

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

Contract Number: 19038

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

Amount of Funding Awarded: \$15,000

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Report Submitted on: 12-31-05

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This project was initiated in 2002 and was financially supported by the ADD program for 3 years. This marks the final report for the specific goals and objectives outlined by that project. Even though the project has been completed the experiences and knowledge gained through the research have led to several other key questions. This report will specify accomplishments, products, potential and realized economic impacts, and key questions that need to be addressed in the future.

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

*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.*

**Accomplishments:** When this project was initiated, Jim Nienhuis had identified 12 inbred parental tomato lines that had early ripening, flavor, and storability characteristics. From these parents over 30 tomato hybrids have been generated that maintain these traits. The hybrids are primarily Roma type tomatoes that have high value for canning. Roma types are specialized tomatoes grown by 1/4 to 1/3 of the WI fresh market vegetable growers.

**Products:** Several hybrids show potential commercial value and were evaluated on producer farms during 2005.

**Economic Impact:** Economic impact at this point is hard to estimate due to the time frame required to develop and release a new variety or hybrid. In addition, market adoption of new varieties or hybrids is hard to predict, but development of 3 to 5 hybrids is moving forward with funding from UW Alumni Research Foundation.

**Key Questions:**

- 1) The potential impact of newly developed Roma tomato hybrids
- 2) Can the earliness, flavor, solid, and storability characteristics of the Roma tomato parents be incorporated into table type tomato hybrids?

*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.*

**Accomplishments:** Research was conducted over 4 site years to quantify the impact of plastic mulching and low tunnel (zip house) techniques for promoting early growth and ripening of several different tomato hybrids. The research has led to several distinct findings.

First, neither plastic mulching nor zip house techniques had a substantial impact on minimum daily temperatures. However, we do believe both practices diminish the period of time the tomato plants experienced the minimum temperatures. As a result, neither practice may prevent cold temperature disorders such as cat-facing, but may increase early season tomato growth.

Plastic mulching increased daily maximum temperatures by 5 to 10 F. Zip houses increased daily maximum temperatures by more than 20 F depending on incoming solar radiation. Warmer temperatures promoted more rapid canopy development and flowering in tomato, especially during the cool summer of 2004.

Second, plastic mulching increased yields of all tomato varieties over various planting dates in all site-years by 15 to 20%. Fruit ripening was also 7 to 10 days earlier under plastic mulching conditions. These responses occurred to green plastic mulch conditions. Green colored mulch has been shown to have less impact on tomato growth compared to red and other colored mulches. The yield and maturation benefits are believed to be due to moisture conservation, improved weed control, and improved micro-site climate around the tomato plants.

Zip houses did not improve tomato yield or quality over plastic mulching techniques. Management of zip houses was a daily task that was easier potentially than floating row covers, but not nearly as effective. Improved zip house management may allow for yield and quality benefits in tomato and other crops, but we did not realize those benefits in our research.

**Products:** I now recommend all fresh market tomato growers in WI utilize mulching techniques. Currently, many tomato growers do not utilize these practices due to limitations in equipment, objections against use of plastic mulch, and lack of knowledge regarding potential benefits.

Publications include manuscript under preparation for Hort Technology and Extension Bulletin

Extension presentations have been delivered at the 2003 and 2004 WI Fresh Fruit and Vegetable Conference by me and Bill Shoemaker (University of Illinois), respectively. Field days include the small fruit field day in 2004.

**Economic Impact:** Several growers have adopted mulching techniques since this research was completed. Tomato is a key crop for many growers and utilization of mulching techniques would improve gross returns by more than 10 % due to earlier maturation and yield.

