Effect of Grafting and Fertilizer Source on Tomato Yield and Fruit Quality in High Tunnel Production

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Introduction

- Tomato (*Solanum lycopersicum* L.) is an important crop for fresh market growers (farmers market, farm stands, restaurants and community supported agriculture) in Washington State, including the coastal climate in the major vegetable production area of the Skagit Valley in northwestern Washington
- The ideal temperature for tomato fruit set is 18° to 24 °C, and temperatures below 10 °C prevent fruit set. Because the 20-year average temperature during the summer growing season (June through Sept.) in the Skagit Valley is 16 °C, there is a potential for high tunnels to be used to increase summer production of tomato in this relatively cool region.
- Organic fertility sources such as manure and compost, can enhance soil health and crop yield by enhancing the physical and chemical characteristics of the soil. Organic fertilizers release nutrients slowly, which can limit crop productivity. Chemical fertilizer provides concentrated nutrients quickly to the crop, but excessive salts can accumulate in the soil. Use of organic and chemical fertilizers together, called integrated fertility management, may provide the benefits of both organic and chemical approaches.
- Vegetable grafting is used extensively to increase nutrient uptake and extend the tomato harvest season within greenhouse and high tunnel production systems.
- The goals of this study were to investigate fertilizer source and the use of grafted plants for season extension and enhanced fruit yield and quality of tomato grown in high tunnels in Northwest Washington.

Materials and Methods

This study was carried out during the summer growing season of 2015 and 2016 at Washington State University (WSU) Northwestern Washington Research and Extension Center (NWREC) in Mount Vernon, WA.

Treatments:

Main plot treatment was fertilizer:

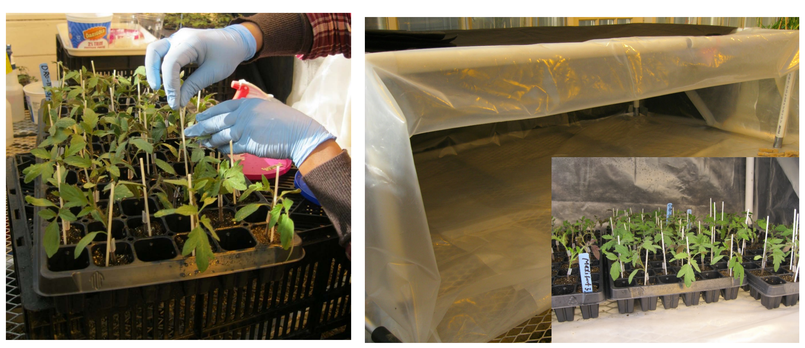
1) **Commercial conventional fertilizer:** A mixture of monoammonium phosphate (11-52-0), potassium sulfate (0-0-50), urea (46-0-0) and agricultural lime (36% Ca).
2) **Integrated fertilizer (Poultry manure + urea)**: Manure was provided by a local farm and applied at 2.4 $t \cdot ha^{-1}$ which provided amounts of P and K equivalent to the commercial fertilizer. Urea fertilizer was added at 90 $kg \cdot ha^{-1}$ N to provide balance for the N application rate.

Subplot treatments:

1) Non-grafted 'Panzer' (control)
2) 'Panzer' grafted on 'DRO138
3) 'Panzer' grafted on 'Estamino'
4) 'Panzer' grafted on 'Maxifort'

Grafting:

Plants were grafted using the splice technique. The rootstock and scion were cut at 45° where the diameter of the stem was comparable to the rootstock's stem diameter. Plants were held together with a silicone clip (1.5–2 mm; Harris Seed, Rochester, NY) and immediately placed into a healing chamber in the greenhouse (Johnson et al., 2011).



'Panzer' tomato seedlings and DRO138' 'Estamino' and 'Maxifort' rootstocks in the greenhouse following grafting (left), and placement into a healing chamber (right).

Materials and Methods Continued

Plant Material:

- 'Panzer' was selected for this study because it has resistance to common greenhouse diseases and is recommended for high tunnel production systems (Reid et al., 2012).
- 'DRO138' 'Estamino' and 'Maxifort' rootstocks were selected as they are strong, highly vigorous and disease-resistant rootstocks.

The experiment used a randomized complete block split plot design with four replications. Fertilizer treatments were tilled into the soil prior to transplanting tomato.

Transplanting tomato in high tunnel plots.

