MESSAGE FROM THE COORDINATOR

This year marks a notable milestone for Project GREEEN (Generating Research and Extension to meet Economic and Environmental Needs). For 20 years, Michigan State University researchers and Extension specialists have teamed with plant agriculture industry groups and the Michigan Department of Agriculture and Rural Development to lead important initiatives that solve problems and create opportunities for Michigan's growers.

To celebrate two decades of Project GREEEN's positive influence on the plant agriculture sector and Michigan's economy, MSU hosted an event Sept. 19 at the Lansing Center. Partners from throughout the program's history joined together to commemorate our innovative work. The event highlighted Project GREEEN's successful past and critical future priorities.

Serving in a leadership role with Project GREEEN for much of its 20 years, I've had the pleasure of witnessing firsthand its effect on Michigan agriculture. It's truly a testament to what can be accomplished when collaboration is encouraged.

Project GREEEN has been the beneficiary of steady funding from the state of Michigan – more than $100 million over 20 years. With a financial commitment that significant, the expectations are set rightfully high. We take seriously this tremendous responsibility.

To that end, this substantial investment has yielded a bountiful return of more than $2.5 billion in estimated total economic impact for our state.

The resources of Project GREEEN have also helped bring additional support to our industry. Researchers and Extension specialists often leverage dollars from funding sources such as the U.S. Department of Agriculture, the National Science Foundation, private industry and other funders. These projects routinely expand in scope to include collaborators from institutions nationwide.

DOUG BUHLER

I take great pride in our responsiveness and flexibility. Being nimble in a constantly changing environment is vital to maintaining utility to our audiences. Addressing long-term issues such as soil health, as well as fast-emerging threats such as spotted wing drosophila, are a hallmark of Project GREEEN's commitment to delivering the most relevant information in a timely fashion.

While it's important to acknowledge our past, it's also necessary to look toward the future. Plant agriculture faces a bevy of challenges. Finding new ways to grow food in changing conditions and feeding a ballooning global population are just a couple of these worldwide problems. Using the renowned scientific and educational expertise at MSU, we look forward to our next 20 years of contributing to the solutions.

Doug Buhler
Coordinator, Project GREEEN
Director, MSU AgBioResearch

DIRECTORS' ACTION TEAM

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

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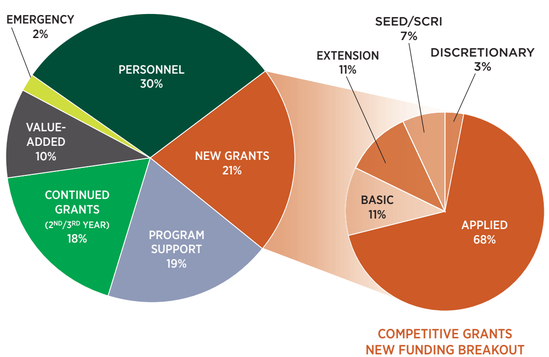
FINANCE AND OPERATIONS



COMPETITIVE GRANT SUMMARIES

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

Optimizing apple thinning

Researcher: Todd Einhorn

Awarded: $37,500 | Leveraged: $83,000

Fruit thinning is an essential practice for achieving marketable fruit size, optimizing fruit quality and ensuring consistent return bloom. Failure to thin reduces profitability in the current season due to an overproduction of small fruits of low value and in the subsequent year as a result of poor return bloom. Decades of research has led to the development of several chemical thinners for apple with varying modes of action, yet thinning remains enigmatic – a blend of science and art with an often unpredictable outcome. To further complicate the situation, proven thinning chemistries have uncertain futures due to changing regulations. First, Todd Einhorn, an associate professor in the Department of Horticulture, and his team will conduct multiple thinning trials using a range of sites and cultivars. The team is seeking to develop new thinning compounds that achieve thinning in early and mid-timings, as well as late timings for rescue thinning. Second, researchers are developing a novel method to improve the precision crop load management procedure by photographically imaging hundreds to thousands of fruits daily. They will then analyze the images to calculate daily fruit growth rate and, ultimately, enable the early estimate of abscission probabilities. Einhorn said that these efforts will directly improve profitability, increase production efficiency and improve fruit quality.

