's agricultural products.
- Improve access to financial resources.
- Expand and improve farmers' networks.
- Enhance accessibility to information about local agriculture.

Some of the recommendations outlined in the tri-county plan are already coming to fruition. A team made up of the Greater Lansing Convention and Visitors Bureau, several economic developers from area municipalities, the regional Chamber of Commerce and an area small business has applied for a grant to help expand the market reach for local vendors by creating a Web-based registry cataloging farm markets, roadside stands and agricultural tourism venues in the region. The Lansing Economic Area Partnership was inspired by the plan's recommendation to identify agricultural business development as one of its key initiatives over the next few years. It has since established an agriculture committee and is considering a number of the plan's recommendations for funding. Additionally, LEAP partnered with the Tri-County Regional Planning Commission's economic development program to establish a regional coalition of economic development professionals serving Clinton, Eaton and Ingham counties. Called the Lansing Tri-County Region Economic Partnership, the group of 40-plus people meets monthly to share ideas for economic planning and address topics of common interest related to economic development. LTREP considered the agricultural business plans during one of its spring 2012 meetings. The next step will be to formally incorporate the recommendations into the Comprehensive Economic Development Strategy, the economic blueprint for the area's U.S. Department of Commerce designated Economic Development District.

### > STEVE MILLER

#### Regional Planning for Agriculture Economic Development in Mid-Michigan

AWARDED: \$32,000 over two years  
LEVERAGED: \$4,500



**THE TRI-COUNTY** project team gauged the potential economic impacts the region could realize with a conservative 5 percent increase in business activity by agricultural businesses. The estimated returns were significant:

- more than \$3.4 million in labor income
- more than \$5.7 million in property-related income
- \$21.8 million in economic output
- creation of 259 new jobs

**Scheduling Bedding Plants for Energy-Efficient Greenhouse Production**

> **ERIK RUNKLE**

AWARDED: \$52,000 over two years

**Developing LED Photoperiodic Lighting for Specialty-Crop Production**

> **KRISTEN GETTER**

AWARDED: \$70,000 over two years

## FLORICULTURE RESEARCHERS IMPROVE THE INDUSTRY'S ENERGY EFFICIENCY

WHEN MSU HORTICULTURE associate professor Erik Runkle talks about his research, he usually begins with an explanation of the impact of floriculture on Michigan.

"I think a lot of people don't understand the contributions this industry makes to the state," said Runkle. "It is the fourth-largest segment of agriculture in Michigan, larger than all vegetables combined. It's about a \$400 million industry at the wholesale level."

New hire MSU Floriculture outreach specialist Kristen Getter agrees.

"Floriculture is a major industry in the region of the state that I cover," she said. "I work with 300 growers, and that's just southeastern Michigan."

And the biggest segment of this major Michigan industry is bedding plants, or decorative, ornamental plants for gardens.

With Project GREEN funding, Runkle is researching how plants respond to temperature and how to make greenhouse lighting more energy-efficient for the bedding plant floriculture industry.

Nurseries generally start selling flowers in the early spring. To have plants ready for sale at this time, growers plant them around January and February. Obviously, Michigan's climate at this time is not particularly conducive to growing flowering plants, so Michigan growers create artificial climates within greenhouses. To do this, they use low-intensity greenhouse lighting, traditionally with incandescent bulbs. Incandescent light bulbs are highly inefficient, however, converting less than 10 percent of their energy into light and emitting the rest as heat. Runkle examines LED alternatives to incandescent bulbs.

In his research, he found it is possible for LED manufacturers, whose bulbs are 30 percent efficient (and quickly increasing in efficiency as technology improves), to design bulbs that emit more defined wavelengths of light, which greatly benefits plant growth. While remembering that all plants are different and results can vary greatly, Runkle found that, in general, plants are positively affected by a roughly equal combination of red and far-red wavelengths of light.

Runkle believes that if 20 percent of Michigan's floriculture industry could switch from incandescent bulbs to LED bulbs with specifically designed wavelength characteristics, growers could save up to \$87,000 per week statewide.

Project GREEN also allowed Runkle to discover energy-saving alternatives in greenhouse temperatures.

By growing various bedding plants at different temperatures and for different lengths of time, Runkle found that higher temperatures generally cause plants to grow faster, though again stressing that plant results can vary. While it initially costs more to heat greenhouses to higher temperatures, this cost is ultimately less than growing plants at lower temperatures for longer periods of time, Runkle found.

Runkle's research is helping a USDA program called Virtual Grower, software in which growers can design their greenhouses virtually and calculate the most energy-efficient temperatures and timings for their situations.

Runkle and Getter assist each other in some of their projects.



"Erik is helping me with a new GREEN project this year reinventing an old program formerly called 'College of Knowledge,'" Getter said.

The program is a former in-person class, discontinued in 2009, that provided basic greenhouse growing education to non-MSU students.

"It was designed for people who didn't have a lot of floriculture education to come in and learn the basics so they could grow these plants," she said. "I'm turning it into an online course so that it can benefit not just my eastern region, but the whole state and, potentially, a national audience."

Getter, whose salary is funded by GREEN, joined MSU floriculture in 2011, and provides education, outreach and advice to eastern Michigan growers through MSU Extension.



# ACADEMIC INFRASTRUCTURE SUPPORT

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 agriculture. That's why Project GREEN awards funding to Michigan State University academic departments, specialized programming and MSU Extension.

Generating Research and Extension to meet Economic and Environmental Needs, Project GREEN 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.

