

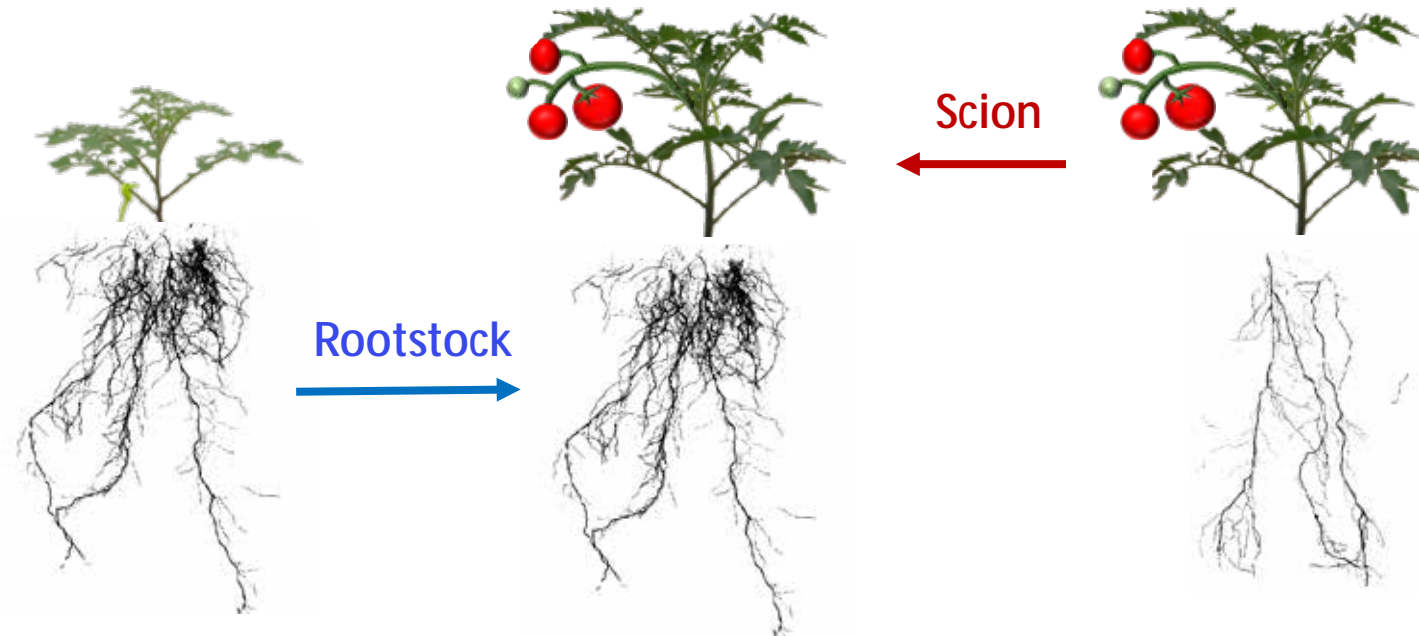
Updates on Cantaloupe melon and tomato trials evaluating vegetable grafting, irrigation and nitrogen management



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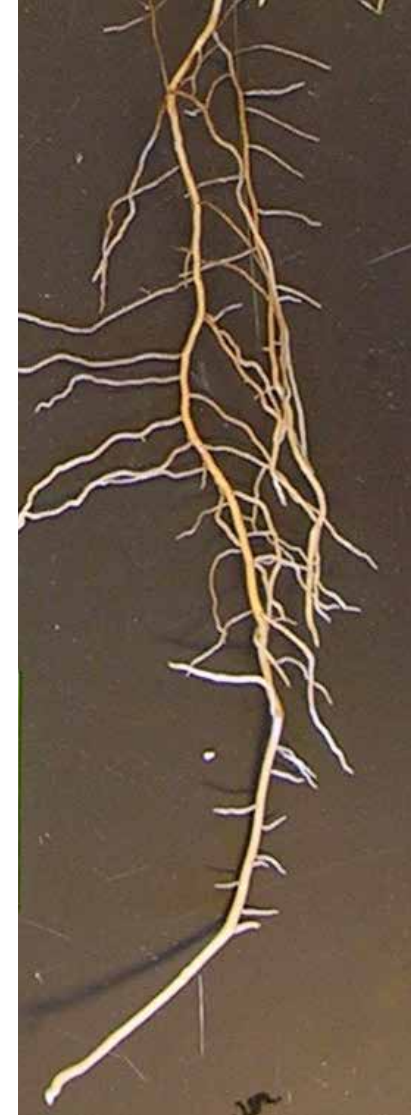
Is vegetable grafting a technique to help cope with stress?



Can grafting help with:

- Colder soils early in the Spring?
- Soil nutrient availability and uptake?
- Yields and fruit quality?
- Reductions in irrigation volumes?

Most answers to those questions can start belowground,
and although difficult, we need to get to the roots!



Our relative understanding about roots

Dr. Allanore, MIT : "We are about to know the full genome of humans, but we don't yet know how a crop uptakes nutrients,"

<https://phys.org/news/2019-02-method-fertilizer-production-farms-africa.html#jCp>

