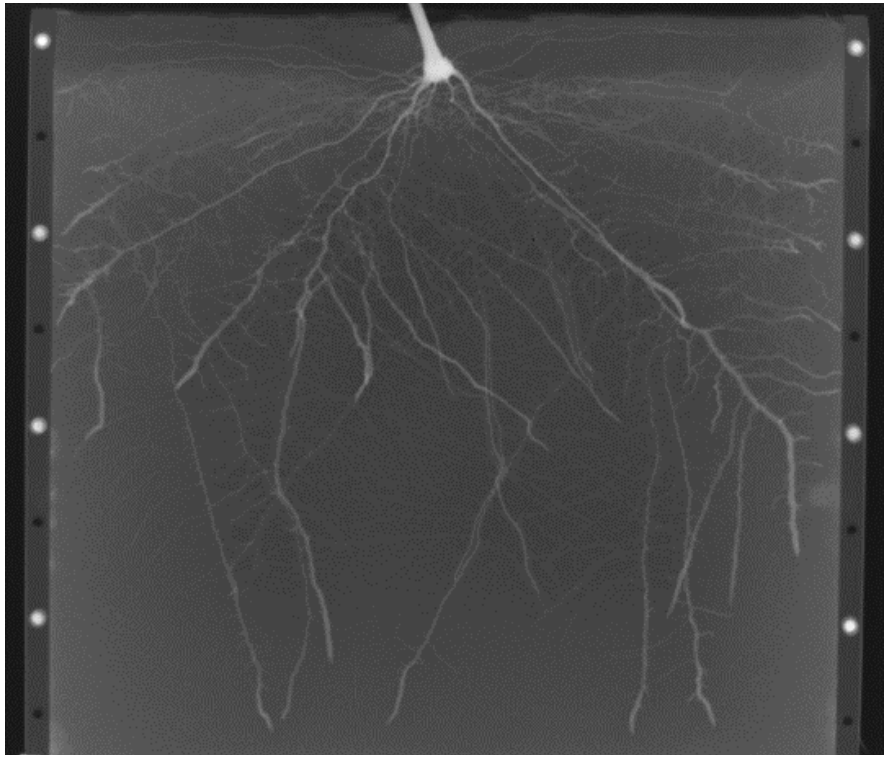
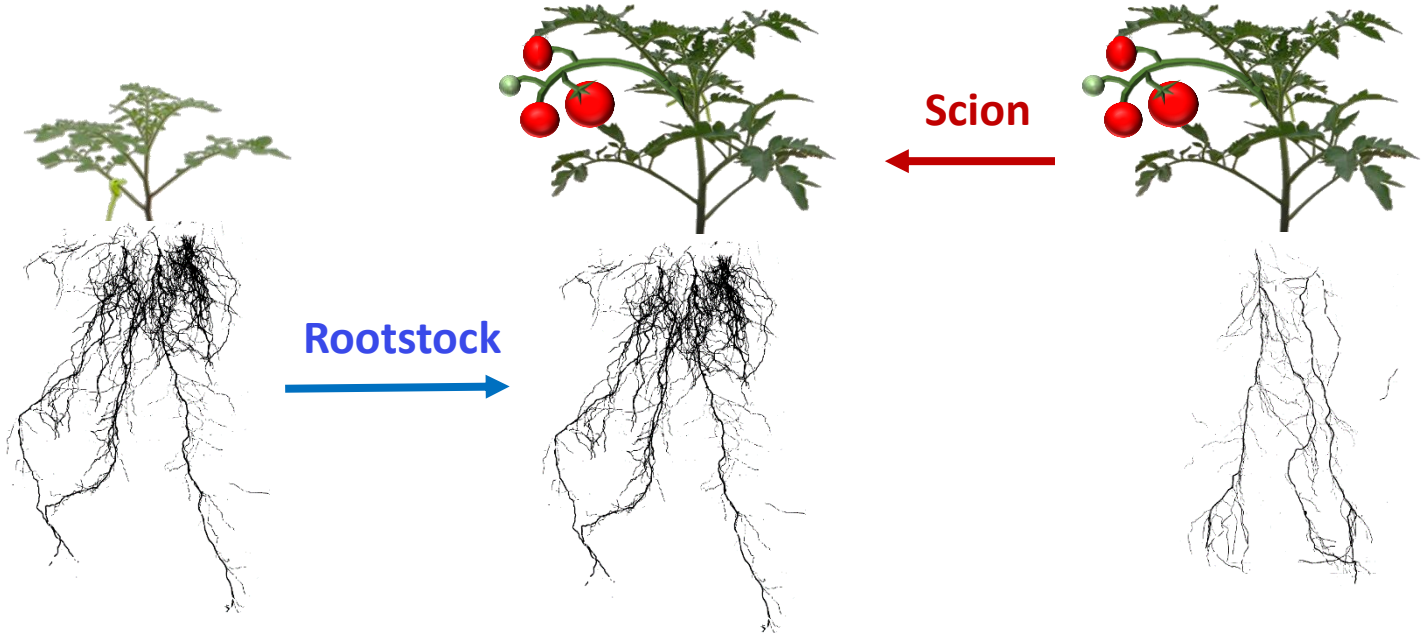
Updates on Cantaloupe melon and tomato trials evaluating vegetable grafting, irrigation and nitrogen management



Felipe H. Barrios Masias, Maria-Sole Bonarota, Heinrich di Santo

Associate Professor in Sustainable Horticulture
Dept. Agriculture, Veterinary and Rangeland Sciences
University of Nevada, Reno