## TIME AND RESOURCES TO HARVEST 100 BUSHELS OF WHEAT

— 1930 —

5 acres in 15 to 20 labor hours using a 3-bottom gang plow, a grain binder and a community threshing machine

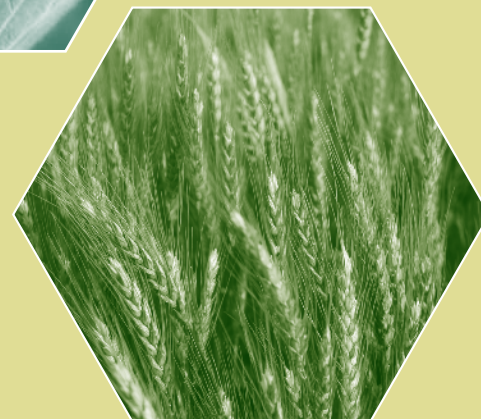
— 1965 —

2 acres in five labor hours with a tractor and a pull-type combine

— 2012 —

less than 1 acre in less than one hour with a self-propelled combine

SOURCE: [www.wheatgrowers.com](http://www.wheatgrowers.com)



## THE DEPARTMENT OF Agriculture, Food and Resource Economics

Through the MSU Product Center in the department, Project GREEN funds assisted food product entrepreneurs by providing services and professional technical advice toward starting food businesses, improving products and expanding food product lines.

Partnerships with the W.K. Kellogg Foundation led to the MSU faculty participating in the first-ever Michigan FFA Food Science career development event, held at MSU in April. Other cooperative events with 4-H, Boy Scouts of America, and the University Research Corridor helped expand the reach of the efforts of the Product Center and AFRE.

There are times when two (or more) heads are better than one. AFRE used Project GREEN funding for multidisciplinary team projects that gave impetus to developing or evaluating the quality of value-added products to keep Michigan farm producers profitable.

These projects include

- enhancing the safety of fresh-cut fruit and vegetable salads during processing, packaging and distribution
- developing bio-based packaging systems to extend blueberry shelf life
- discovering the effect of processing, packaging and vibration treatment on the sensory quality of fresh-cut apple slices
- studying low-dose X-ray irradiation on the quality of fresh-cut asparagus in microwaveable vacuum skin packs



## THE DEPARTMENT OF Biosystems and Agricultural Engineering

Project GREEN funding allowed professionals in this department to mentor 15 undergraduate students in instrumentation, environmental monitoring and project management, and to conduct work that led to adoption of new technology quantifying soil-moisture levels for irrigation scheduling models. They also conducted work on detecting environmental changes affecting white mold in soybeans; developed a remote monitoring system to automate the feeding of yellow perch; and designed a system to accurately quantify irrigation needs. In addition, Project GREEN operating dollars were invested in

- developing an instrumentation system to monitor irrigation
- remediating wastewater on treated croplands
- identifying the causes of Black Spot on potato seedlings
- designing an instrumentation system to monitor aquaculture habitats
- developing a solar-powered bioreactor system





### THE DEPARTMENT OF Crop and Soil Sciences

Project GREEN operating funds allowed Crop and Soil Sciences faculty members to travel an estimated 10,000 miles around the state to attend meetings and field demonstrations and visit MSU Extension offices, all of which helped faculty members and specialists stay well connected so they can be more responsive to farmers' needs. A 500-bushel Grain Kart and a John Deere Gator were purchased for the MSU Agronomy Farm. Grain deliveries are safer and more efficient with the Grain Kart, and the Gator is used for plot maintenance. CSS projects in the following research areas benefited from Project GREEN funding:

- barley, canola, oat and wheat breeding
- bioenergy and cropping systems
- biosolids on soils
- Christmas trees
- dry bean and soybean breeding
- entomology
- field crops
- forages
- groundwater stewardship
- plant pathology
- potato breeding, variety testing and promotion
- soil science, fertility and modeling
- sugarbeet breeding for the U.S. Department of Agriculture
- switchgrass breeding
- vegetables
- weed science

### THE DEPARTMENT OF Entomology

Project GREEN infrastructure and operating dollars benefited research targeting apiculture (beekeeping); field crops, forestry, medical and small fruit entomology; integrated pest management for organic agriculture, tree fruit, turf grass and vegetables; and nematology.

A spotted wing Drosophila invasion in 2011 had the potential to plague growers throughout Michigan. Project GREEN funding allowed researchers to develop management recommendations that saved growers from significant crop loss. Regional pest alerts and supporting materials for managing the spotted wing Drosophila were also produced.

Project GREEN funding gave faculty members the opportunity to work with Extension educators to teach Good Agricultural Practices to more than 200 non-English-speaking Latino blueberry growers and farm workers in their native Spanish.

In addition, 17 field residue trials that resulted in new Environmental Protection Agency registrations for use in blueberries, pome and stone fruits were conducted at the Trevor Nichols Research Center. A proof-of-concept study was also completed for a trunk injection delivery system in apples using 2011 Project GREEN SEED money.

Additional results from MSU Department of Entomology work included:

- More than 7,000 people gained further understanding about entomology by visiting the MSU Bug House or attending Bug Camp.
- The North American Blueberry Council adopted the MSU "Good Agricultural Practices for Food Safety in Blueberry Production: Basic Principles" manual as a food safety checklist for the entire highbush blueberry industry.

### THE DEPARTMENT OF Food Science and Human Nutrition

In Michigan, the quality of the wheat, which eventually becomes the bread that is spread with the strawberry jam that is served with the eggs and cereal for breakfast have all benefited from the use of 2011 Project GREEN funds.