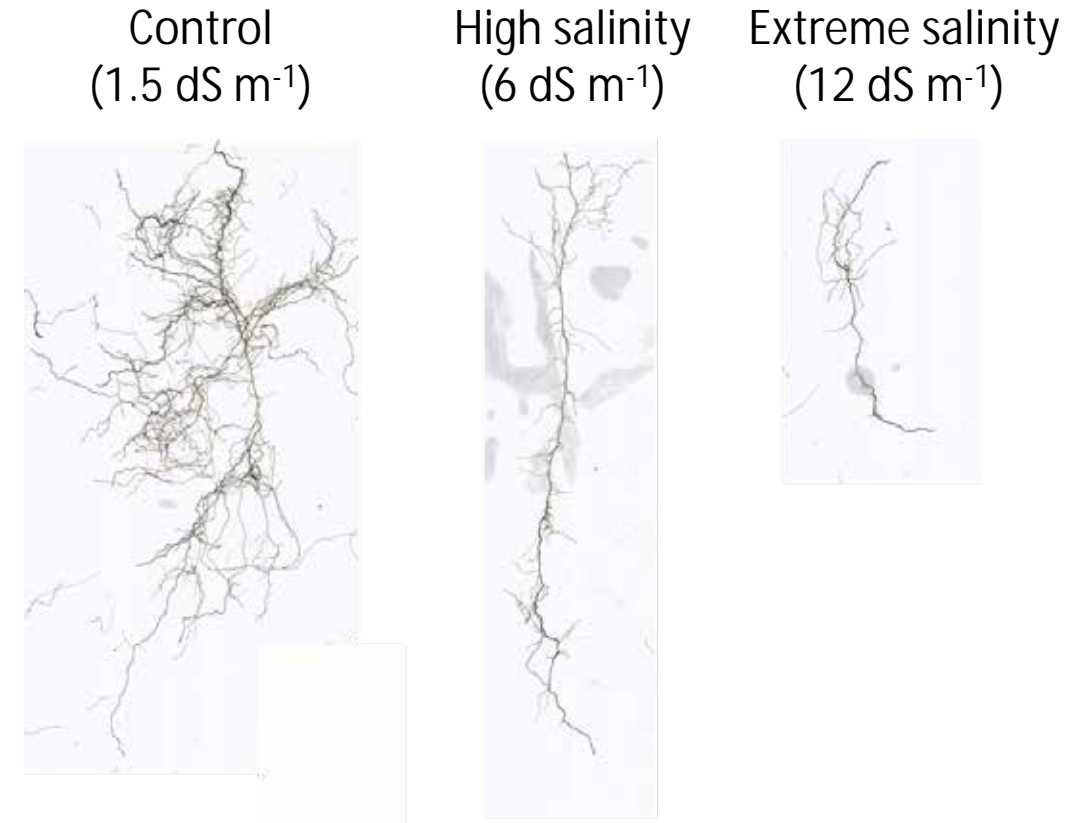
“A complete, scientific understanding of the soils-crops relations cannot be attained until the mechanism by which the soil and plant are brought into favorable relationships, i.e., the root system, is also understood.”

(Weaver and Bruner, 1927)

The role of roots on plant performance

- Meet the plant water and nutrient demand:
 - Maintain plant water status
 - Improve crop performance and yield
- Ameliorate abiotic stress such as:
 - Drought
 - Nutrient deficiencies
 - Heat and chilling stress
 - Salinity

Salinity effect on roots

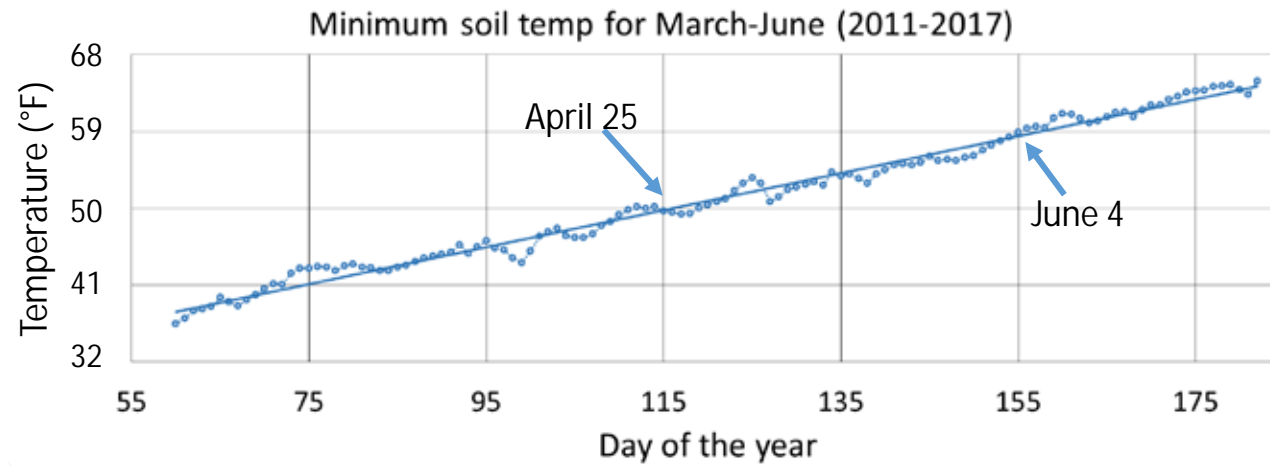


Bonarota et al. 2021 (UNR Extension publication)

<https://extension.unr.edu/publication.aspx?PubID=4183>

Background on tomatoes and melons in northern Nevada

- Both are Summer crops and chilling sensitive.
- Exposure to suboptimal soil temperatures can inhibit establishment (<60 °F).
- Reductions in water and nutrient uptake can cause stress and reduce growth.
- Slower canopy growth can decrease yield and quality.



Rootstocks can provide root traits for chill tolerance in tomatoes

Colder soils early in the Spring?



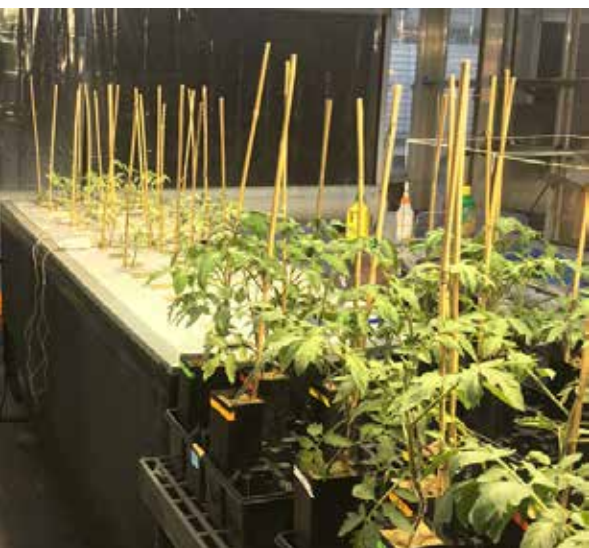
Root traits for chill-tolerant tomato rootstocks

Colder soils early in the Spring?

