

PROJECT GREEN

CULMINATION OF INNOVATION 



MISSION

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

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 Michigan State University AgBioResearch, Michigan State University Extension and the Michigan Department of Agriculture and Rural Development to advance Michigan’s economy through plant-based agriculture.

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MESSAGE FROM THE COORDINATOR



Project GREEN was designed to support Michigan’s growing plant-agriculture industry by providing targeted research and Extension programming in the face of evolving challenges. As I look back on the past year, I can say with confidence that 2013-14 was another banner year for Project GREEN—its commodity and government partners, Extension educators and world-class researchers creatively labored to bring Project GREEN’s foundational goals to fruition.

We now live and work in a time that requires us to accomplish more with less. Conversely, challenges with pests, plant diseases, processing logistics, shifting climates and the need for consumer education have only become increasingly complex. These truths have made leveraged and competitive funding more important than ever before—and that much more difficult to secure. But Project GREEN researchers and educators continue to demonstrate an apt for flexibility, innovation and a perseverance that equips them to respond to these challenges. Rufus Isaacs is a great example.

In early August, the United States Department of Agriculture awarded him and his team a \$6.9 million Specialty Crop Research Initiative (SCRI) grant to develop sustainable pollination strategies. Project GREEN has granted seed funding to Rufus for more than 10 years to help him develop this research and outreach program, working to position him to obtain this grant. The role of Project GREEN as a catalyst for developing comprehensive projects that capture the attention of competitive granting agencies is and will continue to be a high priority—the findings these projects produce are too important to stop pursuing.

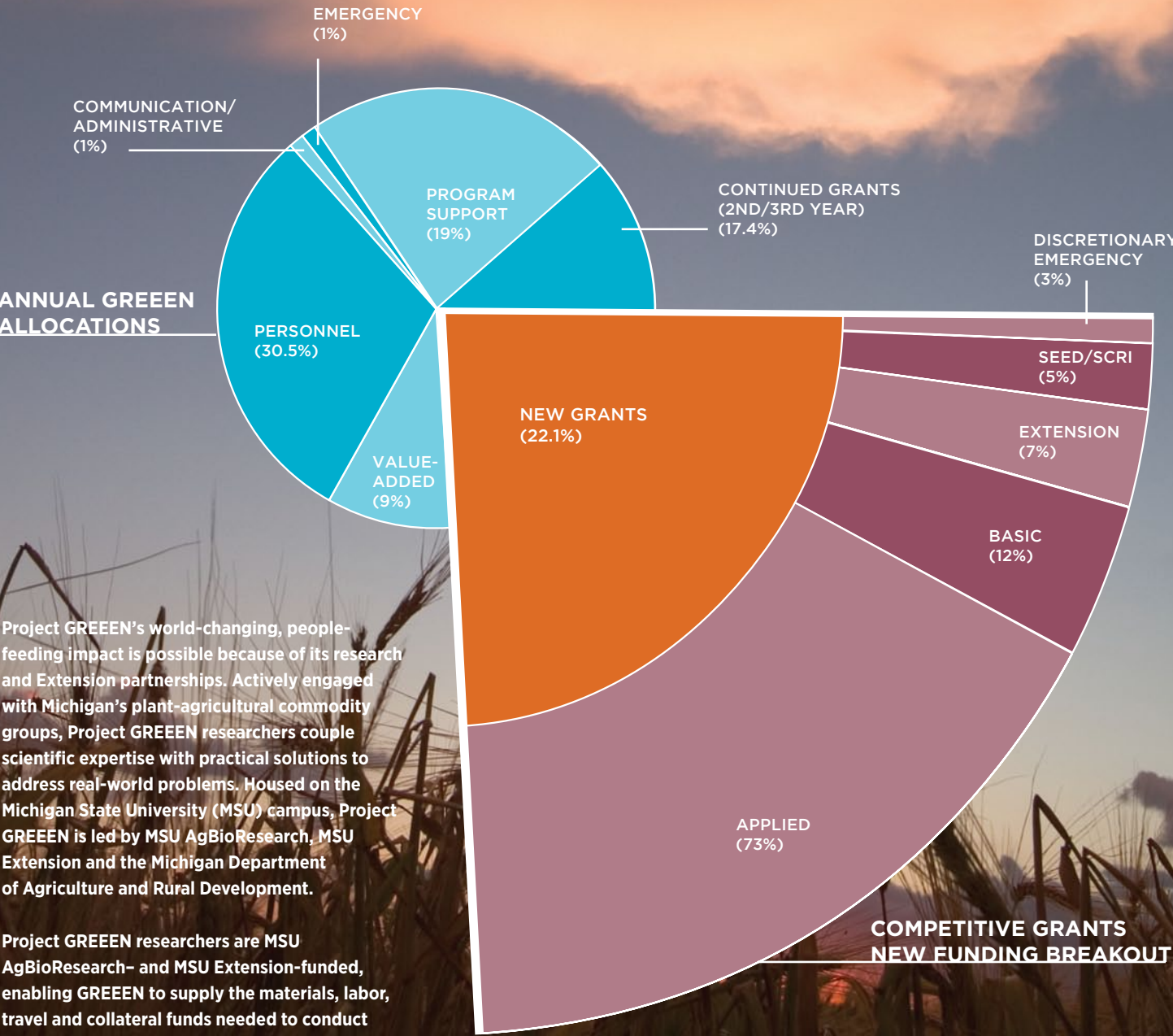
In vein with our spirit to pursue opportunity, I would like to acknowledge and thank **Tom Coon** and **Steve Lovejoy** for their service to Project GREEN. Both have recently moved on to new positions, but the hard work and expertise they’ve lent to this initiative over the years has been invaluable. I wish them success in their new roles.

Project GREEN scientists and Extension educators will continue to respond to the challenges Michigan producers, processors and others face as they feed and fuel the nation. On behalf of MSU AgBioResearch, MSU Extension, the Michigan Department of Agriculture and Rural Development and our 43 partner organizations, thank you for reviewing this year’s legislative summary. I hope you are encouraged by the novelty and resourcefulness of the research and Extension endeavors it contains.

Sincerely,

Doug Buhler
Program Coordinator, Project GREEN
Director, MSU AgBioResearch
Senior Associate Dean of Research,
MSU College of Agriculture and Natural Resources

FINANCIAL INVESTMENT



Project GREEN’s world-changing, people-feeding impact is possible because of its research and Extension partnerships. Actively engaged with Michigan’s plant-agricultural commodity groups, Project GREEN researchers couple scientific expertise with practical solutions to address real-world problems. Housed on the Michigan State University (MSU) campus, Project GREEN is led by MSU AgBioResearch, MSU Extension and the Michigan Department of Agriculture and Rural Development.

Project GREEN researchers are MSU AgBioResearch- and MSU Extension-funded, enabling GREEN to supply the materials, labor, travel and collateral funds needed to conduct relevant research and to deliver high-quality outreach programs. Because its dollars are primarily used to fund projects, administrative costs account for only a small portion of GREEN’s annual expenditures.



COMPETITIVE GRANT SUMMARIES

Competitive grants are the foundation of Project GREEN. Michigan State University, the Michigan Department of Agriculture and Rural Development, and Michigan plant commodity organizations work together to ensure that Project GREEN research aligns with industry priorities and scientists respond to the changing needs of plant agriculture in Michigan.

“PROJECT GREEN HAS BEEN A MODEL PARTNERSHIP EFFORT. THE COLLABORATION BETWEEN UNIVERSITY, GOVERNMENT AND COMMODITY GROUPS IN DETERMINING RESEARCH PRIORITIES HAS SERVED TO CREATE A COMMON DIRECTION FOR MICHIGAN’S PLANT SCIENCE EFFORTS. NOT ONLY HAS THIS PARTNERSHIP GENERATED OUTSTANDING RESEARCH, IT HAS ALSO HELPED CREATE A STRONG, UNIFIED PLANT SCIENCE INDUSTRY.”

TIM BORING
RESEARCH DIRECTOR,
MICHIGAN SOYBEAN PROMOTION COMMITTEE

CROSS COMMODITY

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

Awarded: \$79,600 over 2 years

Cercospora leaf spot, caused by *Cercospora beticola* Sacc., is the most important foliar disease in sugarbeets worldwide. It continues to be problematic for farmers in Michigan, especially during growing seasons when environmental conditions favor disease progression. Limited fungicide alternatives, coupled with economic conditions, limit fungicide application and raise genetic fungicide resistance concerns about cercospora leaf spot. The discovery of insensitivity to certain fungicides has led to a cooperative effort between MSU, the USDA, the Michigan Sugar Company and the agrochemical industry to develop recommendations that can sustain viable economic sugarbeet production in Michigan. The characterization of fungicide sensitivity within the Michigan *C. beticola* population will direct the development of effective recommendations specific to production areas. **Diagnostics used in this Project GREEN-funded study will provide an effective tool in the high-throughput processing of samples to evaluate effective fungicide resistance management strategies for cercospora leaf spot** while requiring minimal start-up costs. It is anticipated that the industry will not create new fungicides. Therefore, this cooperative effort is a vital part of ensuring that existing fungicide treatments remain available.

Comparison of Overhead, Drip and Subirrigation for an Extensive Green Roof

BRAD ROWE

Awarded: \$40,800 over 2 years
Leveraged: \$20,281

Investing in green roofs for existing and new buildings can have many benefits, including energy conservation, stormwater management, mitigation of noise and air pollution, and a healthier and aesthetically pleasing environment. Green roofs hold outstanding potential for positive economic and environmental impact in Michigan and the rest of the country. **With assistance from Project GREEN, MSU researchers determined the effectiveness of various irrigation methods—overhead, drip and subirrigation—and quantified biomass and carbon sequestration among the treatments.** They were able to demonstrate that the growing trend of specifying drip irrigation for green roof applications might not necessarily be the best option. According to these researchers, neither drip nor subirrigation methods are the most efficient because of the green roof substrates’ low water-holding capacity and low capillary movement.



