

GROWING GREEN

PROJECT GREEN 2010 LEGISLATIVE SUMMARY




Project GREEN
MICHIGAN STATE
UNIVERSITY



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OUR 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 the Michigan Agricultural Experiment Station, Michigan State University Extension and the Michigan Department of Agriculture to advance Michigan's economy through plant-based agriculture.

OUR MISSION

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

DID YOU KNOW?

The agri-food industry has a **\$71.3 billion** impact on Michigan's economy from the farm to the fork.

The MSU Product Center

RESEARCH AND EDUCATION HELP AGRICULTURE THRIVE



Doug Buhler, Project GREEN Coordinator

PHOTO: KURT STEPNIK

It's a common mantra that you'll hear throughout the industry: as Michigan's economy struggles, agriculture thrives.

I'm proud of the fact that the industry I work in is considered a bright spot in the economy of our state, but we didn't get here by accident. **Agriculture remains profitable, in part, because of the forward-thinking research that has helped farmers, turf managers, greenhouse operators and others stay ahead of the game.**

Project GREEN (Generating Research and Extension to meet Economic and Environmental Needs), Michigan's plant agriculture research and Extension initiative housed at Michigan State University, is proud to be part of that progress. Each year, we leverage the outstanding partnerships we have developed between the Michigan Agricultural Experiment Station (MAES), Michigan State University Extension (MSUE), the Michigan Department of Agriculture (MDA) and 43 other partner organizations to determine the research and education priorities for those involved in plant agriculture (and each year I become more and more impressed with the depth and breadth of scientific answers we can uncover when we all work together.)

This legislative summary features the highlights of research and educational programs that were completed in 2010. These programs will help farmers control pests, increase yields, maintain profits and reduce our dependence on fossil fuels – all of which add up to a prosperous economic future.

I hope you'll take the time to review the 2010 legislative summary, and be assured that Project GREEN will continue to move Michigan forward with industry-driven, cutting-edge programs.

Sincerely,

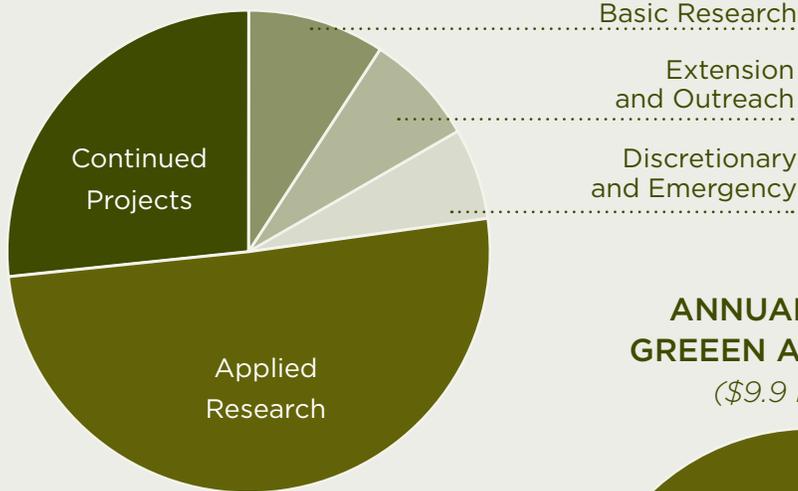
Doug Buhler

Project GREEN Coordinator

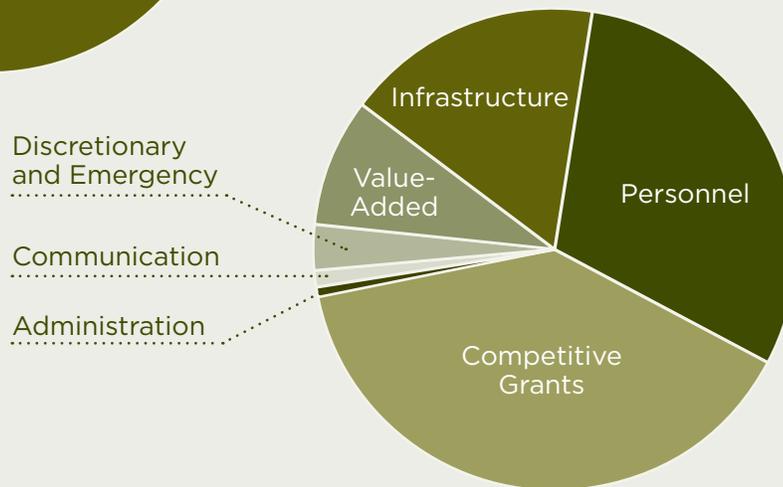
Associate Director, Michigan Agricultural Experiment Station

Associate Dean for Research, MSU College of Agriculture and Natural Resources

COMPETITIVE GRANTS AT WORK
(\$2.2 MILLION)



ANNUAL PROJECT GREEN ALLOCATIONS
(\$9.9 MILLION)



WORKING TOGETHER

Project GREEN engages all plant agriculture commodity groups in Michigan. Housed on the Michigan State University campus, Project GREEN is led by the Michigan Agricultural Experiment Station (MAES), Michigan State University Extension (MSUE) and the Michigan Department of Agriculture.

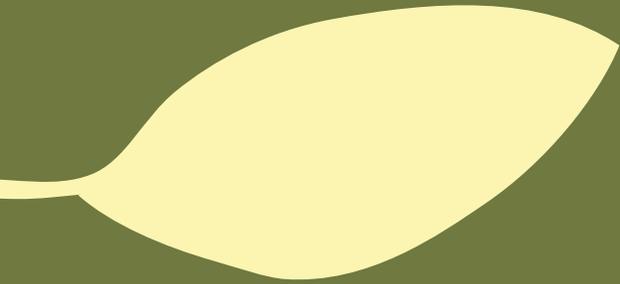
Administration costs make up a small portion of Project GREEN’s annual expenditures – a feat only possible because GREEN dollars primarily fund projects. Project GREEN researchers are MAES- and MSUE-funded, allowing GREEN funding to supply the materials, labor, travel and collateral funds to conduct research and Extension programs. But the big ideas, the ground-breaking, world-changing, people-feeding work, is possible because of our partnerships in research and Extension.



COMPETING FOR GREEN

Grants Address Industry Needs

The foundation of Project GREEN funding is the competitive grant cycle. The process is driven by plant commodity groups, which annually publish their research priorities on the Project GREEN Web site. Researchers at Michigan State University and the Michigan Department of Agriculture then develop funding requests in accordance with these priorities. A panel of university, state government and industry professionals reviews proposals and makes funding recommendations to the Director's Action Team, the governing body of Project GREEN. This annual process allows for flexibility and nimbleness to address the changing needs of plant agriculture in Michigan.



Competitive Grant Summaries: Fruits



Mechanization of Juice Grape Production Under Michigan Growing Conditions

-Thomas J. Zabadal

Want more profits to go back to vineyard owners in Michigan's plentiful grape-juice-producing regions? One way to accomplish this is to encourage growers to use more mechanization to prune vines and position the precious new shoots that produce bountiful grapes. **Thanks to this project, vintners in Michigan and throughout the United States can choose from 12 commercial mechanical shoot-positioning devices.**

Apple Rootstock Evaluation Trials -Greg Lang

The apple orchard production system is composed of two plant components: the fruiting variety and the rootstock. Both parts are critical to optimizing and sustaining yields, labor efficiency, fruit quality and disease management. This project focused on developing and evaluating the field performance of new apple rootstock genotypes with improved traits. Increased yields and improvements to fruit size have occurred after adopting some of these new rootstocks. **Smaller, more intensively-managed trees using certain rootstocks have helped reduce pesticide use by up to 40 percent.** This research has guided the planting of more than 170,000 acres of trees over the last five years.

Rescue of High Value Michigan Peach Breeding Lines from Plum Pox Virus -William Shane

Plum pox virus (PPV) strain D is a serious viral disease that has the potential to devastate the stone fruit (such as cherries, peaches and plums) industry. Careful screening detected the virus for the first time in Michigan in July 2006. In spring 2007, the more than 10,000 peach, plum, apricot and nectarine trees at MSU's Southwest Michigan Research and Extension Center (SWMREC) had to be removed and burned. This drastic measure eliminated the possibility that plum pox virus could persist on the station grounds and spread to other, unaffected trees. That action **saved elite peach lines representing more than 17 years of research and \$180,000 dollars by the MSU breeding program. The development of these lines were jointly funded by the Michigan peach industry and MSU.** New varieties arising from the elite breeding material saved will help ensure the competitiveness of the Michigan peach industry in national markets.

Michigan's 14,600 acres of vineyards make it the fourth largest grape-growing state. The grape and wine industry contributes \$790 million annually to Michigan's economy.

Michigan Department
of Agriculture

Validation of a Degree-Day Model for Pest Prediction and Optimizing Spray Decisions in Michigan Vineyards

-Rufus Isaacs

The grape berry moth (GBM) is the most damaging insect pest in Michigan's 13,000 acres of vineyards. A major limitation to effective control of this pest is the lack of understanding on optimal timing of insecticide applications. **This project has developed and tested a model for timing sprays that is being adopted widely on the National Grape Cooperative's 12,000 acres of juice grape vineyards.** Management based on this model will reduce pesticide applications and yield loss from GBM, while providing an economic benefit to the industry and reducing the environmental impact of grape production in Michigan.