Forty percent of the 680,000 acres of wheat harvested in the state in 2011 was white wheat, and more than 80 percent of the white wheat varieties harvested were MSU-developed lines. This added about \$100 million to Michigan's economy that year through MSU-developed lines alone. Project GREEN infrastructure funding supported the MSU Wheat Quality Testing program, which made this economic boost possible.

Industries benefiting from Project GREEN funding include cherry producers and processors, dry bean producers, and the chestnut producer group. It also supported processing of value-added products using Michigan plant commodities, helping Michigan entrepreneurs develop food products, and maintaining pilot plant equipment and machinery used for outreach, training activities, and other short courses.

Without Project GREEN funding, continued exploration of extrusion

technology for producing value-added products from Michigan-grown wheat would have been difficult. The funding also makes other product development possible.

These are some of the Food Science and Human Nutrition projects benefiting from Project GREEN funding:

- extrusion projects on the utilization of wheat bran and flour for value-added projects
- product formulation projects for specific entrepreneurs: increasing protein in peanut butter, increasing shelf life of bean dip, and improving the consistency and shelf life of canola dip
- development of a value-added dried product from cherry processing waste
- pilot plant support for the drying of chestnuts by the Michigan Chestnut Grower Group
- USAID-funded bean extruded products for Africa
- sensory testing of Michigan products, such as sweet cherries, military MRE shelf-stable egg sandwiches, ready-to-eat cereal, hot dogs, corn muffins, blackberries and Michigan beans

### *Potato specialist enhances CSS efforts*

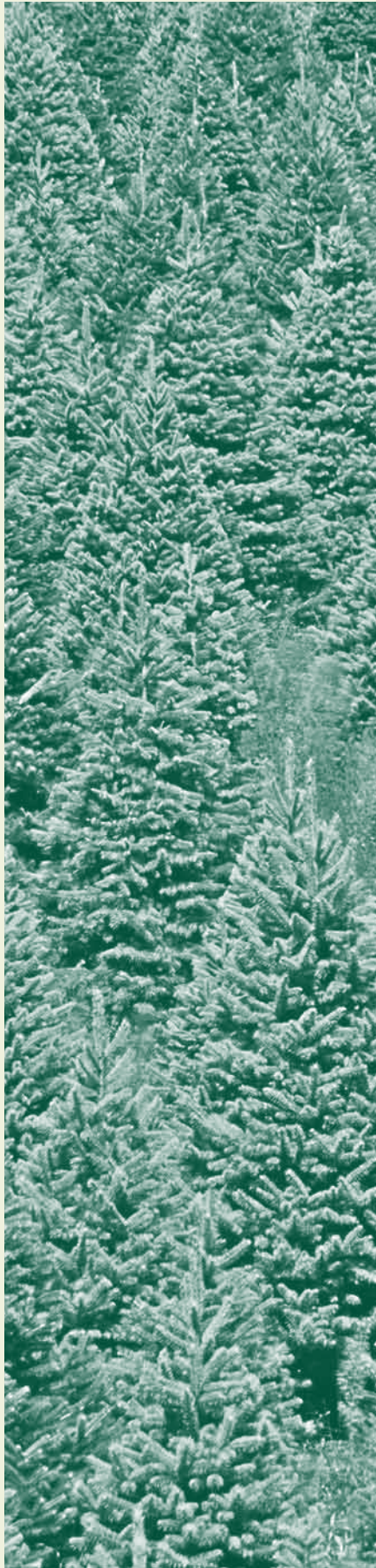
**A FIRST RESPONDER** to issues or problems affecting the Michigan potato industry, Chris Long serves as the liaison between MSU and the state's potato industry. A potato specialist in the Department of Crop and Soil Sciences and funded by Project GREEN, Long also manages the Michigan Potato Industry Commission's storage facility and coordinates chip-processing and table-stock potato variety commercialization efforts in the state.

In the past year, Long hosted the annual "Variety Day" event and conducted four grower field days. He also secured funding from the Michigan Department of Agriculture and Rural Development to add four weather stations to the Enviro-weather network in northern potato-growing areas of the state and enhance the Potato Maturity and Heat Stress Graphing Tool. Four to eight percent of the state's potato crop, \$5 million to \$12 million worth, is lost annually because of poor weather conditions during the growing or harvesting season. Being able to accurately predict these events will aid growers in making informed management and post-harvest decisions.

During 2011-2012, Long worked on 11 research projects, including 18 on-farm variety trials, and helped generate \$121,900 in additional dollars for potato-related research.



Chris Long



### THE DEPARTMENT OF Forestry

The department purchased two pieces of equipment, a lab-based system for measuring carbon dioxide concentrations and a freeze drier. The CO2 analyzer will allow bioenergy and Christmas tree researchers to completely account for carbon levels in projects performed under various forest management scenarios, including the production of biofuels and Christmas trees from short-rotation woody crops. The freeze drier will have broad use in preparing laboratory samples.

Arginine, a nitrogen-rich amino acid, is less likely to leach into ground and surface water thanks to improved nitrogen management recommendations that resulted from a project studying arginine fertilization in poplar, Fraser fir and red pine. The Christmas tree industry benefited from Project GREENE-funded work, including the development of improved Scotch pine seeds and grafted root stock for Fraser fir. More potential sites for growing Fraser fir were also identified. Additional research projects focused on the following areas:

- soil carbon dynamics in bioenergy plantations
- effects of fire on soil carbon
- effects of snowfall and winter climate on soil carbon storage
- use of cover crops in Christmas tree plantations

### THE DEPARTMENT OF Geography

Enviro-weather remains a key tool that growers rely on to make science-based management decisions to keep their crops healthy and productive. The Department of Geography plays an integral role in ensuring that Enviro-weather users receive timely, accurate information via the Michigan Automated Weather Network. Thanks to Project GREENE funding, the department successfully obtained an EPA grant (in collaboration with the University of Wisconsin) to add six new automated weather stations to the network, thereby increasing forecast accuracy in some areas.