FIELD CROPS

Evaluation of Binary Mixtures of Alfalfa and Grass and Their Responses to Supplemental Nitrogen Fertilization

KIM CASSIDA AND DOO-HONG MIN

Awarded: \$53,400 over 2.5 years

Mixed alfalfa and grass crop combinations are estimated to account for a significant amount of the 660,000 alfalfa acres planted in Michigan each year. The advantages of growing alfalfa in combination with a forage grass include improved forage digestibility, establishment-year yield, stand persistence, hay drying rate and pest control. Alfalfa also provides nitrogen via nitrogen fixation, thereby reducing the need for nitrogen fertilizer. This information is vital to forage producers because it reduces fertilizer expenses. The purpose of this project was to determine whether greater forage yield and quality are obtained from alfalfa-orchardgrass or alfalfa-tall fescue mixtures, and calculate the optimum nitrogen application rate for these mixtures. **With support from Project GREEN, MSU researchers discovered that total forage dry matter yield is greater for alfalfa-orchardgrass than for alfalfa-tall fescue mixtures.** They also found that the forage protein and relative feed quality were greater for alfalfa-tall fescue mixtures.

Best Management Practices for Corn Stover Harvest

PAUL GROSS

Awarded: \$18,650 over 2 years

More than 2.4 million acres of corn are planted for grain each year in Michigan. That makes corn stover one of the largest potential crop-based biofuel feedstocks in Michigan. Despite the potential benefits, a number of environmental and sustainability issues are associated with harvesting corn stover. Excessive stover removal can lead to wind and water erosion, carbon loss, reduced soil organic matter and reduced soil productivity. **Data collected through Project GREEN-funded research will help corn growers determine the most appropriate sustainable corn stover harvest system, allowing them to increase the value of their corn crop through the biofuels market.** The research found that direct baling behind the combine resulted in the lowest cost per ton of stover harvested.



Interaction of Soybean Sudden Death Syndrome and Soybean Cyst Nematode, and the Assessment of *Fusarium virguliforme* Virulence and Sensitivity to New Fungicides

MARTIN CHILVERS

Awarded: \$48,000 over 2 years

Leveraged: \$117,004

Soybean sudden death syndrome (SDS) has become a significant threat to nearly all major soybean production regions, including Michigan. Growers are experiencing losses greater than 50 percent in some fields. These losses affect crop choices and often result in the elimination of soybeans from the rotation. **With support from Project GREEN, MSU researchers mapped the interaction between SDS and soybean cyst nematode, helped growers identify SDS, informed them of its distribution within the state and assessed fungicide treatments.** Researchers developed a detection and diagnostic assay that improved the response time of the MSU Plant Diagnostic Services, enabling it to provide same-day confirmation of SDS. They confirmed it in 25 counties in southern Michigan and found evidence of it spreading northward. This study has promoted awareness of SDS in the state, which will aid breeders, growers and the industry in improving disease management.

Investigation of Potato Plant Resistance Mechanisms to Colorado Potato Beetles and Development of Resistant Varieties

DAVID DOUCHES

Awarded: \$66,000 over 2 years

Leveraged: \$95,142

The Colorado potato beetle is one of the most economically significant potato pests. Michigan growers are reporting high levels of resistance to the pesticide imidacloprid, without which controlling the beetle would be expensive and difficult. The purpose of this study is to provide growers with long-term, sustainable and environmentally conscious solutions that will allow the continued production of high-quality Michigan potatoes. **With funding from Project GREEN, researchers are monitoring the pest's status and change in resistance to insecticides, in addition to screening for resistance in various potato plant species.** They have found that, as long as growers continue to use a variety of control methods, insecticides can continue to play a major role in managing the pest. Researchers have identified several new, wild potato species with innate resistance to the beetle; crosses with these plants can improve breeding effectiveness. As part of an integrated pest management response, the development of inherently resistant potato varieties is under way, along with continuing research to find other sources of beetle resistance.

New Tools for Identifying Resistance to Potato Common Scab and Improving Disease Management

DAVID DOUCHES

Awarded: \$66,000 over 2 years

Michigan potato growers contend with potato common scab, a devastating disease that limits market quality and value. The best method of control is to leverage the resistance of host plants and to supply growers with a selection of scab-resistant varieties. Another need is a reliable means of assessing resistance in these cultivars. **Through funding from Project GREEN, researchers are currently field testing various lines, conducting genome-wide analyses and developing pathogen management strategies to help Michigan potato growers fight this disease.** Two locations were used to test the susceptibility of identified resistant strains: a commercial field with a history of severe scab infection and the MSU AgBioResearch Montcalm Research Center, which also has a high level of infection. After extensive trials, 24 plant lines with the highest level resistance are being grown for yield and quality testing. This project's monitoring and strategies will enable information-based decision making concerning the fate and management of high-risk fields.



Uptake of Pharmaceuticals by Crops from Soils Amended with Biosolids
HUI LI
Awarded: \$30,000

Pharmaceuticals have been defined as a class of contaminants of emerging concern because of their widespread presence in the environment and potential risks to human and ecosystem health. Large fractions (50 percent to 90 percent) of pharmaceuticals administered in animal feeding operations or as part of disease treatment remain in animal excrements, as does a portion of pharmaceuticals administered to humans. The subsequent application of biosolids (animal manures and sludges) to agricultural fields as fertilization and in irrigation systems that use reclaimed water introduces pharmaceuticals, along with nutrients and water, into agricultural soil and water systems. Research confirms that many plants absorb these pharmaceuticals. The consumption of pharmaceutical-laden produce could lead to changes in microbial communities in human intestinal tracts. **With support from Project GREEN, MSU researchers developed a sensitive and effective analytical protocol to identify and measure pharmaceuticals in plants and vegetables.** The results will advance the basic understanding of plant uptake of pharmaceuticals from water and soil, and lead to insights about the implications on human health.

Improved Michigan Soybean for Resistance to Sudden Death Syndrome
DECHUN WANG
Awarded: \$15,000
Leveraged: \$78,000

Sudden death syndrome (SDS), a disease caused by a soil-borne pathogen, reduced U.S. soybean production by more than 444 million bushels from 1996 to 2010. Yearly loss from the disease was estimated at over \$190 million. Sparking serious concern for growers, SDS caused more than 90 percent yield loss for a commercial soybean variety in 2011 at an MSU research plot. Fungicides are not an option—using SDS-resistant varieties has been recommended as the most important method of controlling the disease. **The outcome from this one-year project funded by Project GREEN paves the way for follow-up research to continue to improve soybean resistance to SDS.** After evaluating more than 300 germplasm lines for resistance and testing, researchers derived 500 progeny and selected five promising varieties for further evaluation. These targeted SDS-resistant varieties will work to protect soybean growers from yield losses and millions of lost dollars in damage from the disease.

A New Crop for a Variable Climate: Intermediate Wheatgrass Biology and Forage Potential
STEVE CULMAN
Awarded: \$29,900 over 2.5 years

Michigan forage producers can now consider intermediate wheatgrass for inclusion in their forage production systems. A project conducted by MSU researchers has found that intermediate wheatgrass holds promise as a high-yielding forage grass when planted in a solid stand as well as when planted with alfalfa. **With Project GREEN funding, researchers explored the suitability of intermediate wheatgrass during two field seasons and across three sites in Michigan to evaluate the performance of alfalfa-wheatgrass mixtures and to determine the effects of wheatgrass on forage quality and forage yield.** They found that intermediate wheatgrass grown with alfalfa can yield dry matter equal to or greater than orchardgrass. The researchers also assessed the effects of nitrogen fertilization on forage quality and forage yield. The two varieties of wheatgrass that were tested with increasing rates of nitrogen fertilization have shown a response to fertilization.

FRUITS

Components of Intensive Cherry Orchard Systems Development
GREGORY LANG
Awarded: \$77,600 over 2 years
Leveraged: \$2,884,977

Regional market demand for high-quality, locally produced sweet cherries is challenging the Michigan sweet and tart cherry industries. Traditional orchards producing fruit for processing markets are increasingly being augmented by new fresh market varieties planted at higher densities for intensive, high-value production. **This project is using funding from Project GREEN to examine individual factors critical to the establishment, development and early fruiting of intensive cherry production systems for sweet and tart cherries.** Promising production technologies such as dwarfing rootstocks, improved varieties and tree canopy architectures that facilitate partially mechanized harvesting will result in more consistent cropping, improved fruit quality and reduced pesticide use. Several Michigan growers are already adopting these strategies, and this research has served as a template for collaborating scientists around the world.



Developing Better Monitoring and Management Strategies for Obliquebanded Leafroller Populations in Michigan Tree Fruit
JULIANNA (TUELL) WILSON
Awarded: \$76,000 over 2 years

Obliquebanded leafroller (OBLR) is a significant pest in Michigan tree fruits, causing direct damage to apples and showing up as a contaminant at harvest in cherry cooling tanks. Despite the dramatic crop loss in 2012, which lowered pest populations, OBLR is expected to rebound, and insecticide resistance is playing a major part in helping the pest to return. Control of this pest requires accurate timing and effective insecticides. **With funding from Project GREEN, MSU researchers support the long-term sustainability of Michigan cherry and apple production by providing growers with reliable phenology models, insect monitoring and an insecticide-resistance management plan.** The scientists tested several lure bait doses to reduce monitoring costs and developed a database of pesticide resistance. All findings contributed to growers' knowledge and management strategies for one of the country's largest producers of apples and tart cherries

Development of DNA Probes for Rapid Detection of SDHI Fungicide Resistance in Apple and Stone Fruit Pathogens

GEORGE SUNDIN

Awarded: \$79,800 over 2 years
Leveraged: \$26,430

The tree fruit industry in Michigan relies heavily on fungicides to control major diseases such as apple scab, cherry leaf spot and American brown rot. The transition from broad-spectrum fungicides to single-site fungicides increases the risk of crops developing diseases. With only three to five effective fungicide modes of action available for management of major diseases, fungicide resistance significantly reduces the number of tools available to growers. **Researchers used Project GREEN funds to address this need by working to develop a biochemical detection system for reduced sensitivity to a specific class of fungicides, allowing them to perform detection assays and inform growers quickly.** Understanding the evolution of fungicide resistance to this particular class of fungicides—SDHIs—is critical to ensuring that they remain viable disease treatments. Genetic studies and the development of probes for rapid resistance detection are important to resistance management and Extension efforts. Enhanced screening and rapid detection will make up a critical component of fungicide resistance management to protect these fungicides for the long-term control of diseases in apple and cherry trees.