Wine Grape Canopy Management: Effect on Carbon Assimilation, Partitioning and Fruit Quality -Paolo Sabbatini

During the growing season, two things compete for the energy produced by grape vines: new shoots and grape clusters. The key to quality production is ensuring grapes gobble up as much energy as possible while leaving the shoots to develop the following spring. That's especially important in Michigan where vintners must get the most from their crops in a short period. **Thanks to Project GREEN funding, researchers discovered that the optimal timing of leaf pulling and shoot trimming reduces the cost of vineyard management by improving quality, improving the market value of grapes and reducing hours of labor.** The timing of cultural practices is fundamentally important in achieving the goal of high-quality grapes for high-quality wines in a cool climate area.

Regulation of Return Bloom in Honeycrisp by Fruit Position, Fruit Growth Rate, Seed Number and Gibberellic Acid -Jim Flore

Honeycrisp apples are not only delicious and nutritious: they're also the most profitable apple variety in the industry. Because honeycrisps are biennial, yields swing drastically from high one year to low the next. By reducing variability among trees, growers can improve the success rate of their crop management strategies. This project substantiated previous research findings that crop load has the greatest influence on return bloom. Thinning the crop so there are **four to seven fruit per square centimeter across the trunk ensures maximum performance** - and that means a more consistent supply of Honeycrisps for consumers each year, and steadier profits for apple growers.

Apples and apple juice are two important foods that contribute the mineral boron to the diet, which may promote bone health.

U.S. Apple Association



Mummyberry and Pollinator Interactions in Michigan Organic Blueberries: Determination and Manipulation of Critical Agro-Ecological Processes

-Matthew J. Grieshop

Michigan produces more blueberries than any other state. But that No. 1 status could be threatened if mummyberry – a fungal disease that infects healthy blueberries, making them inedible and unmarketable – isn't controlled. Because this infectious disease is carried by pollinators, this project sought to identify the insects responsible for spreading it. **Flies were observed visiting fungus locations more often than bees, although research indicated that bees actually carry the pathogen more frequently.** Research using the techniques developed in this study will allow researchers to continue to develop an understanding of the identity of key pollinators, as well as their activity in response to management practices.

Improving Codling Moth Management by Maximizing the Utility of Pheromone-Baited Monitoring Traps

-Larry Gut

Codling moth (CM) is the most economically devastating apple pest in Michigan. Pheromone-baited traps are used to determine the time of CM emergence and to track their seasonal activity, allowing growers to more accurately time sprays. As orchard production systems are moved toward greater reliance on expensive control methods, more precise trapping systems are required to monitor CM activity and help make cost-effective management decisions. The development of excellent monitoring systems and decision-making protocols will allow growers to eliminate unnecessary treatments and reduce the cost of CM management programs. **That means an additional \$1.48 million in the pockets of Michigan apple growers.**



Development of Damage Thresholds for Foliar Diseases in Juice Grapes

-Annemiek Schilder

Powdery and downy mildew are grape diseases requiring fungicide treatment. Researchers aimed to develop damage thresholds for mildew to achieve optimal fruit yield and quality in an environmentally and economically sustainable manner. **Results indicate Niagara grapes can withstand 50 to 60 percent downy mildew and Concord grapes 30 percent powdery mildew on the foliage by the end of the growing season without significant reduction in juice quality.** This work has the potential to significantly reduce the number of fungicide applications in Michigan juice grapes, reducing costs and exposure to fungicides.

Sustainable Management Strategies for Potato Leafhopper in Michigan Wine Grapes

-Rufus Isaacs

Potato leafhopper is a potentially damaging insect pest of grapevines, but effective management currently involves only sprays of broad-spectrum insecticides when the insect or symptoms are first seen. This project determined relationships between infestation and symptoms for resistant, intermediate and susceptible wine grapes. **This data will save wine grape growers one to two insecticide applications a year in areas with high pressure from potato leafhoppers, saving them thousands of dollars in unnecessary costs.** Results also provide improved guidance on vine protection, the most effective insecticides to use and the point at which symptoms are likely to appear.

Determining the Utility of Managed Bumble Bees for the Pollination of Commercial Highbush Blueberry

-Rufus Isaacs

Michigan is the world leader in the production of highbush blueberries, and optimizing yields depends on good pollination. However, there are often insufficient numbers of worker honey bees around when they're needed to pollinate commercial blueberry fields.

This study found commercially reared bumble bees are an adequate alternative to native honey bees, and 50 to 70 percent of worker bees will collect pollen if the hive is in close to the bushes.

The results of these trials will be used to refine recommendations for bumble bees as a component of pollination strategies for blueberry production.

Current Status of Virus and Phytoplasma Infection of Blueberries in Michigan and Improvement of Diagnostic Methods

-Annemiek Schilder

When it comes to viruses, prevention is the only cure. In the plant kingdom, that means using clean planting material. When MSU scientists saw an increase in undiagnosed symptoms and plant decline in Michigan blueberries, they surveyed virus diseases to diagnose the unknown symptoms. **The survey resulted in early detection of blueberry scorch virus, thus substantially mitigating its effect on the blueberry industry and potentially saving growers millions of dollars.** Identifying the disease quickly, destroying infected bushes and testing surrounding farms eliminated a potentially devastating problem in the Michigan blueberry industry.

Reducing Economic Limitations From Maximum Residue Limit Regulations Faced by Michigan Fruit Industries

-Suzanne Thornsberry

Maximum residue limits (MRLs) are the maximum level of a pesticide compound allowed to remain on a food or feed product in order to be sold. Several major Michigan trading partners have revised their MRL policies, and it is critical that fruit industry participants are aware of and understand the new limits. **Thanks to Project GREEN funding, more than 3,000 fruit industry members from Michigan, 34 other states and nine Canadian provinces have been informed of recent changes in MRL regulations.** Awareness and understanding of market impact from these policies is the first step for firms in developing strategies for global competitiveness.



Impacts of the Pilot Projects to Introduce Planting Flexibility to Farm Programs in Michigan

-David Schweikhardt

Planting restrictions for fruits and vegetables dominated the debate in the 2008 Food, Conservation and Energy Act (commonly known as the Farm Bill). Central to this debate was the effect of eliminating fruit and vegetable restrictions on program acreage and commodity pricing. The final version of the bill failed to reconcile the issue but did authorize a pilot program to allow limited planting of fresh market and processing vegetables on program acreage in the Midwest. **Results suggest the pilot program has had a limited effect on fruit and vegetable plantings.** These results are being used as deliberations on the 2012 Farm Bill begin.

Genetic Control of Crop Load and Fruit Abscission

-Steven van Nocker

Crop load management is a high priority for the Michigan fruit tree industry – too many or too few apples can be the difference between a healthy, profitable tree and one that can't do its job effectively. Using plant growth regulators (PGRs) in flowers and young fruit is one of the best ways to achieve consistency in apple load among trees. Many apple cultivars are prone to pre-harvest drop, often requiring application of PGRs, adding to material and labor costs. As the industry transitions to mechanical harvesting, precise methods to best manage crop load will be required. **This project has added to the body of scientific knowledge and will be used to design hypotheses and more advanced studies.**

Genetic Manipulation of *Venturia inaequalis* for Control of Forcible Ascospore Discharge

-Frances Trail

When *Venturia inaequalis* oozes out of spores onto fruiting trees, it causes apple scab – a yield- and profit-robbing disease that can require up to 10 fungicide applications in a single season. Thanks to this project, MSU researchers performed genetic tests that will help them understand ascospore discharge, thereby helping find methods of controlling the disease. **Their long-term goal is to design chemical controls that will eliminate the dispersal of ascospores, resulting in much less fungicide use.**



A serving of blueberries contains almost 25 percent of the daily requirement for Vitamin C, which is needed to form collagen, maintain healthy gums and capillaries, aid in the absorption of iron and promote a healthy immune system.

U.S. Highbush
Blueberry Council



Genetic Tools for Regulating Flowering and Enhancing Production for the Michigan Apple Industry

– Steve van Nocker

Critical issues related to flowering limit the Michigan apple industry's profitability and growth. Juvenility is a state during early growth characterized by an inability to flower. Alternate bearing is a phenomenon caused by inhibition of flowering by developing fruit. Both result in inconsistent crop load, or number of apples per tree. The industry needs effective strategies to address flowering-

related problems. **By maintaining a similar crop load year after year, productivity can be approximately doubled, while production costs are decreased.** The increase in fruit quality resulting from optimal crop load would add significant profit; high quality fruit can be sold in the fresh market at a higher price.

Delivery of Effective Entomopathogenic Fungi and Nematodes for Managing Plum Curculio in Orchards

–Mark Whalon

The Food Quality Protection Act of 1996 created a need to develop the science required to discover biopesticides and other methods needed to control pests on food crops. Thanks to Project GREEN funding, MSU scientists developed an online Enviro-weather-based tool growers need to precisely time applications of newer insecticides and biologicals to control Plum Curculio (PC) – a top pest in cherry and apple orchards. **Researchers anticipate most organic growers, and growers facing high PC populations who use integrated pest management, will find biological insecticides more accessible and effective with the improved timing using Enviro-weather.** These innovations will also reduce the cost of using such environmentally friendly methods.



Trevor Nichols Testing for Blueberry Viruses

–Ray Hammerschmidt

In 2009, “shock and awe” was trumped by “shock and scorch,” two highly destructive viruses that reared their ugly heads in Michigan blueberry fields. The main source of spreading these viruses is through infected planting material, but it can also be spread by aphids. The most severe symptom of infected plants is the simultaneous death of blossoms and shoots, resulting in crop loss. The virus can kill entire bushes in three to six years. **MSU scientists stopped the spread of these diseases by destroying mother plants (those that are used for planting material) found with blueberry shock virus and infected fields.** This, combined with a campaign to alert growers to watch for more occurrences, reduces further threats to Michigan’s plentiful and profitable blueberry crop.