Genotype	Role
BHN-589	scion
Estamino	rootstock
Maxifort	rootstock
RST-04-106T	rootstock
SuperNatural	rootstock

Cold soil

Warm soil



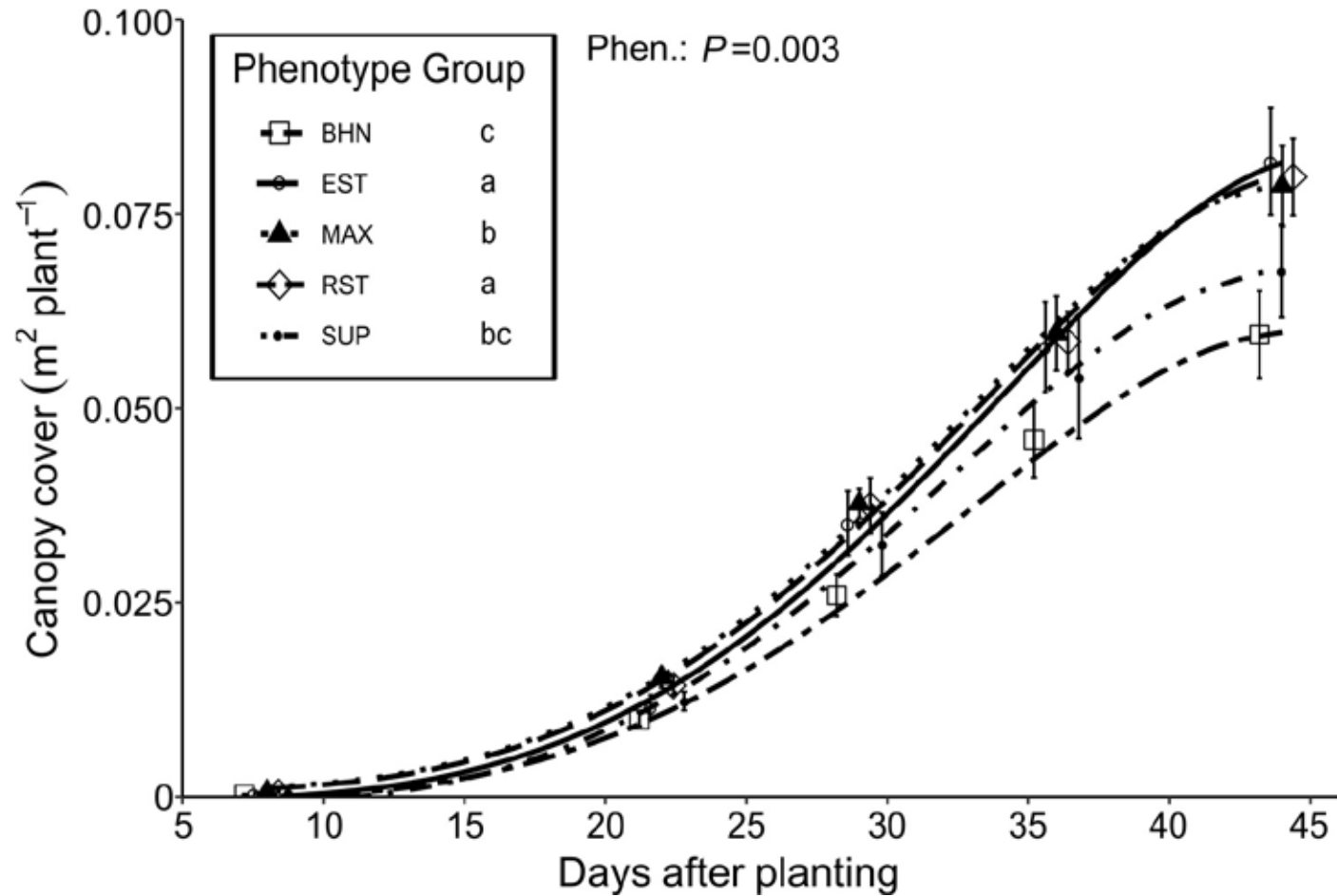
Grafted

Own rooted



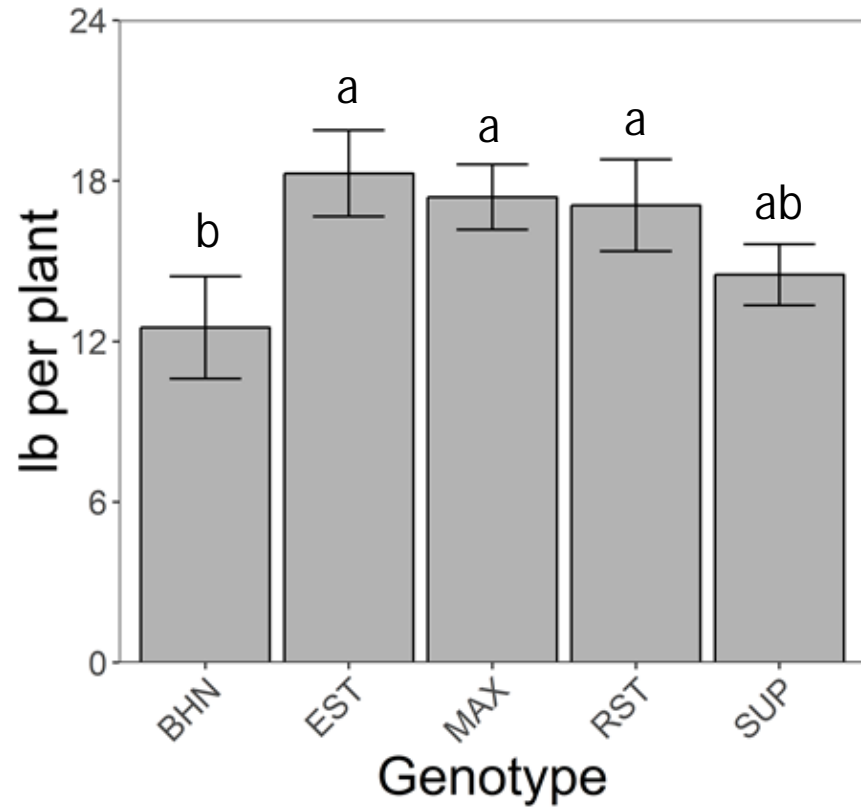
- Greenhouse study with controlled soil temperature of <59 °F

Grafting and plant establishment



- Under high tunnels, most rootstocks also increased canopy growth.
- Bigger canopies can allow more carbon assimilation and higher yields.