Development and Delivery of Digital Media-based Extension Programming for Tree Fruit Disease Management

GEORGE SUNDIN

Awarded: \$50,000 over 2 years

With more than 109,000 acres of orchards valued at more than \$363 million, Michigan is the leading producer of tree fruits in the Midwest. Time constraints and methods of delivery can be challenges to keeping orchard growers up-to-date with the latest fruit tree disease management information. **To address this issue, Project GREEN funds were used to help create a library of tree fruit disease management videos posted online and publicized through Michigan State University Extension channels. Concept-driven tree fruit disease companion documents focusing on critical disease management topics such as fungicide resistance management are also being created.** The tree fruit pathology educational video site has shown success in providing needed information on disease control to tree fruit growers and others in the tree fruit industry in a format that is accessible by growers at any time through the internet.

Development of an Attract-and-kill Lure for the Oriental Fruit Moth

MATTHEW GRIESHOP

Awarded: \$50,000 over 2 years
Leveraged: \$181,759

Concerns about worker and food safety, environmental contamination and insecticide resistance make the development of new forms of pest management that mitigate these issues an important priority. This is especially true for high-value specialty crops such as apples and peaches, where pest complexes require multiple insecticide applications. The Oriental fruit moth (OFM) is a key pest of peach, pear and apple worldwide, capable of reducing crops by up to 50 percent. **With support from Project GREEN, MSU researchers are developing an insecticide-based attract-and-kill lure to help producers manage OFM.** The device is a modification of mating disruption but is more effective because of the addition of a lethal component. Because it uses fewer point sources than mating disruption, it significantly reduces grower costs. The research team is engaged in related research projects testing this approach against obliquebanded leafroller and Japanese beetle.

Intra- and Extracellular Signaling and Regulation of Pathogenicity in *Erwinia amylovora*

GEORGE SUNDIN

Awarded: \$70,000 over 2 years
Pending leverage: \$500,000

Fire blight, caused by the bacterium *Erwinia amylovora*, seriously limits apple production in Michigan. Losses during epidemics due to yield loss and tree death can be economically devastating to orchard owners. The disease is particularly difficult to manage, and there are no known sources of host resistance. The apple and pear industries desperately need new, non-antibiotic-based methods for controlling fire blight. **MSU researchers used Project GREEN funds to learn more about host-pathogen interactions in the fire blight pathosystem in order to identify and pursue pathogen targets and create potential long-term disease control strategies for fire blight in apple and pear trees.** This research will be used as a baseline to pursue additional funding to help save these major tree fruit industries.



CUTTING EDGE MSU CENTER'S EXPERTISE SUPPORTS MICHIGAN AGRICULTURE AND AGRICULTURAL RESEARCH



Vance Baird and Guo-Qing Song

Advances in technology help drive research in many scientific fields. With funding from Project GREEN, the **MSU Plant Biotechnology Resource and Outreach Center** (PBROC) has used technology to its advantage to help MSU researchers and Michigan growers. The center focuses on two areas of expertise: micropropagation and transformation/regeneration systems.

“Nurseries often don’t have the capabilities to create thousands of very small plants, called plantlets,” explained **Vance Baird**, director of PBROC and chair of the MSU Department of Horticulture. “Through micropropagation, our center can accomplish this, all while verifying that the plantlets are the correct cultivar and are virus- and disease-free.”

Micropropagation is the practice of rapidly multiplying plant material in sterile culture to produce a large number of plantlets that then grow into full-size plants. Usually, these plantlets mature in commercial nurseries; from there, they are sold to growers who plant them in fields, orchards or landscapes.

These plants offer the benefit of having been developed with specific characteristics through conventional plant breeding and selection methods. In contrast, propagation by seeds (sexual propagation) sometimes results in a loss of this uniformity and takes much longer to complete.

Examples of the center’s micropropagation work include assistance to requests from organizations such as MBG Marketing, a Michigan

producer-owned blueberry-marketing cooperative, and nurseries that have been licensed to sell plants of new blueberry varieties. They have asked for PBROC’s help in creating thousands of plantlets from five or six cultivars.

“These are not genetically modified plants or ones that have undergone any molecular transformation,” Baird explained. “We take plants and, from their original genotypes, can propagate them, being absolutely certain that we are providing nurseries with the correct varieties.”

Baird explained that PBROC is also on the cutting edge of developing new transformation and regeneration systems for specialty crops. These systems provide a way for efficient gene transfer within plant types and ensure a mature, fertile plant in the end.

“PBROC has gained a reputation as the ‘go-to player’ for crop systems that are difficult for others to develop,” he said.

Guo-Qing Song, PBROC associate director and an associate professor in the MSU Department of Horticulture, specializes in this technology and works to develop transformation and regeneration systems for emerging or recalcitrant crops (plants whose seeds die when they are dried). “There are already transformation systems for staple crops such as rice, soybeans and corn, but not many groups are working on transformation systems for specialty crops, especially the ones that are important to Michigan agriculture,” Song said.

Song explained that once the transformation system for a specific crop is developed, researchers can take several steps to advance the plant, including improving its quality, cold tolerance or some other attribute the agriculture industry is interested in. This process generally involves modifying or adding genes to the plant. Examples of transformation systems that PBROC has created include ones for blueberries, cherries and celery.

In addition to providing these services to Michigan’s agricultural community, PBROC also engages in outreach. One recent conference was for Master Gardeners to bring them up to speed on current plant technologies. The center has also hosted scientists from around the world to share technology and communicate its appropriate use and value to agriculture in their countries as well as in the United States.

“This work with international researchers is important because Michigan agriculture does business in an international world,” Baird said. We believe we’re helping both plant agriculture in general and Michigan industries in particular with this outreach. We also believe we’re helping our own faculty members develop beneficial and long-lasting collaborations with these international researchers, which in turn helps Michigan agriculture.”

Plant Biotechnology Resource and Outreach Center

- Approximately 80 percent of the base budget for PBROC comes from Project GREEN; the Department of Horticulture and project contracts cover the remaining costs
- The center provides contract services for tissue culture, micropropagation, transformation and molecular fingerprinting
- PBROC researchers deliver training in environmental biosafety of genetically engineered crops and molecular plant breeding

Redesigning Viticulture and Enology Extension Through the Effective Use of Electronic Technology

LARRY OLSON AND PAUL JENKINS

Awarded: \$17,000 over 1.5 years

A growing portion of the MSU viticulture and enology Extension audience is seeking information electronically. Electronic media are particularly valuable in helping with mental imagery and are essential for conceptual learning. **To meet the needs of stakeholders and provide an alternative way of delivering information for increased impact, this project, supported by Project GREEN, seeks to develop key educational videos, webinars, a website and mobile applications for new grape and wine producers.** Videos on common insect and disease pests were developed, along with a completely redesigned website with improved function and format, and three webinars were conducted. Impact data are being gathered on these measures, which have great future potential to assist grape and wine producers in managing their crops with the aid of a real-time network of experts.

Optimizing Controlled Atmosphere and Air Storage of Honeycrisp Apples

RANDOLPH BEAUDRY

Awarded: \$18,000

Leveraged: \$135,500

Honeycrisp is the most profitable apple, on a per fruit basis, grown in Michigan. As the planted acreage increases dramatically each year, the need to extend the marketing season intensifies. However, high sensitivity to storage disorders—including chilling injury and controlled atmosphere (CA) injury—poses a serious risk to successful storage of Honeycrisp apples. **Through Project GREEN-funded studies, researchers determined that apple storage operators can use a three-day prestorage holding period to protect Honeycrisp apples from CA injury without increasing risk of other storage disorders and with minimal impact on fruit flavor.** The findings demonstrate that Honeycrisp apples can be safely stored in CA if they are preconditioned properly, thus extending the marketing season and protecting the value of the harvested crop beyond its normal marketing period.



LANDSCAPE & NURSERY

Teaching, Researching and Demonstrating Encapsulated Soil Lift Techniques at the W.K. Kellogg Biological Station (KBS)

JANE HERBERT

Awarded: \$8,275 over 2.5 years

Leveraged: \$7,010

Michigan’s landscape and native plant nursery industries are positioned to capitalize on a growing interest in lake-friendly and aesthetically pleasing designs that restore fish and wildlife habitat, reduce pollutant runoff, deter geese, and stabilize soils against wind, waves and ice action. To avoid the loss of shoreline and littoral zone habitat and to further explore this growing industry, plant-based, bioengineered erosion control techniques were employed at the KBS Shoreline Management Demonstration Area. The purpose of this project was to enhance the educational value of the area through construction, maintenance and demonstration of traditional and prefabricated encapsulated soil lifts. **With Project GREEN support, MSU researchers conducted a one-day, hands-on workshop, which resulted in the construction of two types of encapsulated soil lift structures that were monitored for three years.** Nineteen landscape professionals from across Michigan gained skills at this workshop that will help them accommodate growing “lakescape” needs among their customers.

