

Long term high tunnel production: Grafting tomatoes

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My farm consists of 225 acres on hilly land in Lancaster County, PA. We grow a diversity of crops and our early tomatoes are grown in two acres of multi-bay high tunnels. I reluctantly was forced to fumigate in the tunnels due to problems with verticillium wilt (race 2). At my farm, we have looked at grafting to manage verticillium and other soilborne diseases in our tunnels, and have seen that grafted plants are more vigorous and produce more yield than non-grafted plants. In 2008 and 2009 we did extensive testing with the aid of a USDA SARE grant coordinated by Cary Rivard, grad student of NC State. Those results still influence us today as we graft 100% of our tomato plants. In fact Kaitlin Dye, my high tunnel manger has started a grafting business, ReDivined, and she supplies grafted tomato plants for producers all over the Northeast.

Economics

One of the primary objectives of this project were to determine the actual variable costs associated with grafted transplant production and use these values to determine any economic benefit of grafting for multi-bay high tunnel production. Furthermore, data was available from 2008 to determine the optimum plant spacing for economic efficiency. Therefore, transplant production budgets generated in 2009 were applied to data from the 2008 and 2009 growing season. The net returns of grafting are listed in Table 3. These values represent calculated gross revenue minus any harvesting costs in addition to transplant and fumigation costs. Production costs are assumed to be equal for grafted and non-grafted plants, and at various plant spacings.

Table 3. Economic effects of grafting, fumigation, and plant spacing on net revenue (\$ per acre)

		Yield	Gross	Plant	Fumigant	Net
Treatment / Description		(t/a)	Returns^W	Costs^X	Costs^Y	Returns^Z
2008	Non, 18" (Std)	50.1	\$48,125	\$3,648	NA	\$0
	Non, 24"	48.5	\$46,560	\$2,736	NA	-\$653
	Non, 36"	40.9	\$39,302	\$1,824	NA	-\$6,999
	Graft, 18"	58.7	\$56,390	\$9,024	NA	\$2,889
	Graft, 24"	56.9	\$54,595	\$6,768	NA	\$3,350
	Graft, 36"	52.1	\$50,045	\$4,512	NA	\$1,056
2009	Fum, Non, 24" (Std)	52.8	\$50,650	\$2,736	\$350	\$0
	None, Non, 24"	38.9	\$37,306	\$2,736	\$0	-\$12,994
	Fum, Graft, 24"	70.5	\$67,642	\$6,768	\$350	\$12,960
	None, Graft, 24"	67.1	\$64,445	\$6,768	\$0	\$10,113

^W Gross Returns = (Gross revenue - harvesting costs)

^X Based on 2009 propagation study

^Y Fumigation not effective in 2008

$$^Z \text{ Net Returns} = [(\text{RETURNS}_{\text{TRT}} - \text{COSTS}_{\text{TRT}}) - (\text{RETURNS}_{\text{STD}} - \text{COSTS}_{\text{STD}})]$$

In all cases and at all plant spacings, the cost of transplants was offset by higher fruit yield. In 2008, grafting increased farm profit by \$1,056-\$3,350 per acre. Furthermore, the 36” plant spacing offers a unique opportunity for growers to utilize grafted plants without dramatically increasing transplant costs. The cost of non-grafted transplants grown at 18” was \$3,648/acre and the cost of grafted plants at 36” was \$4,512/acre. Based on the transplant cost determined in 2009 combined with the yield data from 2008, it appears that 24” in-row spacing is the most efficient production system for grafted plants. Marketable fruit yield of grafted plants at 18” was only 1.8 t/a higher than grafted plants at 24” (Table 3), and the reduction in transplant costs resulted in \$461 more profit per acre than grafted plants grown at 18”. Furthermore, at 24” in-row spacing, transplant costs were increased by 85% compared to 147% when utilizing grafted plants at 18” in-row spacing, thereby reducing early-season costs.

The results from 2009 showed strong evidence that grafting helped to increase net revenue and ultimately added profitability to the farm. When used in combination with fumigation, grafted plants resulted in an added \$12,960 per acre in profit. Furthermore, this increase in net revenue dramatically increased farm-gate income. When grafted plants were grown without fumigation, the net return of grafting in comparison with fumigated, non-grafted plants was \$10,113. More importantly, the fumigation treatment had a lesser economic impact on grafted plants. The introduction of fumigation into the non-grafted production system increased per acre profit by \$12,994. However, a similar comparison of fumigation within the grafted treatments shows that fumigation contributed \$2847 per acre when grafted plants were utilized. These results suggest that grafting can be used as an alternative to fumigation to manage verticillium wilt without the use of chemical fumigants. Furthermore, they suggest that the adoption of grafting in multi-bay high tunnels adds substantial per acre profit.

Assessment

This project was very successful. We have demonstrated that grafting with ‘Maxifort’ rootstock is an excellent management tool to increase crop productivity for growers trying to manage verticillium wilt (race 2). The results of this study also indicate that grafting is an economically-feasible technology for commercial high tunnel growers, and that plant spacing can be manipulated to reduce economic constraints. Further research that clarifies the interactions of grafting and fumigation will demonstrate the relationship that ‘Maxifort’ rootstock has with *V. dahliae* (race 2) and similar studies should be repeated to determine the mechanism behind the fruit yield increase seen in these trials..

Adoption

After our over 50 ton/acre yield from the 2009 season, where 95% of our high-tunnel tomatoes were grafted, we have never looked back and continue to graft all our plants.