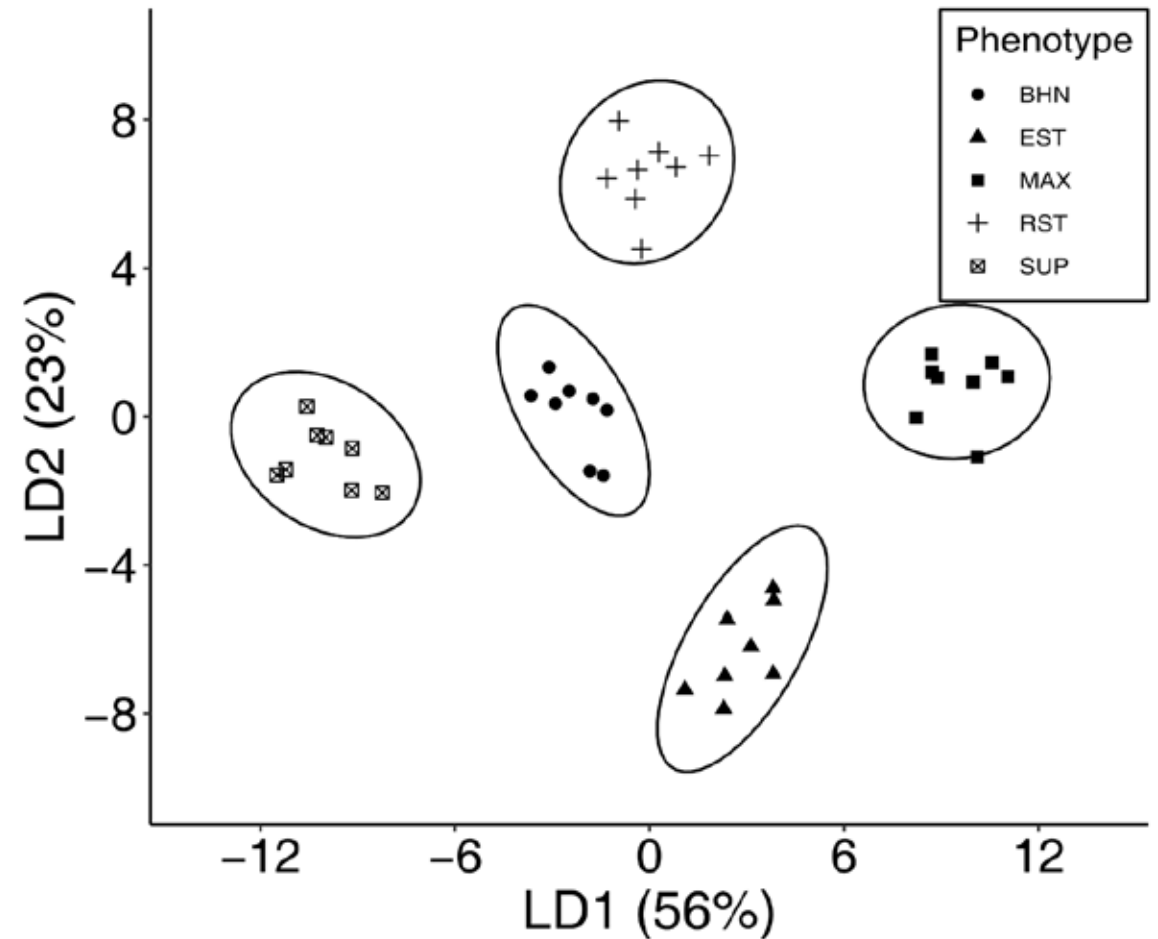
Grafting and Yields



- Shoot biomass tends to be proportional to yields; higher yields in bigger canopies.
- Local tomato producers have experienced increased yields from grafted tomatoes.

Soil nutrient uptake

- Tomato cultivar BHN-589 non-grafted
 - Scion grafted onto four rootstocks
 - Estamino, Maxifort, RST-04-106T, and Supernatural
- B, Ca, Cu, Fe, K, Mg, Mn, Na, P, Zn
 - Three time points
- C and N
 - At final time point



Rootstocks affect nutrient uptake and plant nutrient profile

Soil nutrient uptake

Trials on nitrogen and grafting

- Study on the response of tomato under high tunnel to nitrogen fertilization.
- Two treatments: a high (N+) and a low (N-) nitrogen.

Soil analysis	Fallon	MSFL	DFI
Nitrate	9-22 ppm	14-25 ppm	4-11 ppm
Ammonium	5-26 ppm	3-5 ppm	4-14 ppm
Organic N	50-120 lb/acre	60-120 lb/acre	35-50 lb/acre
Org. matter	1.2-4.2 %	1.6-3.8 %	1.8-2.5 %

Soil analysis	Fallon	MSFL	DFI
N-	67 lb/acre	0 lb/acre	67 lb/acre
N+	134 lb/acre	67 lb/acre	134 lb/acre