China Produce Supply Chains: Evolution and Impacts on Michigan’s Horticultural Industries

–Suzanne Thornsberry

In 2007, four fruit crops (apples, grapes, sweet cherries and strawberries) were identified as major crops of interest to the Chinese government. Michigan producers seek to understand how Chinese produce might enter the U.S. market and how Michigan firms might access markets in China. **More than 3,000 specialty crop industry participants have been informed about evaluation and analysis of key market information critical to Michigan produce firms seeking to understand how a major world fruit producer is developing its industry and international market potential.** Developing or maintaining viable markets for Michigan fruit industries will increase the viability of the agricultural sector and its contribution to a sustainable Michigan economy.

Because of the high fiber content in apples, the fruit’s natural sugars are slowly released into the bloodstream, helping maintain steady blood sugar levels.

U.S. Apple Association

Improvement of Fruit Pest Mating Disruption and Attract and Kill Techniques: Elucidation of Key Insect Behaviors

–Matthew J. Grieshop

Better understanding of insect behaviors will allow for the development of science-based management recommendations on the use of mating disruption (MD) and attract and kill (AK) approaches, two sustainable pest management techniques that play an increasingly important role in organic and conventional fruit production in Michigan. **In recent areawide pest management projects relying on mating disruption, growers have reported at least a 60 percent reduction in broad-spectrum insecticide applications.** These research findings will help increase sustainability of the Michigan fruit industry by providing economic pest management without the environmental damage associated with broad-spectrum insecticides or compromising fruit quality.

Competitive Grant Summaries: Vegetables

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

-David Douches

Potato scab is the primary factor limiting the market quality of potatoes in the United States, yet there has been no reliable test for selecting scab-resistant potatoes. In this project, MSU researchers built a nutrient film technique (NFT) system to efficiently and accurately identify resistant breeding lines. **This is the first step toward creating a system that can be replicated on multiple breeding lines.** Additionally, the MSU potato breeding and genetics program is advancing a set of potato lines for large-scale testing that displays both scab resistance and potato chip processing quality. Developing and identifying scab resistant varieties will provide for scab mitigation and improve tuber quality for the table and processing industry.

Screening Selected Michigan Vegetable Crops for Resistance to Root-Knot and Root-Lesion Nematodes

-Haddish Melakeberhan

The northern root-knot (NRKN) and root-lesion (RLN) parasites are the most problematic nematodes in Michigan agriculture. With no resistant crops and restrictions on pesticides to control them, the vegetable and nursery industries face many challenges in managing NRKN and RLN. This project found that degrees of susceptibility to NRKN vary by nematode populations and cultivar. **This information provides commodity groups, seed companies and researchers with a foundation for developing integrated approaches to developing resistance to and managing nematodes.** The project results will also provide breeders and growers with options for selecting crop lines that are resistant to specific nematode populations.



Characterization and Management of Cucurbit Downy Mildew

-Mary Hausbeck

Michigan is the top producer of pickling cucumbers in the nation, but downy mildew robs growers and processors of as much as \$6.4 million annually. This research sought to monitor plots for mildew and identify effective fungicides and resistant cucumber lines. Information from the project was made available to growers online. **If growers, following the recommendations generated by this research, were able to eliminate one fungicide application it would generate a cost savings to the Michigan pickle industry ranging from \$920,400 to more than \$1.5 million.** New resistant lines would also provide a valuable disease management tool for growers.





The value of vegetable production in Michigan was \$211 million in 2007.

Michigan Vegetable Council

Predicting Occurrence of Key Insect Pests of Vegetables: Field Validation of Phenology Methods

-Beth Bishop and Mike Brewer

Growers must be able to manage insect pests effectively to produce quality crops in an economically sustainable manner. Insect development is largely driven by temperature, and the occurrence of damaging pests can be predicted using weather data. **The Michigan's fruit industry depends on tools from MSU's Enviro-weather – a tool that uses data collected from a network of weather stations to predict when pests are present. This project developed similar predictive tools for insect pests that damage vegetables.** These new tools will help Michigan vegetable growers to more precisely time scouting and control efforts, saving money, yield and time.

Revitalizing the Michigan Onion Industry Through Cost Effective and Horticulturally Sound Weed Control Practices

-Bernard H. Zandstra

Michigan onion acreage has decreased because of declining yields and loss of profitability. Inadequate weed control has been a major factor in poor yields. **Early adoption of weed control practices by growers in this project resulted in a 25 percent increase in average state yield, and total return for the state grew from \$12.2 million to \$14.3 million.** Using new herbicides and herbicide combinations improved weed control in onions by increasing the number of weed species controlled, enhancing the efficacy of herbicides and reducing crop injury associated with herbicide application.

Integrated Approach to Managing Replant Suppression Problems in Asparagus

-Mathieu Ngouajio

Replant suppression is a phenomenon that occurs when new asparagus is planted in fields previously used for asparagus. Suppression occurs because most asparagus fields have soil-borne disease pressures and there is limited land on which to establish new fields. **Controlling foliar pathogens with fungicides, using safe and effective herbicides, proper rotation of crops, soil management and fertility will help keep asparagus vigorous and resistant to infection.** This project showed the importance of integrated management strategies in mitigating the effects of asparagus replant suppression.



Host Range of *Ascochyta* spp. From Pea and Description of the Sexual State and Mating System of *A. pinodella*

-*Martin Chilvers*

Three fungal pathogens cause blight on pea, a significant disease recorded in all temperate regions where peas are grown. **A greater understanding of these fungi is critical to implementing relevant control strategies in pea and determining their significance to Michigan plant agriculture industries.** Through this project, MSU scientists were able to study fungal mating systems to identify if it is capable of sexual recombination, which could lead to potential fungicide resistance and further disease spread. Studies are continuing to look at the presence of these fungal pathogens on pea, as well as determining if they could affect soybean and other Michigan crops.

Understanding and Managing Imidacloprid and Thiamethoxam Resistance in the Colorado Potato Beetle

-*Edward J. Grafius*

Colorado potato beetle is the most serious insect pest in Michigan potato fields, and it's resistant to most insecticides. That resistance could cost the potato industry more than \$4 million. **By monitoring insecticide resistance and beginning to develop diverse control methods, scientists may be able to save growers more than \$1 million a year in added control costs.** Identifying fields with resistant beetle populations can help growers carefully plan management activities such as scouting, use of trap crops, crop rotation strategies and use of alternative insecticides.

From the Lab to the Field: Developing Genomic Tools to Determine Pathogenicity in the Cucumber Downy Mildew Pathogen *Pseudoperonospora Cubensis*

-*Brad Day*

Since 2004, farmers east of the Mississippi River who grow cucumbers and other cucurbits – including watermelon, cantaloupe, gourd, squash and zucchini – have experienced a significant increase in downy mildew susceptibility, costing growers and processors millions of dollars. **This project generated significant data to both develop short-term tools for management of the problem, as well as preliminary data for the foundation of a USDA Coordinated Agricultural Project proposal for an additional \$9.5 million.** Researchers completed the genome sequence of the downy mildew pathogen and were able to develop a method of detecting downy mildew in real time, in the field.

Competitive Grant Summaries: Field Crops

Pasture Renovation Using Improved Forage Species and Varieties -Doo-Hong Min

Forage and pasture is still one of the major feed sources supporting dairy and livestock production in the Upper Peninsula of Michigan. Sometimes pasture renovation is necessary to improve forage yield, quality, stand persistence and animal performance. Renovating old pastures using improved forage species and varieties with unique traits would improve pasture quality and further dairy and beef performance. **Based on a current study, about \$50 of nitrogen fertilizer an acre can be saved annually when the nitrogen-fixing traits of legumes are added to grasses.** This would allow a farmer owning 20 acres to save \$1,000 on nitrogen fertilizer costs. Legume-grass mixtures also reduce environmental impacts (such as surface runoff or leaching) more effectively than pure grasses.

Interactions Between Weed and Disease Management Practices in Glyphosate-Resistant Sugarbeets -Christy L. Sprague

Sugarbeets resistant to the commonly used herbicide glyphosate became commercially available to Michigan growers in 2008. Weeds and sugarbeet diseases can substantially reduce yields without proper management. Potential interactions of glyphosate with common diseases and disease management strategies in glyphosate-resistant sugarbeets needed to be evaluated while the industry was in the early stages of adopting this technology. **The new glyphosate-resistant technology does not affect field level disease management for the diseases studied.** This research helped growers adapt to new technology.

Best Management Practices for Stover Harvest in Continuous and Rotated Corn Systems -Lowell E. Gentry

Corn stover (mature stalks of corn with the ears removed that are typically fed to livestock) may become an important biofuel in the near future. This would help fulfill a goal of the 2007 Energy Independence and Security Act to increase ethanol production to 36 billion gallons, including 21 billion gallons from cellulosic feedstock. This project found that producing cover crops in a corn-soybean-wheat rotation system will allow for a 50 percent stover harvest. **Stover harvest at this rate in Michigan is valued at \$20 million a year.** This information will allow bioenergy markets and manufacturing to sustainably harvest corn stover for a given agricultural system and soil type.

