Cantaloupe Physiological Responses to Deficit Irrigation and Impacts on Crop Water Productivity

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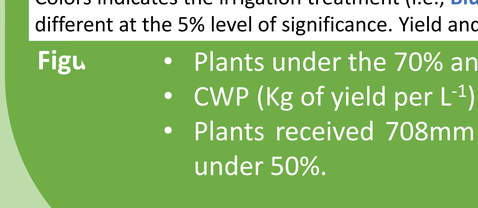
INTRODUCTION

In the high desert, Nevada farmers are challenged by a short summer growing season 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 grafted and ungrafted cantaloupes under deficit irrigation. Integrating soil moisture sensors for monitoring soil water availability and determining irrigation amounts has the potential to enhance the effective use of water (i.e., increase crop water productivity) and reduce the amount of water applied without decreasing yield.

MATERIALS AND METHODS

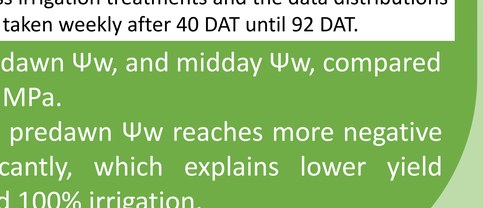
Plant material

A commercial squash hybrid rootstock from a cross of *Cucurbita maxima x C. moschata* (i.e., Carnivore) was 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.

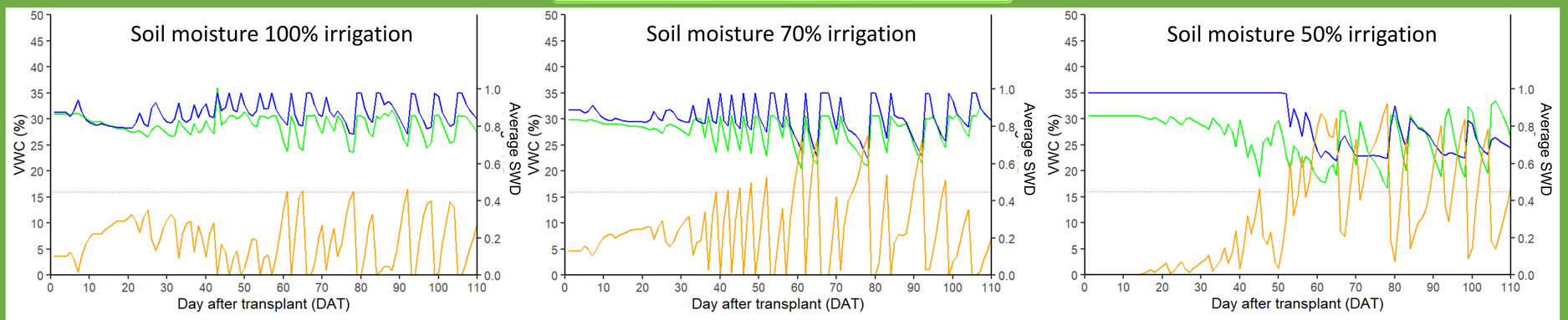


Experimental design

- A randomized complete block design (RCBD) was used.
- Irrigation treatments started after three weeks from transplant and replenished moisture to either 100%, 70% or 50% of field capacity.
- Two phenotypes: one rootstock/scion combination and the ungrafted cultivar.
- Six replicates per treatment.
- Plant spacing: three by seven feet.