Insecticide Resistance Management of the Greenhouse Pest Western Flower Thrips

DAVID MOTA-SANCHEZ

Awarded: \$75,000 over 2.5 years

Leveraged: \$47,000

The greenhouse industry in Michigan is worth more than \$612 million. The western flower thrip (WFT) causes severe damage to greenhouse plants and is responsible for the transmission of devastating plant viruses, including the tospoviruses. Failure to control this pest threatens to compromise greenhouse production across the state—a concern because only a small number of insecticides can control WFT, and it is now demonstrating resistance to some of those. **With assistance from Project GREEN, MSU researchers initiated this project to develop improved pest control strategies that prevent WFT crop losses.** Researchers have identified compounds that are ineffective in controlling WFT, thus helping producers to save millions of dollars in insecticide costs and crop losses. They have also uncovered the nature of WFT resistance to several key insecticides. A visiting scientist from Turkey, who is an expert in WFT, is partnering with MSU scientists to compare patterns of insecticide use and resistance in Turkey with patterns observed in Michigan.

Developing the Retired Floriculture College of Knowledge Program into an Online Format for Michigan’s Floriculture Industry

KRISTIN GETTER

Awarded: \$17,500 over 2 years
Leveraged: \$8,500

According to the National Agricultural Statistics Service, Michigan’s floriculture industry has more than 600 producers and a wholesale value of \$402 million. Even though this is the third largest in the nation, most growers are experiencing the effects of the recession. Educating growers about the best sustainable production practices using low-cost training opportunities has potential to improve the overall economy of the floriculture industry. **With the support of Project GREEN, greenhouse growers all over the country can now improve their knowledge and skills in the production of floriculture crops by enrolling in the online Floriculture College of Knowledge.** In the past year, nine growers from eight states have paid for and completed the course; pre- and post-assessment quiz scores demonstrate a marked improvement in content mastery.

Urban Tree Selection in a Changing Climate

BERT CREGG

Awarded: \$70,300 over 2 years
Leveraged: \$103,474

Climate change will add to stresses that already affect the health and lifespan of urban trees. Selecting trees with a high capacity to acclimate to increased temperatures, such as oaks, will contribute to increased success of urban and community tree plantings. **With support from Project GREEN, MSU researchers conducted intensive greenhouse trials to determine which types of street trees could acclimate to increased temperature. They then established long-term plantings to compare the ability of shade tree varieties to acclimate under a variety of urban conditions.** The study demonstrated significant differences in the ability of street tree cultivars to acclimate to increased temperatures, and suggested that the former practice of moving southern trees north may not be beneficial because of Michigan’s harsh winters. Research suggests that a more sophisticated model that accounts for variation in the capacity of species or cultivars to acclimate to changing conditions may be more fruitful.

Improving Productivity of Urban Gardens in Three Michigan Regions Through Education and Outreach Using Information Compiled Through Field and Greenhouse Research

MARY HAUSBECK

Awarded: \$2,700

Urban garden growers are leading the charge in cities such as Detroit and Lansing to improve the landscape, build community, stimulate economic development, and provide a valuable food source for growers and local foodbanks. Surveys in Detroit have shown widespread support for these urban gardens; Lansing gardening groups support more than 90 community gardens and 400 home gardens, which equate to more than 7,000 people who have access to fresh herbs and vegetables during the growing season. Because many urban growers lack agricultural backgrounds, disease identification and management become top priorities in improving garden yields. **This Project GREEN research addresses the need to educate urban growers on vegetable diseases and management practices that improve garden productivity.** MSU researchers developed a 36-page color pocket guide of common vegetable diseases; they are distributed to urban growers in interactive workshops. Workshop participants learned to identify common garden diseases, suitable management strategies and small-scale practices that ward off disease. These growers could then access the resources of MSU and other land-grant universities through the printed guide and online materials this project produced.

Development of Non-destructive Technologies for Rapid Early Detection of Emerald Ash Borer

SOPHAN CHHIN

Awarded: \$14,750
Leveraged: \$50,367

Emerald ash borer (EAB) can infest trees for years before any external signs, such as D-shaped exit holes in bark, are visible. Given the rapid spread of EAB since its identification in 2002, the ability to develop cost-effective, regional-scale approaches for previsual infestation identification is necessary to reduce the risk of EAB infestations in adjacent regions. **With funding from Project GREEN, researchers are working to promote the application of three key non-destructive technologies that will allow rapid and early detection of EAB.** This project will lead to portable field-based devices that will incorporate acoustic tomography, infrared thermal imaging and near infrared spectroscopy to promote early detection of EAB.



OTHER CROPS

Latitudinal Transect Bioenergy Research Plots

DENNIS PENNINGTON

Awarded: \$15,000 over 2 years

Leveraged: \$143,096

Michigan's climate and soil are conducive for bioenergy crops, and as the pressure mounts to meet energy mandates, Michigan growers have become more curious about how to produce them. Data on local growing conditions and market infrastructure are essential to helping growers determine whether to plant energy crops and how to identify crops best suited for their land, location and goals. **To address this need, with support from Project GREEN, MSU researchers are working to provide a resource for and expose producers to potential energy crops.** Switchgrass, miscanthus, two energy sorghums and oilseed crops were tested at incremental latitudes on six research plots scattered across Michigan. Over a three-year period, 312 individuals viewed these plots during educational tours on agronomics and learned about the benefits and challenges of growing each crop. An additional 740 participants attended biodiesel demonstrations, where surveys revealed that the most common factor in determining whether to produce biodiesel crops on a farm was the economics of production. Surveys also revealed an increase in growers' knowledge and likelihood of investing in bioenergy crops.

Contamination and Removal of Engineered Nanoparticles on Fresh Produce Surfaces

WEI ZHANG

Awarded: \$39,900

Pending leverage: \$499,307

Agricultural nanotechnology is being developed to improve agricultural productivity and sustainability that will promote plant and animal production. Once perfected, this technology will allow healthy, effective and sustained delivery of agrochemicals (e.g., pesticides) and rapid detection of contaminants such as pesticide residue and microbial pathogens. Engineered nanoparticles (ENP) could potentially contaminate fresh produce and create a food safety issue. To address this, **MSU researchers used Project GREEN funding to generate preliminary data to support a proposal to the USDA Food Safety program.** Upon USDA approval, research is planned to learn how ENPs affect fresh produce surfaces throughout various production stages and to design effective washing procedures to removal the food-contaminating ENPs, with an emphasis on the processing stage.



TURF

Effects of Higher Polyamines on Abiotic Stress Tolerance of Creeping Bentgrass

EMILY MEREWITZ

Awarded: \$27,700

Leveraged: \$20,000

The U.S. turfgrass industry generated \$124.6 billion in 2005 and continues to be a major source of economic viability and growth. Michigan creeping bentgrass is widely used on golf courses and athletic fields, but it is susceptible to stresses such as drought, temperature and salt. Polyamines within plants have been shown to promote tolerance to these stresses and deserve investigation, particularly in connection with the effects of drought. **With funding from Project GREEN, researchers successfully quantified polyamines in bentgrass, and preliminary results indicate that they may play a major role in drought response.** A better understanding is needed, but the impact of tolerant germ plasm could mean a significant savings in water costs and reduced need for herbicide and fungicide treatments. Additionally, turf could be drier, firmer and greener, thus meeting the high demands of the industry.

VEGETABLES



Improving Michigan Pepper Production through Identification of Genetic Resistance to *Phytophthora capsici* and Development of Field Control

MARY HAUSBECK

Awarded: \$64,000 over 2 years
Leveraged: \$26,883

Growers in Michigan’s \$13.9 million bell pepper industry face the increasing pervasiveness of a deadly crown, fruit and root rot caused by the fungal-like pathogen *Phytophthora capsici*. Commercial peppers are poorly engineered to combat such a persistent pathogen and its resistance to key fungicides. Tomato, cucumber, squash, pumpkin, melon and snap bean plants are also susceptible to the pathogen. **With funding from Project GREEN, MSU researchers identified sources of resistance to fruit and root rot in peppers and tested newly released fungicides.** They found that soil-applied fungicide applications were more effective than fungicides applied to the foliage and stem, significantly reducing plant death. Development of lab-based assays will also serve to help pepper breeders develop hardier strains. Both findings amount to estimated savings of \$1.4 to \$17.9 million in annual crop losses. Results and data gathered from this study were shared with growers and industry representatives and published in several peer-reviewed publications.

Developing an Integrated Pest Management Strategy for Cabbage Insect Pests in Michigan

ZSOFIA SZENDREI

Awarded: \$44,000 over 2 years
Leveraged: \$7,706

Applications of broad-spectrum insecticides continue to be the foundation of conventional cabbage insect pest management, despite the growing number of narrower spectrum products on the market. Part of the reason is the price differences between old and new insecticides. The lack of adoption of new products and technologies shows a clear need for research and education in integrated pest management techniques for Michigan cabbage growers. **With Project GREEN funding, researchers were able to give cabbage growers new information on insecticide alternatives for pest management and the impact that they have on beneficial insects.** Researchers found that pest control in cabbage fields can be more effective if growers preserve beneficial insects with the new insecticides used in the study.

A Statewide Partnership to Detect and Track Downy Mildew on Cucurbits

MARY HAUSBECK

Awarded: \$44,100 over 2 years
Leveraged: \$43,500

Cucumbers are worth \$51.6 million to Michigan producers, and when melons, pumpkins and other cucurbits are added, the total value was \$86.1 million in 2013. These crops are threatened by downy mildew (DM), which is quick moving and catastrophic. The spore arrival of DM in Michigan is the first step of infection—early identification is critical. **Project GREEN researchers used spore traps to monitor the influx of DM in the state and established websites to inform growers of weather conditions favorable to disease development and spread.** With aggressive fungicide use, DM management has climbed to a \$6.4 million expense, narrowing the profit margin for growers. Growers use this tracking system to initiate and time their fungicide sprays, saving on costs and helping prevent fungicide resistance.