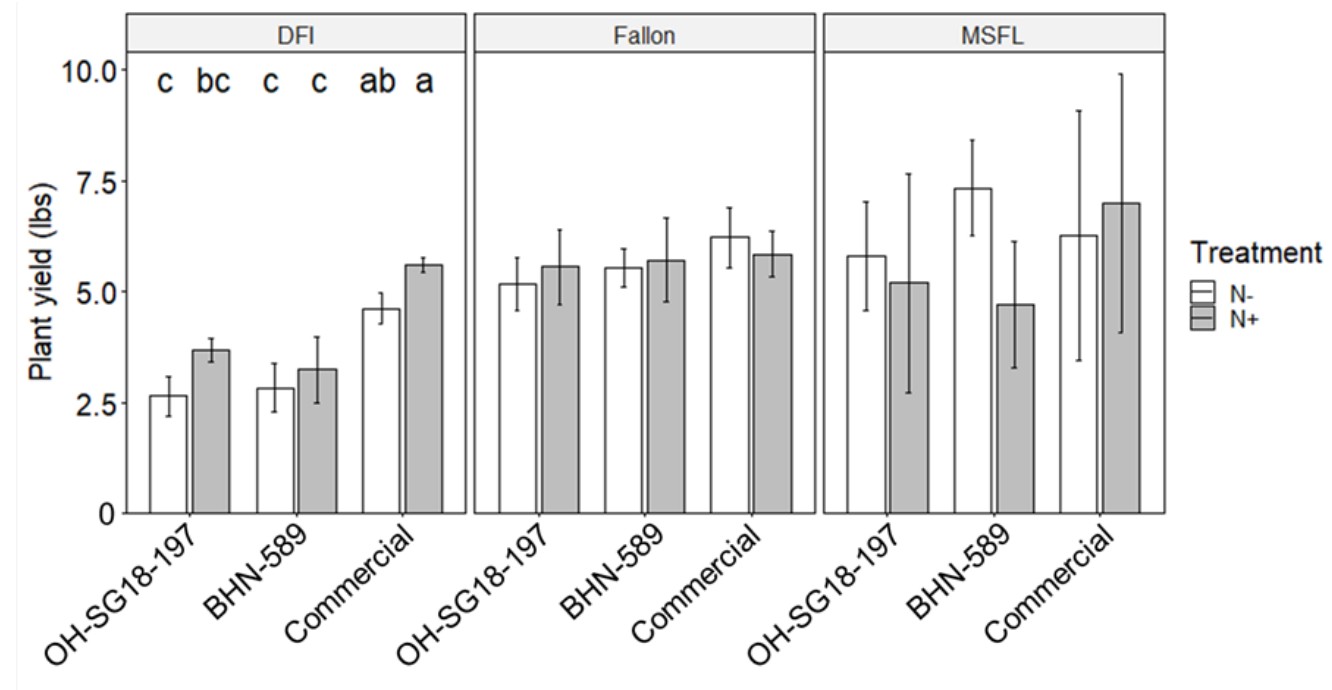


Bonarota et al. (under review) UNR Extension publication

Soil nutrient uptake

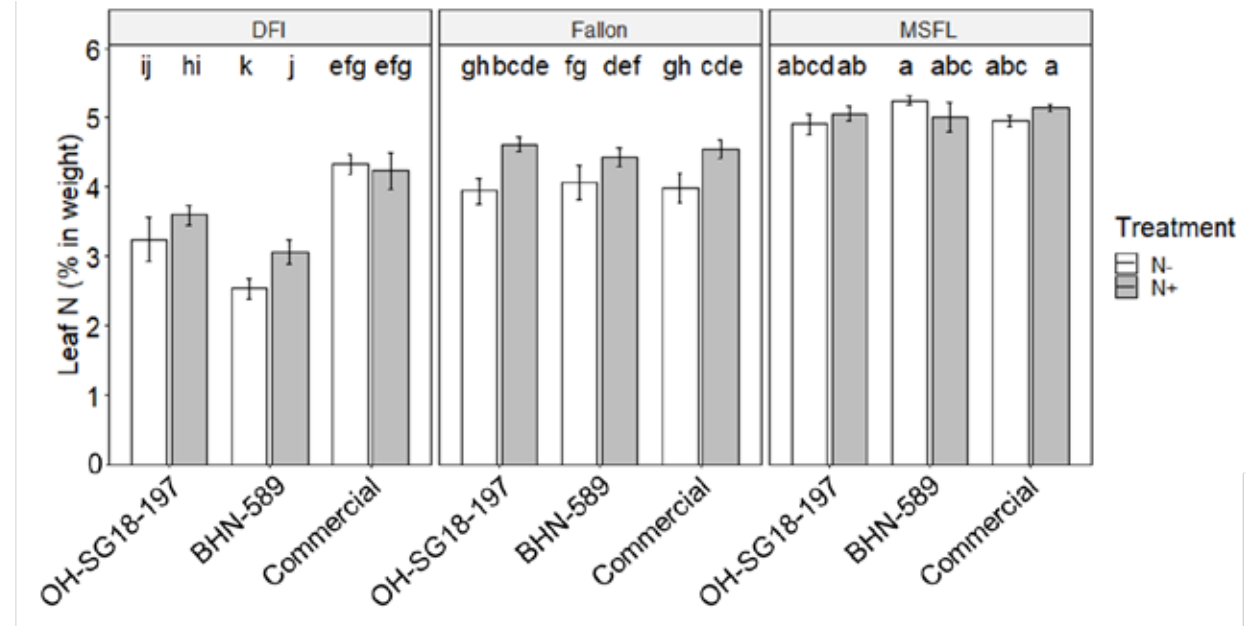
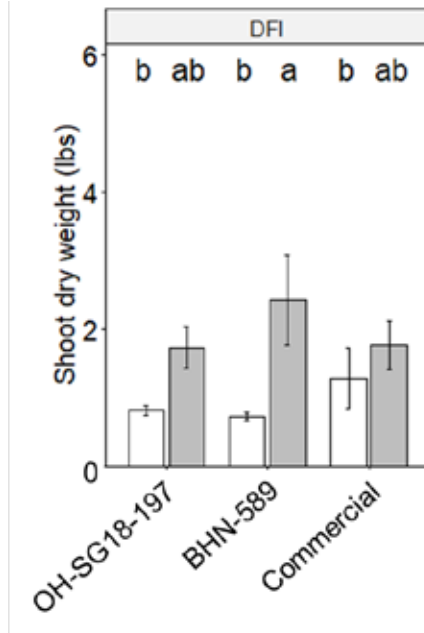
Trials on nitrogen and grafting

- Response to N fertilization was minimal and not consistent across farms.
- Grafting with a commercial rootstock improved performance at DFI.



Soil nutrient uptake

Trials on nitrogen and grafting



- Shoot biomass of the ungrafted cultivar responded to N fertilization at DFI.
- Overall, leaf N was within an acceptable range for Fallon and MSFL, and slightly lower at DFI.
- Optimum leaf N concentration at full bloom: 3.5-4.5% N (Hartz et al. 1998).

Summary on tomato research

Trials on nitrogen and grafting

- Rootstocks can determine the nutrient profile of a common scion and alter plant performance.
- Rootstocks can impact fruit yield and biomass.
- Tomato grafting has consistently shown to support tomato performance in northern Nevada.
- The process of grafting is difficult as it requires controlled conditions (temperature and humidity). More research for developing protocols for 'in-house conditions' would be needed.