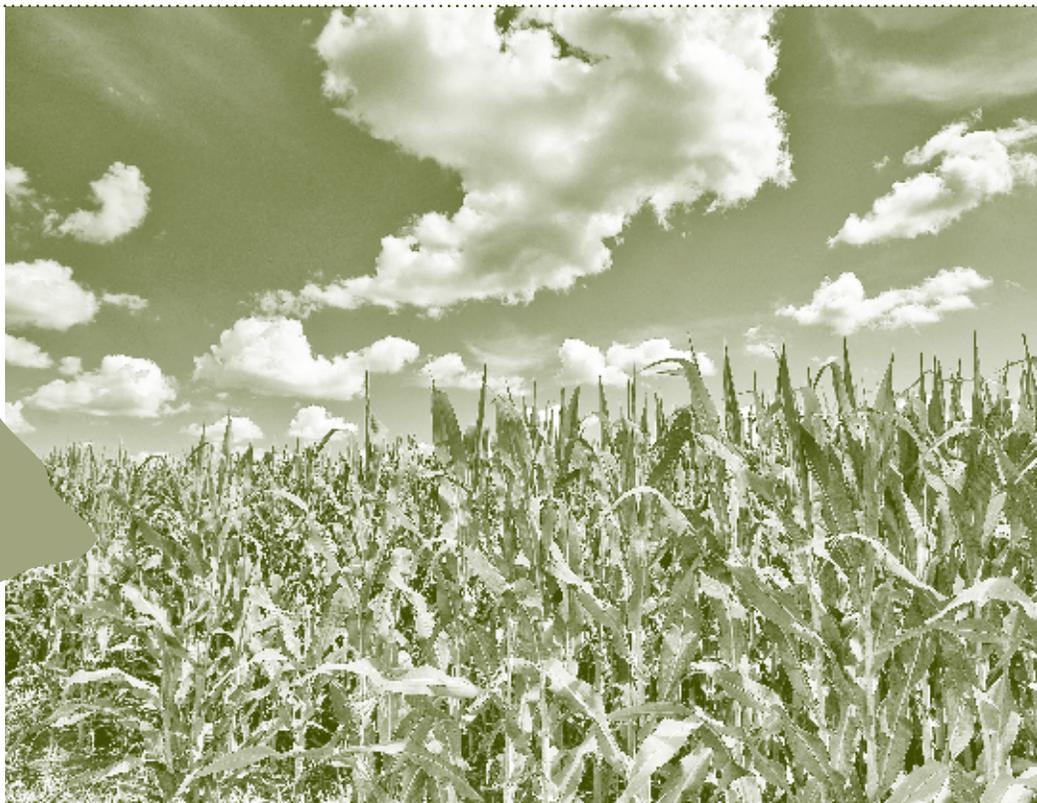
Best Management Practices for Carbon Sequestration in Alfalfa-Based No-Till Versus Conventional Tillage Systems -Doo-Hong Min

Alfalfa is the most widely used source of protein and fiber in dairy rations in Michigan. Because alfalfa can use nitrogen from both manure and nitrogen fixation, applying manure to forage crops can sequester more carbon into the soil and further improve the soil quality while lowering greenhouse gases. **Although no significant difference was found in soil carbon levels between no-till and conventional tillage systems during a short period, no-till would save production costs, build long-term soil organic carbon and slow down the climate change potential due to less fossil fuel usage.**



Corn and soybean production in Michigan is a nearly \$2 billion industry.

Michigan Department of Agriculture and
USDA National Agricultural
Statistics Service



Investigating Hop (*Humulus lupulus*) Varieties for Michigan Production -*Rob Serrine*

Currently, there is a nationwide trend toward brewers preferring to use locally grown hops. This project determined best management practices for growing hops in Michigan by collecting data on winter hardiness, disease susceptibility, yield and quality characteristics. **Based on the results, researchers estimate 90 percent of the hops produced in Michigan will be purchased and used by Michigan brewers. This represents a potential addition of several hundred thousand dollars to Michigan's economy.** The study also generated information for growers on resources for hop infrastructure and connections between growers and brewers interested in purchasing local hops.

Introgression of Aphid Resistance from Exotic Gerplasm to Elite Michigan Soybean Germplasm -*Dechun Wang*

The soybean aphid is the key insect pest of soybeans in Michigan and can decrease yield by up to 40 percent. Soybeans are ranked second in production value among Michigan crops, with an annual production value of between \$399 million and \$546 million in the past five years. Insecticides are the primary control for soybean aphids. **In 2005, 42 percent of soybean acreage in Michigan was treated with insecticides to control soybean aphids, increasing production costs by \$6.7 million.** A more effective, long-term solution to soybean aphid infestation is the use of aphid resistant soybean varieties. This study allows for the development of aphid resistant soybean varieties that can reduce insecticide costs in Michigan by up to \$24 million annually.

Evaluating Western Bean Cutworm Numbers, Damage and Control Options in Dry Beans -*Mike Jewett*

Western bean cutworm (WBC) moths were first detected in Michigan in 2006. This project provided information on the relationship between WBC pheromone trapping, infestation, damage and insecticide use. Knowledge gained will allow growers to make management decisions for this new pest. **Harvest results showed growers who applied insecticide in mid-August had very little or no damage, while untreated loads had 1 percent to 5 percent damaged beans.** Additionally, research found damage occurred despite use of soil insecticides at planting. Researchers continue to study WBC from both a management and biology standpoint.

Competitive Grant Summaries: Cross-Commodity

Michigan Farm to School: Realizing the Opportunity

–Colleen Matts

In 2007, two school food service directors in Manistee County were identified to begin Farm to School (FtS) programs. The project aimed to establish a successful, sustainable FtS program in Manistee County, increase the number of local food purchasing programs in Michigan schools and increase the number of Michigan farmers marketing to schools. **By the second year of the project, the FtS demonstration provided a market for more than \$1,800 of local produce, the majority of which was supplied from two local farmers.** By early 2010, at least 60 FtS programs in the state had been identified.



Linking Agri-Food by Developing Michigan MarketMaker

–Christopher Peterson

In order to grow and remain competitive within the globalized business environment, Michigan businesses and entrepreneurs need to be innovative and have well-established links to markets and partner organizations. **Nearly 30,000 Michigan businesses use the Michigan MarketMaker program to connect participants within the food supply chain in Michigan and other partner states.** MarketMaker has also become instrumental in identifying and sharing seasonal market opportunities for Michigan producers. This program is expected to significantly expand sales for these businesses.

A Computer-Guided, Shielded Flame Weeder and Sprayer for Post-Emergence Weed Control in Organic and Reduced- Chemical Vegetable Crops

–Bernard H. Zandstra

Organic field crop growers have used flaming, in which propane-generated flames kill weeds at a designated growing point, for weed control for years. Weed control is a major expense for vegetable growers, but flaming has not been used widely because of potential crop injury. A computer guidance system allows for precise placement of flamed bands and less potential injury. **Based on this project, researchers estimate that two post-emergence flame applications may reduce weed control expenditures by about \$900 an acre for organic producers.** Using this machine as a shielded sprayer will allow vegetable growers to use herbicides that provide excellent weed control and do not threaten the integrity of the environment.

Sustainable Economic Development, Agritourism and Health Benefits of Hoophouses in Munising

–Jeffrey Dwyer

Hoophouse systems have gained popularity as communities seek to provide fresh food without requiring extensive infrastructure. Hence, they represent a means to address economic development, agritourism and health needs in rural areas. A hoophouse was built in Munising as a result of broad community collaboration. **In the first year, sufficient volumes of product were produced to sell at the farmers' market and directly to customers at the hoophouse location nearly every day.** The system allowed for the development of a highly collaborative and sustainable community model that affected individuals, families and the community as a whole.



Minimizing Soil-Borne Pest Risk in a High-Tunnel System Through Soil Rotation *-Ron Goldy*

Crop rotation is difficult for growers using a high-tunnel system and whose crops share similar soil diseases, which can cause decreased yields. As a means of solving this problem, a process of placing soil in containers and rotating soil, rather than crops, was investigated. **The system shows promise as a way to organically produce high-value crops in a high-tunnel system.** Weed, disease and insect pests are generally easy to control, while the most effective water and nutrient management techniques have yet to be satisfactorily determined.

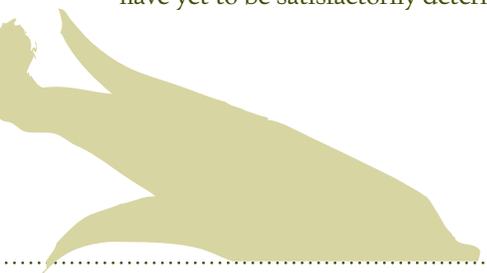
Refining the Water Needs and Availability for Michigan’s Agriculture From a Spatial and Temporal Perspective

-Jon F. Bartholic

Research generated by new groundwater legislation that required use of a Water Withdrawal Assessment Tool is showing the possibility that some high agricultural irrigation areas might be overtaxing the aquifer. Such overuse has potential effects on nearby streams. The agricultural industry requires an improved understanding of the water resource situation to optimally maintain and expand irrigation. **Project results give a general indication of areas where water is likely to be available for expanding irrigation.** Techniques for enhancing water recharge to move toward a more neutral water footprint were also implemented in this research.

Business Plan Development for Hoop Houses *-David Conner*

Michigan’s limited growing season poses an obstacle to meeting the growing demand for locally grown foods. One solution to this limit is to use hoop houses, or passive solar greenhouses. This project developed a model business plan to help growers overcome production and marketing challenges. **One USDA and two commercial agricultural lenders are now more familiar with hoophouses and their economic potential, while three farmers have requested advance copies of the marketing plan.** It will soon be available as an MSU Extension bulletin and is now on the C.S. Mott Group for Sustainable Food Systems website.



