Could melon grafting and deficit irrigation enhance yield and crop water productivity in high desert environments?

Heinrich di Santo, Manuel A. Andrade, Felipe Barrios-Masias
Dept. of Agriculture, Veterinary & Rangeland Sciences, University of Nevada, Reno

INTRODUCTION

In the high desert, Nevada farmers are challenged by a short growing season, slow crop establishment of warm-season vegetables and water availability. Grafting on squash hybrids and deficit irrigation have shown to be successful techniques for earlier harvests and increased crop water productivity[1]. A field trial was conducted to evaluate the performance of cantaloupe grafted onto squash hybrid rootstocks under deficit irrigation. Incorporating soil moisture sensors to monitor water use and irrigation volumes could optimize water use when soil moisture content is replenished to 100% (i.e., field capacity) or to 70% of the maximum soil moisture content.

MATERIALS AND METHODS

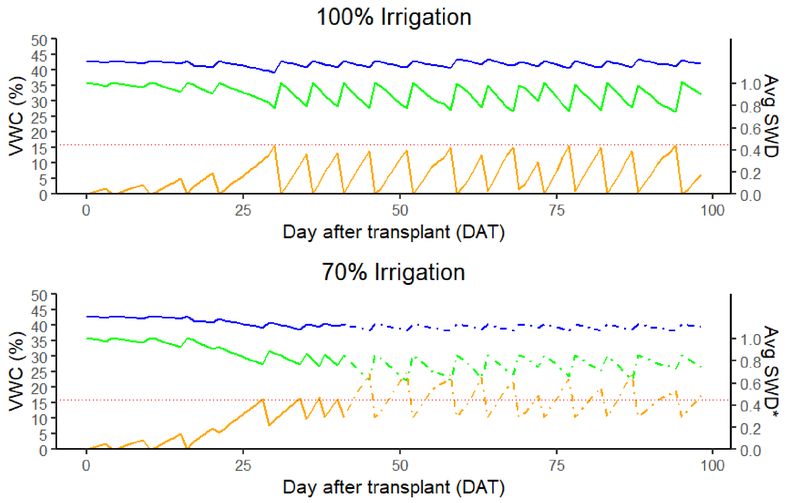
Plant material

Two commercial varieties of squash hybrid rootstocks from a cross of *Cucurbita maxima x C. moschata* (i.e., Carnivore and Ercole) were evaluated with a common cantaloupe scion (cultivar Sarah's Choice). Ungrafted plants of Sarah's Choice were used as control. The study was conducted at the UNR Valley Road Experiment Station, Reno, NV.

Experimental design

- A Randomized Complete Block Design (RCBD) was used.
- Irrigation treatments replenish moisture to either 100% or 70% of field capacity.
- Three phenotypes: two rootstock/scion combinations and the ungrafted cultivar.
- Six replicates with eight plants per plot
- Plant spacing: three by seven feet.

SOIL MOISTURE



VWC(%) = Volumetric soil water content (m^3/m^3)
* In the deficit irrigation plots VWC and SWD were estimated after DAT 41
Soil moisture at 20cm VWC(%)
Soil moisture at 40cm VWC(%)
Average soil water depletion (Avg SWD)
The dashed line shows the maximum SWD for Cantaloupe (i.e., 0.45) according to FAO irrigation and drainage paper No 56[2].

Figure 1. Volumetric water content (VWC) (left y axis) and soil water depletion (SWD) (right y axis) patterns in the 100% and 70% irrigation treatment.