Identifying genes for stripe rust resistance in elite Michigan wheat varieties

Researcher: Eric Olson

Awarded: $30,000 | Leveraged: $98,310

Stipe rust is a yield-limiting disease of wheat that can significantly reduce the profitability of wheat farming operations during epidemics. The MSU wheat breeding program has identified a set of lines with high levels of resistance to stripe rust. The genes conferring resistance can be localized to chromosome intervals using association analysis. Three new resistance genes have been identified from a relative of wild wheat that can be fine-mapped to discrete physical intervals. The sources of stripe rust resistance and resources developed in this study will ideally sustain long-term profitability of wheat in Michigan through the development of resistant varieties. The 2016 epidemic provided an opportunity to evaluate the stripe rust resistance in 100 elite lines of the MSU wheat breeding program. Five replicates of stripe rust severity were evaluated on a 0 to 9 scale at three locations in Michigan: East Lansing, Mason and Richville. A high frequency of resistant lines were identified with severities lower than 6. A set of seven parents were common in the pedigrees of resistant lines. In addition to the scientific merits, this work has great potential to impact rural communities by increasing on-farm profitability. Protecting wheat yields delivers economic benefits across the entire wheat value chain in Michigan. Project lead Eric Olson, MSU assistant professor in plant, soil and microbial sciences, said that wheat growers will experience higher profitability on their farms by having improved wheat varieties available with high levels of resistance to stripe rust.

Epidemiology, biology and population genetics of oak wilt

Researcher: Monique Sakalidis

Awarded: $40,000 | Leveraged: $410,000

The fungal pathogen that causes oak wilt is responsible for the widespread decline of oaks across the United States, including 24 states and 829 counties. It is particularly devastating to trees in the red oak group, which can succumb to this disease within four weeks of infection. Spread of this disease is rapid and occurs on multiple fronts from root-to-root transmission, insect transmission and sporadic long-range infections due to movement of firewood. The decline of oaks is an aesthetic blight across the landscape, requires costly tree removals and causes devastating ecosystem damage. There is no natural resistance to this disease in the red oak group. The only means of preserving these valuable trees is to reduce the spread of oak wilt to new locations and reduce inoculum load in known oak wilt-positive locations. This is particularly relevant to activities that result in tree wounding or movement (pruning, harvesting, thinning, utility line clearance and firewood). Currently, disease management decisions in Michigan are primarily based on research conducted in other states and anecdotal observations. This project is looking at evaluating whether effective molecular methods of detection are available. Researchers are also trying to determine key periods of oak susceptibility to infection, including when those trees are exposed to insect vectors of the disease.

Integrating fall-planted cereal cover crops to aid in the management of glyphosate-resistant horseweed

Researcher: Christy Sprague

Awarded: $20,300 | Leveraged: $22,100

Horseweed, also commonly known as marestail, is a weed that was not on the radar of most Michigan soybean growers 10 years ago. However, over the last five years this weed has become a major concern. Extended emergence and the development of resistance to glyphosate and other herbicides have made horseweed management a challenge, especially in soybean. Horseweed is an annual weed species that was historically classified as a winter annual since the majority of seedlings emerged in the fall. However, more recent studies and observations have shown higher numbers of horseweed plants emerging early in the spring. Researchers are evaluating the effect of the fall-planted cover crops, cereal rye and winter wheat, at two seeding rates on the suppression of glyphosate-resistant horseweed in no-till soybean. They are then comparing the integrated approach of the combination of cover crops and different herbicide strategies with the herbicide programs alone. The continued spread of glyphosate- and multiple-resistant horseweed will have a detrimental effect on the economics of Michigan crop production. Plant, soil and microbial sciences professor Christy Sprague, the project lead, said that this research is important to provide effective information to soybean growers on management of this economically significant weed problem. It also provides alternative options, in addition to herbicides.

Michigan hop growers face several disease challenges

Researcher: Mary Hausbeck

Awarded: $25,000 | Leveraged: $329,000

Hop is a perennial specialty crop grown for use in beer production. Michigan is the largest hop producer outside the Pacific Northwest, and harvested hop production acreage doubled from 320 acres in 2015 to roughly 800 acres in 2016. Michigan's hop industry was valued at $16.4 million in 2016. Downy mildew is the most significant disease affecting hops. All parts of the plant can become infected, and crown rot can cause total yield loss. Downy mildew populations are prone to develop resistance to multiple fungicides, which complicates management. Viruses are also a significant and limiting problem for hop production, and viral infections can result in substantial yield loss. All Michigan hop propagators tested positive for at least one of five viruses in preliminary tests. Hop seedlings infected with downy mildew or viruses while in the nursery should not be used to establish hopyards, but infected plantlets may not show symptoms. Project lead Mary Hausbeck, University Distinguished Professor of plant, soil and microbial sciences, said that because of this, disease management strategies and cultivar selection specifically tailored to Michigan need to be developed. The research team is developing a management program for Michigan that samples nurseries and tests for viruses. The team will identify fungicides effective against downy mildew and evaluate hop cultivars. Through MSU Extension, the group will work to educate growers, implementing outreach strategies to disseminate information.

