

**MDA Specialty Crop Block Grant Program-Farm Bill
Final Grant Report to the
Michigan Department of Agriculture**

Project Title: Innovative Fruit Plantings: Keeping Michigan Fruit Producers Competitive by Establishing Research Plots Designed for 21st Century Production Needs

State Point of Contact: Mike DiBernardo

Sub-Grantee: MI State University

Grant Number: 791 N0200077

Index: 10159

Inventory Number: 09-030

Funding Amount: \$75,000.00

Contract Period: October 1, 2009 to September 30, 2010

Reporting Period: October 1, 2009 to September 30, 2010

Project Summary: Bordered by the Great Lakes, Michigan's climate uniquely positions the state as the lead producer of perennial fruit crops in the Midwest, U.S.A. with an annual farm level value of \$314 million. The competitiveness of Michigan fruit production is largely dependent on growers' abilities to adapt to changes driven by technological innovation, regulatory policies and demands of local, national and global markets. It is research on experiment station farms that has allowed growers to adopt innovation without risk to commercial enterprises. To maintain this competitive edge, research plots need to reflect modern horticultural systems and agricultural technology. This project team established high density and other innovative research plantings of apple, cherry, grape, blueberry and peach at four MAES fruit experiment stations, providing optimal arenas for a multidisciplinary team of scientists to develop and deliver the ever evolving management tactics, strategies and tools that will keep MI fruit producers profitable. This project provided a unique collaborative opportunity for leveraging funds from federal and state governments, the IR-4 Program, the Michigan State Horticultural Society, targeted fruit industries and MAES to address a glaring need to update research plantings to reflect the current and future needs of Michigan's fruit producers.

Project Approach: This project expanded and enhanced fruit plantings at Michigan Agricultural Experiment Stations (MAES) and the Horticulture Teaching and Research Center (HTRC) on the MSU campus. Modern high efficiency orchard and vineyard plantings and infrastructural technologies are necessary for research targeting implementation of new management strategies to keep the MI cherry, apple, grape, blueberry and peach industries profitable and competitive in markets from regional to international. Such research is critical for optimization of land and labor use as well as to advance more efficient harvest technologies and to obtain consistently profitable crop yields. Several new horticultural plantings at MAES research stations are critical to keep up with testing needs for new rootstocks, varieties, technologies (production and harvest) and pest management strategies and tools. High tunnel fruit production is expanding across Europe, and preliminary MSU high tunnel fruit research at the SW MI Research and Extension Center (SWMREC) and the Clarkesville Horticultural

Experiment Station (CHES) has confirmed a strong potential for MI conditions, with results that include higher fruit quality, more consistent yields, and less pesticide use for production of premium fresh market sweet cherries.

Areas of research to benefit from these new plantings includes: labor performance, machine assist technology, pest management, plant growth regulator research, vegetative & crop load control, precision planting, nutrition, machine adaptations, soil & water management, chemigation, frost susceptibility and control, harvest technology and canopy management.

Project Goals and Outcomes:

1. Expansion and enhancement of quality apple, grape, cherry, blueberry and peach plantings at MAES research stations
2. Determine the effectiveness of new management practices in these modern plantings

The project team proposed a 4-year work plan and budget to upgrade fruit plantings at Michigan Agricultural Experiment Stations and the MSU campus, but requested funding for the first year only, through this proposal. The team was notified on September 2, 2009 of its successful application for funding from the MDOA. The Michigan State University Contract and Grant Administration received project funds from the MDOA on January 15, 2010. Project team members participated in planning meetings on September 30, 2009 and February 8, 2010. At these meetings adjustments were made to the 2009-2010 work plan to address two concerns, 1) higher than expected labor costs resulting from MSU budget cutbacks at the Clarksville Research Station (33% operating budget reduction), and 2) unavailability of some desired nursery stock for year 1 plantings. The revisions to the project work plan and budget are attached as appendices 1 (work plan) and 2 (budget). Changes to the year 1 work plan include:

- 1) Removal of plans for planting a 2ac vertical axe apple plot at Trevor Nichols Research Complex for disease and insect pest management trials from year 1; with plans to accomplish this planting in year 2.
- 2) Addition of a 1ac high-density sweet cherry planting at Clarksville Horticultural Experiment Station.
- 3) Increase size of the Southwest Michigan Research and Extension Center grape planting from 2 to 6 acres
- 4) Removal of 1ac organic wine grape planting at Clarksville Horticultural Experiment Station, with plans to accomplish this planting in year 2 or 3.
- 5) Include purchase of plants for 2ac blueberry planting at Trevor Nichols Research Complex in year 1.
- 6) Decrease number of peach trees to be planted at the Southwest Michigan Research and Extension Center from 600/ac to 300 trees per acre.