Optimizing the Efficacy and Environmental Fitness of a Commercial *Pseudomonas* Bacterial Biocontrol Product for the Control of Turfgrass Disease

–Joseph M. Vargas Jr.

Turfgrass managers across the United States battle a variety of turfgrass diseases by many means, including chemical applications. Environmentally friendly biological control products offer alternative methods of disease control. Tests confirmed a commonly used commercial biocontrol agent is sensitive to ultraviolet radiation (UVR), making it ineffective at high levels of disease pressure. **This UVR degradation can be reduced by the addition of a UV-protectant product.** Applied at high concentrations and with the protectant additive, the agent provided promising disease control during field studies. Development of UV-tolerant biocontrol bacteria and application of a UV-protectant could improve the effectiveness of other control products.

Wetland Treatment for Food Processing Wastewaters

–Dawn Reinhold

Research compared low-cost assessments to determine the toxicity of food processing wastewaters to wetland plants. Results showed that the standard method of counting fronds to measure toxicity was not reliable for multiple wastewaters and chlorophyll analysis was extremely labor intensive and costly. **An analysis that measured oxygen concentration in wastewaters was far superior and was performed on three wastewaters from Michigan food processors.** Based on feedback from the food processing industry and the Michigan Department of Agriculture, an alternative treatment solution using poplar plantations is being pursued.

Built-Up Sand-Capped Soil System for High Traffic Areas

–John N. Rogers III

High school athletic fields often serve as focal points for social gatherings and add to a sense of community pride. However, in order to have a significant number of events on a natural playing surface and provide reasonable playing conditions throughout the fall, regardless of weather conditions, the field must be artificial or sand-based. Unfortunately, the majority of high school athletic fields are constructed on native soil. A new alternative to complete field renovation is intercept drain tile installation and subsequent sand topdressing, providing a “built-up sand-capped” athletic field system. **Renovation specifications designed in this project would provide a renovation process for approximately \$70,000, without removing the field from play.**

Alternative Groundcover Management for Fraser Fir Production

–Pascal Nzokou

Fraser fir is Michigan’s most important Christmas tree species. Growers routinely apply 50 to 200 pounds of nitrogen an acre to ensure proper tree nutrition, but this is costly and can be detrimental to the environment. This project sought to improve understanding of nutrient fluxes in Christmas tree cropping systems, including legume and nonlegume groundcover. **An estimated 5 to 15 percent reduction in fertilizer and other chemical use can be achieved, leading to estimated savings of \$150,000 to \$450,000 annually.** Researchers recommend a 30 to 50 percent reduction in fertilizer use when alfalfa or white clover is intercropped.



Photoperiodic Lighting Strategies to Accelerate Development of Floriculture Crops -Erik Runkle

It has been recommended that compact fluorescent lamps (CFL) replace energy-inefficient incandescent lamps when promoting flowering of long-day ornamental plants. This project investigated several lighting strategies to generate recommendations on the most effective and economical strategies for providing long days to ornamental crops. **Either CFL or rotating high-pressure sodium lamps (HPS) can replace incandescent lamps to provide long days to most crops studied, saving growers an estimated \$16,347 to \$33,858 per acre over 10 years.** Some crops are sensitive to different light spectra, which vary between CFL and incandescent lamps, but this can be overcome by varying and combining lighting strategies.

The Use of Groundcovers in Conjunction With Chemical Mowing for Weed Management in Christmas Tree Plantations in Michigan -Bernard H. Zandstra

Christmas trees are a valuable crop on marginal land in much of Michigan. It is difficult to maintain good weed control in Christmas tree plantations because of the large number of weeds that thrive in a perennial crop and the difficulty of applying herbicides in established trees on sloping terrain. **The use of groundcover appears to be a method of managing weed control with minimal inputs of time and chemicals by growers.** Perennial rye grass and hard fescue maintained by broadcast treatment of low rates of glyphosate, a commonly used herbicide, may be an effective, efficient and environmentally sound alternative to the current practice of extensive herbicide use.

Management Approaches for Treatment of Leaf Scorch and Decline in Landscape Trees -Gerard C. Adams

Leaf scorch in landscape trees occurs under many circumstances, including stress from drought, bacterial pathogens, soil compaction, buried rubble and planting problems. The goal of this project was to discover causes of leaf scorch and develop management techniques. **Investigation and diagnosis of the causes of leaf scorch and decline in landscape trees yielded new insight into the roles of planting problems, soil problems, foliage nutritional status, water transport and physiological responses.** Economic effects will depend on the adaptation of treatment methods and sales techniques of the landscaping industry in encouraging customers to purchase effective tree maintenance services.

Energy Efficiency and CO2 Emissions in the Michigan Greenhouse Industry -Zhengfei Guan

It is critical to know how the greenhouse industry is performing in energy efficiency and CO₂ emissions and how potential economic and environmental gains from energy conservation can be achieved. Answers will help growers survive energy price shocks, improve decision-making and help provide policy makers with information. **This project found materials, labor and energy are the largest cost items in greenhouse operations, accounting for 48 percent, 39 percent and 10 percent of operating costs, respectively.** Michigan greenhouse firms could achieve a reduction in energy costs and CO₂ emissions if the best performing firms' technologies and practices are used.



Light-Emitting Diodes as a New Supplemental Lighting Source for Greenhouse Crops

–Erik Runkle

Michigan is the nation's largest producer of floriculture starting material. Many of these young plants are produced when natural light levels are excessively low. Growers have made an increasing number of requests for research-based information on the applications and viability of light-emitting diodes (LEDs) for greenhouse use. **LEDs are becoming increasingly energy efficient and have lifespans that are 400 percent longer than that of the standard greenhouse lamps.** This project found the use of LEDs for plant growth lighting will reduce energy consumption and LED arrays can be constructed to emit precise ratios of light to achieve the most desirable growth attributes.

Improving Irrigation Management for Pot-in-Pot Nursery Production Systems

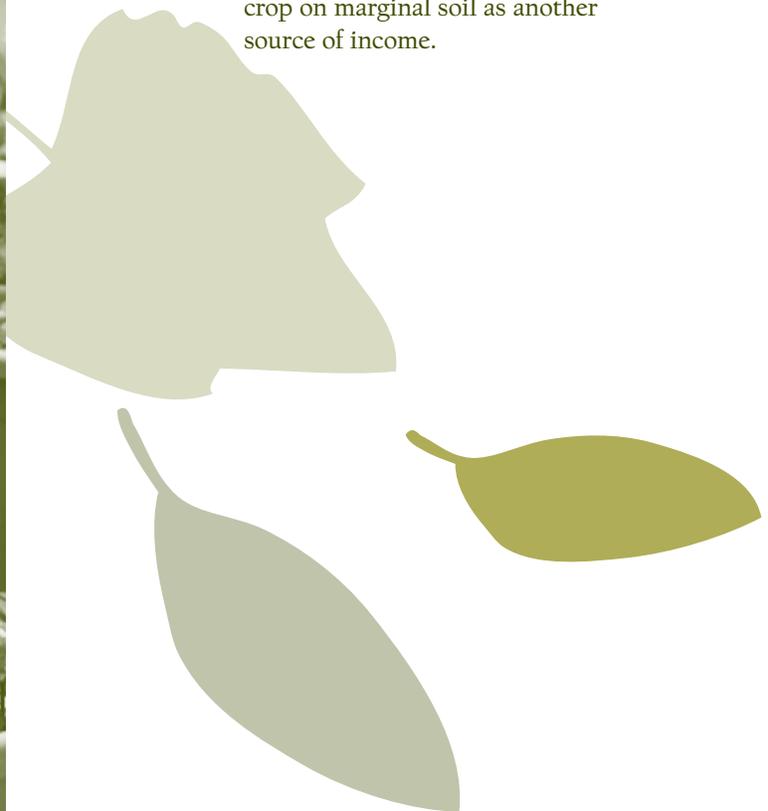
–Bert Cregg

Water management is a critical component of Michigan nursery production, yet most research has been conducted in the southern U.S. and relatively little information is available on irrigation guidelines for container grown trees in Michigan. Container production requires relatively large amounts of irrigation compared to field production, increasing the potential for adverse environmental impacts. **Growers seeking to improve irrigation management should focus on managing the amount of water applied each day.** Applying two centimeters of water daily will produce acceptable growth rates, though lower rates may be applied during periods of low potential evaporation and plant transpiration.

Assessing the Effectiveness of Warm-Season Grasses as a Bioenergy Crop in the Upper Peninsula of Michigan

–Doo-Hong Min

With rising energy costs and uncertain fossil fuel reserves, it's important to look for cheaper, safer and more renewable energy forms. As a supplemental alternative energy source to coal, bioenergy crops, such as warm-season grasses, could play an important role as an environmentally safe and economically profitable energy source. Michigan's Upper Peninsula has land that can be used for bioenergy crop fields. The MSU Upper Peninsula Experiment Station has been working very closely with Renewafuel since 2007 to develop this potential. **Renewafuel is in the process of building a \$19 million plant that will create 25 jobs and produce 150,000 tons of biofuel a year.** In the future, farmers and the general public in the Upper Peninsula region may grow switchgrass as a bioenergy crop on marginal soil as another source of income.



INFRASTRUCTURE SUPPORT

Michigan ranks second in the nation in agricultural diversity. Only California, a state with three times Michigan's land mass, ranks higher.

Michigan's agricultural diversity gives the state a wide breadth of opportunities, but also presents challenges: the more crops you grow, the more research you need to ensure your industries keep their competitive edge. By investing funds in MSU academic departments, specialized programming and MSU Extension educators throughout the state, Project GREEN can continue to meet the needs of the growers of Michigan's more than 200 commercially grown commodities.