Improving nutrient management for Michigan agriculture through enhanced online decision support and extension

Researcher: Zachary Hayden

Awarded: $24,800 | Leveraged: $11,000

Nutrient loss from agricultural fields is a pressing challenge that harms both farm profits and the environment. Recent water quality issues in Lake Erie and elsewhere highlight the importance of sound nutrient management for protecting our water resources. The U.S. Department of Agriculture Natural Resources Conservation Service's recent $77 million investment in the Western Lake Erie Basin Initiative identified avoiding excess nutrient application as the first of four key strategies for addressing this problem. In addition, inefficient and excessive fertilizer nutrient applications can lead to higher input costs and potential yield losses for farmers, costs that may be exacerbated by more frequent extreme weather events in the future. Sound nutrient management rests on understanding both the current fertility status of the soil and specific crop demands. Testing the soil and fertilizing according to science-based nutrient recommendations is the foundation of minimizing nutrient losses – including that of phosphorus and nitrogen – while maximizing productivity. Growers across Michigan's plant agriculture sectors rely on Michigan State University as a resource for accurate, research-based nutrient recommendations. Researchers and MSU Extension specialists are preserving and upgrading the MSU Nutrient Recommendation Program – a novel, web-based decision support tool for obtaining crop-specific fertility recommendations from soil test results. Then, they are pursuing a cross-commodity outreach effort to promote responsible nutrient management while expanding awareness and use of the modernized NRP tool. As a result of increased knowledge and enhanced decision support, potential impacts for growers and the environment include more accurate fertilizer management, cost savings, yield gains, increased profits, reduced nutrient losses from fields, and improved quality of surface and groundwater resources.

For a complete list of competitive grant summaries, visit greeen.msu.edu.

Developing a long-term strategy for cover crop research in Michigan's Upper Peninsula

Researcher: Ashley McFarland

Awarded: $15,000 | Leveraged: $17,920

Although the benefits of cover crops to soil health are widely accepted, the practice is not often used in Michigan's Upper Peninsula because of the perception that there is little time to establish a fall cover crop after harvest due to a narrow growing season. That perception is beginning to change as more farmers are struggling with maintaining soil health and exploring new opportunities to maximize productivity. The U.P. is a diverse region, both in terms of landscape and the agricultural industries it supports. The challenging climate limits the scope of crops that can be grown and has kept many farmers from adopting soil health improvement practices, such as planting fall cover crops following harvest. The U.P. soil, degraded due to intensive tillage and nutrient mining, has potential for improvement and increased productivity through the use of cover crops. Their ability to improve the biological, chemical and physical soil properties can improve nutrient efficiency in the system. Two separate trials are being used to better understand the feasibility of cover crop use in the U.P. and to target appropriate crop species, seeding dates and management. Trial one addresses interseeding of cover crops – a management tool used to overcome the challenge of a short season after silage harvest. Trial two examines cover crop species and their success and effectiveness based on seeding date. Through these efforts, researchers hope to strengthen relationships among farmers, the MSU research community and conservation professionals serving the area.

Climate change-induced changes in the phytobiome: Implications for disease management in the 21st century

Researcher: Robin Buell

Awarded: $39,900

Plants and microbes have a complex relationship within their environments, as both complementary and adversarial. Whether a microbe is or has the potential to be pathogenic is attributable to the evolutionary and adaptive pressure on both the microbe and the host. However, a key and essential factor governing the outcome of a plant-microbe interaction is that of the environment. Corn, an industry worth $1.2 billion in Michigan, is a major agricultural commodity crop in which disease affects grower productivity. It is clear that climate conditions have changed in the last century in Michigan, and based on future climate predictions, a warmer growing season is expected. It is the hypothesis of the researchers that climate change has had a key role in changing the composition of the phytobiome and contributes to not only the emergence of new diseases but also to the severity of diseases in agricultural systems. The team designed a research study to collect empirical data to develop predictive models on how pending climate change will have an impact on the corn phytobiome and to demonstrate how historical and future climate conditions affect key diseases of corn. First, researchers are characterizing the historical composition and profile of the corn soil phytobiome and modeling how historical climate variability and change influenced the composition of the phytobiome. Then, they will experimentally demonstrate the impacts of historical and future climate on key disease pathosystems of corn. Data from this project will be disseminated to Michigan corn growers through presentations at stakeholder meetings and through publications.

FEATURE

Project GREEEN committed to controlling spotted wing drosophila

Spotted wing drosophila is an invasive fly that was first detected in the U.S. in California in 2008. SWD has now been reported in 34 states, including detection in Michigan in 2010. SWD is able to attack undamaged, ripening fruit using a specialized ovipositor to pierce the skin of the fruit and deposit eggs.