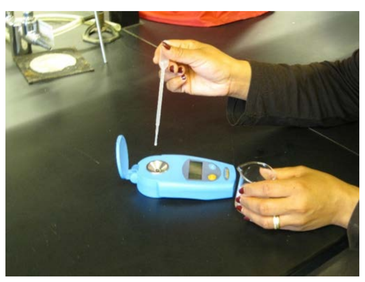
Total and marketable yield:

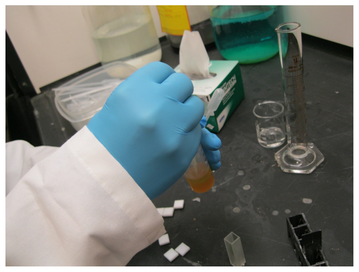
Fruit was harvested once a week as needed during the growing season, when fruit was at least 75% ripe. Weight and number of both marketable and unmarketable fruit were recorded.

Harvesting tomato fruit in high tunnel plots.

Marketable fruit quality measurements:

For each subplot, tomato fruit were placed into a blender and homogenized at highest speed for 2 minutes. Fruit homogenate was used for total soluble solids and lycopene measurements.





Total soluble solids (TSS, measured as ^{0}Brix) and lycopene measurements.

References

Johnson, S., P. Kreider, and C. Miles. 2011. Vegetable grafting: Eggplants and Tomatoes. Washington State University Extension Fact Sheet. FS052E.

Reid, J., K. Klotzbach, and N. Hoover. 2012. 2011 High tunnel tomato variety trial. Cornell Univ. Coop. Ext. Publ. 8(2):3- 20.

Acknowledgements

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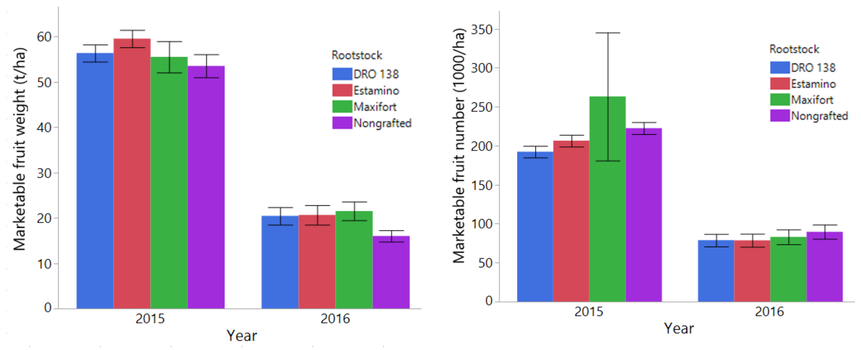
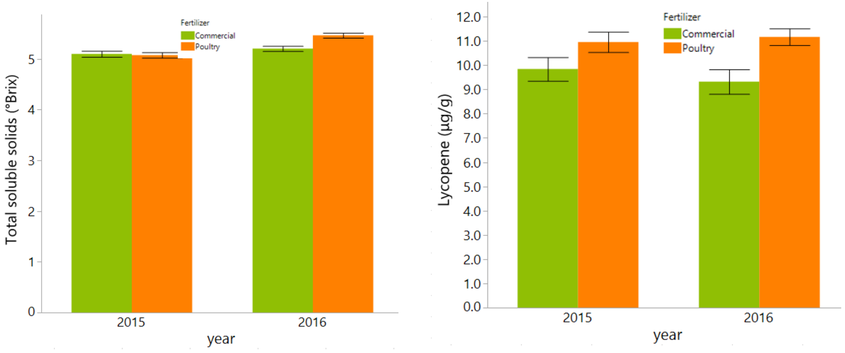
Results



Mean marketable fruit weight (t/ha) and number (1000/ha) of 'Panzer' tomato grafted with three rootstocks, 'DRO138', 'Estamino' and 'Maxifort', in a high tunnel at WSU Mount Vernon NWREC during 2015 and 2016 summer growing seasons.



Mean total soluble solids (TSS, ^{0}Brix) and lycopene (µg/g) of 'Panzer' tomato grown with two fertilizer treatments in a high tunnel at WSU Mount Vernon NWREC during 2015 and 2016 summer growing seasons.

- Both years, number and weight of marketable fruit did not differ due to fertilizer source.
- There was no difference in weight or number of marketable fruit due to grafting in 2015, but the weight of marketable fruit was greater for grafted plants as compared to non-grafted plants in 2016 ($P = 0.03$).
- TSS and lycopene content were higher in tomato fruit grown with integrated treatment than for those grown with conventional fertilizer in 2016 but not in 2015 ($P = 0.002$, $P = 0.0001$, respectively).
- TSS and lycopene content did not differ due to grafting treatment in 2015, however, fruit from grafted plants had higher TSS than from non-grafted plants in 2016 ($P < 0.0001$).

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