2013 ON-FARM GRAFTED TOMATO TRIAL TO MANAGE BACTERIAL WILT

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North Carolina is ranked 7th in the nation for the production of tomatoes and grosses over $33.7 million in annual sales. The Piedmont region of the state is a production center for fresh market tomatoes. Patterson Farm, located in Rowan County, NC, has been producing and selling tomatoes since 1946. An increasingly significant production constraint for tomato in this region and other production centers across the state is bacterial wilt(BW) caused by *Ralstonia solanacearum* (race 1). Growers like Randall Patterson (co-owner, Patterson Farm, Inc.) are looking for alternatives to traditional soil fumigants as a management strategy for this disease. In 2013, Patterson planted 20 acres of grafted tomatoes with rootstocks known to be resistant to bacterial wilt. The objectives of this on-farm trial were to evaluate two grafted rootstocks for disease susceptibility and production in a field with known bacterial wilt history. Plant spacing and pinching the apical meristem to allow for a single or double leader of growth were also imposed as treatment.

Two experimental sites within the commercial fields with a significant history of bacterial wilt, one fumigated and one non-fumigated, were set up in a randomized complete block design with four replications. Treatment blocks were imposed within each of the four 300ft.-rows, in a commercial plasticulture system. Each row contained 13 treatment plots (2*2*3 Factorial + Control) comprised of: two rootstocks (‘801’, ‘802’; Rijk Zwaan), two pinching systems (non-pinched-single leader, pinched with double leaders), and three spacings (18”, 24”, 30”) all with ‘Mountain Fresh’ as the scion and an nongrafted ‘Mt. Fresh’ spaced at 18” as the control. Each plot contained ten plants with a ‘Mt. Fresh’ guard plant at both ends of each plot and at the same spacing. All other cultural and pest management methods were consistent across both fields and were managed by the Patterson Farm staff using their production protocols. Plant height, scion-derived adventitious root count (SDARC), flower count, and wilt incidence were collected throughout the growing season. Two harvests, that included nearly all fruit set, were conducted (69 and 84 days after transplanting) and the fruit were sorted into four categories based in consultation with grower’s grading standards. The fruit sizes were Small (4.5-7.5cm), Medium

(7.5-9cm), Large (>9cm), and Cull (<4.5cm or damaged). All grades were counted and weighed per 10-plant plot. This report highlights data from the fumigated experiment.

A significant rootstock x pinching interaction was observed in the formation of adventitious roots derived from the 'Mountain Fresh' scion plant, above the graft union (Figure 1). These scion-derived adventitious roots (SDAR) showed a 5-10 fold decrease in '802' in the pinched (two-leaders) treatment compared to the other grafted treatments (Figure 1). The control, nongrafted 'Mt. Fresh', did not form adventitious roots. The formation of SDAR represents a risk to bacteria colonization and subsequent BW incidence. Preliminary analysis demonstrated that BW incidence was significantly greater in non-pinched compared to pinched plants (Figure 4). Rootstock ('801' vs '802') did not impact BW incidence but the 'Mt. Fresh' control had high levels in the fumigated experiment (Figure 4).

Rootstock choice did not significantly impact yield, however, the main effect of pinching the apical meristem and allowing two leaders per-plant increased yield per plant by 14.3% ($P \leq 0.01$; Figure 2B). Yield, when measured on a per plant basis, tended to increase as spacing between plants increased (Fig.2). The increase amounted to 0.34lbs (R^2=0.987) for every inch increased between plant distances. However, when yields were calculated on a total plants per acre basis, a negative trend was observed (Fig.3). As interplant distance increased yield decreased 1361lbs/acre (R^2=1.0) (Figure 2C). On a per acre basis 18" spacing represented a population of 5808 plants, 24" spacing represented a population of 4356 plants, and the 30" spacing represented a population of 3485 plants per acre.