Improving System-wide Nitrogen Use Efficiency in Sweet Corn Through Better Nutrient Placement

DANIEL BRAINARD

Awarded: \$62,200 over 2 years
Leveraged: \$285,131
Pending: \$713,932

Sweet corn growers typically supply the crop’s nitrogen needs in three applications: before, during and several weeks after planting. Researchers at MSU found that replacing the initial broadcast application with banded or deep placement puts nitrogen closer to developing roots, where it has a greater chance to be taken up by the crop rather than lost to the environment. **With assistance from Project GREEN, researchers were able to improve system-wide nitrogen use efficiency in conventional and organic sweet corn production systems using cover crops, reduced tillage and banded nitrogen placement.** The results demonstrate that both systems have potential to increase nitrogen use efficiency, improve profitability and reduce nitrogen loss to the environment.

Improving Carrot Profitability through Integration of Slow-release Nitrogen Fertilization and Strip-tillage

DANIEL BRAINARD

Awarded: \$41,400 over 2 years
Leveraged: \$14,000

Nitrogen management in carrots is expensive and energy-intensive and can have large impacts on carrot quality and yield. Most growers currently broadcast urea three or four times during the season, but slow-release nitrogen products that are surface-applied or deep-banded during strip-tillage may reduce or replace side-dress applications. **With support from Project GREEN, researchers demonstrated that slow-release polymer-coated urea can reduce the number of tractor passes needed for fertilization while maintaining carrot quality and yield.** Fewer side-dress applications can reduce fuel and labor costs and limit the adverse effects of soil compaction from multiple tractor passes. Slow-release nitrogen may also reduce fluctuations in soil nitrogen. Results are improved carrot quality, improved harvest efficiency and increased revenues.

VEGETABLE, GRAIN CROP RESEARCH SUPPORTS LONG-TERM PROFITABILITY OF MICHIGAN CORN GROWERS



Corn is an important Michigan crop, and two Project GREEN projects support its long-term profitability by boosting yield and capitalizing on its added-value qualities. **Dan Brainard**, MSU associate professor of horticulture, is working to make nitrogen use more efficient for sweet corn growers. **Paul Gross**, MSU Extension educator in Isabella County, is helping to refine best management practices for harvesting corn stover.

“Nitrogen inputs are important costs for growers, but they are necessary to maintain or improve yields,” Brainard explains. “If we can find ways to help reduce nitrogen costs and also maintain or improve yields, it can improve profitability for corn growers while reducing negative impacts on the environment.”

Using Project GREEN funding, Brainard, aided by two graduate students—Carolyn Lowry and Erin Haramoto—has worked with a cover crop called hairy vetch that can be used by both conventional and organic sweet corn growers. Hairy vetch is winter-hardy and fixes nitrogen in the soil. It is grown before the sweet corn is planted to put atmospheric nitrogen into the soil. Brainard has evaluated hairy vetch alone and in combination with zone tillage. In the zone-tillage system, vetch is planted and incorporated only in the root zone where the sweet corn will grow.

“Putting the vetch only in the zone where you are tilling means there is less risk of it coming back as a weed,” Brainard said. “This potentially lowers costs because growers don’t have to buy expensive commercial nitrogen fertilizers.”

The project has shown equivalent or greater sweet corn yields than past plantings. A second, environmental advantage is that the amount of nitrogen being released into the environment may be reduced.

Gross is looking at a different aspect of corn production that can help growers increase profits. His work focuses on corn stover, the leaves and stalks of the corn plant left in the field after the corn harvest. Stover has increased in value in recent years because of its possible use as a feedstock for cellulosic ethanol production.

Gross’s research explores various harvesting methods for corn stover—round bales versus square bales, and whether the stover could be harvested right behind the combine or cut, then raked and baled.

“One of the most important things we discovered is that the more you handle the stover, the more expenses you have, therefore reducing its profitability,” Gross explained. Additionally, the likelihood of soil getting mixed into the stover increases the more it’s handled, especially when it’s cut and raked. This can further decrease its value, especially for the fermentation process.

Gross points out that Brainard’s work with a cover crop is helpful because the cover crop may enable growers to pull off a little more stover and still retain soil health.

“By adding a cover crop, growers might be able to take 30 percent more stover every year,” Gross said.

Successfully managing stover is becoming increasingly challenging in Michigan.

“Because corn yields in the state are continuing to increase, the amount of stover is increasing, so managing tillage and the residue is important to have good planting conditions for the next year,” said Gross, whose work was done with field corn on a farm near Rosebush, Michigan.



LEFT: Dan Brainard, MSU Associate Professor of Horticulture
RIGHT: Paul Gross, MSU Extension Educator in Isabella County.

“Project GREEN is tremendously valuable to the agriculture industry in Michigan because it invests in research that needs to be done,” Gross said. “The real value of GREEN is that the knowledge generated will be for the common good of the agriculture industry.”

These two projects show the breadth of Project GREEN, said Stephen B. Lovejoy, former associate director of programs for MSU Extension and professor of agricultural economics.

“The project by associate professor Brainard is focused on the efficiency of inputs, thereby providing the opportunity to reduce production input costs and protect the environment from excess nitrogen,” Lovejoy explained. “The Gross project is focused on the other end of the production process by evaluating the potential market for non-grain products (residue), while still providing adequate environmental protection of the soil surface from rainfall and erosion. Both projects are consistent with the priorities of the corn industry.”



ACADEMIC INFRASTRUCTURE REPORTS

Project GREEN invests in Michigan State University departments, specialized programming and MSU Extension. In turn, scientists and educators lead research and Extension programs that help producers, agriculturists, entrepreneurs and others.

“PROJECT GREEN NOT ONLY ALLOWED ME TO BE HIRED INTO THE DEPARTMENT BUT ALSO ENABLED ME TO ESTABLISH A MSU TURF PHYSIOLOGY RESEARCH PROGRAM. WE’VE USED THIS SUPPORT TO FUND RESEARCH WITH THE POTENTIAL TO IMPROVE THE EFFICIENCY AND SUSTAINABILITY OF TURFGRASS MANAGEMENT ON GOLF COURSES AND ATHLETIC FIELDS THROUGHOUT MICHIGAN.”

EMILY MEREWITZ

ASSISTANT PROFESSOR, MSU DEPARTMENT OF PLANT, SOIL
AND MICROBIAL SCIENCES

THE DEPARTMENT OF AGRICULTURAL, FOOD AND RESOURCE ECONOMICS

Project GREEN funds allowed professionals in this department to collect data for two major projects: the first aims to understand the economics of third-party food certification; the second explores local government finance/taxation, and their implications, for local producers. Project GREEN support also enabled them to develop a series of economic models related to both projects.

The MSU Product Center, which this department houses, used Project GREEN support to provide business counseling for venture start-up and acceleration in food, agriculture, natural resources and bio-based products. Additionally, professionals in the center created nutritional labels and provided pH/water tests to more than 150 Michigan businesses.

In 2013-14, the MSU Product Center:

- Conducted 4,947 counseling sessions with more than 580 clients.
- Aided 259 groups in the venture start-up process; helped 72 move to launch.
- Helped Michigan businesses create or retain 208.5 jobs.

THE DEPARTMENT OF BIOSYSTEMS AND AGRICULTURAL ENGINEERING

Project GREEN funding gave professionals in this department the opportunity to mentor 72 students in instrumentation, environmental monitoring and project management, and to conduct work that led to the development of new methodologies to monitor water tables in irrigated croplands. Researchers were also able to provide instrumented data to a newly developed model that will work to identify black spot in chipping potatoes.

In addition, Project GREEN dollars were invested in:

- Collecting data for a soybean white mold monitoring system.
- Managing data to quantify the impact of environmental variables on potato plant disease.
- Refining wastewater remediation methods on treated croplands.
- Optimizing an instrumented data collection system for high-pressure canning systems in Michigan food industries.

THE DEPARTMENT OF
ENTOMOLOGY

Project GREEN infrastructure dollars supported the development, delivery and adoption of integrated pest management (IPM) for insect and nematode pests of forests, medical entomology, organic agriculture, small fruit, field crops, tree fruit, turfgrass and greenhouse crops, and vegetables. These efforts resulted in the reduction of pesticide applications throughout Michigan and an increase in growers’ profits.

Through MSU research and Extension programs, the department delivered information to IPM practitioners in readily accessible forms. The IPM program was also able to build public interest and understanding of IPM and collaborate in activities encouraging adoption of IPM practices.

Some of the department’s other accomplishments through Project GREEN funding included:

- Addressing emerging issues such as spotted wing drosophila and brown marmorated stinkbug.
- Evaluating alternative delivery systems for crop protection materials.
- Investigating and communicating the safety threat of greenhouse-grown and nursery-grown plants to pollinators.
- Making progress in understanding and managing colony collapse disorder in honeybees.
- Supplying important IPM information to more than 130,000 visitors across four websites.

THE DEPARTMENT OF
FOOD SCIENCE AND HUMAN NUTRITION

Project GREEN support is critical in maintaining the department’s ability to provide pilot-scale processing, research and development for Michigan growers and plant commodity groups. Most of the machinery and equipment in the Fruit and Vegetable Lab is more than 30 years old. Without Project GREEN funding, lab managers would not be able to maintain and service this lab’s aging equipment. Project GREEN support also enables the department to build partnerships with processing companies such as ConAgra Foods, Kenya-based BlueSkies and Michigan-based Burnette Foods, among others.

Project GREEN funding is critical to the department’s mission and ability to create outreach and product testing opportunities for up-and-coming Michigan entrepreneurs.