In addition, the director of MAWN is a member of the investigative team on research projects that have received in excess of \$1.5 million in competitive funding. An additional \$20.2 million worth of competitive project funding is pending review.

In 2011, the Enviro-weather program conducted a survey of approximately 1,000 Michigan cherry and apple growers. Enviro-weather users reported significant reductions in their use of pesticides because of the information they were able to obtain from Enviro-weather. They also reported an increase of more than 5 percent in both crop yield and quality compared to non-users. Collectively, the yearly economic impact associated with the use of Enviro-weather-based information helped cherry and apple growers reduce pesticide applications, increase yields, and save money on labor. This resulted in a total of estimated savings of \$1.7 million.

### THE DEPARTMENT OF Horticulture

Project GREENE invested in the operations of the Horticulture Teaching and Research Center, thereby advancing work on 92 research, outreach or teaching projects benefiting a wide range of horticulture industries, from fruits and vegetables, vineyards, and landscape plants, to IR-4 pest management registrations, soil fertility and water use.

The department awarded operating dollars to 16 horticulture faculty members with MSU Extension appointments. All totaled the group

- presented at 247 industry/grower meetings or workshops/short courses
- wrote 79 articles, three peer-reviewed scientific papers and one book chapter, and edited the plant growth regulator section of the Michigan Fruit Spray Guide
- produced 22 publications, MSU Extension bulletins and reports
- coordinated 13 workshops or field days and the fall (2011) Apple Maturity Program
- conducted research that resulted in the registration of nine herbicide labels for Michigan fruits and vegetables
- lectured in a U.S. Department of Agriculture-sponsored post-harvest training program
- served as the MSU Extension coordinator for the widespread problem of Imprelis herbicide damage
- provided content for six videos on pruning cherries
- developed more than three dozen short videos on important issues of sustainable greenhouse practices
- participated in weekly Vegetable and Fruit Crop Advisory Team Alert meetings
- contributed to the Garden Professor Blog, which one faculty member developed in collaboration with Extension colleagues across the country
- judged two wine competitions and provided the wine technician for the Michigan Wine Competition

### THE DEPARTMENT OF Plant Biology

Gathering and analyzing data for two projects—one looking at interactions between invasive exotic and native species, and another involving the role of barley and cereal yellow dwarf viruses—were among the ways in which research efforts in the Department of Plant Biology benefited from Project GREENE funding this fiscal year. Because the department uses specialized programs in its research, it supports its own computing facility for compilation. Project GREENE helps make that happen.

The allocation of Project GREENE funds for information technology support has allowed faculty to generate more than \$10 million in external research grants that meet GREENE objectives and priorities.



### THE DEPARTMENT OF Plant Pathology

Researchers in this department used Project GREENE funds to set up and maintain research trials on threats to many of Michigan's high-value crops, including

- Phytophthora capsici on melon, pepper, squash, cucumber
- downy mildew on cucumber
- fungal diseases on onions
- foliar diseases and root rots on asparagus
- anthracnose in carrot, onion and celery

Other funds were used to support ongoing, high-priority research and secure additional funding.

- Researchers collected data regarding soybean sudden death syndrome (*F. virguliforme*) in dry beans. MSU hopes these preliminary data will help researchers make a case for more funding from USDA's National Institute for Food and Agriculture.
- Scientists conducted research on a new class of fungicide that may help control apple scab, cherry leaf spot and brown rot in tree fruit. This initial research enabled scientists to leverage the Project GREENE investment to secure additional funding from the USDA's Interregional Research Project No. 4 program, two companies and the Michigan Apple Committee to conduct additional research.

— 1906 —  
Michigan Agriculture College  
(now MSU) appointed its first  
Extension specialist

— 1914 —  
Congress passed the Smith-Lever Extension  
Act, providing funding for “the rapid expansion  
of the county agent system into every agricultural  
county in the nation.”

— 1955 —  
An amendment to the Smith-Lever Act provided  
for Extension rural development work.

— 2012 —  
The state of Michigan’s \$61.9 million  
investment in the AgBioResearch  
and MSUE generates nearly \$1 billion  
for Michigan’s citizens

SOURCE: MSU Extension

**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](http://www.msue.msu.edu)

## OUTREACH & EDUCATION THROUGH MSU EXTENSION

**EIGHT RESEARCH AND OUTREACH PROJECTS**  
receiving \$30,000 in funding benefited from Project GREEN  
infrastructure and operating dollars.

Project GREEN operating dollars were used to conduct a survey to  
measure the impact of Enviro-weather use. A total of 1,202 growers  
and homeowners who participated in programs during 2010 and  
2011 were surveyed to determine the effects of MSU Extension  
efforts. The following figures are examples of the success of various  
agriculturally based water-quality programs:

- 937,830 fewer pounds of nitrogen applied over 87,821 acres
- 44,871 fewer pounds of phosphorus applied over 4,912 acres
- a 402,155-pound reduction in active ingredient of pesticides  
applied over 403,498 acres
- a 39,626-pound reduction in broad-spectrum pesticide used on  
15,055 acres in favor of new, narrow-spectrum chemistries that  
limit the effect on nontarget organisms

Based on change in cover crop seed sales, use of cover crops has  
increased by an estimated 202,209 acres over the past year. Using  
predictive models, it’s estimated that the increase in cover-crop use  
corresponds to:

- 506,817 fewer tons of soil sediment loss
- 26,530 fewer pounds of nitrogen moved
- 136,575 fewer pounds of phosphorus entering surface waters

By working with growers and homeowners, MSU Extension was  
able to report a total water-use savings of 5,910,000 gallons  
on 4,876 acres. Water quality and conservation have greatly  
improved for homeowners and growers alike because of the efforts  
of MSU Extension. Farmers are saving on pesticides and being  
environmentally responsible while maintaining the productivity of  
their land, and consumers are benefiting from clean, safe water.