MICHIGAN STATE UNIVERSITY DEPARTMENTS THAT RECEIVE ANNUAL INFRASTRUCTURE FUNDING FROM PROJECT GREEN:

AGRICULTURE, FOOD, AND
RESOURCE ECONOMICS

BIOSYSTEMS AND AGRICULTURAL
ENGINEERING

CROP AND SOIL SCIENCES

ENTOMOLOGY

FOOD SCIENCE AND HUMAN NUTRITION

FORESTRY

GEOGRAPHY

HORTICULTURE

PLANT BIOLOGY

PLANT PATHOLOGY

Academic Infrastructure

Each year, Project GREEN invests funding in Michigan State University Departments that, in turn, conduct research and Extension programs to help farmers, agriculturalists, entrepreneurs and others.

RESEARCHERS IN THE DEPARTMENT OF AGRICULTURAL, FOOD AND RESOURCE ECONOMICS used their Project GREEN investment to create a model to evaluate the elimination of the planting flexibility restrictions for specialty crops, as outlined in the 2008 Food, Conservation and Energy Act (commonly known as the Farm Bill). The data will provide baseline production information that will be used to compare counties over time and help farmers determine their participation in a pilot program.

THE DEPARTMENT OF CROP AND SOIL SCIENCES maintained the MSU south-campus agronomy farm and a wheat farm in Mason. In addition, Project GREEN funding:

- Helped scientists complete several research projects.
- Provided a direct link between researchers and farmers with agronomic questions.
- Helped potato scientists introduce two new commercially viable chip varieties and a new russet variety.

PROJECT GREEN FUNDS HELPED THE DEPARTMENT OF ENTOMOLOGY AT MSU conduct research and educational programming that addressed insect challenges prevalent in all aspects of agriculture and natural resources. In 2009, teams there:

- Developed and delivered two new degree-day models available through the popular Enviro-weather website (also a Project GREEN-funded venture) that help fruit growers track and control grape berry moth and cranberry fruitworm.
- Created the *Good Agricultural Practices for Food Safety and Blueberry Production: Basic Principles* manual that was adopted by the North American Blueberry Council and applies to the entire highbush blueberry industry.
- Taught more than 6,000 people about insects at their Bug House and Bug Camp.
- Increased the adoption and implementation of profitable and environmentally sound integrated pest management systems in Michigan tree fruit production.
- Developed new pest control programs that provide effective and economical alternatives to Guthion – a blueberry insecticide that will be phased out by 2012.





THE DEPARTMENT OF FOOD SCIENCE AND HUMAN NUTRITION (FSHN) used their Project GREEN investment to provide nutritional labeling to 41 MSU Product Center clients so they can market their products. In addition, FSHN team members are helping add new life to Michigan-grown food products by:

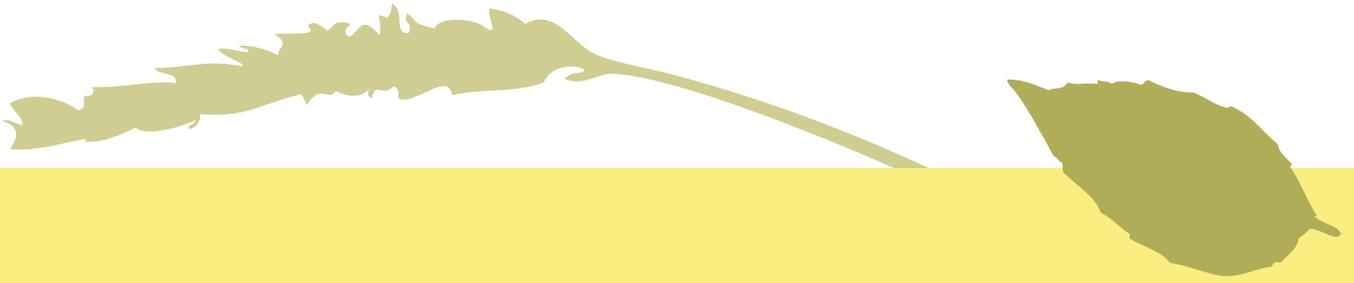
- Extending the shelf life of tart cherry juice concentrate, fresh-cut pears, and peeled and diced onions.
- Investigating the antioxidant activity of autumnberry.
- Researching value-added processing alternatives for antioxidant-rich autumn olive berries.

PROJECT GREEN FUNDING GAVE THE DEPARTMENT OF FORESTRY an opportunity to purchase equipment necessary to measure photosynthesis in conifers. This will help scientists better understand the physiology, growth and hardening off of Michigan's various Christmas-tree species, and allow farmers to make smart choices when it comes to choosing species to grow in the future.



RESEARCHERS IN THE DEPARTMENT OF GEOGRAPHY worked closely with the Michigan Automated Weather Network (MAWN), which provides data to Enviro-weather. The reliability of MAWN data is critical in ensuring that information that farmers and agriculturalists gather from Enviro-weather is useful and timely. Researchers in Departments of Geography used Project GREEN funds to create new weather models for Enviro-weather, which has, in part:

- Streamlined the process of incoming weather data to improve response time.
- Created an Enviro-weather Frost Alarm, a trial project designed to help fruit producers monitor and respond to the threat of cold weather before it hits.
- Taught growers how to use Enviro-weather to their economic advantage through a series of meetings throughout the state. Since its creation in 2006, the number of hits on the Enviro-weather site has increased from less than 500 per day to more than 4,200.



THANKS TO PROJECT GREEN FUNDING, SCIENTISTS IN THE DEPARTMENT OF HORTICULTURE were able to purchase equipment that will allow them to apply modern methods to advance research projects. That includes:

- Several pieces of environmental monitoring equipment for high-tunnel systems, inexpensive greenhouse-like structures that are used for high-value crop production.
- A Minolta ChromaMeter 300 that allows digital and quantitative assay of fruit and vegetable color – a fundamental component in measuring the quality of fruit and vegetables.
- A no-till grain drill aimed at integrating cover crops and reducing tillage in vegetable cropping systems.
- An updated X-ray film processor that is essential to routine plant molecular biological research.

SCIENTISTS IN THE DEPARTMENT OF PLANT BIOLOGY used their Project GREEN investment to purchase a laser dissection microscope, the only one of its kind at Michigan State University. This high-tech piece of equipment allows multiple researchers to explore gene expression patterns in specific cell and tissue types. Researchers in the department are also:

- Studying how chestnut blight changes over space and time to gain insight into how blight spreads so they can attempt to control the deadly disease.
- Leveraging funds to support an informational technology staff person who ensures the enormous amount of data generated by the department are secure so research is not interrupted.

IN THE DEPARTMENT OF PLANT PATHOLOGY, scientists used their Project GREEN investment to stay ahead of potentially devastating crop diseases. For example:

- A new genotype of *Phytophthora infestans* was identified in potatoes and tomatoes, and scientists are gathering information to assess the risks associated with it.
- Waitea patch, a new disease that can cause turf loss on putting greens, negatively affecting golf courses' bottom lines, is under careful scrutiny.
- Stigmina, a new disease that threatens Michigan's profitable spruce tree industry, is being studied.
- Researchers are taking a close look at bacterial spots on peaches, nectarines and plums in southwest Michigan.



Outreach and Education Through MSU Extension



Project GREEN helps MSU Extension educators in all 83 counties extend their resources to localized projects throughout the state. Here are some examples:

- Creating energy from renewable, plant-based materials is top of mind for legislators, regulators and researchers alike. MSU Extension educators and specialists developed bioenergy research trials at six locations across the Lower Peninsula, each featuring six to eight crops.
- A bioenergy research and demonstration trial in Antrim County was created to determine the viability of corn, flax, teff and switchgrass as fuel-producing crops.
- In the Upper Peninsula, MSU Extension educators are investigating the viability of canarygrass as a potential bioenergy crop. They provided research data from ongoing farm demonstration trials that compare biomass production, BTU value and optimum nitrogen fertilization.
- Nothing hits the spot on a hot summer day more than a cold, Michigan-brewed beer. MSU Extension educators in northwest Michigan are investigating hops varieties in hopes of encouraging Michigan brewers to use homegrown product in their beverages.
- Most irrigation equipment is only 70-percent efficient. Project GREEN funds allowed an MSU Extension educator to create four irrigation-system uniformity kits, each made of 150 individual measuring devices and graduated cylinders. This helps determine whether the nozzles on overhead irrigation equipment are performing optimally. The kits were distributed to U.P. and Northern Michigan water technicians who will do the testing or loan kits to farmers who want to do their own testing. Farmers who increase their irrigation efficiency by as little as 20 percent can save up to \$3.50 an acre annually and improve yields.



