

DISEASE MANAGEMENT AND CROP PRODUCTIVITY UTILIZING GRAFTED TOMATOES

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Grafting tomato scions with superior fruit quality characteristics onto rootstock that confers host mediated resistance to serious soilborne pathogens is a viable management tactic for tomato growers in the Southeast USA. To date, the organic sector has been the keenest to implement grafted tomato plants in their production systems. We have conducted multiple field trials over the past three years documenting the utility of resistant rootstock to manage bacterial wilt (*Ralstonia solanacearum*), Fusarium wilt (*Fusarium oxysporum* f.sp. *lycopersici*) and root knot nematodes (*Meloidogyne* sp.), common problems in central and eastern North Carolina on organic and non-organic farms. In the western NC tomato production region, Verticillium wilt (*Verticillium dahliae*, race 2) is the most important soilborne pathogen. The challenge is to determine if grafting is a viable management tactic, to complement methyl bromide alternative strategies, for large acreages and for conventionally produced tomatoes in fields and/or high tunnel production systems.

Grafting is common in most regions of the world (Spain, Italy, Morocco, Taiwan, Japan etc) where there is intensive tomato production (Besri 2001, Lee et al. 1998). This is particularly true where soilborne diseases limit productivity. However, proper selection of vigorous rootstock and scion typically results in enhanced yield even in the absence of disease (Lee et al. 1998). Worldwide, grafted tomatoes are used in the field and under plastic high tunnels. High tunnels are emerging as an important production system component for tomato growers in the USA, and implementation of capital-intensive production systems for niche markets requires superior host genetics to manage disease, enhance yield, and ultimately reduce economic risk.

A program was implemented to evaluate the utility of grafting as a tool for commercial tomato production in NC. Organic growers typically pursue niche markets that depend on heirloom tomato varieties which do not carry resistance to foliar or soilborne pathogens. Many organic growers implement high tunnels to decrease foliar disease and provide season extension, but crop rotation length is decreased, resulting in greater soilborne inoculum from *F. oxysporum*, *R. solanacearum*, and *Meloidogyne* sp.

All grafted plants were produced on the NCSU campus using the tube grafting technique (Rivard and Louws 2006). Scion and rootstock seedlings are severed at a 45° angle and reattached using a tube-shaped silicon clip. The newly-grafted plants are exposed to specific light and humidity conditions while the scion and rootstock stems fuse and the vascular tissue reconnects As the stem diameter

increases, the silicon clips fall off, and the plants are ready for field planting 12-14 days after grafting

Field trials were conducted where growers consistently had bacterial wilt pressure (*R. solanacearum*). Treatments included grafts where rootstock/scion combinations were: heirloom/heirloom (self-graft), CRA 66/heirloom, and Hawaii 7996 /heirloom. Additionally, the heirloom variety was planted without grafting to determine the effect of the grafting process itself. The experiments were arranged in a randomized complete block design with four replications per treatment and repeated for 2 years. In both years, CRA 66 and Hawaii 7996 provided complete control of bacterial wilt compared to the self-grafted and non-grafted controls (Figure 1A).

A second series of field trials was carried out to evaluate heirloom tomato productivity on organic farms using commercially-available rootstock-specific hybrids, 'Maxifort' (De 'Ruiter) and 'Robusta' (Bruinsma). In one trial, an unexpected epidemic of Fusarium wilt occurred. Maxifort carries major resistance genes for race 1 and race 2 of *F. oxysporum* f.sp. *lycopersici*, and complete control of Fusarium wilt was seen (Figure 1B). 'Robusta' confers resistance to race 2 of the pathogen, and symptomatic plants were seen, although symptoms were delayed as compared to non-grafted and self-grafted controls (Figure 1B).

A trial was implemented in western NC in a field where a history of Verticillium wilt (*V. dahliae*, race 2) pressure was evident. A split plot design was used, whereby the main plot was crop rotation (continuous tomatoes for 12 years or 3 year crop rotation with non-solanaceous vegetables) and the subplots consisted of grafting treatments (non-grafted, self-grafted, and 'Maxifort' rootstock). Shoot biomass accumulation demonstrated that continuous tomato production suppressed plant growth of non- and self-grafted plants whereas 'Maxifort' rootstock resulted in the highest biomass accumulation in both systems. 'Maxifort' compensated for lack of rotation as indicated by plant growth. The holistic utility of 'Maxifort' in western NC fields with known Verticillium pressure is under evaluation in current trials and will be discussed further.

In summary, grafting of tomato plants offered complete control of southern bacterial wilt and Fusarium wilt reducing risk of crop losses due to soilborne diseases. This management tactic is being quickly adopted into organic production systems. Current work seeks to determine the utility of grafting as a viable tactic to manage soilborne diseases historically managed by fumigation of soils with methyl bromide.

References Cited:

Besri, M. (2001). New developments of alternatives to methyl bromide for the control of tomato soilborne pathogens in covered cultivation in a developing country, morocco. 2001 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions San Diego, California, USA.

Lee JM, Bang HJ, Ham HS. 1998. Grafting of vegetables. *Journal of the Japanese Society for Horticultural Science* 67:1098-104.

Rivard, C., Louws, F.J. 2006. Grafting: for disease resistance in heirloom tomatoes. NCSU –CES Extension Bulletin AG-675. (<http://www4.ncsu.edu/~clrivard/TubeGraftingTechnique.pdf>).

Figure 1: Impact of selected rootstock on incidence of southern bacterial wilt (A) and area under disease progress curves (AUDPC) due to Fusarium wilt (B).

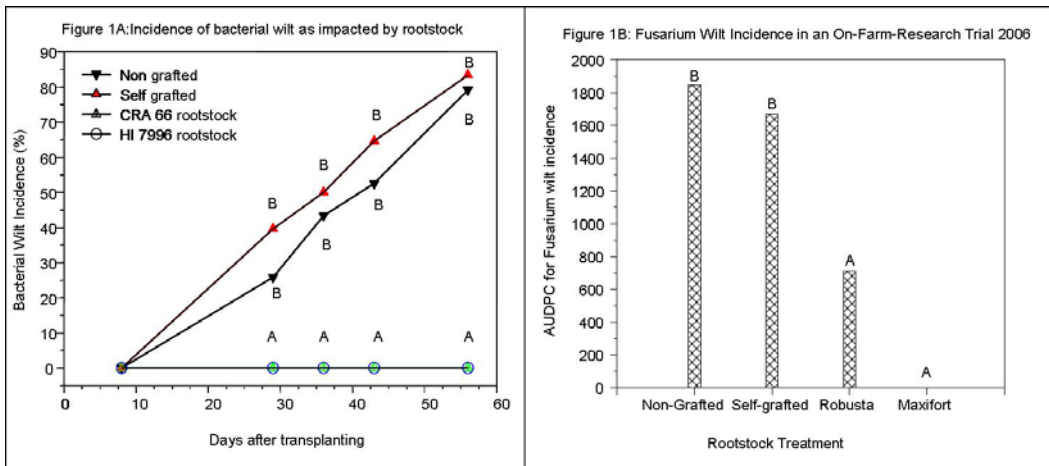


Figure 2: Impact of rootstock on plant dry weight in plots under continuous tomato (12 years) or rotated to tomatoes every 3 years.