Funding was also used to transition the Crop Advisory Team Alerts  
to the new MSU Extension website, which features news articles  
written by educators and specialists, and to evaluate and modify  
the method used to deliver articles. A staff member was hired to  
modify articles written by MSU Extension educators and distribute  
them to mainstream and farm-based media outlets, thereby  
extending reach to multiple audiences. Over a 12-month period,  
print media reprinted MSU Extension-based articles at a rate of  
approximately 2.5 daily, thereby extending the reach of educators’  
and specialists’ work.

In addition, MSU Extension  
invested Project GREEN  
funds in educating and  
training farmers about  
biodiesel processing and  
biomass pellet production,  
providing counseling on  
the Michigan bioeconomy  
to businesses and  
entrepreneurs, fostering  
the development of  
expertise in bioenergy crop  
production on nontraditional cropland, and forging the formation  
of a biomass energy project workgroup.

**ONE GROWER** who attended  
an in-depth MSU Extension  
workshop on improving irrigation  
practices for potted and field-  
grown nursery stock reported that  
because of attending this program,  
spray stakes were installed at his  
operation. This practice reduced  
irrigation requirements by 20  
to 25 percent, saving nearly 3  
million gallons of water.

Project GREEN funds were used to support MSU Extension  
educators who took part in the first-ever cross-commodity  
Integrated Pest Management Academy. Targeting scouts,  
chemical company representatives, educators, students and  
growers from across Michigan and the United States, the courses  
were designed to help participants increase adoption of IPM  
practices to increase crop efficiency, minimize unnecessary  
pesticide applications, and increase employee and employer job  
skills and satisfaction. Follow-up surveys indicated that a majority  
of the respondents intend to implement a number of the IPM  
practices they learned during the upcoming production season.

# PROGRAM SUMMARIES

When it comes to agriculture, Michigan is the land of plenty. The state's farmers grow more than 200 commodities, and Michigan ranks as a top contender in many fruit and vegetable crops. According to a report released by the MSU Product Center in April 2011, Michigan's food and agriculture system contributes \$91.4 billion to the state's bottom line.

Project GREEN helps fund key research and outreach programs to ensure that entrepreneurs and others can tap into world-class research and outreach to help grow the economy and keep our land productive.



— 1925 —  
49 percent of Michigan's land was dedicated to farming.

— 1959 —  
The total percentage of state farmland had dropped to 40.5.

— 2012 —  
About 28 percent of Michigan's land is used for agriculture.

**SOURCE:**  
USDA Agricultural Census



## MSU LAND MANAGEMENT OFFICE

**BEING ABLE TO CONDUCT** critical field research at MSU depends on the MSU Land Management Office, which keeps field stations operating. Farm managers invest Project GREEN infrastructure dollars in new equipment and use funds to hire laborers. This past year in particular, funds were used to offset reduced operating budgets experienced across the entire field station network.

At the Northwest Michigan Horticultural Research Station, no projects would have been started or continued on-site without funding from Project GREEN. Thanks to Project GREEN infrastructure and operating dollars, more than 60 projects targeting critical issues in the fruit industry were able to occur. Specific projects included

- using native pollinators for fruit crops
- multiple insecticide and fungicide efficacy trials
- planting and rootstock, training and harvesting system projects that will benefit high-density sweet cherry orchards in the future
- controlling bacterial canker in sweet cherry
- oblique-banded leafroller scouting and degree-day model development

The Saginaw Valley Research and Extension Center applied operating capital to research projects benefiting

- dry bean and sugar beet breeding programs
- projects focused on controlling disease and insect infestations in the dry bean, sugar beet, soybean and corn crops
- bioenergy projects; Thumb Ag Research and Education corn and soybean plots; and fertility, wheat, cover crop and Sugarbeet Advancement trials
- U.S. Department of Agriculture cercospora and breeding program trials
- Production Research Advisory Board cooperative research with the Michigan Sugar Company and the state's dry bean industry

Field station employees at the Trevor Nichols Research Center conducted more than 25 insecticide-screening trials. Baseline data supported the spray recommendations listed in the MSU Extension bulletin E-154 (Michigan Fruit Management Guide). Four new reduced-risk pesticides were registered by the EPA for specialty crops as a result of 17 Good Laboratory Practice field residue trials with the IR-4 project. Additionally, more than 200 fruit growers received Integrated Pest Management and Good Agricultural Practices training at the TNRC. Other activities included

- successful elimination of Blueberry Shock Virus-infested plants at the TNRC and reestablishment of five acres with new virus-free plant stock
- production of two journal publications and new best management recommendations for fruit farmers in response to precipitation, based on data generated from studies in cherry and blueberry in a rainfall simulation chamber



## ENVIRO-WEATHER

**THE ENVIRO-WEATHER SYSTEM** is a comprehensive network of weather stations strategically located throughout the state's crop-producing regions. Weather information is collected, processed and archived, providing a Web-based databank that can be used with a variety of tools and applications to help Michigan farmers predict weather events and pest outbreaks so they can better manage their crops. Data are also shared with other groups, such as the National Weather Service, and used in more than a dozen college and university classes to teach students about weather, agriculture, integrated pest management, and how to use weather information to manage risk. Below are additional results of Enviro-weather system use.