- Several MSU Extension educators throughout the state conducted demonstrations to show farmers the value of scientifically based irrigation scheduling, thus saving them time and money while boosting yields.
- Programming about improved soil nutrition and pest management helped Michigan Christmas tree growers save an average of \$1,000 to \$1,500 an acre.
- A survey of Michigan crop farmers showed that most would consider growing a new crop if it could generate net profits of more than \$100 an acre. MSU Extension educators in northern Michigan are determining whether canola can meet the challenge by conducting a canola fertility trial that will evaluate 14 unique fertilizer programs in hopes of boosting yields up to 50 acres a bushel. (Canola is the basis for a popular vegetable oil that is high in monounsaturated fats.)
- Educators in the fruit ridge (the west side of the Lower Peninsula) repaired and refurbished apple scab monitoring equipment to help ensure they could generate reliable data for apple producers who rely on it to determine when to apply crop-protection products.
- The Thumb Agriculture Research and Education program organizers evaluated 125 corn hybrids, 83 soybean varieties (including 22 food-grade varieties), and investigated corn and soybean planting populations and nitrogen rates on corn. The data they compiled are used as a basis for educational meetings designed to help corn and soybean growers maximize their yields and profits.
- Project GREEN funding allowed MSU Extension educators to support the bioeconomy through public education and business development support. In 2009, one MSU Product Center innovation counselor helped 14 entrepreneurs evaluate proposed ventures, and developed five bioenergy bulletins to help educate farmers and investors about bioeconomy opportunities.
- Good fences make good neighbors – and even better grazing pastures. One MSU Extension educator used Project GREEN funds to demonstrate how temporary fencing equipment, some complete with solar chargers, can enhance grazing lands for cattle, sheep and horses. He now conducts the Temporary Fencing Olympics, which features hand-on events including speed fencing, fault finding, acreage calculation, fence removal and paddock building.
- Project GREEN-funded research showed that biological control agents can be used to control thrips, a yield-robbing insect pest, in fall chrysanthemums, thereby eliminating weekly insecticide applications, saving money and protecting the environment.
- MSU Extension specialists at the Kellogg Biological Station are investigating the effect of cover crops on soil health, nitrogen retention and biomass potential.
- Ten varieties of heirloom tomatoes – traditionally known as highly perishable cultivars – were tested for their shipping ability. The results showed clear and significant differences among varieties. Growers can use this information when determining marketing channels for their crops, and the financial feasibility of growing heirloom tomatoes.

PROGRAM SUMMARY

Funding Supports Specialized People, Programs

Michigan is a special state, but Michigan's agriculture industry is especially special. Farmers in Michigan grow a diversity of crops second only to California, a state almost three times the size of Michigan. This world-class diversity necessitates a unique mixture of research and Extension programs to meet the needs of more than 200 commercially grown commodities. Project GREEN funding meets those needs, in part, by providing infrastructure funding for specialized programs throughout the state.

DID YOU KNOW?

There were 83 new research initiatives made possible thanks to Project GREEN funding in 2009.



MSU Product Center

PRODUCTCENTER.MSU.EDU

With an economic impact of \$71.3 billion, Michigan's agri-food industry has set itself apart as the second largest economic driver in the state. The professionals at the MSU Product Center have played a key role in helping entrepreneurs develop and commercialize high-value, consumer-responsive products and businesses in the agriculture, food, natural resource and bioeconomy sectors.

Each year innovation counselors throughout the state meet with would-be and existing business owners for one-on-one counseling sessions to help them determine the viability of their products and services. In 2009 counselors conducted 2,799 counseling sessions, bringing the total number of sessions since the Product Center was founded in 2004 to 14,724. And 274 Product Center clients received help with their business development plans from the MSU Product Center. More than 830 clients have benefitted from specialized services such as product testing, market analysis and feasibility studies.

All that adds up to 152 new businesses, and 720 new and 353 retained jobs in Michigan since 2004 for an annual increase in sales of \$278.7 million.



Enviro-weather

ENVIROWEATHER.MSU.EDU

MANAGING CROPS WHILE DEALING WITH THE ELEMENTS keeps growers on their toes all growing season. Whether it's raining, snowing, hot or cold, Michigan State University's Enviro-weather stations keep on working to provide Michigan's growers with up-to-date information they can use in their crop management plans 24 hours a day.

There are many sources of weather information, but Enviro-weather takes weather many steps beyond precipitation and storm forecasts – it is specifically geared to help growers make timely crop management decisions that can affect crop production throughout the season. Enviro-weather provides growers with pest and crop management models and irrigation schedules, alerts them to specific pest and disease problems, explains how to deal with untimely frost and provides links to articles from MSU Extension specialists on timely crop information, pest identification and more.

Since its inception in 2005, the Enviro-weather station network has grown to 64 weather stations around the state, and the number of hits on the Enviro-weather site has increased from less than 500 a day to more than 4,200.

Pesticide and Plant Pest Management Division, Michigan Department of Agriculture



THE MICHIGAN DEPARTMENT OF AGRICULTURE, through a cooperative agreement with the U.S. Department of Agriculture (USDA), provides official inspection and certification services to Michigan firms that export plants and plant products throughout the world. This symbiotic relationship benefits from Project GREEN investments that allow teams there to conduct valuable work – everything from tracking pests in Michigan to allow timely control treatments to working with other countries to ensure producers can market their crops throughout the world.

For the eighth year, MDA's plant pest specialist cooperated with USDA-Animal Health and Plant Protection Service-Plant Protection and Quarantine, the U.S Apple Committee and MSU Extension to implement an apple certification program in accord with Mexico's strict phytosanitary requirements.

The MDA export manager worked with Enviro-weather staff members to develop an online gypsy moth tracker that helps Christmas tree growers apply treatments more effectively.

The MDA team conducted inspections for blueberry scorch and shock virus to maintain Michigan's disease-free status, thereby protecting blueberry growers' right to market their products.



Integrated Pest Management

PEST MANAGERS ARE CONTINUOUSLY CHALLENGED by weather, invasive species and regulatory mechanisms to adopt pest management techniques that are effective and more environmentally benign. Reduced-risk techniques tend to be more complex to set up and monitor. The MSU Integrated Pest Management (IPM) program encourages adoption of these farm practices that conserve natural resources. It works with MSU Extension, specialists, consultants and commodity groups to help farmers access information that will make their pest management practices effective while safeguarding farm and environmental health.

The IPM Program coordinates pest and crop updates from MSU faculty and Extension field staff that are published in the Crop Advisory Team Alerts. In 2009, more than 96,000 unique visitors viewed one or more articles at the CAT Alerts website. The articles include new pest alerts, crop production and IPM recommendations and regional crop and pest updates from Extension educators.

In addition, IPM scientists created Grape*A*Syst, an on-farm assessment that helps grape growers evaluate the sustainability of their farms. The program was kicked off with considerable success in 2009. Technicians in the MDA Groundwater Stewardship Program are working with growers to complete the workbook, and hope to get 50 percent of Michigan grape producers through the program in 2010. Data from workbook scores will enable growers to promote and market sustainable production as a cornerstone of grape production in Michigan.



MSU Land Management Office

THE MSU LAND MANAGEMENT OFFICE (LMO) provides the backbone for field research critical to university scientists on campus and throughout the state. Because of equipment purchased by the LMO, courtesy of Project GREEN infrastructure funding, researchers were able to conduct numerous projects, including:

- Optimizing irrigation in cherry orchards.
- Conducting apple scab and brownrot fungicide sensitivity screening.
- Tracking insecticide, fungicide and herbicide trails in grapes and cherries.
- Leading integrated pest management and generally accepted practices (GAP) training for growers.

DID YOU KNOW?

Project GREEN funded 31 academic and outreach positions at MSU.

LOOKING FORWARD

Thanks to funding from Project GREEN, 88 plant agriculture research projects will receive \$2.08 million in grant funding for fiscal year 2010-11. The Project GREEN selection committee invested more than \$1.5 million in 58 new projects. In addition, the committee awarded \$568,000 to continue funding for 27 projects already in process.