This pest has a wide host range, with berry crops and cherries most susceptible to infestation. In the first two years following its detection in the U.S., SWD was responsible for annual losses of $500 million in a wide range of crops, including 30 to 40 percent of California cherries. In Michigan, SWD may have up to 13 generations per growing season. The short generation time, coupled with a high reproductive potential, results in rapid population growth.

Project GREEEN has devoted many resources toward understanding SWD behavior and developing control mechanisms. Just this past year, Project GREEEN is supporting these efforts:

Photo: MSU Communications & Brand Strategy

Entomology professor Rufus Isaacs (above left) is exploring alternative approaches for managing spotted wing drosophila in Michigan blueberries

Diversifying tactics for managing SWD in Michigan blueberries

Researcher: Rufus Isaacs

Awarded: $39,700 | Leveraged: $242,000

SWD pressure has driven up production costs and increased insecticide use, an unsustainable situation economically and environmentally. Entomology professor Rufus Isaacs is exploring alternative approaches for making management of this pest more diversified and sustainable. These tactics include adjusted pruning practices and mulching options to make fields less suitable for SWD, testing different insecticides and monitoring current biological control levels. Information from this project will be integrated into an existing online, printed and in-person MSU Extension program for SWD management.

Development of post-harvest cultural management tactics for SWD

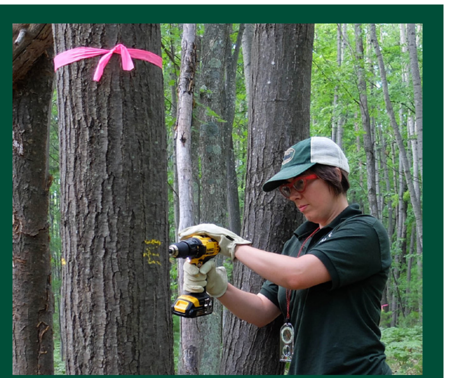
Researcher: Matt Grieshop

Awarded: $30,000 | Leveraged: $15,000

Researchers are trying to determine the potential of fruit compost mixes as potential SWD breeding resources. They are also evaluating cultivation as well as larval and pupal burial as a potential late season SWD management tactic. Sharing project findings via MSU Extension activities and developing leveraged proposals is the next step.

Cover:

Monique Sakalidis, an assistant professor in the Department of Forestry, is studying ways to manage the fungal pathogen that causes oak wilt.



Biology and detection of the overwintering stage of SWD

Researcher: Julianna Wilson

Awarded: $40,000 | Leveraged: $270,000

SWD overwinters as an adult fly. As temperatures and hours of daylight decrease, developing larvae change into what has been described as a winter morph phenotype. Researchers are determining the survival rate of winter morph SWD under Michigan field conditions and the overwintering locations. Wilson said they also seek to understand if the winter morphs behave similarly in terms of which colors and stimuli attract them. This can help to optimize the winter and spring monitoring programs to detect SWD earlier. The team is continuing winter field trapping experiments with the intention of delivering outreach presentations, writing articles and reports, and preparing web-based materials for growers.

Identifying efficient and selective attractants for SWD using its natural yeast symbionts

Researcher: Larry Gut

Awarded: $36,700 | Leveraged: $261,000

Larry Gut, a professor of entomology, said that researchers are determining the behavioral preferences of SWD, comparing its symbiotic yeast and baker's yeast in the laboratory and in the field. Researchers are looking at whether the attractiveness of symbiotic yeast is affected by crop types: blueberry, blackberry and cherry. The team is seeking to develop an attractive dry lure using odors released from preferred yeast strains and determine its attractiveness and specificity in the laboratory and in the field.

Project GREEEN

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RECOGNIZING INDUSTRY PARTNERS

Our research is aided by organizations that identify critical agricultural issues. Project GREEEN would not be possible without these valuable partners:

- Celery Research Inc.
- Corn Marketing Program of Michigan and the Michigan Corn Growers' Association
- Great Lakes Canola Association
- Growing U.P. Agricultural Association
- Hop Growers of Michigan
- Michigan Apple Committee
- Michigan Asparagus Research Inc.
- Michigan Bean Commission and Michigan Bean Shippers' Association
- Michigan Blueberry Advisory Council
- Michigan Blueberry Commission
- 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
- Michigan Wine Collaborative
- Midwest Nut Producers
- National Grape Cooperative
- Pickle Seed Research Fund
- Sugarbeet Advancement Committee
- Western Michigan Greenhouse Association

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