In 2013-14, other projects that benefitted from Project GREEN funding were:

- Improving canning quality of Michigan bean breeding lines.
- Creating value-added dried products from apple processing waste.
- Providing pilot plant support to Michigan chestnut growers.
- Other small projects supporting producers and commodity groups.



THE DEPARTMENT OF
FORESTRY

With funding from Project GREEN, the department was able to provide critical infrastructure support for the MSU AgBioResearch Tree Research Center and projects based there. The funding allowed researchers to maintain the 60-acre hybrid poplar bioenergy plantation that will supply the MSU power plant with wood chips, a renewable energy source. This operational-level project will be an important testing ground and demonstration site for other landowners who hope to use marginal agricultural land for wood-based bioenergy production.

Other projects benefitting from Project GREEN funding:

- Bioenergy supply chain and logistics.
- Treatment options for and variation in ash species resistance to emerald ash borer.
- Tree seedling responses to biochar amendments.
- Improved Scotch pine for Christmas trees.

THE DEPARTMENT OF
GEOGRAPHY

The use of the Enviro-weather website (enviroweather.msu.edu) continues to grow. Since its launch in 2006, data requests and visitor hits have grown from fewer than 500 per day to an average of 7,100 per day over the past year, an increase of more than 1,400 percent. Although resource limitations prevent unrestricted growth, targeted expansions continue. One new station was established in Dowagiac, Michigan, and is one of seven regional test sites for a new leaf-wetness sensor that will supplement Enviro-weather’s current pest and disease models. There are now 79 active, automated weather stations in the network.

Some accomplishments made thanks to Project GREEN funding include:

- Enviro-weather staff members participated in more than 30 conferences, workshops, meetings and symposiums in 2013 and early 2014, giving presentations and updates, presenting posters and distributing materials to educate users about the availability and benefits of Enviro-weather.
- Data-collection software to aid in disaster recovery was installed on a virtual machine, creating added security.
- Enviro-weather staff members partnered with nine major agricultural commodity, public policy and commission groups to deliver sustainable weather-based information to the public.

THE DEPARTMENT OF
HORTICULTURE

The MSU AgBioResearch Horticulture Teaching and Research Center conducted 98 research projects on its 180 acres, thanks to funding from Project GREEN. The facility is a prime location for research and outreach-related activities because of its close proximity to the MSU campus and its varied soil types.

The teaching orchard plantation is imperative to conducting a federally funded study on solid-set delivery of crop protection chemicals—a project led by an interdisciplinary team of scientists from Michigan State University, Washington State University and Cornell University. The researchers’ long-term goal is to help growers better manage chemical inputs, improve pest and crop management, and reduce labor and fuel costs, thereby enabling tree fruit producers to remain globally competitive and environmentally responsible.

- More than 40 other projects benefited from Project GREEN funds, including:
- Developing best management practices for growing vegetables on green roofs.
 - Emerald ash borer and log storage research.
 - Improving the quality of grapevines for economic and sustainable production in Michigan.
 - Improving the sustainability of wholesale production nurseries.
 - Organic high tunnel fruit research.
 - Soybean cysts and nematode control studies.
 - Student Organic Farm year-round farming and organic farmer training program.
 - Tree transplant and rootstock research; examining urban trees in a changing climate.
 - Weed control studies for fruit, vegetable and grain crops.
 - Worm composting and composting campus food scraps for cycling nutrients.

THE DEPARTMENT OF
PLANT BIOLOGY

Project GREEN funds were used to provide information technology (IT) support for several large genomics and bioinformatics projects. Several faculty members in the department conduct research that uses bioinformatics and genomics and rely heavily on the use of servers for computation. Because of the specialized programs used in this research, they cannot use the university computing facility and must maintain their own. More than half of the IT person’s time is spent working with faculty members and maintaining the infrastructure that allows them to conduct their research.

With the help of Project GREEN infrastructure funding, the Department of Plant Biology allocated funds to IT support that has allowed faculty members to generate more than \$10 million in external research grants that meet Project GREEN objectives and priorities.

THE DEPARTMENT OF
PLANT, SOIL AND MICROBIAL SCIENCES

Funds from Project GREEN allowed for the expansion of irrigation systems at the department’s agronomy and plant pathology farms. The increased water capacity enables more experiments to be irrigated simultaneously and with fewer mineral deposits, significantly decreasing experimental variability. The new system also allows researchers in this department to establish a long-term vineyard on campus, creating more opportunity for research and reducing travel expenses.

- More than 30 other project areas benefited from Project GREEN funding, including:
- Potato and dry bean breeding.
 - Weed science.
 - Wheat, oat, barley, soybean and canola breeding.
 - Soils science and modeling.
 - Forages.
 - Plant pathology.
 - Vegetables.
 - Field crops.
 - Groundwater stewardship.
 - Christmas trees.
 - Master Gardener Program.



OUTREACH AND EDUCATION THROUGH MSU EXTENSION

Thanks to Project GREEN funding, MSU Extension educators throughout the state conduct on-farm research and outreach education related to key issues that affect Michigan producers.

- In intensive cropping systems, management of inputs plays a key role in ensuring optimum yields. MSU Extension educators investigated ways to increase corn yields by increasing planting densities using climate-tolerant hybrids and various nitrogen management strategies. Their data allowed them to determine best management practices that promote sensible fertilizer management and good environmental stewardship.
- Spotted wing drosophila (SWD), the pesky insect that began invading Michigan in 2010, can cause major economic damage to fruit crops. In 2013, MSU Extension researchers and educators used Project GREEN funding to trap and track SWD. They shared their findings with stone fruit and berry producers so they could adjust their insecticide treatments accordingly. Thanks to this work, Michigan fruit growers report that they were able to improve the timing of insecticide applications. Though the presence of SWD means that many fruit growers increased their applications to the tune of \$945 per farm, 80 percent of growers said that they treated their crops only when the trap catch showed an increase of SWD in their region. Fifty percent did not spray when the catch was low.
- Poor soil conditions and the harsh climate in northern Michigan and the Upper Peninsula make it difficult to grow traditional field crops. That’s what spurred MSU Extension researchers and educators to look at the feasibility of growing malting barley, a key crop used in the state’s flourishing craft brewery industry. The group compared the performance of several commercial malting barley varieties and measured their harvest quality and yield. This project helped researchers begin to build good agronomic recommendations for growers throughout the region and laid the groundwork for further research.

- American chestnuts, once wiped out by disease in Michigan, are making a comeback. Thanks to Project GREEN funding, MSU Extension researchers created cost-of-production and comparative analysis tools that will help new producers determine best management practices for growing this high-value crop. Their work has the potential to help existing chestnut growers increase profits, and to help other farmers determine if diversifying their orchards by including chestnuts is a sound economic idea.

KEEPING EDUCATORS ON THE ROAD

Two MSU Extension educators who work with key plant agriculture industries received operating funds from Project GREEN.

Jill O’Donnell provides leadership for planning, developing and delivering educational programs that emphasize integrated crop management practices in Christmas tree and nursery production.

Mark Seamon supports the developing bioeconomy through his work as an MSU Product Center innovations counselor. In addition, he conducts field research and educational programming on bioenergy crop production.

SUPPORTING DIGITAL COMMUNICATION

Project GREEN funding helps support the dissemination of MSU Extension Digests. These electronic newsletters, which replaced the popular Crop Advisory Team (CAT) Alerts, help keep farmers, horticulturists, landscape professionals, gardeners, turf professionals and others current on information relevant to their businesses. As of July 2014, nearly 10,000 people have subscribed to digests in more than 50 content areas, eight of which focus specifically on plant agriculture.

The articles also appear on the MSU Extension website (msue.msu.edu) and are reprinted by hundreds of media outlets each month.



MSU Extension Public Value Statements

SUPPORTING FOOD AND AGRICULTURE

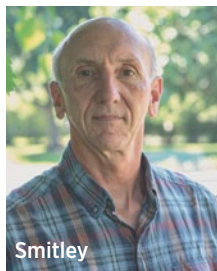
When you support MSU Extension, you help participants learn profitable and efficient business and production practices. Participants also learn how to diligently optimize and reduce the use of pesticides and fertilizers, and how to conserve and protect water resources. This education leads to better use of time, money and human capital, and helps retain and create agricultural jobs. These measures strengthen Michigan’s economy while connecting farmers to local food opportunities and global markets. In this way, you help MSU Extension encourage growth in a sustainable and prosperous Michigan food and agriculture system.

KEEPING BUSINESSES STRONG

MSU Extension and the MSU Product Center help Michigan entrepreneurs develop and commercialize high-value, consumer-responsive products and businesses in the food, agriculture, natural resources and bioeconomy sectors. When you support MSU Extension programs, you help participants understand the economic, environmental and social benefits of purchasing local and regional foods. You also help young people develop business skills that will help them succeed as adults and help communities capitalize on their ecological, social and cultural assets. This fuels the economy by creating and retaining jobs and helps ensure a healthy tax base.

MSUE.MSU.EDU

MSU Extension works to increase farmers’ success while protecting the environment, ensuring food safety, helping Michigan crops reach new markets and advancing agriculture through applied research.



PROTECTING MICHIGAN'S POLLINATORS

Michigan boasts more than 100 native bee species that pollinate a range of economically important crops throughout the state. Recently, concern about the potential effects of neonicotinoid insecticides (NIs) on pollinators has received a great deal of media and legislative attention. Europe has temporarily banned these products on outdoor agricultural crops, and U.S. environmental groups are turning to the nation's experts to assess the legitimacy of this threat.

David Smitley, Michigan State University (MSU) professor and Extension specialist in the Department of Entomology, is using emergency funding from Project GREEN to address this timely issue and to supply Michigan's greenhouse and nursery industries with alternative pest management strategies that protect bees and other helpful insects.