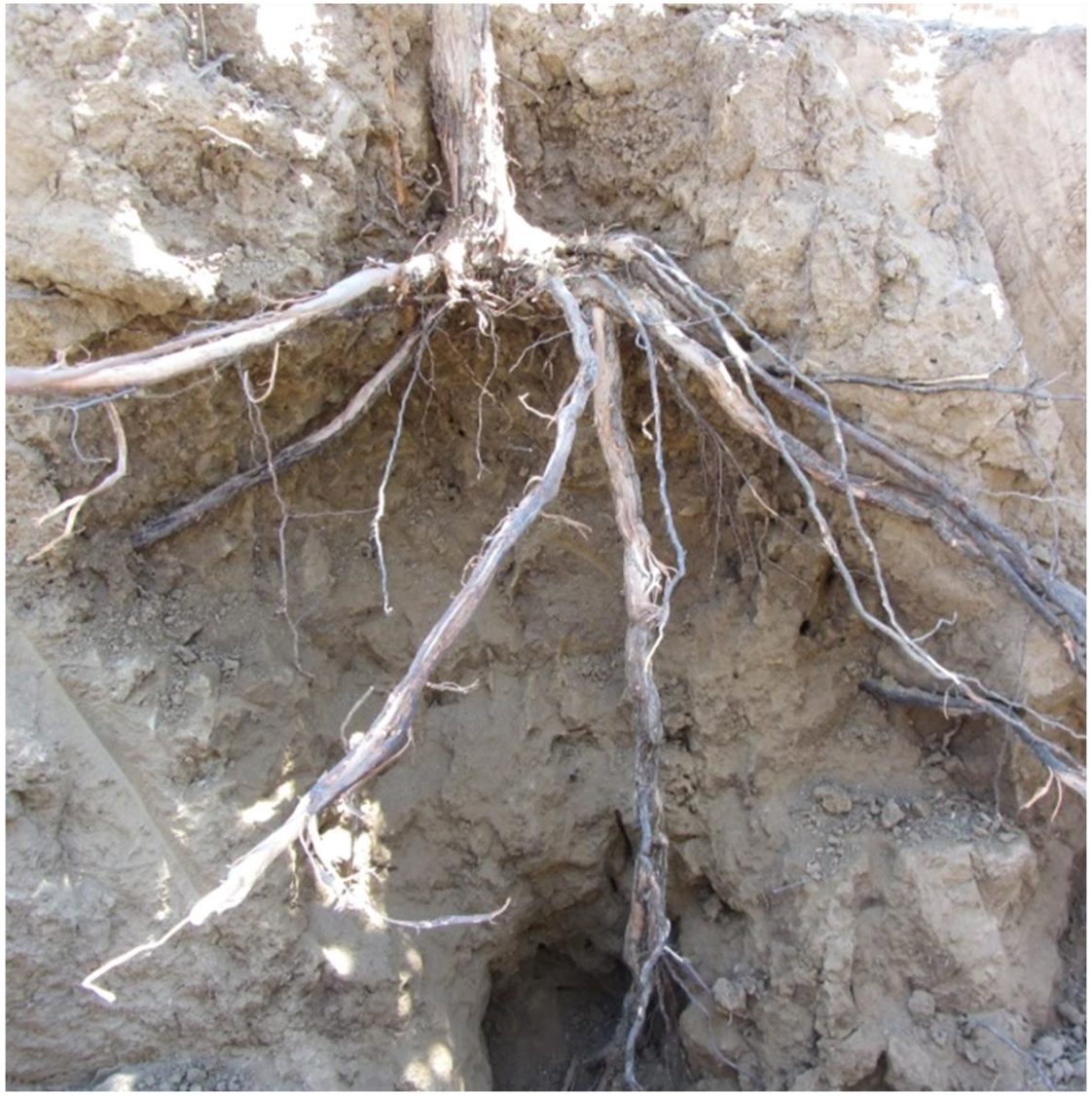
Is vegetable **grafting** a technique to help cope with stress?



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.”

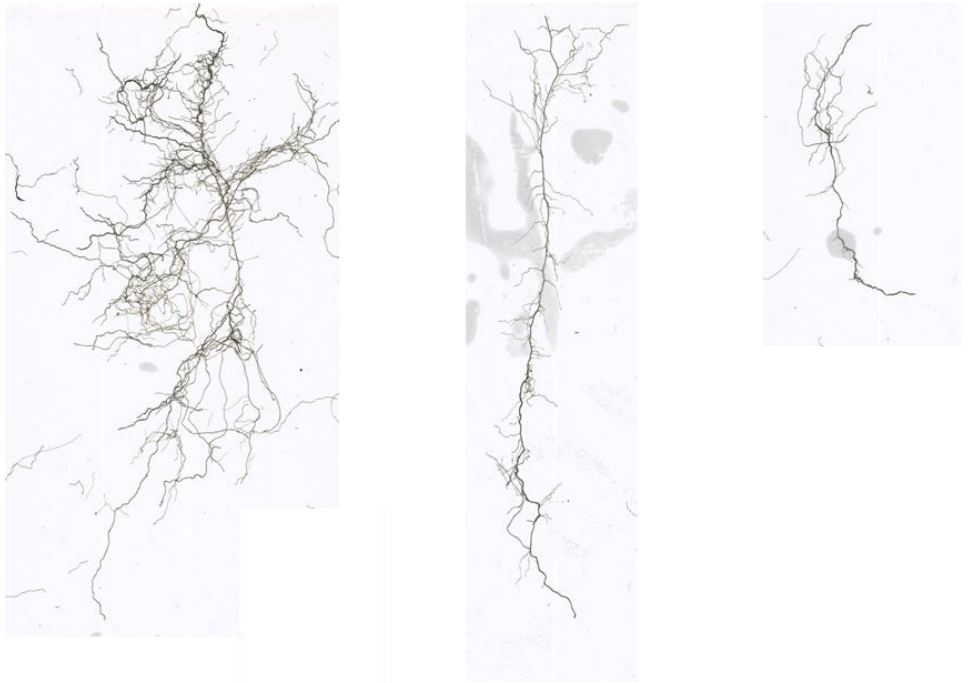
(Weaver and Bruner, 1927)

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

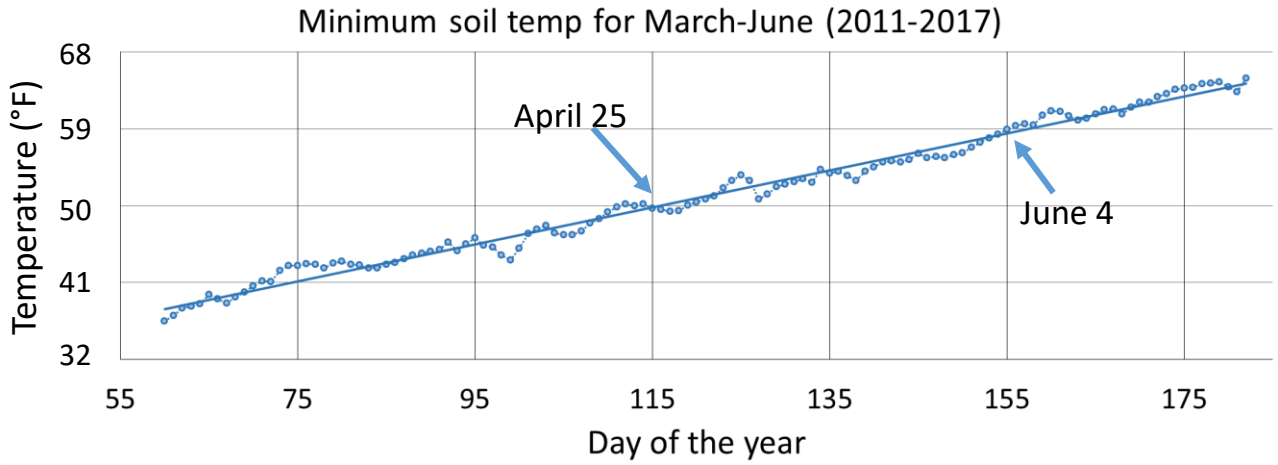
Salinity effect on roots



Bonarota et al. 2021 (UNR Extension publication)
https://extension.unr.edu/publication.aspx?PubID=4183

