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

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**Sub-Grantee:** MI State University
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**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 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 (AgBioResearch, previously 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 AgBioResearch 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 AgBioResearch research centers
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 AgBioResearch Centers and the MSU campus, but requested funding for the second year only, through this proposal. The team was notified in September of 2010 of its successful application for funding from the MDOA. The MSU Contract and Grant Administration received project funds from the MDOA in January 2011. Project members participated in planning meetings in January and March 2011.

In addition to matching dollars previously committed to this project, a $75,000 MSU Project GREEEN 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.

Work to achieve elements of the 2010-2011 work plan are summarized below:

**Trevor Nichols Research Complex (TNRC)**

*Balaton cherry orchard:* Ongoing orchard maintenance of the 2 acre cherry orchard, for screening insecticides through the IR-4 Program, was continued in 2011 after the successfully 2010 orchard establishment. Additional cherry orchard establishment work occurred in Fall 2011.

*Blueberry plot:* Overhead irrigation was successfully used to maintain optimal moisture conditions in the new 2ac TNRC blueberry plot established in 2010. Blueberry disease and insect pest susceptibility trials were run on newly established cultivars, and measurements of the invasive spotted wing drosophila and an emerging rust fungal disease were made in summer of 2011.

*Apple orchard:* A 2ac apple orchard and trellis was established at the TNRC in 2011, and orchard maintenance conducted throughout the growing season to ensure optimal tree growth.

**Southwest Michigan Research and Extension Center (SWMREC)**

*Concord Grape Vineyard:* A 5-acre site was prepared at the Michigan State University Southwest Michigan Research & Extension Center for the planting of a new vineyard design for Concord grapevines. Site preparation began in 2010 with a combination of cover cropping and herbicide applications to control existing vegetation. In May, 2011 the site was prepared and approximately 3200 grapevines
were planted in two experiments. One involves a comparison of top-wire cordon training (the current industry standard) with a two-tier training system, which has potential to increase yields over the current industry standard. A second experiment involves a factorial design involving root stock (five rootstocks involved) and vine spacing (three spacings involved). The purpose was to determine which combination of these two factors provides an optimum vine size for two-tier cordon training. Vine were managed with weed control, fertilization, pesticide spraying, etc. to develop large, healthy vines during the 2011 growing season. At present the trellis for this vineyard is being installed. All aspects of this project are on schedule.

Peach: The purpose of this project is to establish and train a peach orchard at the SW Michigan Research and Extension Center (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 second set of peach varieties (PF11 Peach, PF24C, and Messina) were established in 2011 in four training systems, palmette, spindle, Y and open center, as was done with the three other varieties in 2010. As in 2010, two additional peach rows each with 25 trees, was established adjacent to this planting at 12’ x 18’ spacing for conducting additional palmette training and thinning trials. Appropriate tree training was done for both the 2010 and 2011 trees. Routine fertilizer, weed, insect and disease management was done. A trickle irrigation system was installed and used as needed.

A PT250 Darwin string thinner was purchased from Gelders, a Michigan distributor for the equipment. Initial trials with the string thinner was done on peach trees at three grower locations and the Trevor Nichols Research Station during bloom 2011 with a Carraro lift tractor loaned by a local grower. Experience gained with use of the mechanical thinner on a wide array of tree forms was useful to demonstrate the need for the SWMREC trials to find specific tree training to accommodate the mechanical string thinner.

An educational session on mechanical string thinners was held March 8th, 2011 spring peach meeting at the SW Research and Extension Center. Ken Slingerland, peach research and extension specialist from Ontario, Canada presented their research experiences with the PT250. A second session will be held in December 2011 at the annual state horticultural meeting featuring a New York stone fruit grower with two years commercial orchard experience with the Darwin string thinner.

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 and wire and the remaining posts placed in 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. Varieties planted include Honeycrisp and “Rubinstar” Jonagold on Bud.9 dwarfing rootstock and “Crimson” Gala on M.9 NAKB 337. The trellis system, trickle irrigation system and some initial training was accomplished in summer of 2010. Due to
late planting, and initial training, trees were not pruned in winter 2010/11. The Tall Spindle protocol was implemented in training these trees in the initial year and with more intense training performed in the second year, 2011. 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 SCRI granted study “Development and Optimization of Solid-Set Canopy Delivery Systems for Resource-Efficient, Ecologically Sustainable Apple and Cherry Production. 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 (9 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. The fundamental canopy architectures for state-of-the-art experimental cherry training systems were developed in 2010-2011: 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 2011, two plantings were put in at the Northwest Michigan Horticultural Research Center. The first planting is a new rootstock trial where we are looking at elite rootstock selections from the MSU germplasm bank. This planting also includes new Russian rootstocks from the Krymsk series. Growers and nurseries in the west have used Krymst rootstocks for sweet cherries, but there is little information about these rootstocks under tart cherry. A double line of RAM irrigation was installed in this plot at planting. A new planting of Montmorency-type tart cherry varieties was planted in early May 2011. The new cultivar planting included five elite selections from the MSU tart cherry breeding program. We also planted tart cherries from the Saskatchewan breeding program, and we hope to also obtain some of their newest releases in 2012. These plantings also included a double line of RAM irrigation tubing. A new irrigation systems trial was installed in 2011 in an orchard of newly planted Montmorency cherries on the standard Mahaleb rootstock. Trees were planted at a spacing of 6.1m x 6.1m. Five irrigation systems were installed in six rows of 22 trees/row: 1) single RAM tubing system, 2) double RAM tubing system, 3) a standard drip irrigation system with one emitter per tree, 4) microsprinklers with cross row coverage (full coverage), 5)
microsprinklers in row (rectangular spray) and 6) non-irrigated control. Treatments 1, 2, 3, 5, and 6 will be installed in one row of trees in this block. Treatment 4, microsprinklers with cross row coverage, will be installed in three adjacent rows due to the design of the sprinkler head which applies water in a circular pattern to achieve complete ground coverage.

**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 grow 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 were 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, are being used to study organic pest control objectives. The remaining three bays were planted to sweet cherries in 2011, for which initial training to three high density training systems was begun. These bays had been planted to various organic
cover crop treatments in 2010 to test effects on tree establishment.

**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). 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.

Grant funds expended to date: MDA SCBG - $75,000, Matching funds - $50,355.

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