PRODUCTION OVER TIME

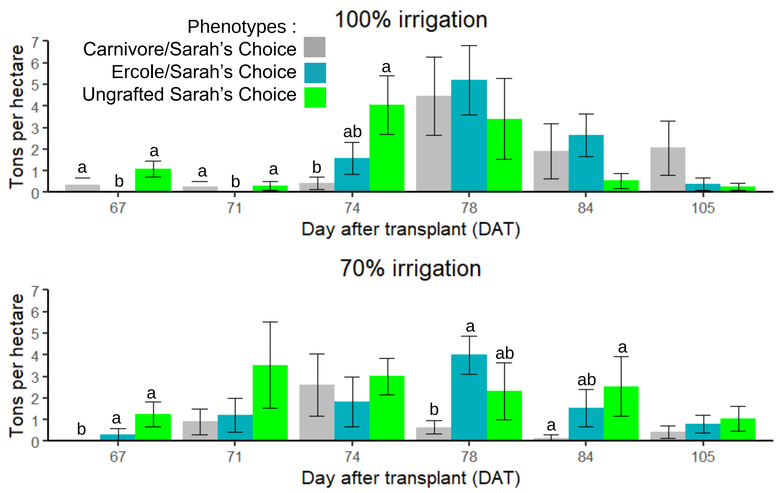


Figure 2. Yield pattern of harvests conducted between DAT 67 and DAT 105. Mean comparisons are within each harvest. Means not sharing any letter are significantly different at the 5% level of significance within each harvest and applies from figure 2 to 6.

SOIL CANOPY COVER

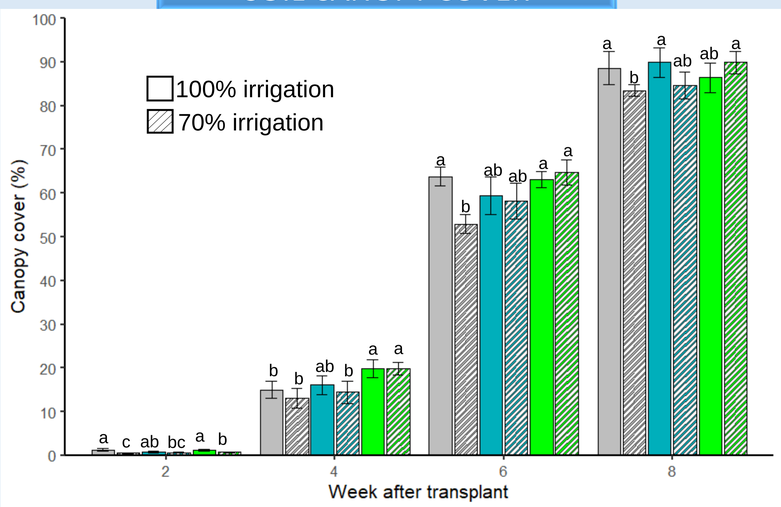


Figure 3. Canopy development from week 2 to week 8 after transplant.

NDVI

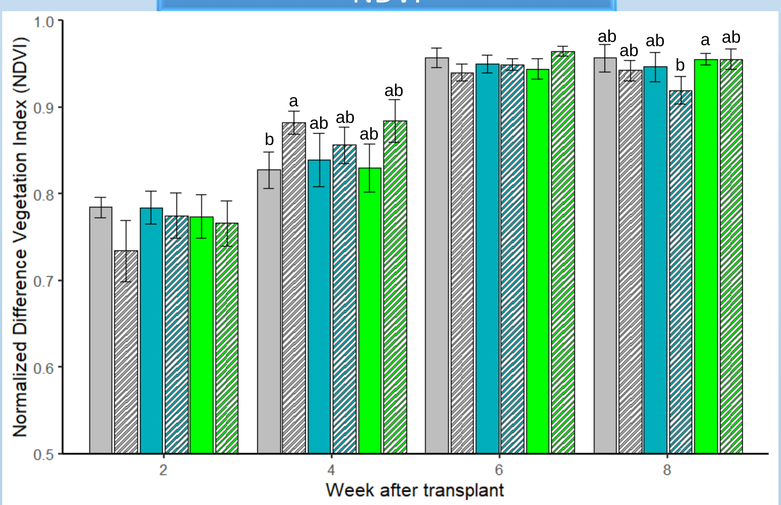


Figure 4. NDVI values collected from week 2 to week 8 after transplant.