The most recent wave of public concern about NIs stemmed from sources that suggested that planting flowers from local garden centers could be harmful to bees because some of these plants have NI traces on their leaves and flowers. Smitley explained that high concentrations of NIs are toxic to bees but the potential harm of these plants to pollinators in yards and gardens has been over exaggerated.

"There's been quite a bit of confusion about what's happening, and many people are nervous that the plants they've purchased from garden centers will be toxic to bees," Smitley explained. "We want to eliminate the concern that people have about buying plants from their garden centers. Professional beekeepers move their colonies through a sequence of agricultural crops during the spring and summer to provide crop pollination, so those bees aren't usually foraging in residential neighborhoods. Ultimately, the

more annual and perennial flowers and flowering trees and shrubs that consumers plant, the better it is for bees."

As part of his Project GREEN research efforts, Smitley and a team of MSU researchers and Extension specialists are visiting greenhouses and nurseries across the state to discuss management practices and to learn how the businesses are using neonicotinoids to control pests.

"We're working with industry growers to identify alternative management practices so that the plants they grow and eventually sell to garden centers are as safe as possible for bees and other beneficial insects," he explained. "They have already adopted some of these practices, such as not spraying flowers just before they're shipped to garden centers."

This year, greenhouse and nursery growers began using fewer NIs as part of an industrywide plan slated for full adoption in 2015.

Smitley has also initiated experiments to assess the risk to bees after NI-treated plants are sold and planted in yards and gardens. He hopes that, with continued research into the effects of NIs on pollinators, he can provide science-based information to industry growers, commercial landscapers and home gardeners across the state.

Project GREEN is committed to responding to the challenges that plant professionals face. When biological pressures threaten to encumber agricultural and horticultural industries, MSU scientists organize quickly and efficiently to engage in research and outreach activities that address the root of the problem, preserve important resources and ensure continued profitability for all involved.





PROGRAM SUMMARIES

It takes strong research and relevant outreach to keep up with the needs of producers and processors of Michigan’s 300-plus agricultural commodities. That’s why Project GREEN helps fund key programs that support the research agendas of growers, entrepreneurs and others throughout the state so they can tap into these world-class findings to help grow the economy and keep our land productive.

“PROJECT GREEN PROVIDES ESSENTIAL SUPPORT TO A WIDE RANGE OF VALUABLE CROPS, PROVIDING RESEARCHERS WITH THE FLEXIBILITY WE NEED TO REACT QUICKLY TO THE CHALLENGES THAT MICHIGAN PRODUCERS FACE. WITH GREEN SUPPORT, WE CAN CONTINUE TO DEVELOP REAL SOLUTIONS THAT HELP PEOPLE PRODUCE NUTRIENT-DENSE FOOD AND IMPROVE THEIR STANDARD OF LIVING.”

KIM CASSIDA
ACADEMIC SPECIALIST, MSU DEPARTMENT OF PLANT, SOIL AND MICROBIAL SCIENCES

Enviro-weather

Enviro-weather is a comprehensive network of weather stations strategically located throughout the state. The network and its associated programs help Michigan producers make pest, plant production and natural resources management decisions. Enviro-weather data are shared with other weather groups across the region and are also used in college and university classrooms to teach students about weather, agriculture, integrated pest management and use of weather information to manage risk.

Since Enviro-weather’s inception in 2006, data requests and visitor hits have grown from fewer than 500 per day to an average of 7,100 per day.

- Project GREEN funds supported many Enviro-weather staff accomplishments, including:
- Participating in more than 30 conferences, workshops, meetings and symposiums in 2013 and early 2014, giving presentations and updates, presenting posters and distributing materials to educate users about the availability and benefits of Enviro-weather.
 - Installing data-collection software on a virtual machine to aid in disaster recovery and create added security.
 - Partnering with nine major agricultural commodity and public policy groups and commissions to deliver sustainable weather-based information to the public.
 - Overcoming a number of system complications resulting from aging infrastructure.

MSU Land Management Office

The MSU Land Management Office invests Project GREEN funds in key areas that help keep MSU AgBioResearch centers operating at full capacity. Most often, farm managers use Project GREEN infrastructure dollars to fund new equipment and skilled labor positions. In 2013-14, Project GREEN dollars bridged operating budget gaps at five of the 13 plant-based research centers and enabled repairs of equipment and several buildings.

- Numerous research center projects also benefited from Project GREEN dollars. For example, the Clarksville Research Center in Ionia County invested Project GREEN funds into more than 35 projects, resulting in the following accomplishments:
- Breeding superior sour cherry varieties with improved fruit quality, yield and disease resistance.
 - Informing Michigan potato growers of best disease practices for late blight.
 - Testing fungicides for several potato diseases.



**Pesticide and Plant Pest Management Division,
Michigan Department of Agriculture and
Rural Development**

The Michigan Department of Agriculture and Rural Development (MDARD) Pesticide and Plant Pest Management Division uses Project GREEN funds to support the division’s export manager and a plant pest specialist. Thanks to this funding, professionals were able to survey stone fruit nursery stock producers in an effort to resolve plum pox virus trade issues, particularly the export of *Prunus sp.* nursery stock to Canada. The plant pest specialist also collaborated with MSU Extension educators to train industry participants and maintain phytosanitary certification protocols for blueberry exports to Canada.

Additionally, the export manager oversaw a pilot program that was developed in collaboration with MSU researchers and MSU Extension specialists. The culmination of this audit-based certification program was a series of workshops that enabled 36 growers, representing 21 firms, to learn best management practices for the successful export of spruce, fir and Douglas fir nursery stock.

- With support from Project GREEN, these two MDARD professionals were also able to:
- Issue 3,822 federal phytosanitary certificates and 71 federal re-export certificates.
 - Work with MSU Extension to make the Michigan apple industry aware of the phytosanitary certification protocols for exporting apples to Mexico and Brazil.
 - Explore the potential for using a rotational sampling protocol with dry bean shippers to reduce export inspection expenses.



**The Plant Biotechnology Research
and Outreach Center**

The MSU Plant Biotechnology Research and Outreach Center (PBROC) offers research support to specialty crop producers in Michigan and outreach programs that deal with molecular breeding and the environmental biosafety of genetically engineered crops.

- With funds from Project GREEN, PBROC scientists were able to:
- Serve Michigan producers by performing micropropagation work on blueberries, apples, sweet cherries, cherry rootstocks and asparagus.
 - Support Michigan soybean and dry bean growers with advances in transformation processes.
 - Participate in research projects with multiple principal investigators, one Michigan blueberry grower and one Michigan asparagus grower.
 - Provide biotechnology teaching and demonstration opportunities to MSU students and local middle and high school students.
 - In partnership with the Gates Foundation, train two Nigerian students and one Fulbright scholar on soybean transformation.
 - Train two graduate students in virus-induced gene silencing procedures.
 - Earn a high international ranking in plant transformation technologies.

The MSU Product Center Food-Ag-Bio

A 2012 MSU Product Center report shows that Michigan’s food and agriculture system contributes more than \$91.4 billion to the state’s economy, a number that continues to grow. With that in mind, professionals trained in working with entrepreneurs work with new and growing food and agriculture businesses to help them reach their full potential. Understanding the value of food and agriculture to Michigan’s economy is key to the success of the services that these professionals provide.

The center is an excellent example of how entrepreneurs can successfully work with university professionals to identify markets, develop new products and make critical decisions from product concept to launch. Since its inception, the MSU Product Center has relied on Project GREEN funds to link Michigan entrepreneurs with support services such as business, marketing, technical and scientific resources, so its specialists can continue to help them produce high-value, consumer-responsive products and businesses.

- In 2013-14, MSU Product Center professionals conducted 4,947 counseling sessions with 589 clients, resulting in:
- 72 new ventures launched.
 - More than \$3 million in total capital formation, including more than \$2.8 million of owner investment in Michigan businesses.
 - 208.5 jobs created or retained.

Continued Project GREEN funding ensures that the center’s associate director is available to serve as the conduit between science-based university research and innovations counselors, who work directly with entrepreneurs. The associate director also helps create and maintain partnerships with key industry partners, including Forgotten Harvest, Eastern Market Corporation, Michigan Integrated Food and Farming Systems, and the Food System Economic Partnership.

REFINING SOLUTIONS: MODIFIED TOOLS AND TACTICS HELP GROWERS MANAGE EXOTIC PESTS



A long-time supplier of food and farm goods, Michigan exports and distributes a variety of agricultural products to communities all over the world. To fulfill this important role, Michigan growers continually work to protect their crops not only from native pests but also from exotic pests that destroy plants and cost millions of dollars to manage.

Project GREEN researchers diminish the threat of these invasive species by supplying growers with tools that combine scientific findings with cost-conscious engineering.

Matthew Grieshop, a Michigan State University (MSU) entomologist and the organic pest management specialist, leads a team that is developing an attract-and-kill lure to help producers manage Oriental fruit moth (OFM). This invasive pest primarily preys on peaches but has an extensive host range that includes apples, plums and cherries—fruits that contribute millions to Michigan's economy.



"The device is a modification of mating disruption, which has been an enormously successful pest management tactic for OFM, codling moth and oblique-banded leafroller," he explained. "We're making disruption more effective by adding a lethal component, which allows growers to use fewer point sources."

The prototype attract-and-kill device consists of two components: a nylon substrate treated with insecticide and a dispenser that sits inside the substrate and distributes a semiochemical (an information-carrying chemical emitted by a plant or animal). In the case of OFM, the semiochemical is a synthetic sex pheromone that attracts male moths.

In a previous Project GREEN study, Grieshop and his research team used digital surveillance to observe the response of several moth species to various pheromones in the field. OFM stood out immediately—it lingered in the presence of the sex pheromone and landed on surfaces around the dispenser. This behavior made it a good target for an insecticide-based attract-and-kill device.

