GRAFTING AS A VIABLE TOOL TO MANAGE MAJOR TOMATO DISEASES IN THE SOUTHEASTERN USA.

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We have initiated a program to evaluate the utility of grafting as an IPM tactic for the management of soilborne diseases and to enhance tomato productivity and/or fruit quality. Utilizing rootstock that integrate desirable attributes such as maximal nutrient uptake, season extension, enhanced fruit quality, and increased yield could aid in reducing the economic constraints of this soilborne disease management strategy. This goal has led us to conduct multiple on-farm experiments and complex projects on research stations which not only highlight the soilborne disease resistance characteristics of certain rootstock, but also horticultural attributes mentioned above. Components of this research and extension program seek to understand the utility of grafting for high tunnel production, the benefit of various rootstocks, efficiency of diverse training systems, and impact of fertility management on grafted and non-grafted plants.

In the southeastern US, major soilborne diseases include bacterial wilt (*Ralstonia solanacearum*), Fusarium wilt (*Fusarium oxysporum* f.sp. *lycopersici;* races 1, 2 & 3), root-knot nematodes (*Meloidogyne* sp.), southern blight (*Sclerotium rolfsii*) and Verticillium wilt (*Verticillium dahliae*, races 1 & 2). We have documented the utility of specific rootstocks to confer superior resistance to bacterial wilt and Fusarium wilt (Rivard and Louws, 2008), and have carried out preliminary work on Verticillium wilt race 2 (Rivard et al. 2007). In our earlier work, rootstocks included breeding lines that were not readily-available to US growers (e.g. CRA 66 and Hawaii 7996), but offered complete control of bacterial wilt (Rivard and Louws 2008). In our current study, we evaluated rootstock that is readily-available to commercial growers and also expanded our work to evaluate rootstock tolerance to root-knot nematodes and the southern blight pathogen (*S. rolfsii*).

All grafted plants were produced on the NCSU campus using the tube grafting technique (Rivard and Louws 2006). Scion and rootstock seedlings were severed at a 45^{o} angle and reattached using a tube-shaped silicon clip. The newly-grafted plants were exposed to specific light and humidity conditions while the scion and rootstock stems fused and the vascular tissue reconnected. The plants were ready for field planting 12-14 days after grafting.

The first field trial was conducted on a certified organic farm where the grower consistently had problems managing bacterial wilt (*R. solanacearum)*. Treatments included grafts where rootstock/scion combinations were: non-grafted 'Celebrity', 'Celebrity'/'Celebrity' (self-graft), 'Celebrity'/'RST-105' (D. Palmer Seed Company, AZ), and 'Celebrity'/'Dai Honmei' (Asahi Seed Company, Japan). The experiment was arranged in a randomized complete block design with four replications per treatment and repeated for 2 years (2008 data is not complete to date). Non-grafted plants had 100% wilt incidence by the end of the season whereas 'RST-105' offered 100% control and the Asahi line offered intermediate levels of control (Figure 1). Management of bacterial wilt translated into substantially improved yields with nearly 20 lb/plant for the

‘Celebrity’ grafted onto ‘RST-105’ compared to ~10 lb/plant for the non- grafted controls (Figure 1).

A second series of field trials was carried out to evaluate heirloom tomato productivity and rootstock resistance to root knot nematode (*Meloidogyne incognita*) and southern blight (*S. rolfsii*) at the Clinton Horticultural Experiment Station, NC. Prior to planting, standard plasticulture raised beds were formed, and Telone® II was injected into the beds where the fumigated plots would lie. Treatments included non-grafted plants (cv. ‘German Johnson’) planted into non-fumigated and fumigated plots, self-grafted plants and ‘German Johnson’ scions grafted onto ‘Big Power’, ‘Beaufort’ or ‘Maxifort’ rootstock. Non-grafted and self-grafted plants were highly susceptible to the root-knot nematode with terminal incidence reaching 100% galling (value 12 on a scale from 0-12; Figure 2). Telone® II fumigants were effective at suppressing galling incidence until the last month of the study after which incidence rapidly increased. ‘Maxifort’ and ‘Beaufort’ rootstock limited incidence more than Telone® II and were similar to each other. Resistance appeared to break down during the hot month of August, a common occurrence with the *Mi* gene that confers nematode resistance. Surprisingly, the *Mi* gene appeared to remain stable in the ‘Big Power’ rootstock, and galling was not observed on these roots for the entire duration of the study (Figure 2).

Southern stem blight (SSB) incidence was high in these plots, and non-grafted and self-grafted plants had a terminal incidence of ~80% and ~70%, respectively (data not shown). Telone® II suppressed incidence to 30% whereas all three rootstocks in the study showed no symptoms of SSB throughout the duration of the study (data not shown). The reduced incidence of SSB in the Telone® II plots suggests that the high level of damage from root-knot nematodes could have predisposed these plants to SSB, making them more susceptible to this fungal pathogen. However, the moderate amount of galling in the ‘Beaufort’ and ‘Maxifort’ combined with the absence of SSB incidence suggests that these rootstock are still capable of reducing SSB levels even under highly susceptible conditions.

Rootstock impacts on root-knot and SSB incidence translated into dramatic yield increases compared to the non-grafted plants and the fumigated plots (Figure 2). For example, ‘Beaufort’ yields were 300% higher than those of the non-grafted controls.

In summary, specific rootstock were documented to offer superior management of bacterial wilt, root-knot nematodes, and SSB. The availability of seed, such as RST-105, is important if growers are to implement grafting as an effective IPM tactic. A surprising outcome of our work was the observation of stable resistance of the *Mi* gene even under hot temperature conditions in the ‘Big Power’ background and the observation that ‘Big Power’, ‘Beaufort’, and ‘Maxifort’ rootstocks offered complete control of SSB. To our knowledge, there are no reports of effective resistance to the SSB pathogen. Additional work in various soils and under varying environmental conditions will determine the viability of using rootstock to manage this serious disease in NC and the South.

References Cited:

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Rivard, C.L., M.M. Peet, and F.J. Louws. 2007. Disease management and crop productivity utilizing grafted tomatoes. Proc. Int. Conf. Methyl Bromide Alternatives and Emissions Reduction, 2007.

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Figure 1: Impact of selected rootstock on incidence of southern bacterial wilt (left) and total yield (right) on an organic farm with a high natural infestation of *Ralstonia solanacearum*.

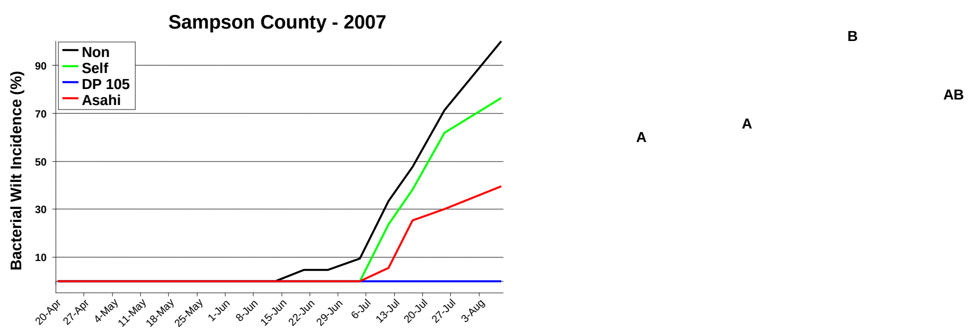

Figure 2: Impact of rootstock on root galling incidence (left) and yield, as impacted by root knot and southern stem blight incidence (right).