- Enviro-weather played a central role in ongoing research projects receiving total funding approaching \$250,000. Another \$175,000 worth of similar research project funding is pending.
- According to a survey among Michigan fruit growers, the yearly economic impact associated with using Enviro-weather-based information on the Michigan tree fruit industry alone, including reduced pesticide applications, increased yield and decreased labor costs, is about \$1.8 million.

Six weather stations were installed in Door County, Wis., in 2011, bringing the total number of weather stations to 70. Another seven stations will be installed by the end of 2012. A redesigned website conforming to new MSU branding standards was launched, as was a new anthracnose disease prediction model for blueberries, in 2011. Enviro-weather debuted its first premium subscription service, a frost alarm, and tasks completed for the development of this feature can be applied to other services.

Operating dollars provided by Project GREEN were invested in a network technician who traveled an estimated 5,000 miles around the state to complete routine and emergency maintenance on weather stations and install new cellular Internet Protocol modems at 28 station sites. Funding was also used to purchase a variety of sensors, data loggers and related equipment needed for the weather network to operate efficiently and effectively.



Photo courtesy of Michigan Apple Committee



## USING ENVIRO-WEATHER BOOSTS ECONOMIC IMPACT OF MICHIGAN'S TREE FRUIT INDUSTRY BY AN ESTIMATED \$1.8 MILLION ANNUALLY

**MICHIGAN TREE FRUIT GROWERS** rely on Enviro-weather, a comprehensive network of weather stations located throughout the state, which collects, processes and archives weather data that can be used with a variety of tools and applications to help farmers more accurately predict weather events and pest outbreaks so they can better manage their crops.

In 2011, the Michigan field office of the National Agricultural Statistical Service (NASS), in collaboration with the MSU Center for Economic Analysis and the Enviro-weather program, surveyed 1,000 Michigan apple, sweet cherry and tart cherry growers about their Enviro-weather usage patterns and subsequently the result that using Enviro-weather had on pest control and crop yield and quality.

The total economic impact associated with using Enviro-weather-based information was estimated to be more than \$1.8 million. Responses suggested that Enviro-weather users require fewer pesticide applications and produced higher yields. Decreasing

pesticide applications saves producers money on pesticides and labor. Higher revenues reflect higher yields for sale at the going commodity prices. Though not measured in the impact estimate, more than 70 percent of the respondents indicated that using Enviro-weather increased the quality of their produce.

Survey findings show that Michigan fruit growers who use Enviro-weather were able to

- apply 50 percent fewer pesticide treatments to achieve control of five major apple and cherry insect pests
- use one-third to 50 percent fewer pesticide applications to control four major apple and cherry diseases
- reduce the amount of pesticide applied to apples and sweet and tart cherries by 306,239 pounds of active ingredient per year

According to the survey, in 2011 the economic impact associated with using Enviro-weather-based information on the Michigan tree fruit industry alone was estimated at \$1.8 million and respondents

reported a more than 5 percent increase in both crop yield and quality, representing an additional 7 million pounds of production.

Survey evidence show that growers use Enviro-weather to optimize pesticide applications and pest management efforts.

"Instead of waiting until pest pressure is evident, growers are able to make predictions based on the past week's weather," said Steve Miller, lead project investigator with the MSU Center for Economic Analysis. "Growers were able to increase their crop yield and quality because they were able to better manage pest pressure by optimizing the timing of their pesticide applications. Being able to optimally predict timing is especially important for organic growers since their control options are more limited."

Information gleaned from this usage survey will serve as a benchmark for future surveys, and will be used by the U.S. Department of Agriculture in its work.

## PESTICIDE AND PLANT PEST MANAGEMENT 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. This year was the fifth year of sampling for Plum Pox Virus in and around the former quarantine area in Berrien County, and all of the more than 5,000 samples collected tested negative for the virus.

The export manager worked with MSU Enviro-weather staff in updating the online Gypsy Moth Tracker. Growers use this website tool to view degree-day accumulation relative to growth stages of gypsy moth, and, from this information, determine when treatment of nursery stock would be most advantageous. Regulatory treatments for this pest must be done during this window of opportunity to meet USDA requirements.

Among other duties, the plant-pest specialist and inspection staff certified numerous commodities as compliant with the requirements outlined by the states and countries importing them. These commodities included fruit, logs, lumber, beans, hay, grain, nursery stock, and other plants and plant parts.

The plant-pest specialist also coordinated the trapping programs for apple maggot, European corn borer and Japanese beetle, which also included pest identification and trap maintenance activities.

