



Evaluation of Grafted and Non-grafted Hybrid and Heirloom Tomatoes in a Midwest High Tunnel Production System



Kristine Neu¹ and Ajay Nair²

¹ PhD Student ² Assistant Professor, Department of Horticulture

Introduction & Hypothesis

High tunnels have emerged as a tool for Iowa vegetable growers to extend the growing season, increase crop production, and improve quality of the produce, but tomato (*Solanum lycopersicum*) production in this system does not come without challenges. Continuous cropping of tomatoes in a high tunnel gives rise to recurring soil-borne and foliar diseases, pest pressure, issues with soil fertility and salinity, and increased irrigation requirements.

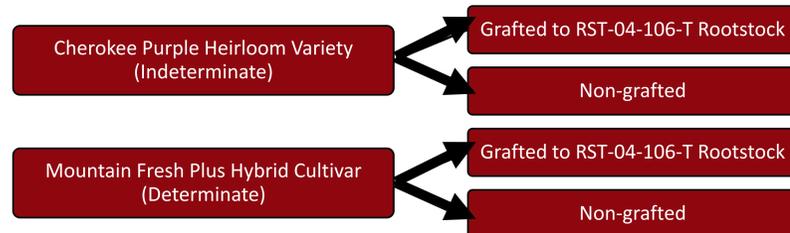
We hypothesize that grafted tomatoes will overcome challenges outlined above through increased plant vigor conferred by a proven, disease-resistant rootstock. The goal of this study is to evaluate hybrid and heirloom tomatoes grafted to a commercially available rootstock as a primary means to overcome production challenges while increasing marketable yield, fruit and nutritional quality, and profitability.

Objectives

1. Compare marketable yields of grafted and non-grafted hybrid and heirloom tomatoes
2. Determine if fruit quality and nutritional differences exist between each treatment
3. Measure differences in plant vigor as a response to grafting

Materials and Methods

Field trials were conducted in 2015 and 2016 at the Iowa State University Horticulture Research Station in Ames, IA.



Tomato transplants were grafted three weeks after seeding using the splice grafting method (Figure 1). On May 7, 2015 and April 29, 2016 the transplants were planted in a 30' x 96' ClearSpan™ high tunnel. Mountain Fresh Plus tomatoes were grown using a stake and weave system. The Cherokee Purple tomatoes were grown as a single leader using the lower and lean trellis technique. Tomatoes were planted in a randomized complete block design with 10 plants per plot replicated four times.



Figure 1. Transplants immediately after grafting.

Results

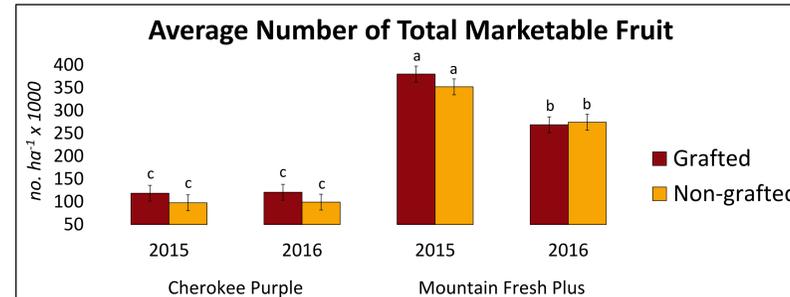


Figure 2. Average number of total marketable fruit July 22 – October 12, 2015 and July 6 – October 3, 2016 seasons. Marketable fruit for Mountain Fresh Plus includes USDA Grade 1, 2, and 3 tomatoes. Marketable fruit for Cherokee Purple includes all tomatoes that were free from disease, insect damage, and severe cracking and other physiological disorders. All mean separations in Figures 1 and 2 are based on least significant differences at $P \leq 0.05$ analyzed using PROC GLIMMIX in SAS Version 9.4.

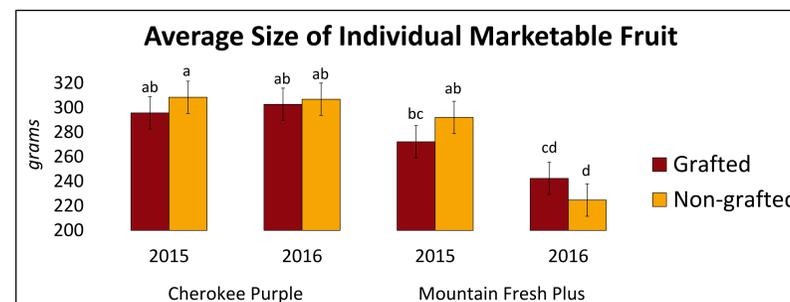
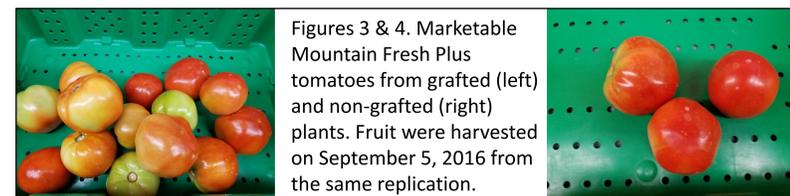


Figure 5. The average size of individual marketable fruit as determined by the ratio of total marketable harvest weight to total marketable harvest number of fruit.