YIELD

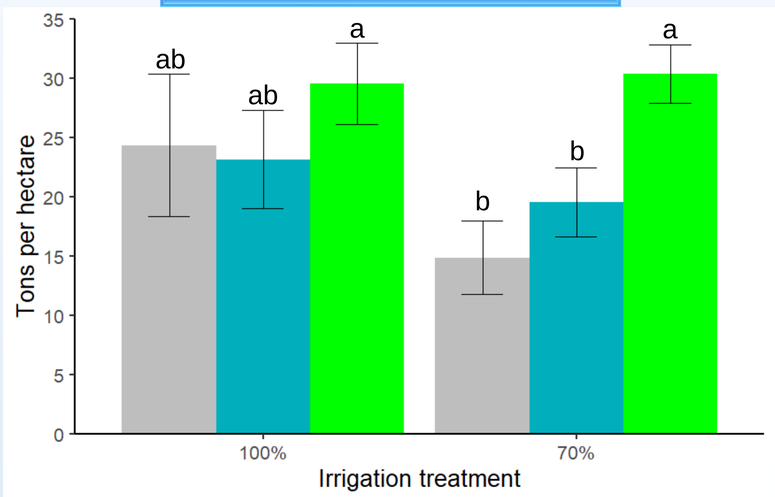


Figure 4. Total fresh fruit of the harvest season.

CROP WATER PRODUCTIVITY

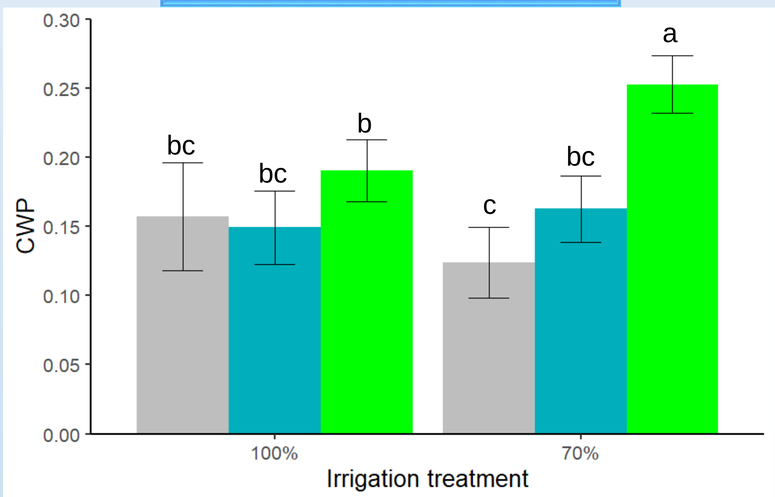


Figure 6. Crop water productivity (CWP) (Yield/unit of water applied) between irrigation treatments.

RESULTS

Soil moisture (Figure 1)

- The 100% irrigation treatment showed no water stress, while the 70% irrigation treatment crossed the maximum SWD threshold after DAT 43, suggesting that the crop experienced moderate water stress.

Production over time (Figure 2)

- Ungrafted plants produced more melons at the beginning and end of the harvest season under the 70% irrigation treatment.

Canopy cover (Figure 3)

- Under the 100% irrigation no differences of canopy growth were observed
- Ungrafted plants grew faster than grafted ones in the 70 % irrigation.

Normalized difference vegetation index (NDVI) (Figure 4)

- Irrigation treatment did not significantly affected NDVI of phenotypes, which suggests that the 70% irrigation did not cause severe drought stress.
- NDVI increased for all phenotypes during canopy growth.

Yield (Figure 5)

- Under the 100% irrigation, no differences in total yield were observed among phenotypes.
- Under the 70% irrigation, the ungrafted plants produced 30% more number of fruits (data not shown) than the grafted plants.

Crop water productivity (Figure 6)

- The ungrafted plants have acclimated better to the moderate water stress and improved significantly the CWP compared to the grafted phenotypes.
- The plants in the 100% irrigation treatment received 361 mm of water while the plants with the 70% irrigation received 284 mm.

CONCLUSION

- Grafting did not show a clear benefit on yield under both full irrigation and moderate water deficit. This suggests that either the type of grafting or the root system of the rootstocks did not provide any advantage to the common scion.
- Moderate irrigation deficit may induce earlier melon production and increase CWP to support local food systems and improve cultivation sustainability in high desert environments.






LAB CONTACTS

AKNOWLEDGMENTS

Work supported by the USDA-NIFA through the WSARE project # SW20-918, and from the Nevada DRIVE Program. Special thanks to Plug Connection, Inc. that provided the grafted plants.

REFERENCES

1. Ezzo, M. & Salem, A.A. & Glala, A.A. & Saleh, Said. (2020). Bulletin of the National Research Centre.
2. Allen, Richard & Pereira, L. & Raes, D. & Smith, M.. (1998). FAO Irrigation and drainage paper N. 56.