## 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. In addition to providing the Center with infrastructure dollars to pay its director, a number of core genetic engineering projects benefit from Project GREEN operating money, including

- breeding programs for apple, Camptotheca ("Happy Tree"), canola, rice, sweet cherry, tomatoes and woody plants
- creating virus resistance in cherries
- increasing cold tolerance in blueberries

Results that have stemmed from the use of Project GREEN operating dollars in 2011-2012 include

- conducting biotechnology training programs for visiting scientists and college students from several countries, including China, Egypt and Ethiopia
- generating \$36,100 in service fees from conducting micropropagation work on blueberry for MBG Marketing/ Berryblue, LLC
- producing five peer-reviewed publications
- generating preliminary data used to apply for an U.S. Department of Agriculture = National Institute of Food and Agriculture grant
- providing the majority of course materials for CSS/HRT 451 course: Biotechnology Applications for Plant Breeding and Genetics
- supporting eight primary investigators working on projects at MSU, one at the U.S. Department of Agriculture and one working with the Michigan hosta industry
- two invention disclosures, with another one pending

## THE MSU PRODUCT CENTER FOOD, AG, BIO

**MICHIGAN THRIVES** on its residents' entrepreneurial spirit. The MSU Product Center helps entrepreneurs reach their goals by providing business services to develop and commercialize high-value, consumer-responsive products and businesses in the agriculture, natural resources and bioeconomy sectors. The Center does this by using its network to counsel clients and provide a bridge between entrepreneurs and support services, such as business, marketing, technical and scientific resources.

Why are creating these links so important? In April 2011, The MSU Product Center released an updated study on the food and agriculture system that shows the industry contributes an estimated \$91.4 billion to Michigan's economy. That's an increase of nearly 50 percent from 2004 to 2010. Helping entrepreneurs and others contribute to this growing system is of utmost importance to Michigan's long-term financial health.

The creation and maintenance of MIMarketMaker ([www.mimarketmaker.msu.edu](http://www.mimarketmaker.msu.edu)) is one good example of how The Product Center invests Project GREEN funds to help move people toward their goals. This Web-based resource links those who want to buy food (processors, wholesalers, retailers, restaurant owners and food service providers, for example) with those who sell food, such as producers, farmers' markets and consumers. The database includes detailed demographic information and consumption information from the U.S. Census that allows a savvy marketer to create a potential list of customers right down to a neighborhood level.



# GRANTING GREEN

## NEW PROJECTS

*Acoustic technology to protect ash trees from emerald ash borer: A potential option for non-insecticidal control of phloem-feeding insects*

**DEBORAH MCCULLOUGH**

*A statewide partner to detect and track downy mildew on cucurbits*

**MARY HAUSBECK**

*Best management practices for corn stover harvest*

**PAUL GROSS**

*Cercospora leaf spot emergency in sugarbeet production: Characterizing the diversity of fungicide resistance in the Cercospora beticola population and managing Cercospora leaf spot under duress*

**WILLIAM KIRK**

*Comparison of water use efficiency of overhead, drip, and sub-irrigation for green roofs*

**BRAD ROWE**

*Components of intensive cherry orchard systems development*

**GREGORY LANG**

*Conidial attachment and disease initiation in the apple scab pathogen*

**FRANCES TRAIL**

*Development and delivery of digital media-based extension programming for tree fruit disease management*

**GEORGE SUNDIN**

*Development of an attract and kill lure for the oriental fruit moth*

**MATTHEW GRIESHOP**

*Development of DNA probes for rapid detection of SDHI fungicide resistance in apple and stone fruit pathogens*

**GEORGE SUNDIN**

*Developing better monitoring and management strategies for oblique-banded leafroller populations in Michigan tree fruit*

**JULIANNA TUELL**

*Elucidating the effects of apple orchard floor management and canopy architecture on the effectiveness of codling moth natural enemies*

**MATTHEW GRIESHOP**

*Genomic characterization of a new bacterial turfgrass pathogen of creeping bentgrass putting greens in Michigan*

**JOSEPH VARGAS**

*Hunting genes important for Varroa survival and reproduction using RNAi*

**ZACHARY HUANG**

*Immuno-marking to understand the effects of conservation plantings on the movement patterns of key insect natural enemies, pollinators and pests*

**RUFUS ISAACS**

*Improving carrot profitability through integration of slow-release N fertilization and strip-tillage*

**DANIEL BRAINARD**

*Improving MI pepper production through ID of genetic resistance to Phytophthora capsici and development of field control strategies*

**MARY HAUSBECK**

*Interaction of soybean sudden death syndrome and soybean cyst nematode, and the assessment of Fusarium virguliforme virulence and sensitivity to new fungicides*

**MARTIN CHILVERS**

*Intra- and extracellular signaling and regulation of pathogenicity in Erwinia amylovora*

**GEORGE SUNDIN**

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

**DAVID DOUCHES**

*Latitudinal transect bioenergy crop research plots*

**DENNIS PENNINGTON**

*Managing and using high-yielding corn residue in Michigan*

**TIM HARRIGAN**

*New tools for identifying resistance to potato common scab and improving disease management*

**DAVID DOUCHES**

*Precise gene modification for potato improvement*

**DAVID DOUCHES**

*Redesigning viticulture and enology extension through the effective use of electronic technologies*

**PAUL JENKINS**

*Urban tree selection in a changing climate*

**BERT CREGG**

Thanks to funding from Project GREEN, 62 plant agriculture research projects will receive more than \$1.8 million in grant funding for fiscal year 2012-13.

