GRAFTING TOMATO WITH INTER-SPECIFIC ROOTSTOCK TO MANAGE DISEASES CAUSED BY SCLEROTIUM ROLFSII AND ROOT-KNOT NEMATODES

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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 rootstocks 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 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 this report, we highlight the role of grafting to manage root-knot nematodes (*Meloidogyne* sp.) and southern blight (*Sclerotium rolfsii*) based on the results of field trials from two locations and in two years. 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). Root-knot nematodes and southern blight are both damaging pathogens in the southeast, and have been previously managed with methyl bromide (Duniway 2002; Punja 1985).

Southern blight (SB), caused by *S. rolfsii* results in rapid and permanent wilt, and control of SB is difficult when inoculum levels are high and environmental conditions are suitable for disease development (Punja 1985). Host resistance may be a suitable management strategy for SB, but Breeders have had little success at deploying host resistance against *S.rolfsii* into commercial cultivars. In contrast, genetic resistance in tomato lines and rootstocks to the root knot nematode (RKN) is well documented but an important question is to determine how deployment of resistant rootstocks will affect RKN populations and crop productivity in naturally-infested soils.

This study has three primary objectives:

1) To evaluate the utility of three rootstock hybrids, 'Beaufort', 'Maxifort', and 'Big Power' to reduce SB incidence (caused by *S. rolfsii*) in naturally-infested soils.
2) To determine the efficacy of these rootstocks to reduce infection and reproduction of endemic populations of RKN.
3) To determine how the deployment of resistant rootstock impacts fruit yield and crop productivity and measure the impact of grafting as an IPM strategy for SB and RKN.

Grafted and non-grafted plants were produced on the NCSU campus using the tube-grafting technique (Rivard and Louws 2006). 'Cherokee Purple' and 'German Johnson' were used as scion and non-grafted controls at the Alamance and Sampson County locations, respectively. In both years and in both locations, a RCBD was utilized with four replications. SB disease incidence was recorded weekly (Fig 1A) and RKN galling index was scored biweekly (Fig 2A). Fruit was harvested and graded weekly. Data from each location was analyzed independently, but similarly. Combined data

from the two years was analyzed using split-plot ANOVA. An F-protected LSD test was used to separate mean treatment values at P=0.05 and the results are shown in the figures.
The Alamance County on-farm trial was conducted at a commercial farm that has been under organic cultivation for >20 years. The research trials were located in heirloom tomato production blocks in both years and were grown under high tunnels. SB incidence was moderate in 2007, but occurred later in 2008. Terminal SB incidence of non- and self-grafted plants ranged from 18-46% (data not shown here). Plants grafted onto 'Beaufort' and 'Maxifort' rootstocks did not show evidence of SB. Marketable and total fruit yield was significantly improved among plants grafted with 'Beaufort' and 'Maxifort' compared to non- and self-grafted controls in both years (Fig 3). Fruit number and average fruit size were both significantly increased (Fig 3).

The Sampson County trials were located at the Horticultural Crops Research Station in Clinton, NC, and were placed in a field with high RKN pressure. All three rootstocks had significantly lower RKN AUDPC values as compared to non-grafted and fumigated (Telone II) controls (Fig 2A). 'Big Power' showed particularly high levels of resistance as compared to non-grafted, fumigated, and other rootstocks (Fig 2A,B). RKN populations in plots with 'Big Power' were <1% of those in non-grafted plots at first harvest and 'Big Power' was the only treatment that had a significant effect on the soil populations at the end of the season (Fig 3B). SB incidence and AUDPC was reduced by grafting, but terminal SB incidence among the rootstock was 1-5% (Fig 1A,B). Fruit yield and marketability was significantly impacted by utilization of rootstock (Fig 3C).

Inter-specific rootstock conferred resistance to southern blight (*S. rolfsii*) in both years and at both locations. In Sampson County, SB was particularly severe, and 'Big Power', 'Beaufort', and 'Maxifort' showed high levels of disease resistance to SB. 'Big Power' was also very effective against RKN compared to fumigation with Telone II© and other rootstocks. This rootstock retained high resistance to RKN throughout the season (Figure 2A) and was the only treatment that significantly reduced soil populations at terminal harvest (Figure 3B).