Additional analysis is required to partition treatment effects on fruit size (small, medium, large etc.; data not shown). The effect of rootstock was assessed by comparing treatments planted at an 18 in. spacing (graph data not shown). The standard treatment 'Mt. Fresh' had the lowest yield per acre. Rootstock 801 pinched plants at 18 in. (801-P-18) increased total yield per acre by 2.1% and this was statistically similar to the standard (*P*=0.05). The 802-NP-18 and 801-NP-18 treatments were similar to each other and significantly increased total yield by 7.5% and 24.8%, respectively, compared to 'Mt. Fresh'. The greatest yield was obtained from the 802-P-18 treatment with an increased total yield per acre 29.5% greater than the standard and also significantly greater than the 801-P-18 and 802-NP-18 treatments.

Capitalizing on the on-farm partnership with a commercial production farm was critical in this trial. Using grafted plants in an open field, commercial production system has been limited primarily due to cost per transplant. Grafted plants are commercially available, but range from 3-5 times higher cost per transplant than traditional seed derived transplants. The large-scale production of grafted plants, and mechanization of that process, is currently being researched in order to bring that production cost down. Large scale trials, like this one, in commercial production systems will be increasingly important

as these grafted transplants become more widely available in larger production volumes. Mr. Patterson, partnering with University researchers, was the driving force behind the research on his farm. He generously provided the land, plants, crop management and other resources used for this study.

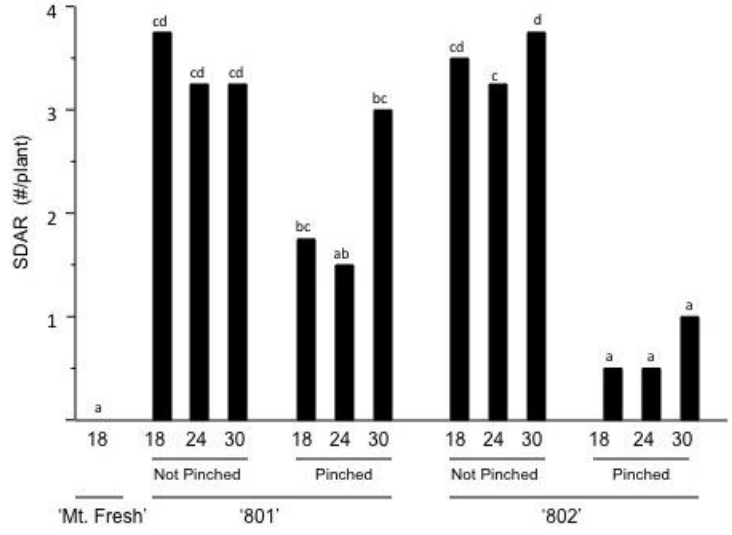

Figure 1. Effect of grafting treatment on scion-derived adventitious root number (SDAR) in the fumigated field at 14 days after transplant (6/13/2013). SDAR were counted per 10 plants on the stem above the graft union. Two bacterial wilt resistant rootstocks ('801', '802') were trained to a single or double leader by removal of the apical meristem (Not Pinched, Pinched) and three between plant spacings (18", 24", 30") were evaluated. A nongrafted control of the scion plant, 'Mt. Fresh' spaced at 18" was also included in each replicated block. Columns sharing the same letter are not statistically different based on LSD (α=0.05).