"When the male moth lands on the substrate, it picks up a lethal dose of deltamethrin," he stated. "The immediate neurological effect is paralysis, but over a relatively short period of time, it kills the insect. With this device, we're not just distracting male moths—we're actually pulling them out of the population."

A field study demonstrated that at 50 devices per acre, results were similar to the full-labeled rate of the traditional mating disruption product, which requires 200 pheromone dispensers per acre. He explained that this technology allows for fewer lures, reduced labor costs associated with placing them, and less money spent on pheromone because the lure requires about a thousandth of the amount used in traditional mating disruption.

“The other real advantage of this device is that it reduces insecticide residues on fruit,” he added. “Using small amounts of insecticides in distinct point sources will also greatly reduce the negative environmental impacts typically associated with broad applications of insecticides. This is of critical importance to the Michigan fruit industry as we face the development and enforcement of maximum residual limit guidelines in domestic and international markets.”

Grieshop explained that he is also exploring how this technology can be used to manage other exotic and invasive pests, including brown marmorated stinkbug and the Japanese beetle.

“You have to have a good attractant, and that’s a limiting factor for many of these pests,” he said. “Many growers have resorted to using insecticides that inadvertently break down natural pest controls as they try to manage invasive insects such as spotted-wing drosophila and brown marmorated stinkbug. If we could take this kind of approach with those insects, we wouldn’t expect to see those kinds of breakdowns because the insecticide is so targeted.”

Grieshop has collaborated with a commercial peach farm in southwestern Michigan to test the devices in addition to giving presentations about its application at horticultural and agricultural trade shows throughout the state. His team is also currently working with several agricultural chemical companies to commercialize the device and make it widely available for growers.

“I’m interested in helping growers be more efficient and leave a smaller environmental footprint,” he concluded. “My focus is pest management, and that comes down to reducing the use of broad-spectrum insecticides. With this technology, that’s exactly what we’re doing. It doesn’t eliminate the insecticide entirely, but it greatly reduces the amount used. Because we’re not applying insecticides to the harvestable portion of the crop, it also lowers worker exposure and ends consumer exposure—two results that directly address the Michigan fruit industry priorities of improving production through better pest management.”

The Michigan Department of Agriculture and Rural Development, MSU Extension and MSU AgBioResearch are committed to helping Michigan growers and commodity groups alleviate the struggles associated with managing invasive pests. Through Project GREEN, these partners support MSU researchers, such as Grieshop and many others, who develop and refine practical solutions for the dynamic pest problems that Michigan growers work to overcome.



INVASIVE SPECIES POSE SIGNIFICANT THREATS TO MICHIGAN’S ENVIRONMENT AND ECONOMY:

- Asian carp threaten the Great Lakes and their \$7 billion fishery industry.
- Michigan’s 7 million acres of hardwood forests are susceptible to the incalculable destruction of the Asian longhorned beetle.
- Brown marmorated stinkbugs can cause enough damage to render fruit and vegetable crops unusable.
- Eurasian watermilfoil is affecting the inland lakes.

Michigan’s new “Stop the Invasion” initiative will annually invest \$5 million in a comprehensive response to invasive species involving the state departments of Environmental Quality (DEQ), Natural Resources (DNR) and Agriculture and Rural Development (MDARD), along with Michigan residents and other local partners. Specifically, MDARD will conduct a comprehensive analysis of the pathways that harmful terrestrial invaders take to migrate into the state.

Additionally, the three state agencies will work closely with researchers from MSU AgBioResearch and Project GREEN to develop and refine strategies to detect and limit invasive species. This type of work is vital in protecting the state’s natural and agricultural resources.



GRANTING GREEN

LOOKING FORWARD: 2014-15 GRANTS

Project GREEN awarded \$1.2 million in grants to 40 new research and outreach projects for the 2014-15 fiscal year. Thirty-one projects received continued or second-year funding, totaling \$975,100.

RUFUS ISAACS: A pocket guide to the bees of Michigan: Identification and conservation.

ANNEMIEK SCHILDER: Advancing knowledge of blueberry pathogens and fungicide timing for effective disease management.

ZSOFIA SZENDREI: Aster leafhopper management and aster yellows detection in Michigan carrots and celery.

KYUNG-HWAN HAN: Biotechnological means for development of drought-tolerant crops.

KIM CASSIDA: Birdsfoot trefoil: An alternative forage legume with bioactive potential.

DOUGLAS LANDIS: Building pollinator-supportive landscapes for Michigan’s diverse agriculture.

DEBORAH MCCULLOUGH: Can high-value beech trees be protected from beech bark disease with a recently developed systemic azadiractin insecticide?

PAOLO SABBATINI: Controlling vine yield and improving cluster-microclimate fruit composition and quality of pinot noir grapes grown in cool and wet climates.

DENNIS MILLER: Conversion of Michigan agricultural residues to high-value furan derivatives.

DANIEL BRAINARD: Cover crops, compost and polymer-coated urea for nitrogen, nematode and weed management in processing carrots.

CHRISTIAN KAPP: Determining the economic feasibility of malting barley in northern Michigan through performance trials and malt characteristics analysis.

PHILLIP TOCCO: Digital food safety record keeping implementation plan.

BRAD DAY: DNA chip-based diagnostic sensors for plant pathogen detection and food security.

BRIDGET BEHE: Does the role of branding on plant quality perceptions vary by age cohort?

SOPHAN CHHIN: Early detection of emerald ash borer using non-destructive technologies.

KEVIN FRANK: Effect of nitrogen rate on runoff water quality from turfgrass.

JAMES MILLER: Enhanced profitability for Michigan fruit and vegetable growers through confident decisions on when insecticide sprays can safely be withheld: Codling moth as a case study.

GEORGE SUNDIN: European brown rot: Understanding infection parameters and devising control strategies for a new threat to Montmorency tart cherry production.

GEORGE SUNDIN: Goss’s wilt of corn: Analysis of epiphytic growth on corn leaves and systemic invasion of the pathogen *C. michiganensis subsp. nebraskensis*.

ERIK RUNKLE: Growing high-value propagules under LED lighting.

DECHUN WANG: Identification and use of new genetic resistance to soybean sudden death syndrome.

KIMBERLY CASSIDA: Identifying superior forage varieties for northern Michigan.

XIAOMING LIU: Imaging technologies for enhancing agricultural productivity, Cercospora leaf spot rating as a case study.

ANNEMIEK SCHILDER: Impacts of grapevine leafroll virus and tobacco ringspot virus on chardonnay vines and the role of potential vectors.

JEFF ANDRESEN: Improvement of potato maturity and stress graphical tool on Enviro-weather.

MARY HAUSBECK: Increasing celery yields begins in the greenhouse with healthy transplants.

ASHLEY MCFARLAND: Integrative farming solutions for soil health and well-being in Michigan’s Upper Peninsula.

WILLIAM KIRK: Managing Cercospora leaf spot: Development and growth responses in *C. beticola* to temperature.

DAVID DOUCHES: Managing potato common scab through breeding and soil health.

DENNIS PENNINGTON: Michigan corn stover project.

EMILY MEREWITZ: Physiological responses of creeping bentgrass to infection by a bacterial pathogen (*A. avenae subsp. avenae*).

BERT CREGG: Physiology and morphology of street trees in response to elevated temperatures.

WILLIAM KIRK: Potato late blight: Host/pathogen interactions and management of invasive and established genotypes of Phytophthora infestans on foliage and tubers.

DAVID SMITLEY: Producing greenhouse and nursery plants that are safe for pollinators in the yard and garden.

RODNEY FERNANDEZ: RFID for decision support and logistics management for the container plant value chain.

ERIC HANSON: Solving the challenges to organic raspberry production.

ANDREW JAROSZ: Spruce decline in Michigan: Disease incidence, causal organisms and epidemiology.

PASCAL NZOKOU: Sustainable irrigation and water management strategies for new fir species in Michigan Christmas tree production.

EMILY POCHUBAY: Understanding and minimizing the effects of evolving tart cherry pest management programs due to the arrival of spotted wing drosophila in Michigan.

KIM CASSIDA: Using cover crops after wheat to improve soil health.



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.

DOUG BUHLER

Michigan State University AgBioResearch

TOM COON
STEVE LOVEJOY

Michigan State University Extension

RAY HAMMERSCHMIDT

MSU Department of Plant, Soil and Microbial Sciences

JAMIE CLOVER ADAMS
GORDON WENK
ROBIN ROSENBAUM

Michigan Department of Agriculture and Rural Development

INDUSTRY PARTNERS

Project GREEN is a grass-roots-driven initiative that agricultural commodity groups endorsed when it was presented to Michigan legislators in 1997. Grower-led organizations continue to help direct Project GREEN activities by submitting their research and Extension priorities that identify critical and emerging issues affecting their industries. Scientists submit competitive grant proposals that directly address 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 Commercial Beekeepers 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
- Michigan Wheat Program
- Midwest Nut Producers
- National Grape Cooperative
- Pickle Seed Research Fund
- Sugarbeet Advancement Committee
- Western Michigan Greenhouse Association

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MSU Agriculture and Natural Resources Communications

JENNIFER HOLTON
Michigan Department of Agriculture and Rural Development

GREG L. KOHUTH, KURT STEPnitz, DERRICK L. TURNER
Photography

REDHEAD DESIGN STUDIO
Graphic Design

FOR MORE INFORMATION ABOUT PROJECT GREEN, CONTACT:

Jackie DeSander
Justin S. Morrill Hall of Agriculture
Michigan State University
446 West Circle Drive, Room 109
East Lansing MI 48824-1039
desander@msu.edu
517-884-3862



Project GREEN—Michigan State University
Justin S. Morrill Hall of Agriculture
446 West Circle Drive, Room 109
East Lansing MI 48824-1039
green.msu.edu

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