

Grafting of Tomatoes for Soil-based Production in Protected Culture

A project supported by CCEs of Ontario, Wayne and Yates Counties

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Justification

Soil based greenhouse and high tunnel production of tomatoes has risen dramatically in the Finger Lakes Region within the last 5 years. This season extension technology offers farmers an opportunity to target market price peaks and capitalize on the rising demand for locally grown produce. Tomatoes from these protected culture systems have proven profitable in wholesale auction settings as well as farmer's markets and CSA's.

As production continues in the same soil beds, risk of root-zone diseases and soil nutrient deficiencies increase. Grafting of desirable fruiting varieties onto vigorous, disease resistant rootstock has become a standard production technique in hydroponic facilities throughout the world. This project seeks to evaluate the potential of grafting for small scale farmers in New York and demonstrate its advantages.

Materials and Methods

On January 25, 2007 seeds of tomato varieties Geronimo and Maxifort (DeRuitter) were sown in a Yates County greenhouse. Seedlings of both varieties were transplanted to 48-cell flats at first true leaf stage. On February 19 10 grafts were made using Maxifort as rootstock and Geronimo as a scion. Cuts were made with a double-edged razor blade on a 45°-angle across the stem of both varieties, immediately above the cotyledons. The rootstock was left within the cell flats. Grafted plants were placed immediately in a healing-chamber with 100% relative humidity and temperature of 80-84 °F. On February 22, 8 of the 10 grafts survived and were placed under florescent bulbs with ambient RH and temperature. These were moved to benches in the greenhouse on about February 25. These first 10 plants were used to test the grafting procedures and facilities. Although they were not used in the replicated trial data, discussed below, was collected.

On March 2, 48 grafts of Geronimo and Maxifort were made at the same facility, as described above, and healed as described above, with 42 grafted plants surviving. On March 16 21 plants were pruned immediately below the apical meristem ('topped'). On March 31 3 treatments were arranged in a randomized block design with 4 replications. Treatments, plants per block and in-row spacing are presented here in table form (Table 1). Transplants were watered-in to soil saturation with 0.3 cups of a 24-8-16 fertilizer diluted in 4 gallons of water. The cooperating grower watered and fertilized the trial uniformly with the rest of his greenhouse throughout the season.

Table 1. Treatment details of grafting trial.

Treatment	Plants per block	In-row spacing
A- Control (ungrafted Geronimo)	8	16” in-row spacing with a double staggered row.
B- Untopped graft with 1 trained gormandizer (sucker) plus 1 leader	4	48” in-row spacing with a double row.
C- Topped graft with 2 leaders	4	32” in-row spacing with a double row.

The differing number of plants accommodates a uniform number of growing points (8) per block. The differing distances of in-row spacing reflect uniform vertical space utilization.

Number of fruit per block and total weight per block was recorded at each harvest, beginning June 19 and ending October 16. Rep 4 was eliminated from the trial due to poor growing conditions eliminating data in one treatment. Data were analyzed using statistical software Analysis of Variance (ANOVA) procedure, and treatment means were separated using Fisher’s Least Significant Difference ($p \leq 0.05$).

At an Ontario County farm near Palmyra approximately 20 grower provided Arkansas Traveler were grafted onto Maxifort rootstock at 2-4 leaf stage on May 2. The grafted plants were placed in an improvised moist chamber with no sunlight. None of these plants survived. On June 1, 5 more Arkansas Traveler’s were grafted onto Maxifort rootstock with 2 plants surviving the grafting process. These were subsequently transplanted into a certified-organic high tunnel. Yield did not warrant data collection.

Results and Discussion

Treatment C (grafted and topped) resulted in the highest mean pounds per plant and highest number of fruit per plant (Table 2.). Yield per plant as measured by pounds per plant was significantly different between the control and topped grafts, however the untopped grafts was not significantly different from either treatment.

Table 2. Yield of different grafting treatments in a Keuka Park greenhouse.

Treatment	Mean Yield per Plant (lbs)	Mean Fruit Weight (ounces)	Mean Fruit per Plant
A- Control (ungrafted Geronimo)	10.2b*	6.4b	25.3 ns
B- Untopped graft with 1 trained gormandizer (sucker) plus 1 leader	16.0ab	8.1a	31.5
C- Topped graft with 2 leaders	18.9a	7.9ab	39.0
<i>LSD</i>	8.4	2.8	-

*Means with different letters (grouping) differ significantly according to Fishers's Protected LSD ($P < 0.05$), **ns=no significant differences between groups.

Data collected from the original set of test grafts reflects very high yields (Table 3). These were the only grafted plants trained to a single leader. As the original test batch for procedure not enough plants were available for replication. Increased individual fruit weight and number on these plants increased yield. It should also be considered that these plants were started prior to those in the trial.

Table 3. Data from untopped grafted plants (no replicates).

Treatment	Mean Yield per Plant (lbs)	Mean Fruit Weight (ounces)	Mean Fruit per Plant
Untopped Grafted	21.6	9.1	38.1

Conclusions

The grafting of Geronimo onto Maxifort offered significantly higher production than the untreated control in the cooperating Yates County farm. Credit for the success of this portion of the project must go to transplant production facility that dedicated attention to the healing process after the grafts were made. The healing process is the critical step to ensuring survival of the grafts. This farm has dedicated germination chambers and greenhouses for vegetable transplant production, which contributed to the high survival rate (88%).

On the contrary in Ontario County, the farmer, although competent in field vegetable production, did not have dedicated transplant production facilities. Due to organic certification we could not conduct the grafting and healing in the Yates County facility. The result of wider temperature and RH swings nearly eliminated graft survival for the transplants.

At the conclusion of year 1, the economics of this system appear favorable. Cost per transplant increased \$2.00 (3.00 vs 1.00 for ungrafted). With a mean increase of 8.7 lbs per plant, the break-even price required is 0.34 per lb. However, this figure does not include the time-cost of the actual grafting process, which was performed by the PI. If the grafting and healing is performed by a commercial greenhouse, costs will likely be higher. If transplant cost is increased by another 1/3, a breakeven price is still less than 0.5 per pound.

In 2008 trials will be established on 2 new farms in Yates County, increasing the total number of hosting/cooperating farms to 5. All grafting will occur in the original greenhouse, as success was highest there in 2007. Poor results with horizontal trellis system in an Ontario County high tunnel has shifted our focus entirely to greenhouse style production (single leader, vertical trellis), although our 2008 trials will be in both 1 high tunnel and 1 heated greenhouse. The horizontal trellis system allows multiple leaders to grow, and without vigilance on the farmer's part, adventitious growth from the rootstock may decrease marketable yield from the desired scion.

Multiple growers outside of the immediate scope of these trials have contacted the PI with requests to include grafting in their 2008 production systems.

Outreach Activities

A group of visiting scholars from CU CALS was hosted at the Penn Yan site in May 2007. A field day with 40 farmers attending was hosted at the Ontario County farm in August 07. A presentation was made to 100 farmers at the Finger Lakes Produce Auction Greenhouse Growers Meeting in December 07 and 50 farmers at the Empire State Fruit and Vegetable Expo. 2008 presentations include the Great Lakes Vegetable Working Group and CCE Ag-Inservice. An on-farm professional development opportunity for extension staff will be offered in 2008.

The PI, and cooperating farmers, extend their gratitude to Cornell Cooperative Extension of Ontario, Wayne and Yates Counties for their support of this project.