On-farm melon research: rootstocks and irrigation

- Establishment



- Full canopy development

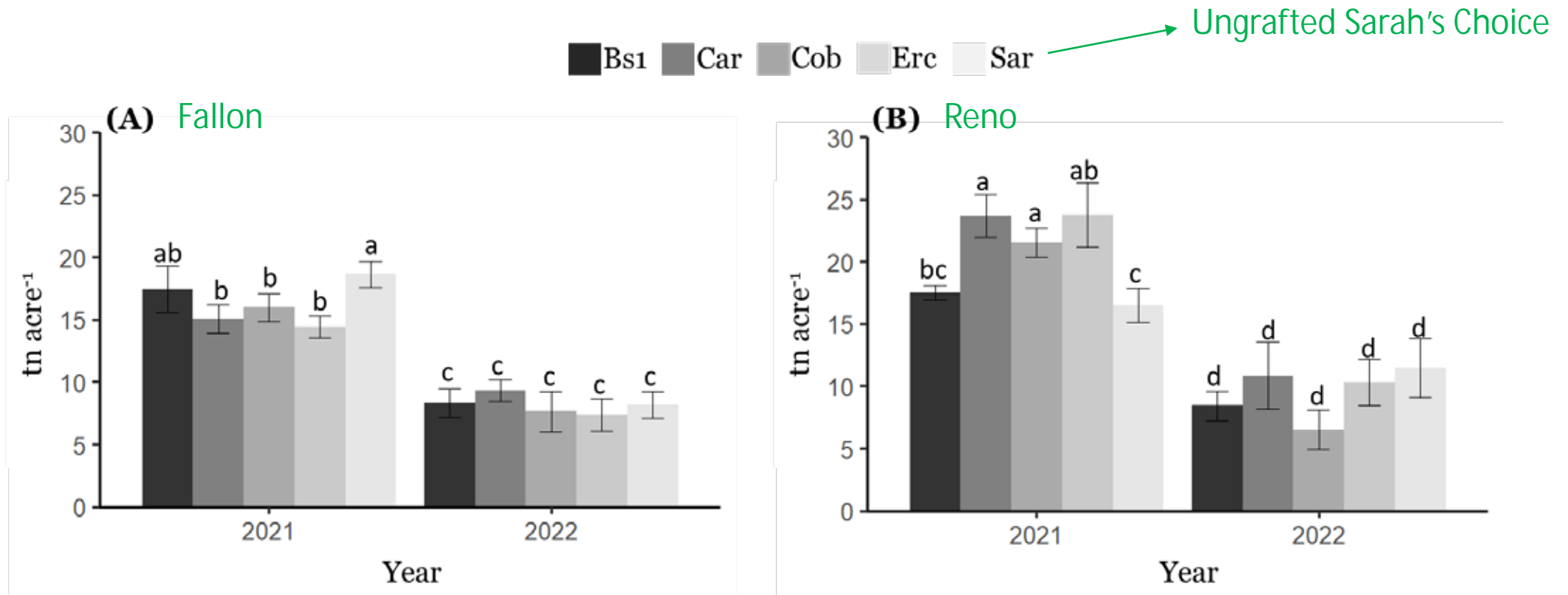


- Drought stressed plants



Melon yields and fruit quality

Trials on commercial rootstocks



Grafting melons did not provide a consistent advantage in yields.

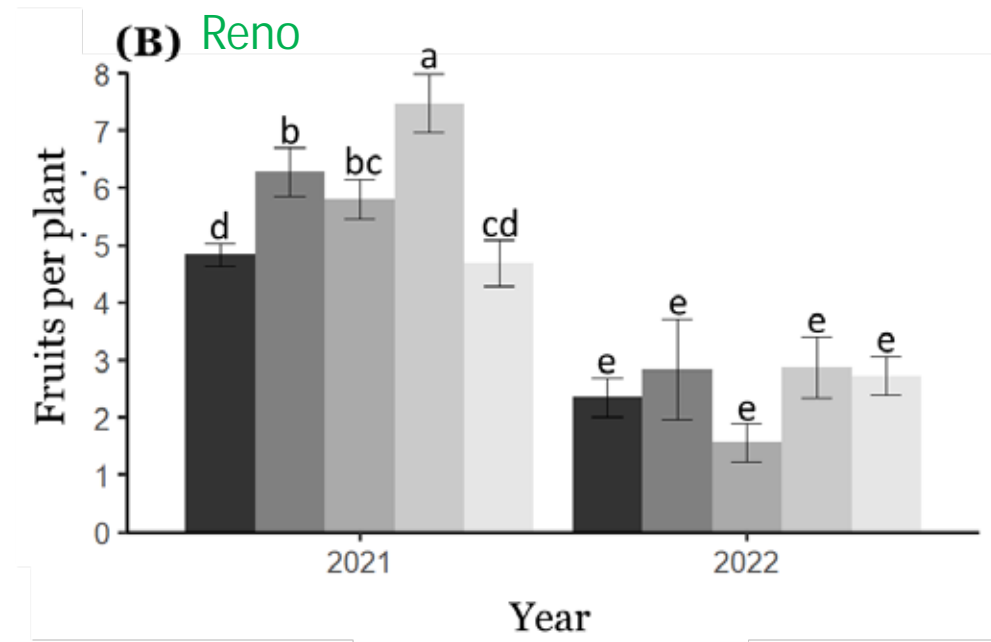
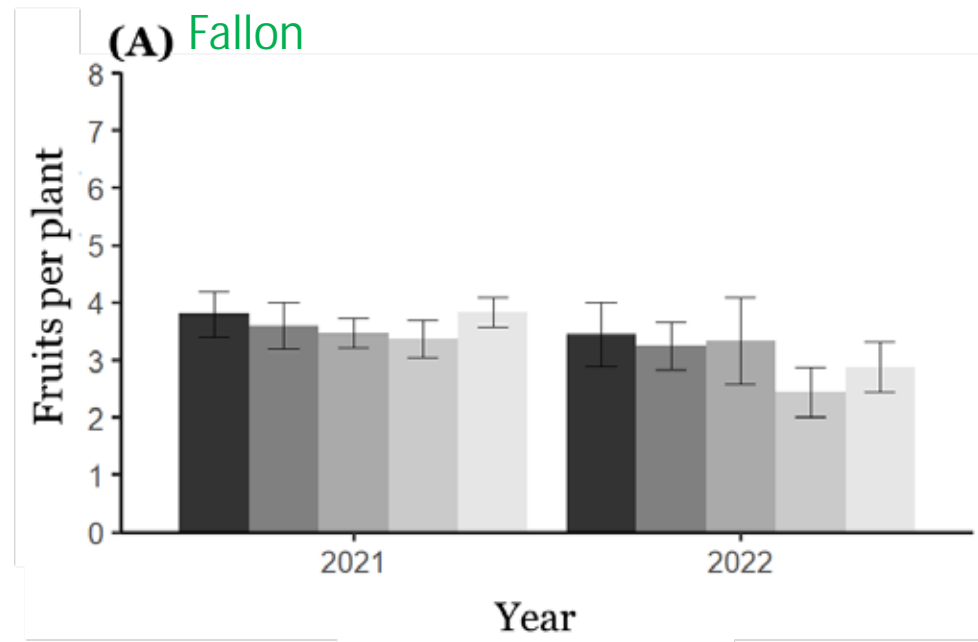
Overall, 2021 yielded 50% more than 2022, regardless of location.