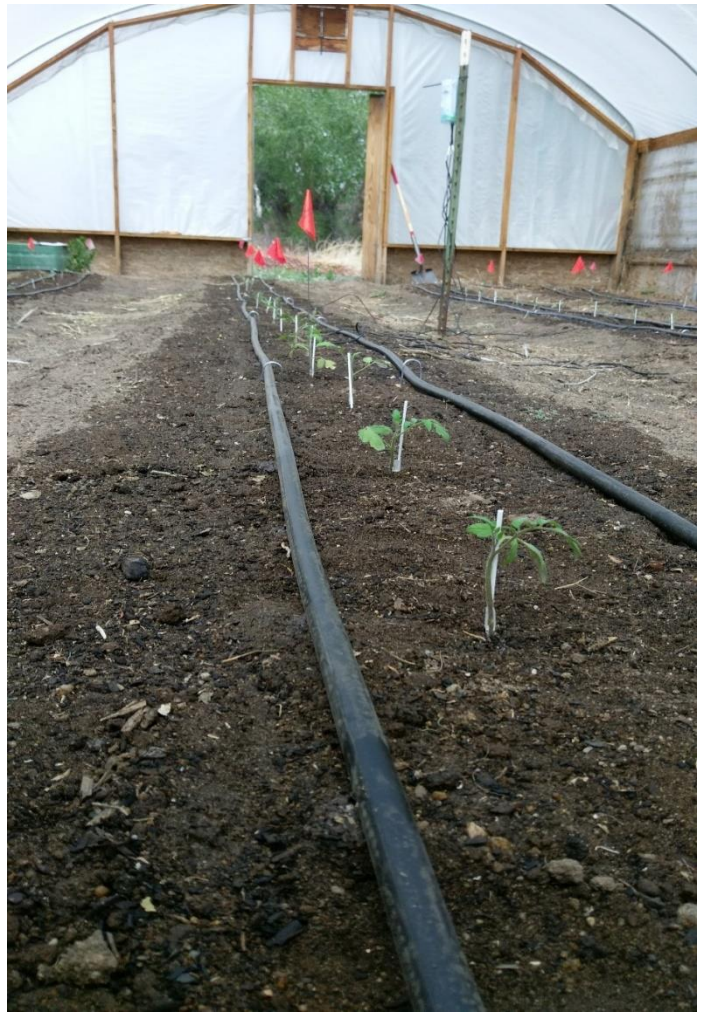
Background on tomatoes and melons in northern Nevada

- 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?

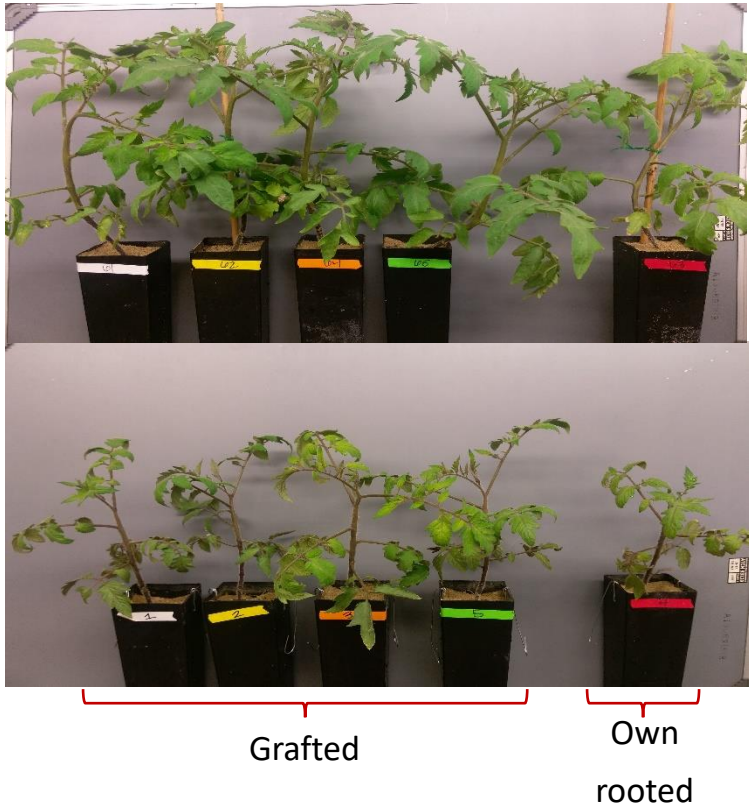


Root traits for chill-tolerant tomato rootstocks

Colder soils early in the Spring?

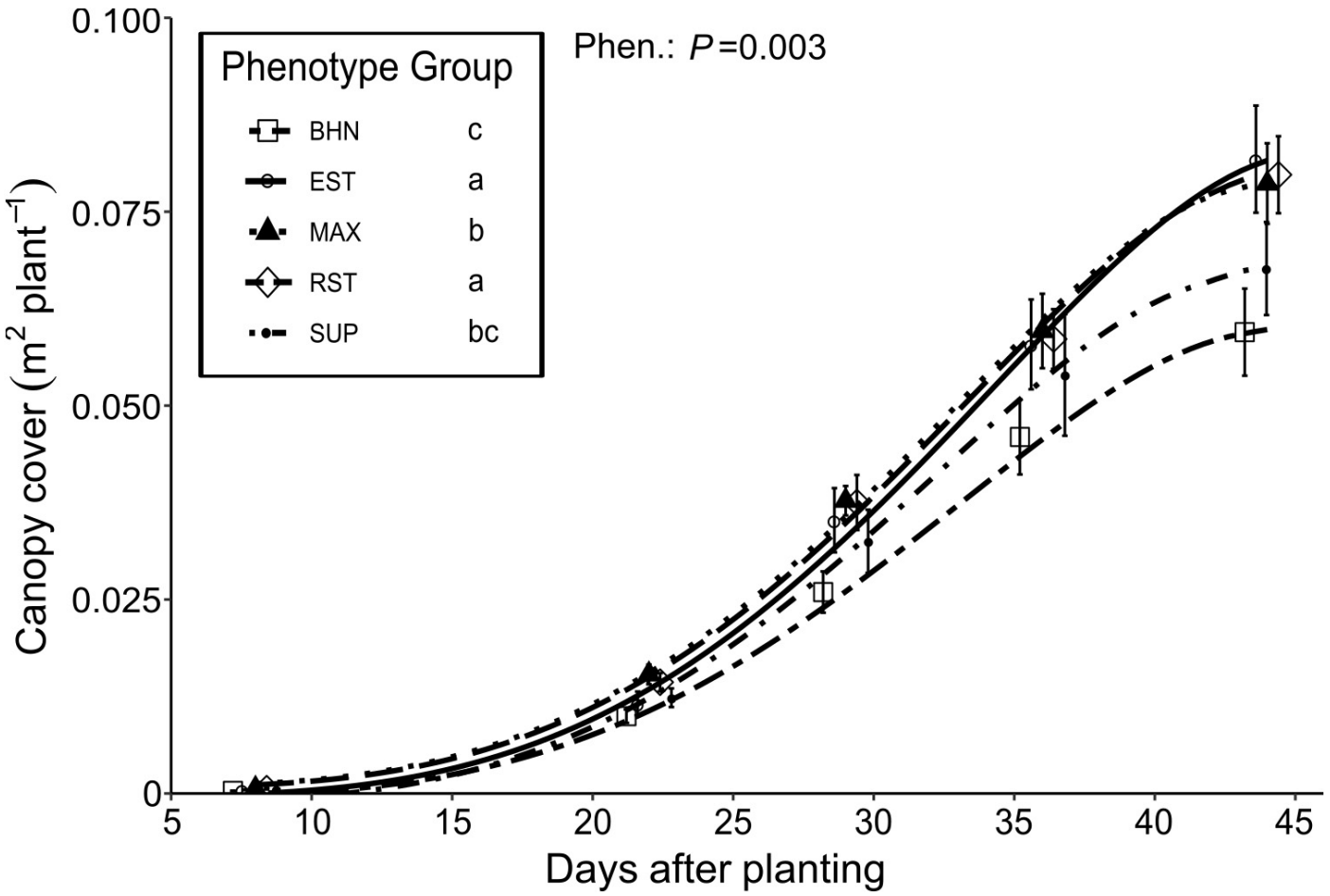
Genotype	Role
BHN-589	scion
Estamino	rootstock
Maxifort	rootstock
RST-04-106T	rootstock
SuperNatural	rootstock