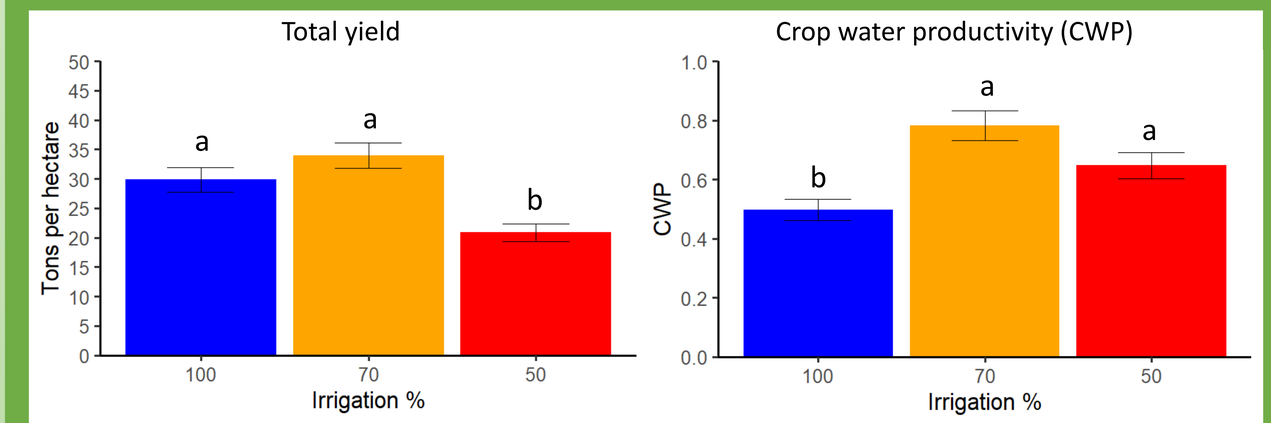


RESULTS



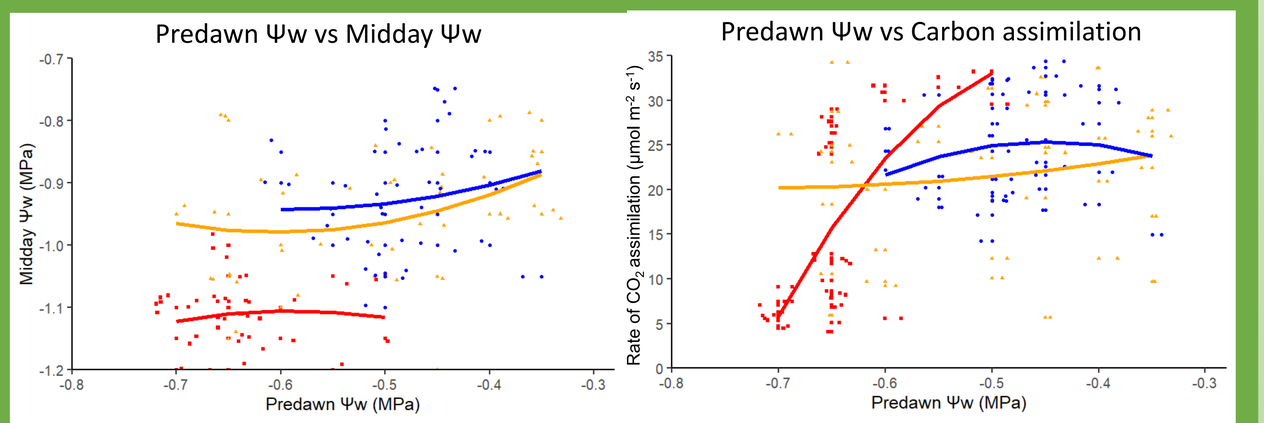
VWC(%) = Volumetric soil water content (m^3/m^3); SWD = Soil water depletion (orange line); Soil moisture at 20cm VWC(%) (green line); Soil moisture at 40cm VWC(%) (blue line); The dashed red line shows the maximum SWD threshold for Cantaloupe (i.e., 0.45) according to FAO irrigation and drainage paper No 56[2].

Figure 1:
- Under the 100% irrigation treatment, the soil water depletion (SWD) was never higher than our threshold of 0.45.
- Maximum SWD was exceeded several times and for consecutive days after 48 and 51 DAT for the 70% and 50% irrigation treatment.



Colors indicates the irrigation treatment (i.e., **Blue = 100%**, **Orange = 70%**, **Red = 50%**); Means not sharing any letter are significantly different at the 5% level of significance. Yield and CWP from grafted and ungrafted plants are combined.

Figu
- Plants under the 70% and 100% irrigation had higher melon yields than the 50% treatment.
- CWP (Kg of yield per L^{-1}) increased significantly under the 70% and 50% irrigation.
- Plants received 708mm of water under 100% irrigation, 511mm under 70%, and 380mm under 50%.



Ψw = stem water potential; Lines and dots represent the non-linear regression across irrigation treatments and the data distributions (i.e., **Blue = 100%**, **Orange = 70%**, **Red = 50%**); Ψw and leaf gas measurements were taken weekly after 40 DAT until 92 DAT.

Figure 3:
- Plants under the 50% irrigation had much lower predawn Ψw, and midday Ψw, compared to the 100% and 70% which had midday Ψw of -0.9 MPa.
- As water stress increases under the 50% irrigation, predawn Ψw reaches more negative values and carbon assimilation reduces significantly, which explains lower yield performance compared to plants under the 70% and 100% irrigation.

CONCLUSION

- This study suggests that a reduction in irrigation volume of 30% from ETc, using soil moisture sensors, could be a valuable strategy to increase water use efficiency in cantaloupes without a yield decrease.
- From a plant physiological perspective, a moderate irrigation deficit (i.e., 70% irrigation treatment) did not impact carbon assimilation rates, resulting in a more conservative use of water at the leaf level (i.e., increased intrinsic water use efficiency).
- Tracking the relationship between predawn and midday Ψw allows to directly assess plant water status, and could be used as a valuable tool for synchronizing plant water demands and irrigation management.

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LAB CONTACTS

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