

**Department of Agriculture, Trade and Consumer Protection**  
**Division of Agricultural Development**  
**Agricultural Development & Diversification Program (ADD)**

**Grant Project Final Report**

Contract Number: 18081

Grant Project Title: Early Maturing Tomato Varieties for Wisconsin Fresh Market Producers

Amount of Funding Awarded: \$15,500

Name of Principal Contact Person: A.J. Bussan

Address: UW-Madison – Department of Horticulture, 1575 Linden Dr. Madison, WI 53706

E-Mail or WEB Address: ajbussan@facstaff.wisc.edu

Submitted by: AJ Bussan Date: December 30, 2004

Department Contact: DATCP – Agricultural Development - ADD Grants  
PO Box 8911  
Madison, WI 53708-8911  
Tel: (608)224-5136  
Fax: (608)224-5111

## **Final Report**

### **Project Overview**

*Opportunity:* Tomato traditionally has been marketed fresh picked from the field and is the best selling fresh market vegetable crop. The shortness of the Wisconsin growing season limits the availability of fresh picked tomatoes. An opportunity exists for vegetable growers in Wisconsin with regard to direct and wholesale marketing of tomatoes. This opportunity has emerged through consumer demand for locally grown produce. In general the view of locally grown produce is one of better quality, healthier crop, and benefiting small family farmers. Increasingly consumers desire a connection with who is growing their crop and an understanding of how that crop is being grown. In response to consumer demands, farmer's markets have increased in scale and grocery store chains commonly promote and sell locally grown produce. Have Wisconsin farmers taken full advantage of the opportunities that exist with regard to fresh market vegetables in particular locally grown tomatoes?

As with all fresh market fruit and vegetables, high premiums exist for having the produce available outside of the growing season. Initially the focus of this research was on developing early ripening crop that would target early season markets. However, opportunities also exist if the crop can be produced beyond the growing season as well. Tomatoes that ripen prior to or after the field grown crop can receive 2 to 4 fold increases in price. In a specific wholesale example, tomatoes that ripened 1 to 2 weeks early received a 10 fold increase in price because grocers want to be the first to stock shelves with locally grown tomatoes. Because high value fruit is difficult to ship to WI, tomato is a good model crop to develop an expanded local market for fresh market vegetable farmers. Tomato is an important crop as it attracts customers to other products at both grocery stores and direct market stands (farmers market or roadside markets).

This project has the potential to expand the current fresh tomato market in Wisconsin. Currently, 800 to 900 small farms (many of them family operations) derive part of their income through fresh market and local marketing of tomatoes. Early types with improved taste and appearance may expand or create opportunities for Wisconsin growers to market tomatoes outside those opportunities presently available. In addition, fresh market vegetables provide an opportunity for the non-agrarian population to connect and become familiar with agricultural enterprises in the state of Wisconsin.

This project was initiated during 2002 and represented the first steps towards development of a tomato production system that will improve the competitiveness of Wisconsin's fresh market vegetable growers. Variety development requires multi-year research and those efforts will continue through the final year of the project. In addition, research has been completed to refine current production systems and evaluate the impact of plastic mulches, low tunnels, and high tunnels on the soil and aerial microclimate surrounding the plant root zone and canopy. Subsequent effects on tomato growth and development, fruit yield, and quality were monitored.

**GOAL:** Develop early ripening varieties and production systems that result in tomatoes with good flavor that meet the needs of WI fresh market growers.

### **Project objectives and activities completed to date**

Form #: MKG - D10.9

- 1) Determine the growth, yield, and quality response of various vegetable crops to plastic mulches, low tunnels, and high tunnels.

Objective 1: Evaluate tomato breeding lines for early ripening, flavor, storability/shelf life, and meeting the needs of WI growers and production systems targeting wholesale and direct markets. (Nienhuis)

Currently, 3 parental lines and 6 early maturing breeding lines (potential varieties) have been developed with early maturity, tolerance to blight, and high solid content as key characteristics. Continued breeding efforts have included crosses to a high flavor Roma type and identification of an appropriate slicing parent for future crosses is under way. These crosses have resulted in more than 30 hybrid tomato lines. With success, this project will become self supported through sales of the developed varieties and provide long-term resources to support tomato variety improvement and cultural management practices. In addition, current funding is being used as matching funds for regional and national competitive grant proposals.

Grower trials were completed in 2002 and 2003, but were not possible in 2004 due to shortages in hybrid tomato seed. Tomato seed increases were completed in Peru during the winter of 2003 and 2004, but seed harvested from the increase were damaged by rodents. As a result, inadequate seed was available to conduct grower trials, but all of the hybrids were evaluated at the Horticulture Farm in Arlington.

**Outcome:** One line has been identified with improved flavor, early ripening, and suitability for roma tomato growers. This line is being considered for becoming a named variety and several grower cooperators are interested in growing this variety for sale within their operations.

Objective 2: Quantify the impact of plastic mulch and low tunnels on soil and air temperature and subsequent effects on plant growth, yield, and quality.

The research trials associated with this objective have been completed over 4 site years. Full description of methods and results will be made available upon publication. Trials were conducted at the Hancock Agricultural Research Station and the Horticulture Farm on the Arlington Agricultural Research Station during 2003 and 2004. Season extension treatments included no mulch or tunnel, plastic mulch (dark green), and plastic mulch combined with a zip house. Zip houses were utilized as the low tunnel system as they could be easily opened to allow for temperature regulation during sunny days. Drip line irrigation was used under all three season extension treatments at Hancock. One of the 6 breeding lines and 2 commercially accepted varieties were planted at three different timings under each season extension treatment. Planting dates approximated May 1, May 15, and May 31.