Cold soil **Warm** soil



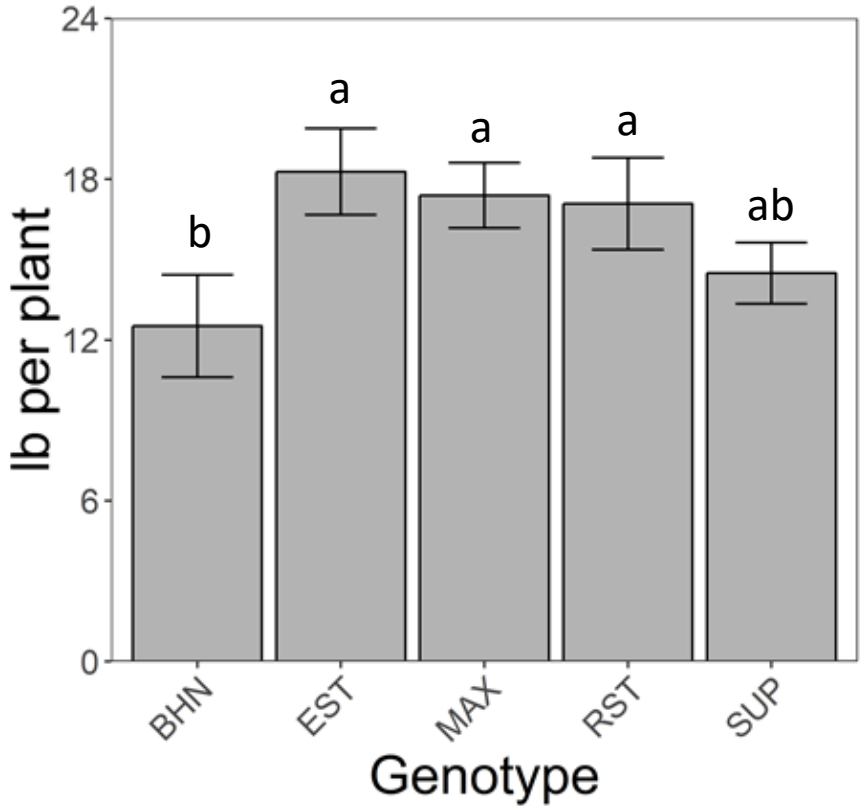
- Greenhouse study with controlled soil temperature of <59 °F

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

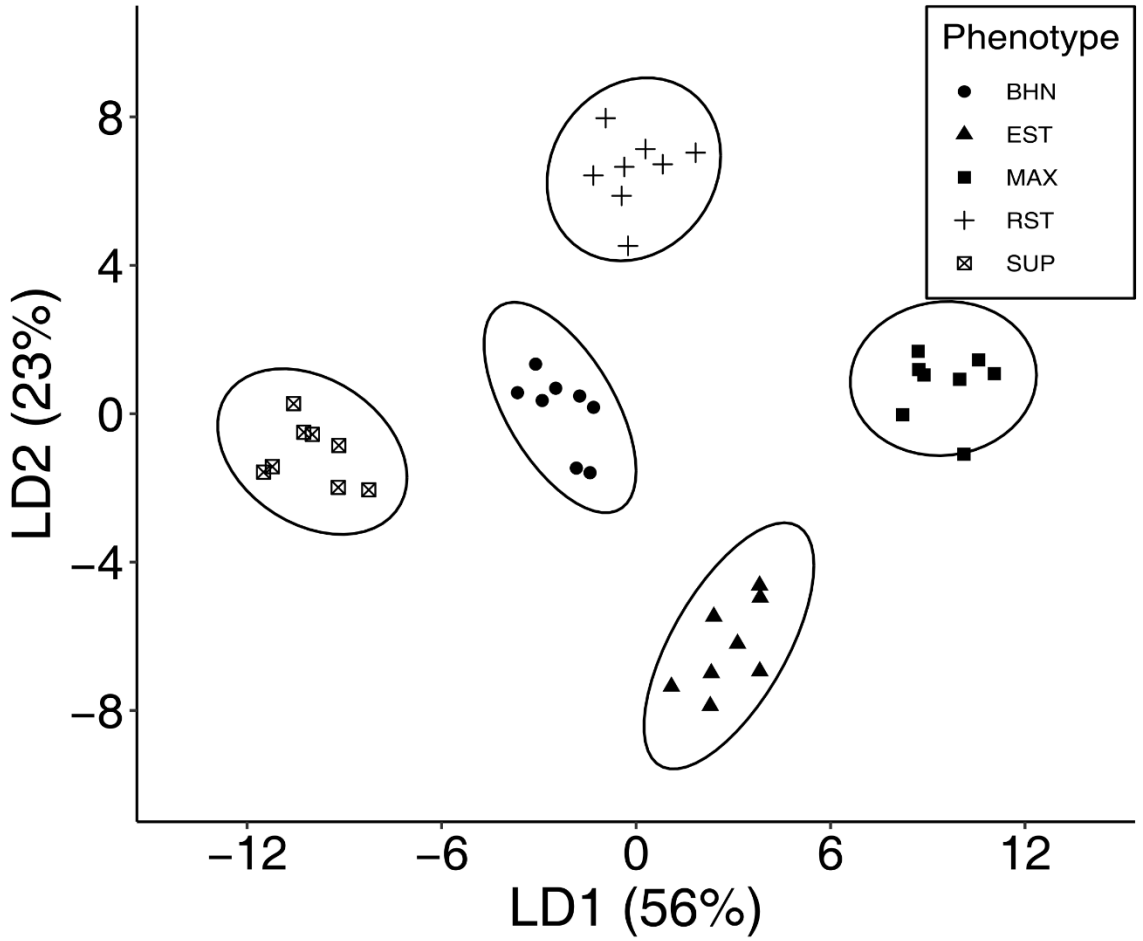


- Shoot biomass tends to be proportional to yields; higher yields in bigger canopies.
- Local tomato producers have experienced increased yields from grafted tomatoes.