Melon yields and fruit quality

Trials on commercial rootstocks

■ Bs1 ■ Car ■ Cob ■ Erc ■ Sar

Ungrafted Sarah's Choice



Over the two years:

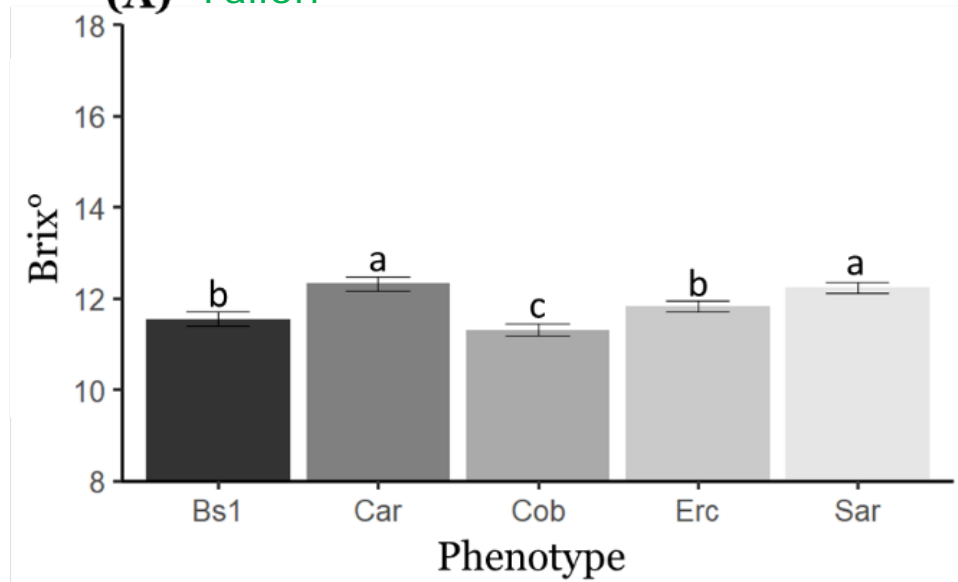
- The number of fruits per plant was maintained in Fallon, but it decreased in Reno.
- Fruit weight:
 - Decreased in Fallon.
 - Increased in Reno.