Data collection included soil and air temperature in the plant rooting zone and canopy. In addition, ambient air temperature and soil temperature under bare ground was monitored. Crop growth and development was monitored weekly from transplanting until harvest. Fruit yield and quality was quantified. Data analysis included ANOVA analysis to test for effects of season extension, seeding date, variety, and potential interactions.

**Outcomes** -Plastic mulch treatments had the largest impact on improving earliness, yield, and quality of tomato. Low tunnels had little effect on tomato yield or quality even though they did affectively alter soil and air canopy temperature. The gain in yield and quality from use of the tunnels likely would not

support the time, resources, and expenses for their installation and maintenance under the conditions we experienced within our experimental sites. However, if sites are susceptible or prone to frost then zip houses may be necessary to protect sensitive tomato plants from frost.

Few growers do utilize tunnels within their farming operations in part due to healthier and more robust plants early in the growing season. We also documented this effect, but it had little impact on return or crop productivity.

**Objective 3: Quantify the impact of high tunnels on soil and air microclimate and subsequent response in tomato growth, yield, and quality**

Jack Buchanan constructed a hoop house (high tunnel) on his farm near the Hancock Agricultural Research Station. Jetstar and several other tomato varieties were produced under this production system. Jetstar were planted on April 20, May 5, and May 20 in the hoop house at Jack's Produce and Greenhouse. Crop growth and development, yield, and quality were measured. In addition, soil and air temperature in the plant root zone and canopy were quantified over the course of the growing season.

The third and final year of funding will be used to construct a hoop house at the Horticulture Farm on the Arlington Agricultural Research Station. Season extension treatments will include double tunnel (low tunnel inside high tunnel) vs. black plastic mulch under the high tunnel. Tomato crop response to air and soil temperatures will be quantified. A significant difference in the on-farm vs. research station experiments will be use of supplemental heat in the on-farm trial. This hoop house is intended for commercial production and as such will utilize techniques to minimize risks of cold temperatures. In contrast, the research station trials will attempt to quantify the risk of low temperatures on tomato growth and development to determine when it is essential for heat supplements in high tunnel systems.

**Outcomes-** High tunnel systems appear much more effective at extending the growing season compared to using low tunnels. The high tunnel system resulted in ripe tomatoes 4 weeks earlier than field grown tomatoes and allowed for continued tomato production for 30 d after frost. Early season tomatoes brought prices in excess of \$3 per pound compared to < \$1 per pound when field production began. The difference in price may have been exacerbated during the 2004 growing season due to the cold spring and late maturing crop. Results from this research will be discussed by Jack Buchanan at the Fresh Fruit and Vegetable Conference, WFMVGA spring field day, and several workshops with different fresh market vegetable crops.

Key questions that remain unanswered following the first year of research:

- optimal irrigation management (amount and timing) under high tunnel
- optimal nutrient management, especially as it relates to N, P, K (grey wall), Ca, and others
- optimal crop rotation – continuous tomatoes is unwise, yet few profitable alternative crops may be available
- year to year variability of tomatoes and other vegetables under high tunnel production systems: will the greatest benefit occur during cold or warm springs
- economic assessment of early maturing tomatoes

- potential for late season production, high tunnels prevent frost damage to plants, but little further fruit development occurs after frost, rather it appears the fruit present are allowed to ripen

Objective 4: Determine the growth, yield, and quality response of various vegetable crops to plastic mulches, low tunnels, and high tunnels.

This research has not been completed, but the acquisition of tunnel supplies and climate monitoring equipment will allow for studies on other vegetables. Crops to be evaluated will include cool season species such as cabbage or broccoli, warm season crops such as peppers, and autumn crops such as squash or pumpkin. In addition, new potential pepper varieties have been developed with superior quality characteristics for WI growers.

**Extend the information:** Walking field tours were planned for the Horticulture Farm on the Arlington Agricultural Research Station during and 2004, but were cancelled due to extenuating circumstances. Data from this research was reported on at the 2004 fresh fruit and vegetable conference in Oconomowoc, 2003 berry field day at Wisconsin Dells, and 2003 fall field day at Cedarburg. Results will be published in extension bulletins and made available through other sources. Jack Buchanan participated in several grower meetings discussing high tunnel production as well and will participate in a grower panel at the 2005 fresh fruit and vegetable conference. There is great amount of interest and excitement relative to season extension especially high tunnel production. Yet many mistakes are being made. This research will assess feasibility of high tunnel production systems and point to key management issues for growers.

*Future work:* The final year of research will focus on research within the high tunnel production system. Results from field and high tunnel research will be summarized and published as well.

**Key personnel:**

Alvin Bussan, Vegetable crop production extension specialist, Horticulture Department, UW-Madison

Jim Nienhuis, Snap bean geneticist, Horticulture Department, UW-Madison.

Ron Wiederholt, Agricultural agent, Clark County, UW-Extension

Jack Buchanan, Jack's Fresh Produce, Hancock

Tomato growers:

WFMVGA members

Central WI Produce Auction members

Phil Oberholtzer, Unity, WI

Larry Eggman, Loyal, WI