Applied Research

- Accelerating blueberry plant establishment, *Eric Hanson*
- Best management practices for weed control in blueberries, *Paul Jenkins*
- Biofumigation and cover crop mixtures for optimizing the performance of cover crops in commercial vegetable production, *Mathieu Ngouajio*
- Clarksville Horticulture Experiment Station agriculture tourism center, *James Flore*
- Combining strip-tillage and cover-cropping for improved insect and weed management in Michigan vegetable crops, *Daniel Brainard*
- Control of parasitic nematodes without fumigates in strawberry planting and its impact on black root rot, *Annemiek Schilder*
- Detecting and assessing potential causes of internal chestnut deterioration, *Daniel Guyer*
- Developing a comprehensive fruitworm management program for Michigan blueberries, *Rufus Isaacs*
- Developing a program of accurate detection and enhanced management of cucurbit downy mildew, *Mary Hausbeck*
- Developing LED photoperiodic lighting for specialty crop production, *Erik Runkle*
- Developing soybean germplasm with resistance to Japanese beetles and aphids, *Dechun Wang*
- Development and delivery of a sustainable asparagus miner management program in Michigan, *Zsofia Szendrei*
- Development and delivery of an effective organic pest management tactic for Michigan organic apples using entomophagous nematodes, *Matthew Grieshop*
- Development and delivery of sustainable, biologically based insect pest management for Michigan greenhouses, *Matthew Grieshop*
- Development and implementation of mating disruption for environmentally sound management of Sesiid borer pests in cherry and apple orchards, *David Epstein*
- Development of attract-and-kill technologies for control of moth pests of fruit crops, *Larry Gut*
- Development of poplar plantations for treatment of food processing wastewaters, *Dawn Reinhold*
- Development of vineyard models for the maximum production of juice grapes with acceptable quality under Michigan growing conditions, *Thomas Zabadal*
- Development of Web-based operational guidance for irrigation of tree fruit and grapes in Michigan, *William Northcott*
- Diversity and management of *Streptomyces* species that cause scab on potato and sugar beets in Michigan, *Jianjun Hao*
- Early leaf removal to improve crop control, cluster morphology and berry quality in vinifera grapes, *Paolo Sabbatini*
- An economically promising plum curculio control strategy in Michigan tree fruit with a reduced risk IGR, *Mark Whalon*
- Effect of endoparasites, *Nosepma* spp. on honeybee behavior and physiology, *Zachary Huang*
- Effects of irrigation and rye living-mulch on weeds, soil health and asparagus yields, *Daniel Brainard*
- Establishment of perennial warm-season grasses for biofuels, *Kurt Thelen*
- Evaluation of anthraquinone for bird control in blueberries, *John Wise*
- Evaluation of strategies to achieve sustainable production of Concord grapes in Michigan, *Paolo Sabbatini*
- Evaluation of tuber health predisposition programs in conjunction with reduced-risk fungicides and biofungicides applied post-harvest for the control of potato storage pathogens, *William Kirk*
- GREEN Pesticide Policy Program, *Mark Whalon*
- Host/pathogen interactions of invasive and established genotypes of *Phytophthora infestans* on foliage and tubers, *William Kirk*
- Improving biological nitrogen fixation in dry beans for Michigan, *James Kelly*
- Improving water management in container nurseries by scheduling irrigation based on real-time sensor derived plant water use, *Rodney Fernandez*
- Increasing sustainability for the Michigan juice grape industry through the development and validation of thresholds for key vineyard insect pests and diseases, *Paul Jenkins*
- Integrating novel mechanical, genetic and horticultural technologies into early-yielding, high efficiency, globally competitive tart cherry production system, *Ron Perry*
- Investigating hop (*Humulus lupulus*) varieties for Michigan production, *Rob Serrine*
- Investigating horticultural methods for overcoming *Armillaria* spp. on cherry orchard sites, *Erin Lizotte*
- Investigating resistance inducers for control of bacterial canker (*Pseudomonas syringae*), *Nikki Rothwell*
- Investigation of potato plant resistance mechanisms to Colorado potato beetles and development of resistant varieties, *David Douches*
- Iris Yellow Spot Virus, a new threat to Michigan onions: evaluation transmission by thrips, monitoring disease incidence and controlling its spread, *Walter Pett*
- Management plans for emerging blueberry insect pests: Putnam scale and blueberry gall midge, *Rufus Isaacs*
- A new approach to grub tolerance for growing healthy lawns without insecticides, *David Smitley*
- New tools for identifying resistance to potato common scab and improving disease management, *David Douches*
- Nursery establishment and physiology of difficult-to-transport ash alternative species, *Bert Cregg*
- Optimizing grape potential: Influence of climate, viticulture practices and vine balance on Michigan terroir, *Paolo Sabbatini*

- Optimizing management of grape berry moth with risk assessment, pest phenology and sustainable controls, *Rufus Isaacs*
- Optimizing row width and plant populations to improve weed management and yield in Michigan dry bean production systems, *Christy Sprague*
- Optimizing the conditions and developing new tools for controlling soybean white mold using cultural and biological means, *Jianjun Hao*
- Plant defense priming: Can plant growth regulators or fertilization enhance resistance of native or Asian ash species to emerald ash borer? *Deborah McCollough*
- Quantifying carbon sequestration in woody and herbaceous nursery production systems, *Robert Schutzki*
- Quantifying carbon sequestration potential in landscape systems, *Brad Rowe*
- Reducing the risk of new and invasive viruses in Michigan blueberries and cranberries, *Annemiek Schilder*
- Scheduling bedding plants for energy efficient greenhouse production, *Erik Runkle*
- Soil moisture depletion patterns, water use and nutrient fate on creeping bentgrass for sustainable golf course putting greens, *Kurt Steinke*
- Soybean sudden death syndrome: Assessment of *Fusarium virguliforme* distribution, pathogenicity genetic diversity and fungicide resistance in Michigan, *Martin Chilvers*
- Storage of Honeycrisp apple fruit, *Randolph Beaudry*
- Strip-tillage and planting density strategies for improving carrot quality and soil health, *Daniel Brainard*
- Sustainable cropping systems for Michigan Christmas tree production, *Pascal Nzokou*
- Sustainable irrigation and water management in Fraser fir Christmas tree production, *Pascal Nzokou*
- Sustainable management solutions for control of aster yellow phytoplasma and associated leafhopper vector in Michigan, *Zsafia Szendrei*

- Sustaining markets and profitability in the tart cherry industry: The role of optimum supply volume in the federal marketing order, *John Hoehn*
- Targeted tillage of manure-enriched planting zones for priming manure nitrogen release in low-disturbance cropping systems, *Timothy Harrigan*
- Timing of powdery mildew cleistothecium production in the fall and ascospore release in the spring under Michigan conditions, *Annemiek Schilder*
- Toxicity of various pyrethroid insecticides to varroa mites, *Zachary Huang*
- Upper Peninsula corn hybrid trials, *Kurt Thelen*
- Validation of disease prediction models for anthracnose fruit rot and mummyberry in blueberries, *Annemiek Schilder*
- Western bean cutworm biology, life history and management under Great Lakes conditions, *Christina DiFonzo*

Basic Research

- Evaluating the importance of visual cues for fruit pest attraction to pheromone dispensers and attract-and-kill devices, *Matthew Grieshop*
- Genetic manipulation of *Venturia inaequalis* for control of forcible ascospore discharge, *Frances Trail*
- Improvements to moth mating disruption by insights from comparative studies of oriental fruit moth versus codling moth, *James Miller*
- Inhibition of biofilm formation and fire blight disease caused by *Erwinia amylovora*, *George Sundin*
- Transcriptome responses of cucumber (*Curcumis sativus*) to the downy mildew pathogen, *Brad Day*
- Uncovering the role of P450 genes in resistance to neonicotinoid insecticides in Colorado potato beetles (CPB), *Mark Whalon*

Extension/Demonstration

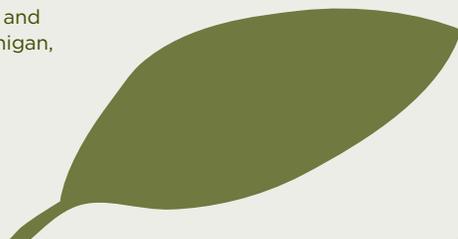
- Cover crop benefits and options for celery and onion rotation systems on muck soils, *Mathieu Nguouajio*
- Creation of virtual turfgrass disease diagnostic profiles for Michigan State University's turfgrass website, *Joseph Vargas*
- Enhancing cover crop selection and performance for field crop and vegetable farmers in Michigan, *Dale Mutch*
- Food safety in specialty crops: Preparedness for third party GAP audits, *John Wise*
- Food safety risk assessment for fresh market fruit and vegetable producers, *Allen Krizek*
- Managing potato and tomato late blight epidemics through the use of weather-based integrated pest management systems to predict overwinter survival of volunteer potato tubers, *William Kirk*
- Regional planning for agriculture economic development in mid-Michigan, *Susan Pigg*

Multidisciplinary Cross Commodity

- Preparing Michigan plant industries for the changing physical and policy climates, *Claire Layman*
- Sachet development and characterization for the delivery of bioactive molecules to improve packaged fresh produce quality and safety, *Eva Almenar*
- Solid-set canopy spray delivery systems for resource-efficient, ecologically sustainable fruit production, *Gregory Lang*

Discretionary Funds

- Environmentally protective land application strategies for food processors' wastewater, *Steven Safferman*
- Establishment of an expanded interdisciplinary enology research and development program at Michigan State University, *Kris Berglund*
- Michigan State University-conducted and -coordinated industry wheat evaluations for wheat quality testing of advanced lines, *Perry Ng*
- Re-establishment of the blueberry research planting at Michigan State University's Trevor Nichols Research Complex, *John Wise*



PLANT COALITION

DIRECTORS' ACTION TEAM

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

Douglas Buhler

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MSU Department of Plant Pathology

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INDUSTRY PARTNERS

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

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

SPECIAL THANKS TO...

Jackie DeSander, Bev Riedinger
Michigan Agricultural Experiment Station

*Ruth Hohl Borger, Rebecca McKee,
Amanda Sollman, Beth Stuever, Joseph
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Design by Redhead Design Studio

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FEATURED TEAM



PLANT BIOTECHNOLOGY RESEARCH AND OUTREACH CENTER

The Plant Biotechnology Research and Outreach Center (PBROC) is dedicated to the safe deployment of plant biotechnological advancements in Michigan and the world. The center:

- Provides contract services, micropropagation and molecular fingerprinting.
- Presents training in environmental biosafety of genetically engineered crops and molecular plant breeding.
- Develops transformation technologies for specialty and orphan crops, those crops which are agriculturally important but have yet to receive a large amount of research attention.

The PBROC advances Michigan biotechnology through research, outreach and contract services. There are currently six projects at PBROC, including molecular mapping of strawberries and blueberries, genetic virus resistance in cherries and testing native cold-responsive genes in blueberries. In previous years, research at PBROC has greatly contributed to the development of efficient transformation technologies for blueberries, cherries and switchgrass, and novel selectable marker genes.

The PBROC has eight contracts with Michigan businesses, MSU researchers and the University of Georgia. The contracts include blueberry micropropagation and canola, dry bean, switchgrass and apple transformations. The PBROC is not only an asset to MSU and its researchers, but also to other universities and the federal government.

The PBROC also is involved in outreach. Projects include coordinating MSU's activities in developing the website for the African Biosafety Network of Expertise, hosting a molecular breeding course for MSU and international students, organizing and teaching biotechnology and environmental biosafety courses, and developing a plant breeding training program.

"We are proud of the diverse array of services PBROC now offers the State of Michigan, MSU and the world," says Jim Hancock, director of the Center. "It could never have happened without sustained, core funding from Project GREEN."



Project GREEN

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