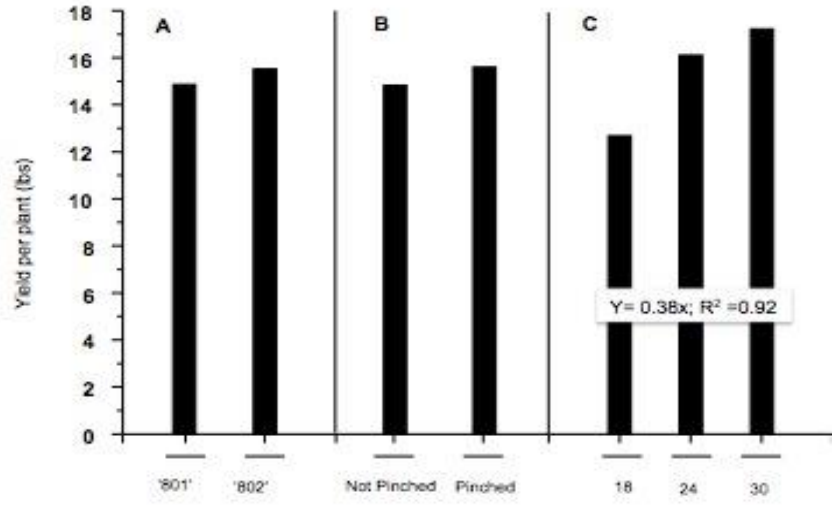

Figure 2. Main effects on total yield of grafted tomatoes per plant in fumigated field. A.) Rootstock main effect (P=NS). B.) Training main effect (P≤0.01). C.) Spacing (in inches) main effect. Two bacterial wilt resistant rootstocks ('61-801', '61-802') were trained to a single or double leader by removal of the apical meristem (Not Pinched, Pinched) and three between plant spacings (18", 24", 30") were evaluated. Plants were harvested on 8/7/2013 and 8/21/2013 (69 and 84 days after transplanting). Data from both harvests was compiled for analysis.

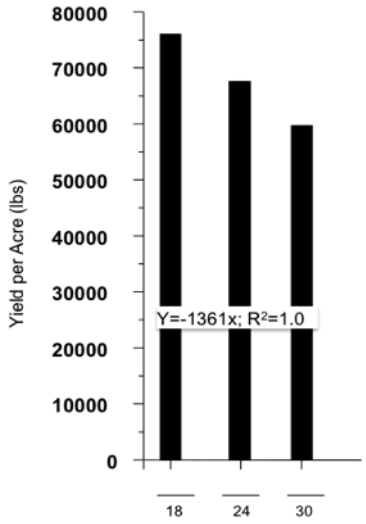

Figure 3. Main effects of spacing on total yield of grafted tomatoes per acre in fumigated fields. Three spacing treatments were used (18",24", 30"). Plants were harvested on 8/7/2013 and 8/21/2013 (69 and 84 days after transplanting). Data from both harvests was compiled for analysis. On a per acre basis 18" spacing represented a population of 5808 plants, 24" spacing represented a population of 4356 plants, and the 30" spacing represented a population of 3485 plants per acre.

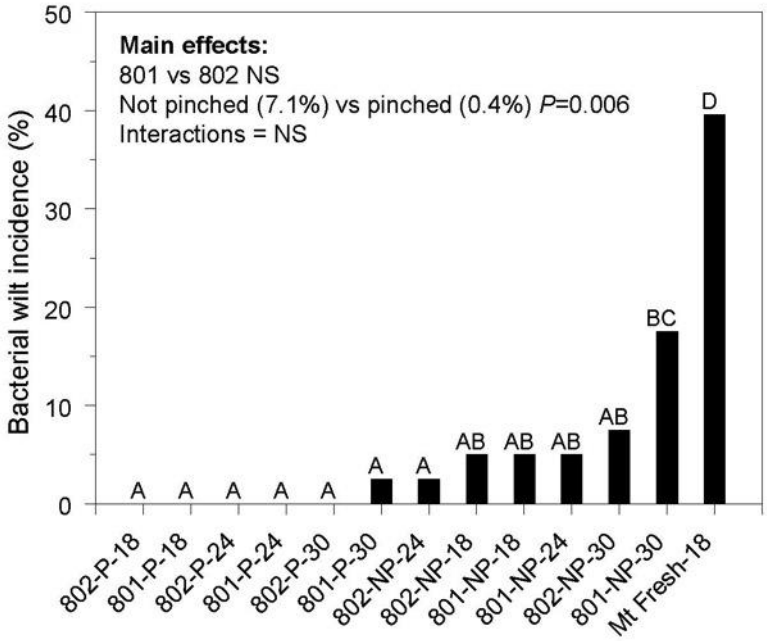

Figure 4. Effect of Grafting Treatment on Bacterial Wilt Incidence. Wilt incidence was based on plant symptoms verified by the presence of bacterial oozing and pure cultures from selected plants. Incidence is based on the mean of 10 plants in 4 replications in the fumigated experiment. Treatments are two rootstocks ('801', '802') with single or double leader (Not Pinched - NP, Pinched - P) and three spacings (18", 24", 30"). Control is nongrafted 'Mt. Fresh' spaced at 18". Bars sharing the same letter are not statistically different based on LSD (α=0.05). Main effects of rootstock and pinching are highlighted in the inset. NS = not significant.