Bristow et al. (2021) Frontiers in Plant Science
doi: 10.3389/fpls.2020.618488

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.

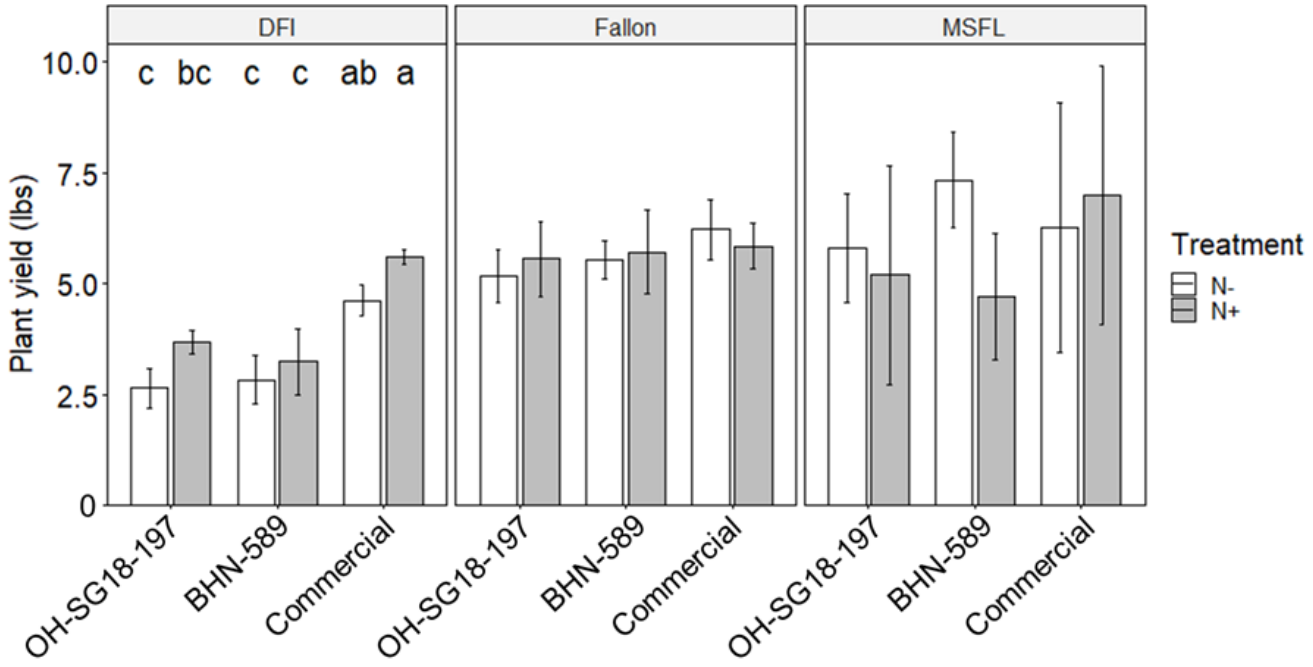
	Fallon	MSFL	DFI
	N in the soil (pre-treatment)		
Nitrate	9-22 ppm	14-25 ppm	4-11 ppm
Ammonium	5-26 ppm	3-5 ppm	4-14 ppm
Organic N	50-120 lb/acre	60-120 lb/acre	35-50 lb/acre
Org. matter	1.2-4.2 %	1.6-3.8 %	1.8-2.5 %
	Added N in the soil (treatment)		
N-	67 lb/acre	0 lb/acre	67 lb/acre
N+	134 lb/acre	67 lb/acre	134 lb/acre

Bonarota et al. (under review) UNR Extension publication

Soil nutrient uptake

Trials on nitrogen and grafting

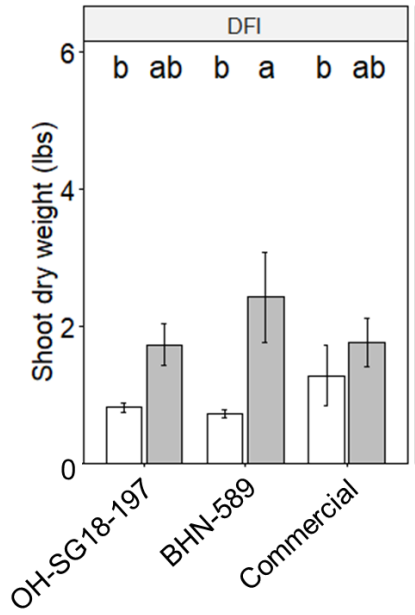
- Response to N fertilization was minimal and not consistent across farms.
- Grafting with a commercial rootstock improved performance at DFI.

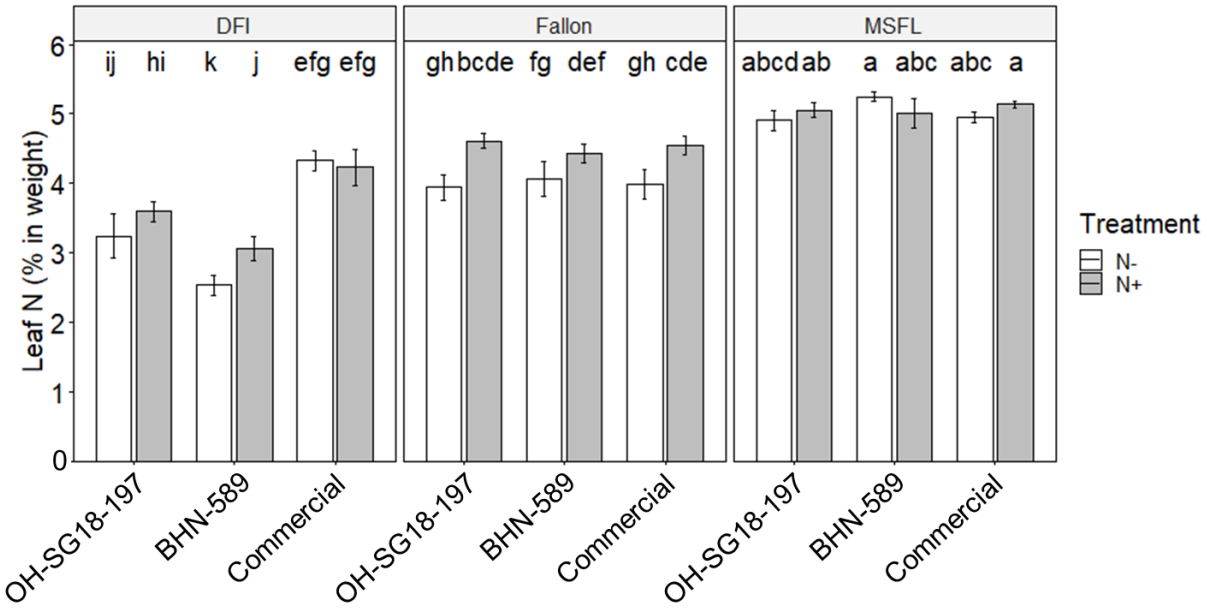


Bonarota et al. (under review) UNR Extension publication

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).