## CONTINUED PROJECTS

*Advancing native plants to support agriculture and the environment*

**DOUG LANDIS**

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

**BRIDGET BEHE**

*Combining strip tillage and dual cover crops to increase profitability*

**DALE MUTCH**

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

**PAOLO SABBATINI**

*Cover crop susceptibility to herbicides*

**CHRISTY SPRAGUE**

*Impact and social acceptance sustainable practices in ornamental crop production systems*

**TOM FERNANDEZ**

*Critical invasive pests of MI tree fruit*

**LARRY GUT**

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

**MATTHEW GRIESHOP**

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

**PASCAL NZOKOU**

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

**DECHUN WANG**

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

**DALE MUTCH**

*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**

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

**CHRIS WOLF**

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

**MATHIEU NGOUAJIO**

*Impact and social acceptance sustainable practices in ornamental crop production systems*

**TOM FERNANDEZ**

*Improving the ecological efficiency of Michigan sugarbeet production*

**KURT STEINKE**

*Insecticide resistance management of the greenhouse pest: Western flower Thrips*

**DAVID MOTA-SANCHEZ**

*Management strategies to alleviate winterkill on golf courses*

**KEVIN KIRK**

*Managing call wasp in Michigan blueberries*

**RUFUS ISAACS**

*MSU-conducted wheat evaluations for wheat quality testing of advanced lines*

**PERRY NG**

*Pest management tech info and state and federal committee service*

**MARK WHALON**

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

**RUFUS ISAACS**

*Teaching, researching and demonstrating encapsulated soil lift techniques at Kellogg Biological Station*

**JANE HERBERT**

*Water management for container nurseries to improve irrigation efficiency and reduce runoff and off-site agrichemical movement*

**TOM FERNANDEZ**

## 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.

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### SPECIAL THANKS TO...

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**JACKIE DESANDER**  
**BEV RIEDINGER**  
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**MADDISON BRADY**  
**SARA LONG**  
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**BETH STUEVER**  
**ROBIN USBOURNE**  
**KATHY WINCHELL**  
*Agriculture and Natural Resources  
Communications*

**REDHEAD DESIGN STUDIO**  
*Design*

### INDUSTRY PARTNERS

Project GREEN was founded as a grassroots-driven initiative that was endorsed by agriculture commodity groups when it was presented to Michigan legislators in 1998. 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.

- 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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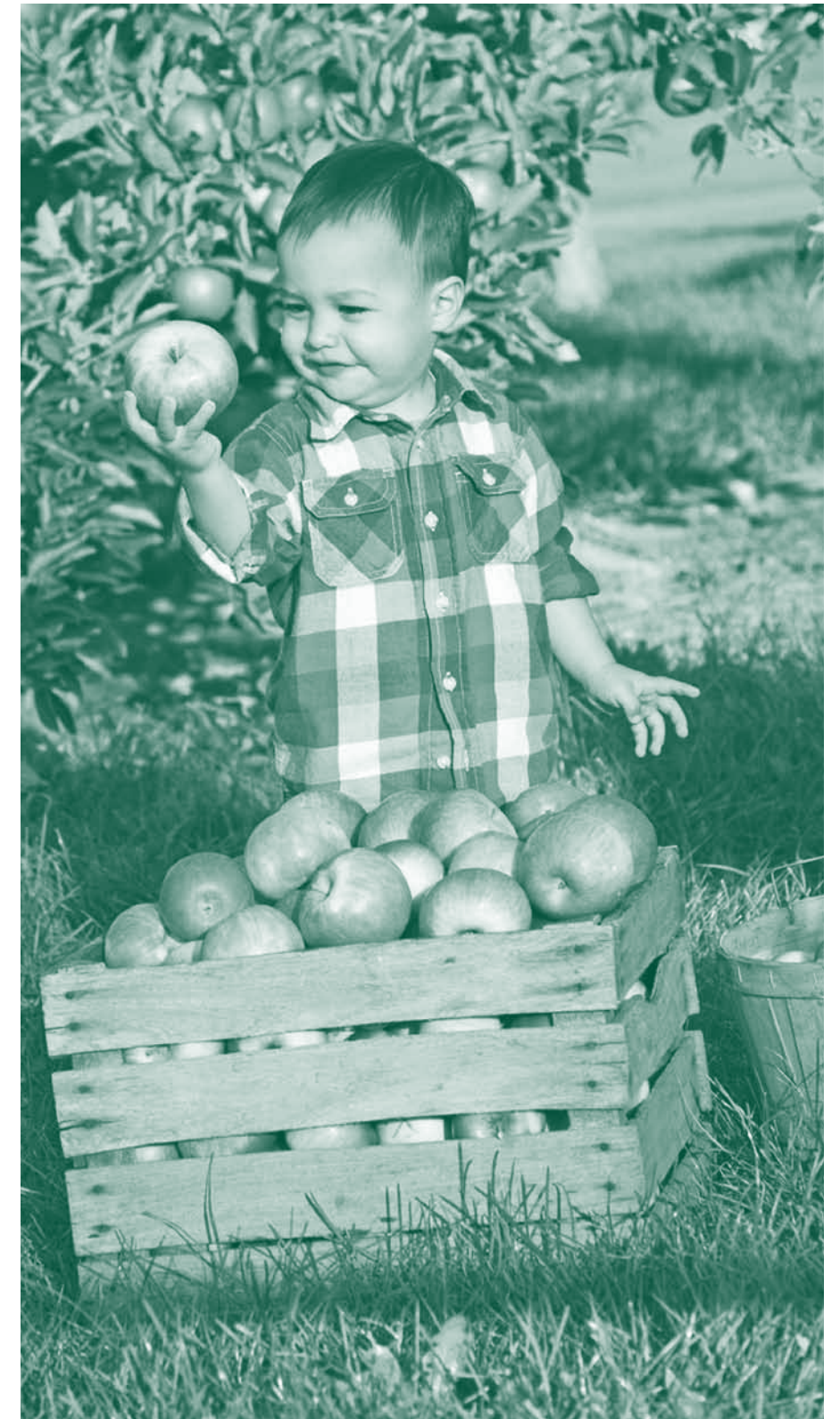


Photo courtesy of  
Michigan Apple Committee





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