In addition to matching dollars previously committed to this project, a \$75,000 MSU Project GREEN grant was obtained in March 2010 to advance the development of

Solid-Set Canopy Delivery spray system technologies for high density fruit tree orchards, such as those being established under the MDA Specialty Block grant at the MSU fruit research stations. Further leveraging of a three-year research grant for \$171,000 was obtained from the Ceres Trust to utilize the new research infrastructure being developed at the MSU Horticulture Teaching and Research Center (below).

Work to achieve elements of the 2009-2010 work plan are summarized below:

Trevor Nichols Research Complex (TNRC)

Balaton cherry orchard: The site preparation, planting and maintenance of a 2 acre Balaton cherry orchard for screening insecticides through the IR-4 Program was successfully completed in 2010.

Blueberry plot: Overhead irrigation was successfully installed and soil preparation and contouring of raised beds completed in the 2ac TNRC blueberry plot in 2010. Blueberry plants were planted in Fall 2010.

Apple orchard: Site preparation including tree removal, deep tilling, soil testing, and planting of rye cover crop was completed in 2010 for the 2ac vertical axe apple orchard to be established at the TNRC in 2011. Plans are set for planting trees in May of 2011.

Southwest Michigan Research and Extension Center (SWMREC)

Concord Grape Vineyard: This project is being conducted for the purpose of creating new production technology for the Concord juice grape. A 5-acre site at the MSU Southwest Michigan Research and Extension Center (SWMREC) was prepared for planting. Existing vegetation on the site was eliminated and Glyphosate-resistant soybeans were planted. Multiple applications of glyphosate were used to eradicate emerging perennials and annual weed populations. Soybean stubble was eliminated from the site in late fall.

Four thousand vines on five rootstocks were propagated. Concord scion wood was collected, treated to prevent storage molds, bundled and stored. Grafted vines of several rootstocks were propagated under contract with a commercial nursery. Own-rooted Concord vines were propagated at SWMREC.

Construction was begun on a prototype mechanical shoot positioner to be used in this project. The positioning heads were fabricated and construction of the framework for supporting and manipulating those heads is in progress. Completion of this unit is scheduled for initial field trials in June 2011.

Peach: The purpose of this project is to establish and train a peach orchard at the SWMREC for research and demonstration of mechanical blossom thinner equipment and techniques. The orchard will use four training systems, planted in two years, using 6 commercial peach and nectarine varieties. The two planting dates will make it easier to show tree training techniques during field day demonstrations.

The peach orchard site at SWMREC was chisel plowed and disked in preparation for planting in spring 2010 and 2011. Three peach varieties (PF28-007, PF Lucky 13, and Allstar) were established in 2010 in four training systems, palmette, spindle, Y, and open center, at tree and row spacing of 12' x 18', 5' x 18', 5' x 18' and 10' x 18', respectively. Two additional peach rows, each with 25 trees, were established

adjacent to this planting at 12' x 18' spacing for conducting additional palmette training and thinning trials. Initial tree training was done in spring 2010. Routine fertilizer, weed, insect and disease management, appropriate for a 1st year orchards, was conducted. A trickle irrigation system was installed and used as needed.

A second planting is planned for 2011 using the peach varieties PF24C and Messina, and the nectarine PF11. The trees have been ordered for early spring planting. This planting will have the same four training systems and tree spacing that were used in the 2010 planting. Initial bids have been secured from N.V. Bartlett, the North American distributor for the PT250 string thinner. Access to a tractor capable of operating the PT250 has been arranged.

An educational session on mechanical string thinners will be part of a March 8th, 2011 spring peach meeting at the SW Research and Extension Center. Representatives from N.V Bartlett will attend and provide instruction on use of the PT250.

Blueberries: A bird exclusion structure was partly constructed over 0.5 acres of blueberries at the SWMREC. Posts were purchased and installed. Netting was purchased. Wire and the remaining posts will be in place for the 2011 harvest season. This site has extreme bird pressure due to the small size and proximity to woods.

Clarksville Horticultural Experiment Station (CHES)

High Density Tall Spindle Apple Orchard: Three acres of orchard was established in spring of 2010 with the focus on apples planted on dwarfing rootstocks and spaced 3 ft by 11 ft. The Tall Spindle protocol was implemented in training these trees in this initial year and a mound of soil was constructed on exposed rootstock shanks to avoid Dogwood Borer infestation. Trickle irrigation and a 4-wire trellis system were installed in the site by the end of the summer. The focus for the 2011 growing season will be on training in compliance with Tall Spindle protocols. The goal will be to develop trees that can accommodate mechanical and mechanical assist harvesting equipment, which will have multi-functional application, such as spraying and other routine tree maintenance work during the growing season.