Bonarota et al. (under review) UNR Extension publication

Summary on tomato research

Trials on nitrogen and grafting

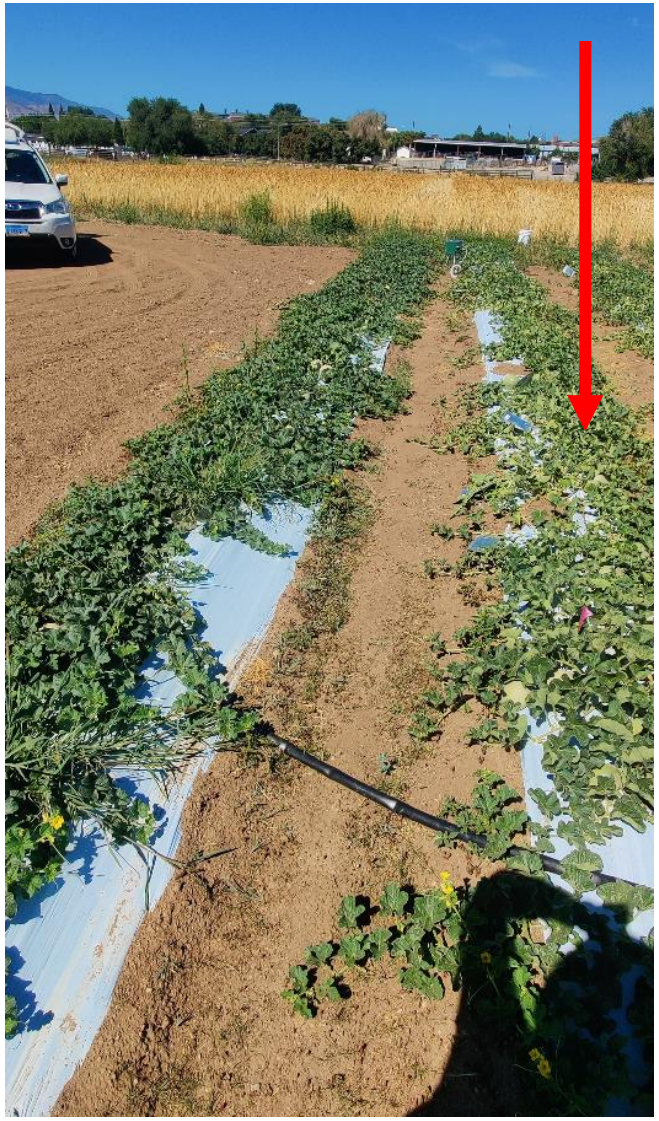
- Rootstocks can determine the nutrient profile of a common scion and alter plant performance.
- Rootstocks can impact fruit yield and biomass.
- Tomato grafting has consistently shown to support tomato performance in northern Nevada.
- The process of grafting is difficult as it requires controlled conditions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