Resistant rootstocks increased yield under disease pressure from SB and RKN.
Even under high disease pressure from SB and RKN, all three rootstocks maintained crop productivity in the Sampson County trials. Interestingly, in Alamance County, grafting*year interactions were not significant for yield, even though the SB epidemic was more severe in 2007. Due to the phaseout of methyl bromide and the expanding market for organic produce, tomato growers in the SE-USA require soilborne disease management strategies that reduce reliance on fumigation. This report provides evidence that 'Big Power', 'Beaufort', and 'Maxifort' rootstock can be utilized to manage SB. This study also highlights the importance of rootstock selection for growers that have to manage RKN. 'Beaufort' and 'Maxifort' had the highest crop yield, but allowed for RKN infection and reproduction. Further work to elucidate the relationship between RKN population dynamics and crop yield would aid in making grower recommendations.

Literature Cited

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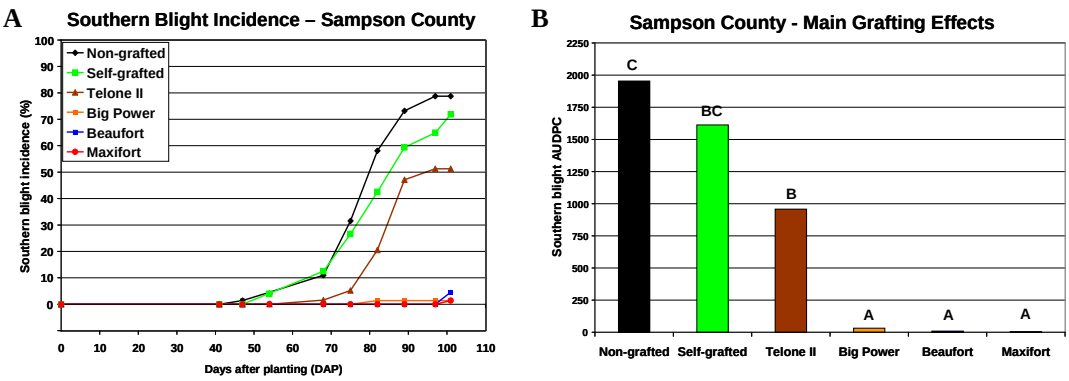

Figure 1 – Southern blight disease incidence (**A**) and AUDPC (**B**) of grafted and non-grafted 'German Johnson' at the Sampson County location. Least significant difference value (*P = 0.01*).

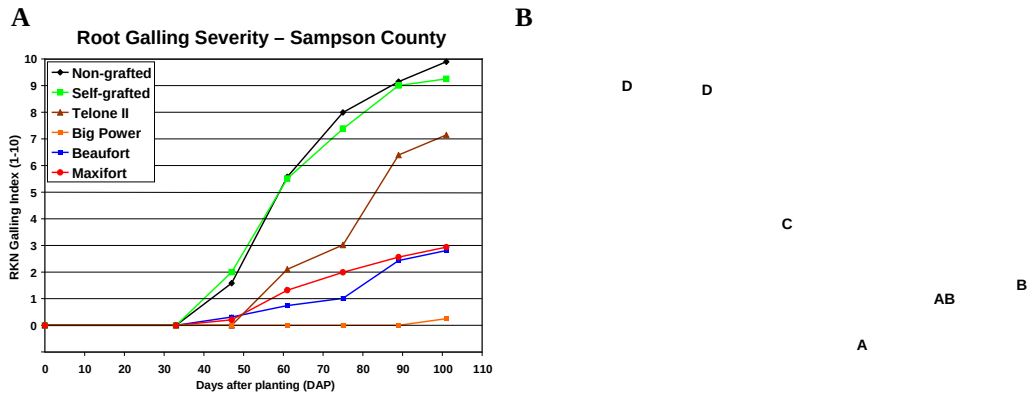

Figure 2 – Root-knot nematode galling index (**A**) and AUDPC (**B**) of grafted and non-grafted 'German Johnson' at the Sampson County location. Least significant difference value (*P = 0.01*).

A

B

Figure 3 – Combined fruit yield and marketability of grafted and non-grafted 'Cherokee Purple' and 'German Johnson' at the Alamance (**A**) and Sampson (**C**) County locations. **B**) Soil populations of root-knot nematodes at the Sampson County location during first and terminal harvest (*P < 0.05*).

C