Additionally, the plot will be used in a USDA Specialty Crops Research Initiative (SCRI) proposed research study "Development and Optimization of Solid-Set Canopy Delivery Systems for Resource-Efficient, Ecologically Sustainable Apple and Cherry Production. Trees were ordered from two nurseries, delivered in May and established in May and June at the Clarksville site. A total of 3300 trees (1100 trees of each of three varieties) were planted: Honeycrisp and "Rubinstar" Jonagold on Bud.9 dwarfing rootstock and "Crimson" Gala on M.9 NAKB 337.

Sweet Cherry: A one-acre site was deer-fenced and prepared (rows and irrigation system installed) at the CHES for a new NC140 regional research project on high density sweet cherry training systems, one of twelve cooperating sites in North America (19 in the US, 2 in Canada, 1 in Mexico). The one-acre site was planted to 14 rows of high-density Benton sweet cherries on three different dwarfing rootstocks (Gi5, Gi6, and Gi12) in spring 2010. Trellis posts and high tensile nylon wires were installed in summer 2010. Four state-of-the-art experimental cherry training systems are being developed: the Tall Spindle Axe (TSA), Kym Green Bush (KGB), Upright Fruiting Offshoots (UFO), and Super Slender Axe (SSA). There is a graduate student and a regional cooperative research project associated with this trial. Two smaller research

trials were planted at the north-south ends of the plot: 1) three rows of Rainier sweet cherry trees trained to the UFO system, with the training system variables under study including trunk angle and height of training to the first trellis wire; and 2) two rows of Montmorency tart cherry trees trained to the UFO system, with the training system variables under study including trunk angle. A two-year grant for ~\$13,000 was obtained from the International Fruit Tree Association to help establish this trial site (and the others across North America).

Northwest Michigan Horticultural Research Station (NWMHRS)

Irrigation/Fertigation Installations into an Experimental High Density Tart Cherry System: In spring of 2010, a high-density tart cherry orchard was planted at the Northwest Michigan Horticultural Research Station (NWMHRS) to investigate production efficiency, fruit quality, and harvest technologies for mechanically harvested tart cherries. High-density systems use dwarfing rootstocks for smaller, more compact trees. Dwarfing rootstocks have significantly smaller root systems, and therefore must receive supplemental water and nutrients to maximize potential.

Irrigation System Installation: Immediately after planting the high-density tart cherries, an irrigation system of a double line of RAM tubing was installed. Emitters are 24”apart and emit 0.42 gallons per hour. The system is automated, using two moisture sensors in the plot, and irrigation needs were based on rainfall and monthly recommendations (Table 1). The method of watering was completed in two different ways due to an upgrade in the fertigation process. Prior to automation of the fertigation system, we watered the plot for one hour/day: water 15 min, inject fertilizer for 30 min., water for 15 min. After automation, we watered for 2.5 hours/day: water 60 min., inject fertilizer 60 min., and water 30 min.

Fertigation System Installation: In late April before planting, fertilizer and lime were applied to the plot. Fertilizer (19-10-26) was applied at 400lb/acre (76lb actual N) and lime at 1 ton/acre. Once the irrigation system was installed, a 28-8-18 water-soluble fertilizer was injected 57 times from 26 May until 11 August. Each day, 1.4lb of total fertilizer was injected, which equates to 37.2lb of actual N/acre. Total N for the whole plot was 113.2lb/acre. The amounts of water and fertilizer applied were based on requirements of similar crops, such as sweet cherries. As this trial moves forward, water and nutrient can be adjusted to meet different seasonal demands, orchard maturity, and tree health, fruit size, and overall orchard vigor.

In addition to the irrigation/fertigation installation, MDA funds were spent on examining irrigation systems on high-density orchards in the region.

Table 1. Daily water use in high-density plot at NWMHRS.

| | Water Use (gal/day) |
|-----------|---------------------|
| May | 5 |
| June | 7 |
| July | 8 |
| August | 6 |
| September | 5 |
| October | 2 |

Entomology Planting – MSU Campus

Six Hundred fifty Crimson Crisp on bud 9 rootstock were planted at the Michigan State University Entomology farm located 0.5 miles west of the intersection of Collins and Dunkle Roads in November 2010. The planting was established in a 3-ac plot on a 5-foot by 14-foot tree x row spacing. Winter Banana was used as the pollinator and

interspaced evenly throughout the orchard. The trees were 5/8" caliper and planted using a Jack Brown tree planter with unions 4 inches above the soil line. Trees were secured to 12.5 gauge galvanized wire on 6 inch treated posts. The entire orchard is enclosed by 8-foot high woven wire deer fencing, with an additional 1.5 feet of high tensile wire above the woven wire extending the protection to 10'. Soil mounding will be established in the spring to protect unions from dogwood borer infestation for the first 3-4 years of establishment, after which the soil will be removed to discourage scion rooting. White plastic spiral tree guards were installed around trunks to protect from rodent damage and winter injury. Trees were trained to a vertical axis by securing lower limbs below horizontal using UV resistant rubber tree training bands. No additional heading or pruning was necessary as trees arrived greatly feathered.