**Key Questions:**

- 1) What alternative strategies could replace use of plastic as a mulching material, but allow for benefits observed in these trials.
- 2) Improved yield and quality from irrigation in fresh market vegetable production

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

**Accomplishments:** We completed 3 years of observational research within commercial tomato hoop house operations. We believe tomato yield potential within hoop houses may exceed 20 lbs per plant or more than 7,000 lbs within a 30 x 100 structure. Hoop house tomatoes ripen 2 to 5 wk earlier than field grown tomato without the expense of hydroponic operations. In 2004, July tomatoes were receiving more than \$3/lb due to cold growing season and delayed crop. In addition, hoop house tomatoes continue to produce for 3 to 5 wks after killing fall frost. Fall tomato can also bring in prices 2 to 3 times seasonal price.

Fertility and irrigation management is crucial for optimizing productivity of hoop house tomato production. Fertility issues resulted in quality losses due to gray wall and blossom end rot. Inadequate irrigation resulted in 50% yield losses as well. High productivity requires intensive management. Relative to prices for field grown tomato, the potential benefits appear to outweigh the risks.

Temperature management is also crucial for hoop house tomato production. Supplemental heat in spring and fall can increase productivity. However, heating units need to be appropriately designed and ventilated to prevent pollution damage to the tomato crop within the hoop house (i.e. ethylene, CO<sub>2</sub>). Summer ventilation is equally important. Sunny clear days can lead to air temperatures 30 to 40 F higher in the hoop house compared to outside. Air temperatures over 95 F led to flower and immature fruit abortion and early senescence of the crop.

**Products:** This project has made me aware of the potential economic value and importance of tomato hoop house production in WI. This has led to a cooperative project with season extension experts in the tropics.

My program has also purchased a hoop house to allow for highly specialized research in the future. The hoop house will be constructed on the Horticulture Farm on the Arlington Agricultural Research Station.

We are currently co-authoring a manuscript reviewing high tunnel vegetable production with collaborators from Costa Rica. We are also beginning a basic production manual for high tunnel tomato production for publication as an extension bulletin.

**Economic Impacts:** Less than 20% of the fresh market vegetable growers of WI currently utilize this practice. This relatively low cost practice has more profit potential than any other current management practice for fresh market vegetable growers. Our collaborator, Jack Buchanan, was able to cover the hoop house and installation costs within 1 growing season. He produced over 2 ton of tomato on less than 1/10 of an acre even though yield potential was limited by fertility and other management practices.

**Key Questions:**

- 1) Optimal fertility levels for high tunnel tomato production – especially N.
- 2) Optimal irrigation management in high tunnel systems.
- 3) Low energy heating practices for early spring and late fall vegetable production in tunnels
- 4) Heat conservation strategies in high tunnels
- 5) Profitable alternative crops for tomato in high tunnels
- 6) Managing soil health and quality under high tunnels – options beyond moving soil and structure.

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

**Accomplishments:** High tunnel research has been limited to tomatoes to date. Upon construction of the research high tunnel more activities will be initiated with alternative vegetable crops. Cantaloupe, pepper, and squash productivity were evaluated under plastic mulching techniques. Weed management and microclimate benefits observed in tomato were confirmed in other crops as well.

Jim Nienhuis has also conducted breeding trials and evaluations of specialized pepper and squash hybrids for production in Wisconsin. Habenero and Poblano pepper hybrids were evaluated on fresh market vegetable farms in the Madison area. Habenero types showed excellent traits for earliness, flavor (low capsaicin content), and yield compared to traditional types in 2005. Research trials have identified Poblano peppers with excellent yield, earliness and quality in previous years, but drought and heat caused flower abortions on all Poblano hybrids during 2005.

**Products:** Nienhuis has acquired funding from UW-Madison to continue development of habenero and poblano pepper hybrids for WI. He has also identified a parent for improved color and flavor in butternut squash.

**Economic Impacts:** Growers are very interested in new habenero pepper hybrids and have marketed fruit to high end restaurants. Poblano hybrids suitable for Wisconsin also have large potential for improving yield and quality in WI. These peppers are high quality and demand high price. Current hybrids do not perform in well in WI, but new lines have high yield potential and demand a high price.

**Key Questions:**

- 1) How do we optimize yield on new pepper types?
- 2) Can a new butternut squash with improved flavor and appearance improve markets for fresh vegetable growers?