Melon yields and fruit quality

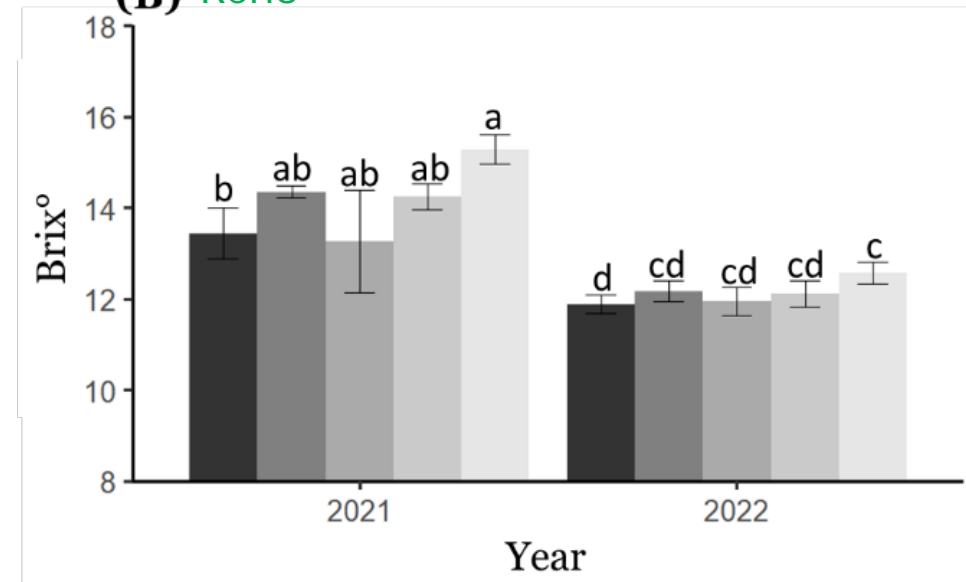
Trials on commercial rootstocks

Bs1
 Car
 Cob
 Erc
 Sar
 → Ungrafted Sarah's Choice

(A) Fallon



(B) Reno



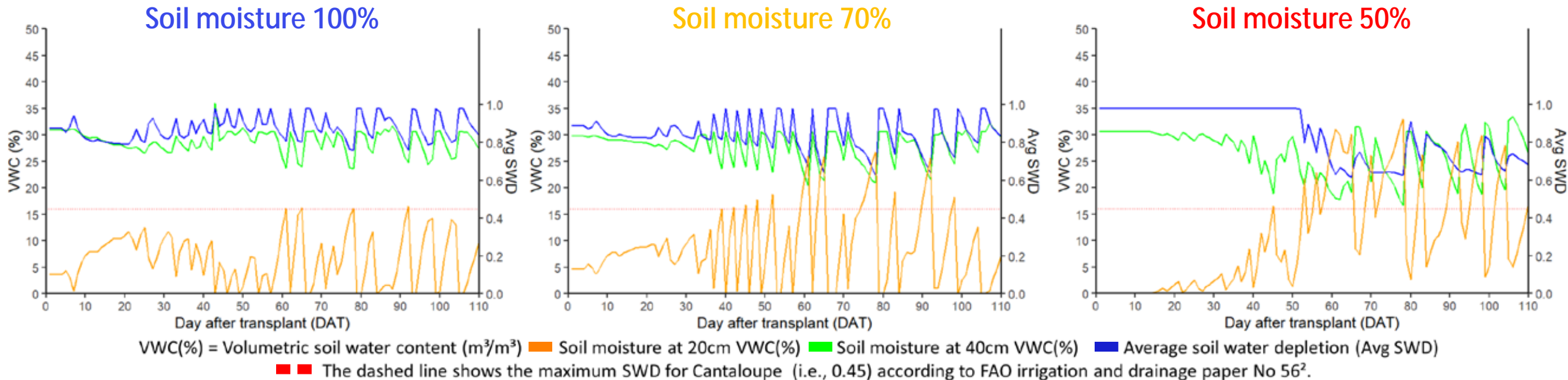
Fruit quality (sweetness) was consistently high in the ungrafted cultivar.

Overall, melon grafting is not consistently providing benefits for yields.

- But, grafted plants produce more of their fruit a bit earlier in the season.

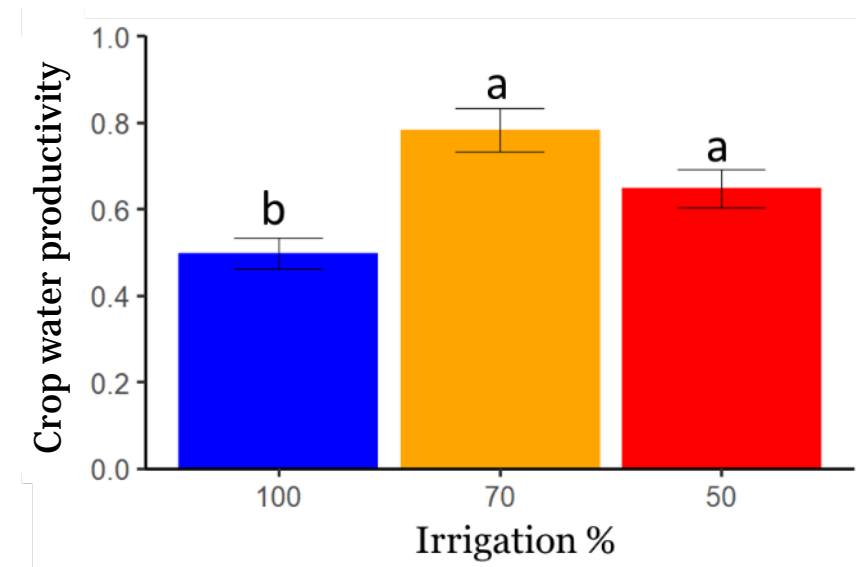
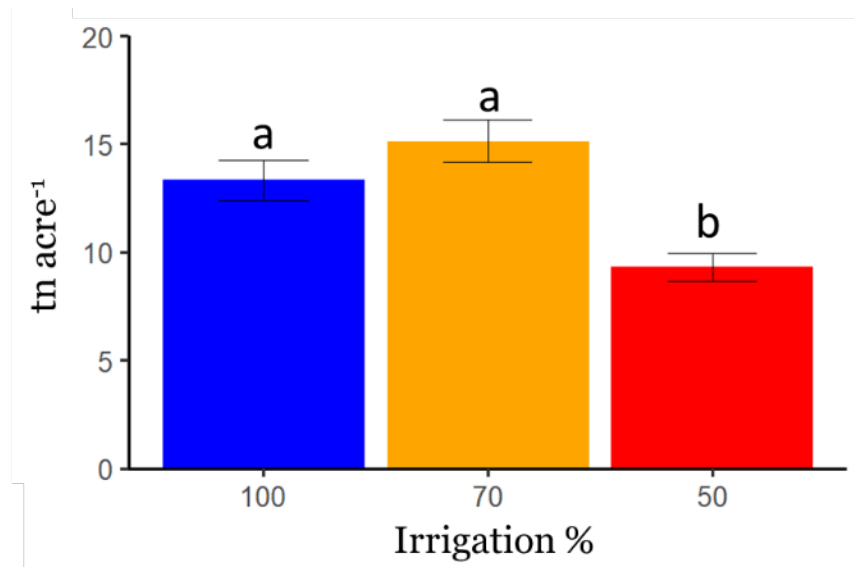
Reductions in irrigation volumes - melons

- Can we lower irrigation volumes in melon and increase crop water productivity?
- Understand how the use of soil moisture sensors help determine irrigation amounts.



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

Reductions in irrigation volumes - melons



Colors indicate the irrigation treatment (i.e., Blue = 100%, Orange = 70%, and Red = 50%)

- Crop water productivity increased significantly under the 70% and 50% irrigation.
- Plants received 28" of water under 100% irrigation, 20" under 70%, and 15" under 50%.

Summary on melon research

Trials on commercial rootstocks

- Grafting melons did not provide a consistent benefit for crop performance and yield.
- Reductions in irrigation volume of 30% from crop evapotranspiration (ET_c) could be a valuable strategy for cantaloupe without incurring in a yield decrease.
- The use of soil moisture sensors could support farmer's decision on when and for how long to irrigate.
- Studies under different growing conditions and different crops could support the development of guidelines for integrating soil moisture sensors in local and highly diverse farms.



Thank you



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- Desert Farming Initiative at UNR

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“Those who disseminate information should find ways to incorporate expert-vetted knowledge into their content.”

<https://www.theatlantic.com/ideas/archive/2024/03/truth-decay-experts-hilary-putnam/677590/>

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IDEAS

How to Tackle Truth Decay

The social contract of trust between experts and society is in danger of dissolving. We need to start putting it back together.

By Deb Roy