On-farm melon research: rootstocks and irrigation

- **Establishment**

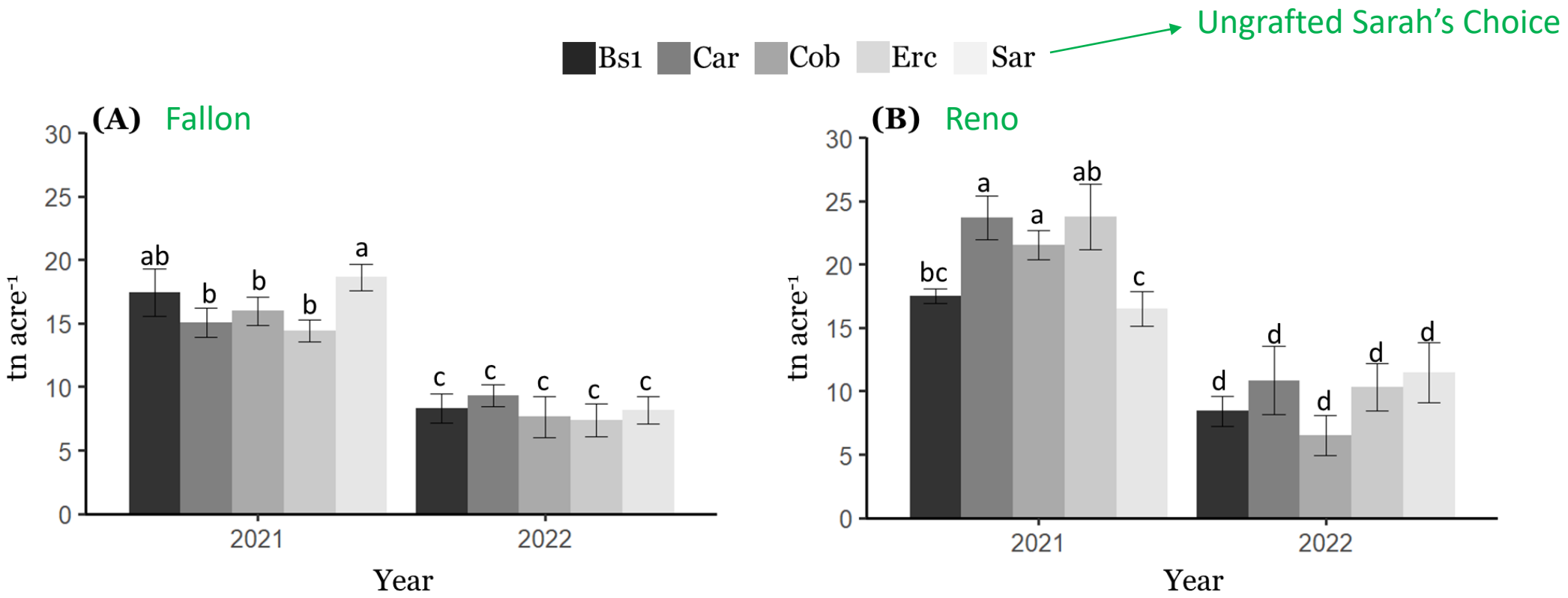
- **Full canopy development**

- **Drought stressed plants**



Melon yields and fruit quality

Trials on commercial rootstocks

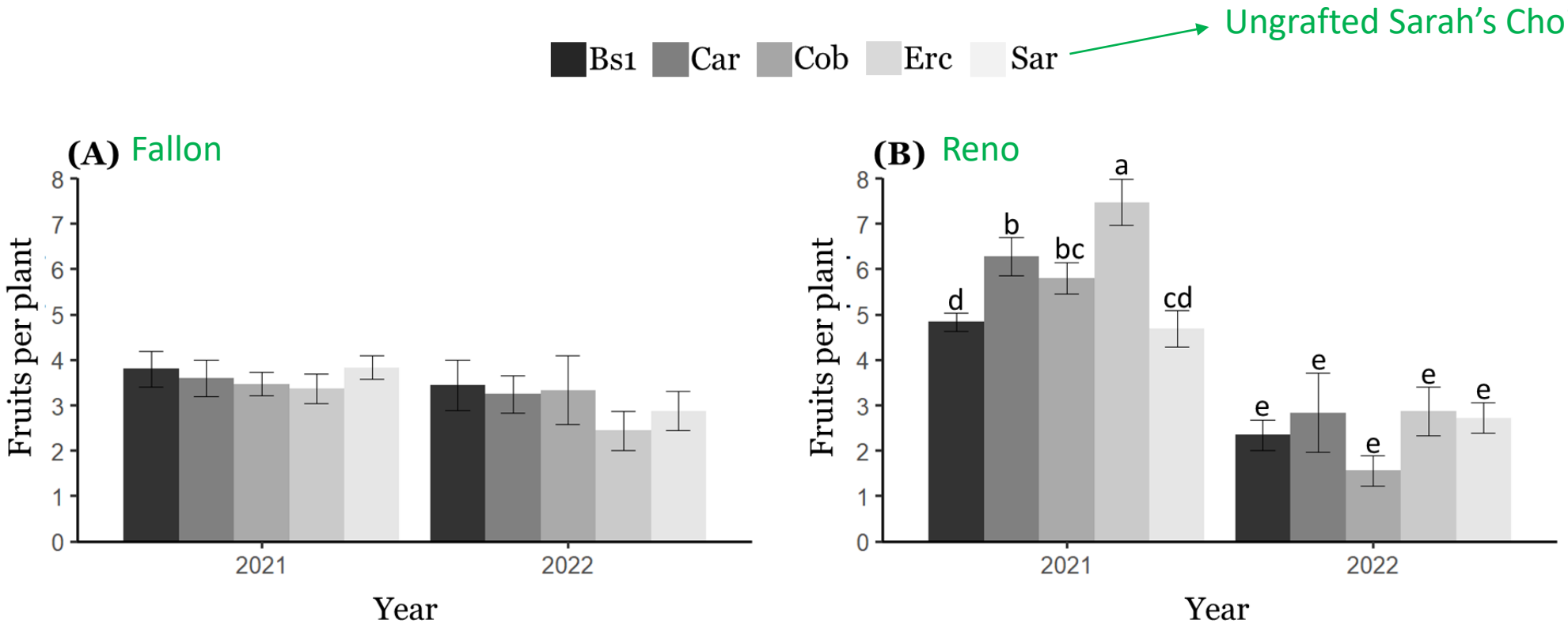


- Grafting melons did not provide a consistent advantage in yields.
- Overall, 2021 yielded 50% more than 2022, regardless of location.

di Santo and Barrios-Masias (under preparation)

Melon yields and fruit quality

Trials on commercial rootstocks



Over the two years:

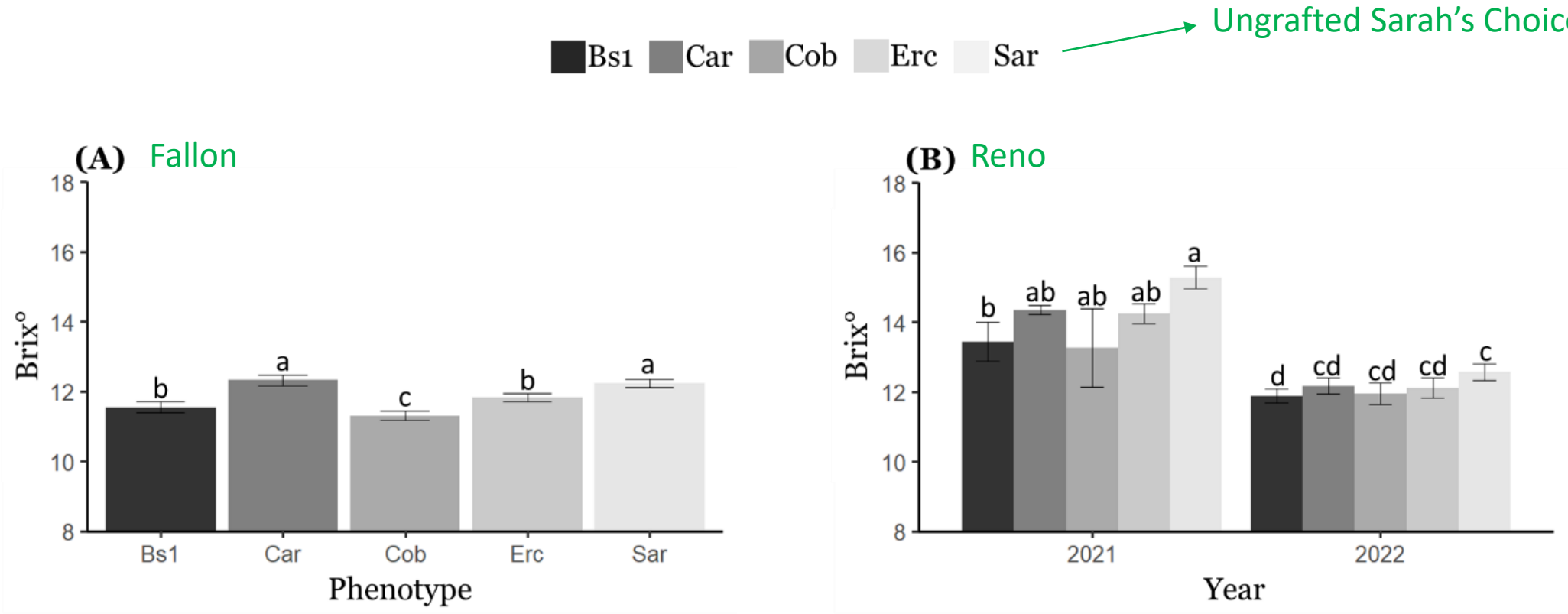
- The number of fruits per plant was maintained in Fallon, but it decreased in Reno.
- Fruit weight: - Decreased in Fallon.
  - Increased in Reno.

di Santo and Barrios-Masias (under preparation)