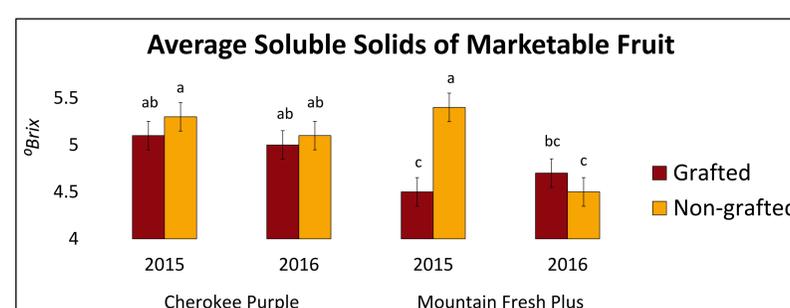


Figure 6. The average soluble solids were measured using marketable fruit at the same stage of ripeness collected from a mid-season harvest. Higher values indicate a higher sugar content within fruit samples.

Results Continued

Table 1. Plant vigor indicators [Dry plant biomass, stem diameter, and SPAD (leaf chlorophyll content)]. Data is an average of 20 plants for SPAD and stem diameter and 12 plants for biomass. SPAD readings were collected at mid-season and stem diameter and biomass were measured at the end of each growing season. Values followed by the same letter within a column are not significantly different from one another at $P \leq 0.05$.

Cultivar	Graft	Shoot	Root	Stem	SPAD
		Biomass (g/plant)	Biomass (g/plant)	Diameter (mm)	
2015					
Cherokee Purple	Grafted	111.7 b	5.8 c	15.4 a	44.4 cd
	Non-grafted	115.58 b	5.8 c	14.7 ab	43.4 cd
Mountain Fresh Plus	Grafted	339.8 a	14.9 a	15.2 ab	45.7 bc
	Non-grafted	346.2 a	12.9 ab	14.3 b	47.0 b
2016					
Cherokee Purple	Grafted	154.62 b	8.0 c	15.1 ab	44.0 cd
	Non-grafted	145.20 b	7.5 c	14.4 ab	42.8 d
Mountain Fresh Plus	Grafted	338.8 a	11.6 b	15.2 ab	47.9 ab
	Non-grafted	334.0 a	10.9 b	14.3 ab	49.45 a

Conclusions

- The main effect of grafting with the rootstock RST-04-106-T significantly increased the number of marketable fruit by an average of 16,200 fruits per hectare as compared to non-grafted plants ($P = 0.040$ based on the F test). However within each year there were not any significant difference in the number of marketable fruit by cultivar (Figure 2).
- The size of individual marketable fruit harvested from grafted plants was not significantly different from fruit of non-grafted plants (Figure 5), but there was a slight decrease in the size of fruit from grafted plants overall. The individual fruit size decrease may be due to the allocation of resources to the overall higher number of fruit on grafted plants.
- Fruit collected from grafted plants had a significantly lower amount of soluble solids when pooled across year and cultivar ($P = 0.036$)(Figure 6). This result was unexpected, as our hypothesis was that the grafted plants would produce fruit with a higher concentration of sugars.
- The use of the rootstock, RST-04-106-T, did not significantly increase plant shoot or root biomass (Table 1). Stem diameter was significantly larger for the grafted plants ($P = 0.005$), which could increase the overall durability of plant stems. There was not an effect of the grafted rootstock on the chlorophyll leaf content; however, there was a significant interaction between the cultivar and grafting.
- While grafting shows promise to increase marketable yields the trade-off of fruit quality must be considered. Localized trials of additional hybrid rootstocks should be utilized to drive decisions on the adoption of large-scale tomato grafting for high tunnel production.

Acknowledgements

We would like to thank the Iowa Department of Agriculture and Land Stewardship for funding this research. A special thank you to the staff of the ISU Horticulture Greenhouse, the Horticulture Research Station, and the Plant and Insect Diagnostic Clinic. Thank you to fellow graduate students and undergraduate research assistants in the Sustainable Vegetable Production Lab.