Effect of Grafting and Fertilizer Source on Tomato Yield and Fruit Quality in High Tunnel Production
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Introduction:
Tomato is a major vegetable crop world-wide in general and specifically in high tunnel production. Numerous studies have explored tomato production under high tunnels in the U.S. and found that the cost of constructing a high tunnel is relatively low when compared to the positive outcomes of its use. Intensive production in high tunnels, however, can lead to long term issues in the soil such as soil-borne diseases and salt buildup from fertilizer applications. Vegetable grafting has been used for the last 60 years by commercial growers in Asia, and the last 20 years in Europe, to manage plant soil-borne diseases, increase plant vigor, and improve plant production. Only recently has commercial production of grafted plants occurred in the U.S. This study investigates two fertilizer sources (commercial conventional blend vs. poultry manure plus urea) and the use of three rootstocks (‘Estamino’, ‘Maxifort’, ‘DRO138TX’) as well as non-grafted plants to determine if there are benefits for season extension, fruit yield and fruit quality of tomato cv. Panzer grown in high tunnels in northwest Washington.

Materials and Methods:
This study was conducted at Washington State University (WSU) Northwestern Washington Research and Extension Center (NWREC), Mount Vernon, WA.

Experimental design:
The experiment used a randomized complete block split plot design with four replications.

Treatments:
Main plot treatment was fertilizer:
1) Commercial conventional fertilizer: a mixture of monoammonium phosphate (11-52-0), potassium sulfate (0-0-50), urea (46-0-0) and agricultural lime (36% Ca).
2) Poultry manure + urea: manure was provided by a local farm and applied at 1 ton per acre which provided equivalent amounts of P and K as the commercial fertilizer. Urea fertilizer was added at 80 lb N per acre to provide balance for the N application rate.

Subplot treatments:
1) ‘Panzer’ grafted on ‘Estamino’
2) ‘Panzer’ grafted on ‘Maxifort’
3) ‘Panzer’ grafted on ‘DRO138TX’
4) Non-grafted ‘Panzer’ (control)

Panzer’ was selected for this study because it has resistance to common greenhouse diseases and is recommended for high tunnel production systems.

Plant Measurements:
Plant height, number of leaves, and number of nodes were measured at planting and every 3 weeks thereafter. Pruning was started at 5 weeks after transplanting and conducted once per week thereafter, and pruned biomass was measured each time. At 5, 7, 9 and 11 weeks after transplanting, nitrate-N was measured in both plant tissue and fresh petiole sap.

Plant samples prepared for nitrate measurements

 Marketable fruit quality measurements:
- Firmness
- Juice content
- Total soluble solids.
- pH and titratable acidity
- Lycopene and β-carotene

Results and Discussion:
- Total marketable fruit weight was 6.3 kg/plant and did not differ due to fertilizer source (P = 0.82) or rootstock (P = 0.46) (Fig. 9 & 10).
- Fruit harvest did not occur significantly earlier or later in the high tunnel due to use of grafted plants (Fig 10).
- There was no significant effect due to fertilizer source on the juice content of tomato fruit (P = 0.94).
- Fruit from grafted plants had higher juice content (%) than non-grafted plants on 10 and 17 Aug (P = 0.005, P = 0.009) (Fig. 9 & 10).
- Data analysis for plant nitrate and other fruit quality measurements are underway.

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Figure 1. Grafted Panzer at WSU NWREC
Figure 2. Transplanting tomato in high tunnel plots at WSU NWREC
Figure 3. Plant height measurement in high tunnel plots at WSU NWREC
Figure 4. Pruning tomato in high tunnel plots at WSU NWREC
Figure 5. Panzer tomato in the high tunnel on 21 July, 2015 at WSU NWREC
Figure 6. Harvesting tomato fruit in high tunnel plots
Figure 7. Plant samples prepared for nitrate measurements
Figure 8. pH and titratable acidity measurements in the Vegetable Horticulture Lab at WSU NWREC
Figure 9. Mean marketable fruit weight (kg ha⁻¹) of Panzer for fertilizer source at WSU NWREC, 2015
Figure 10. Mean marketable fruit weight (kg ha⁻¹) of Panzer by rootstock at WSU NWREC, 2015
Figure 11. Mean fruit juice content (%) of Panzer by rootstock at WSU NWREC, 2015