Melon yields and fruit quality

Trials on commercial rootstocks

Ungrafted Sarah's Choice

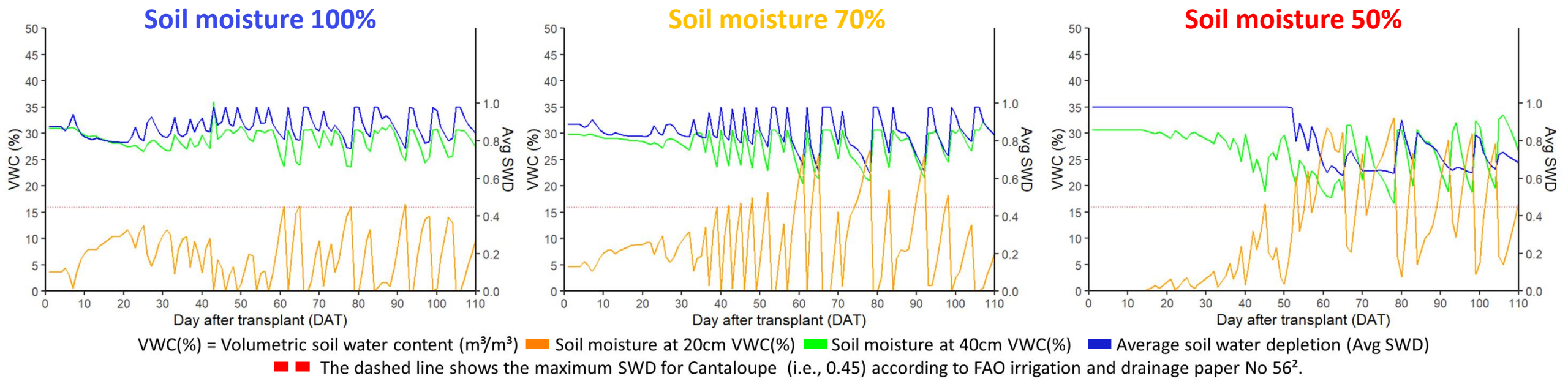


- Fruit quality (sweetness) was consistently high in the ungrafted cultivar.
- Overall, melon grafting is not consistently providing benefits for yields.
  - But, grafted plants produce more of their fruit a bit earlier in the season.

di Santo and Barrios-Masias (under preparation)

Reductions in irrigation volumes - melons

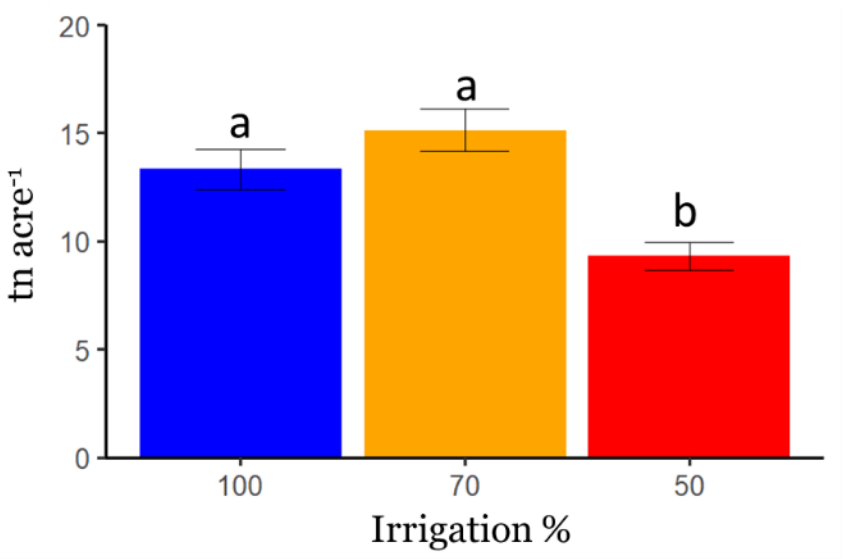
- Can we lower irrigation volumes in melon and increase crop water productivity?
- Understand how the use of soil moisture sensors help determine irrigation amounts.

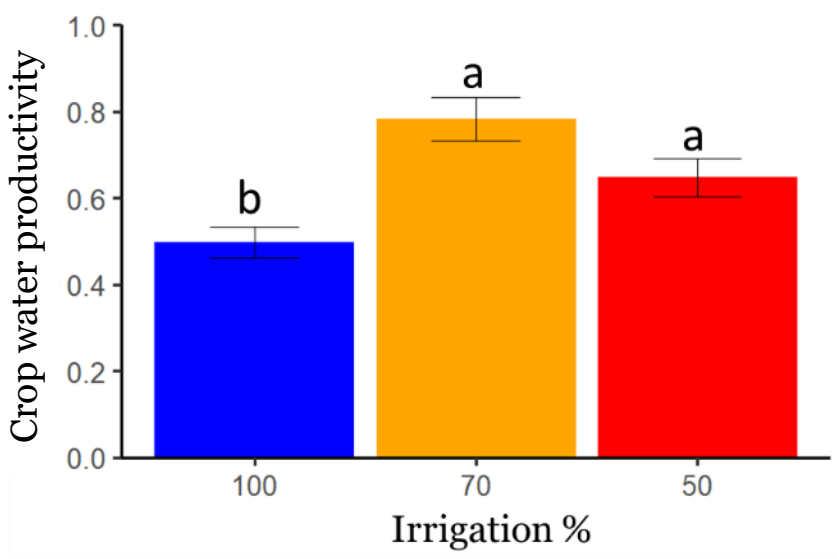


- Under the 100% irrigation, the soil water depletion (SWD) was never higher than our threshold of 0.45 VWC.
- Maximum SWD was exceeded several times and for consecutive days after 48 and 51 DAT for the 70% and 50% irrigation treatment.

di Santo et al. (in progress)

Reductions in irrigation volumes - melons





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

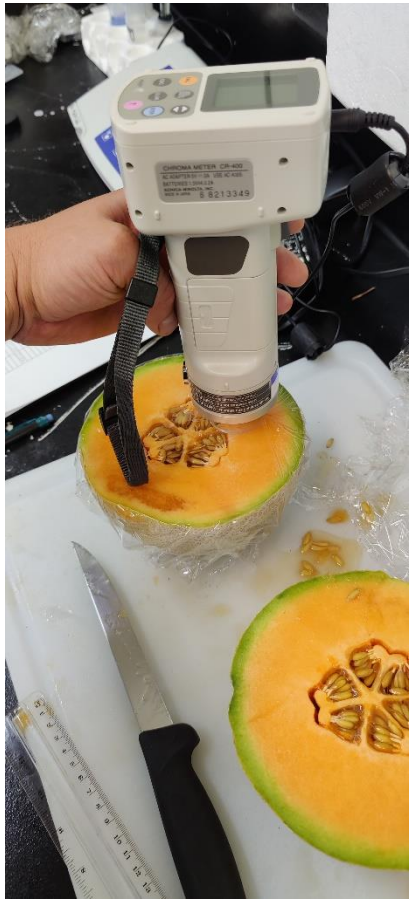
- Crop water productivity increased significantly under the 70% and 50% irrigation.
- Plants received 28” of water under 100% irrigation, 20” under 70%, and 15” under 50%.

di Santo et al. (in progress)

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

Acknowledgements

- Steven Bristow – Former graduate student
- Several undergraduate assistants, and in particular:
    - Gabi Franco
    - Zachary Heinhold

- Rick Lattin
- Holley Family Farm
- Desert Farming Initiative at UNR

This work is supported by:

- Work supported by the USDA-NIFA through the WSARE project # SW20-918, and from the Nevada DRIVE Program at UNR.
- Nevada Department of Agriculture through the SCBGP subgrant # AMS22-02 and AM170100XXXG038.

NDA
Nevada Department of Agriculture

USDA