We anticipate that leaf and shoot growth will commence normally during 2011 and resident insect pests will be established naturally. Insect pests including mites, codling moth, oriental fruit moth, and leafrollers will immigrate from nearby horticulture and plant pathology research orchards and can be supplemented by live releases from infested fruits and shoots obtained at other research sites. A moderate pathogen management program will be used to protect trees. Crimson Crisp has strong resistance to apple scab and is only moderately susceptible to fire blight. If deemed necessary, irrigation can be obtained by well risers located adjacent to the orchard on the entomology farm. Trees will also receive summer and fall training and pruning as necessary.

Horticulture Teaching and Research Center – MSU Campus

Raspberries and Cherries: A one acre high tunnel range at the Horticulture Teaching and research Center was constructed in 2009 and early 2010. Three bays were planted to raspberries in 2010 and treatments were started to compare organic nutrient management approaches, trellis designs and varieties. The first berries were harvested in the fall of 2010. These were marketed through the MSU Student Organic Farm. Drainage tile was installed in five of the bays to correct for land slope effects on surface water flow patterns and to reduce the future potential for cherry fruit cracking from excess soil water during rain events. Three bays will be planted to mixed stands of sweet cherries and raspberries in 2011, along with an organic apple nursery tree production experiment. These mixed tunnels, which were maintained in cover crops during 2010, will be used to study organic pest control objectives. The remaining three bays will be planted to sweet cherries in 2011. These bays were planted to various organic cover crop treatments in 2010 to test effects on tree establishment. Construction of automatic doors on the tunnel ends was begun during fall 2010 and will be completed by May 2011.

Project Beneficiaries:

Michigan is the leading producer of fruit in the Midwest, with apples, blueberries, cherries, grapes and peaches grown on approximately 104,700 acres (3,400 farms), contributing a farm level value of \$313.8 million to MI's annual economy (MI Agricultural Statistics 2007-2008). Additionally, a viable fruit industry is also a major component of the high value tourism industry that draws people to visit or reside in Michigan. For example, the grape industry has a \$789.3M impact on the state of MI through its contributions to tourism, restaurants and labor

([http://www.michiganwines.com/docs/Industry/micheconimpact_execsum .pdf](http://www.michiganwines.com/docs/Industry/micheconimpact_execsum.pdf)). High property costs due to development pressure is a main driver of farmland conversion in MI. Coincidentally, prime fruit growing areas in MI are on the same highly sought and highly valued property near Lake Michigan. Thus, the continued presence of a fruit industry in MI is in direct competition with development interests. Michigan's fruit belt is ranked as some of the most development-threatened, high quality farmland in the U.S (Sorensen *et al.* 1997).

Fruit industries are at risk from declining profitability, significant production challenges related to invasive pest species, global competition, restrictive regulations and the public's concern over pesticides and the environment. The trends in agriculture show a clear shift towards higher valued crops and management systems. Production costs are largely fixed on a per acre basis, and the ability to increase yield/acre can reduce production costs, significantly increasing profitability and stability of these industries. Concurrent development of rapidly evolving insect, disease and weed management programs and labor and fuel saving technologies in research plots designed for 21st century production needs will further enable MI's fruit industries to remain competitive and viable contributors to Michigan's economy in the face of numerous challenges.

Additionally, the national IR-4 program serves as the primary avenue that new reduced-risk pesticides can be registered for specialty crops. The TNRC and HTRC are two of the few Good Laboratory Practices (GLP) compliant facilities in the state of Michigan capable of conducting the field residue trials needed for IR-4/EPA registration. It is also increasingly important to provide significant evidence of product performance before initiating IR-4 field residue trials. MSU's IR4 program on average helps retain 10 new reduced-risk pesticide registrations per year for MI fruit crops. The research and technology that will be delivered through the conduct of this project will put this industry on a profitable foundation and provide experimental data in support of new product registrations through the USDA IR-4 project.

MSU Contact Person:

John C. Wise, PhD
Michigan State University
206 CIPS, East Lansing, MI, 48824
(517)432-2668 campus office
(517)353-5598 fax