



Developing Biotic and Abiotic Resistant Rootstocks

UCR Avocado Rootstock Program

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Microbiology and Plant Pathology Department

Presented by Peggy Mauk

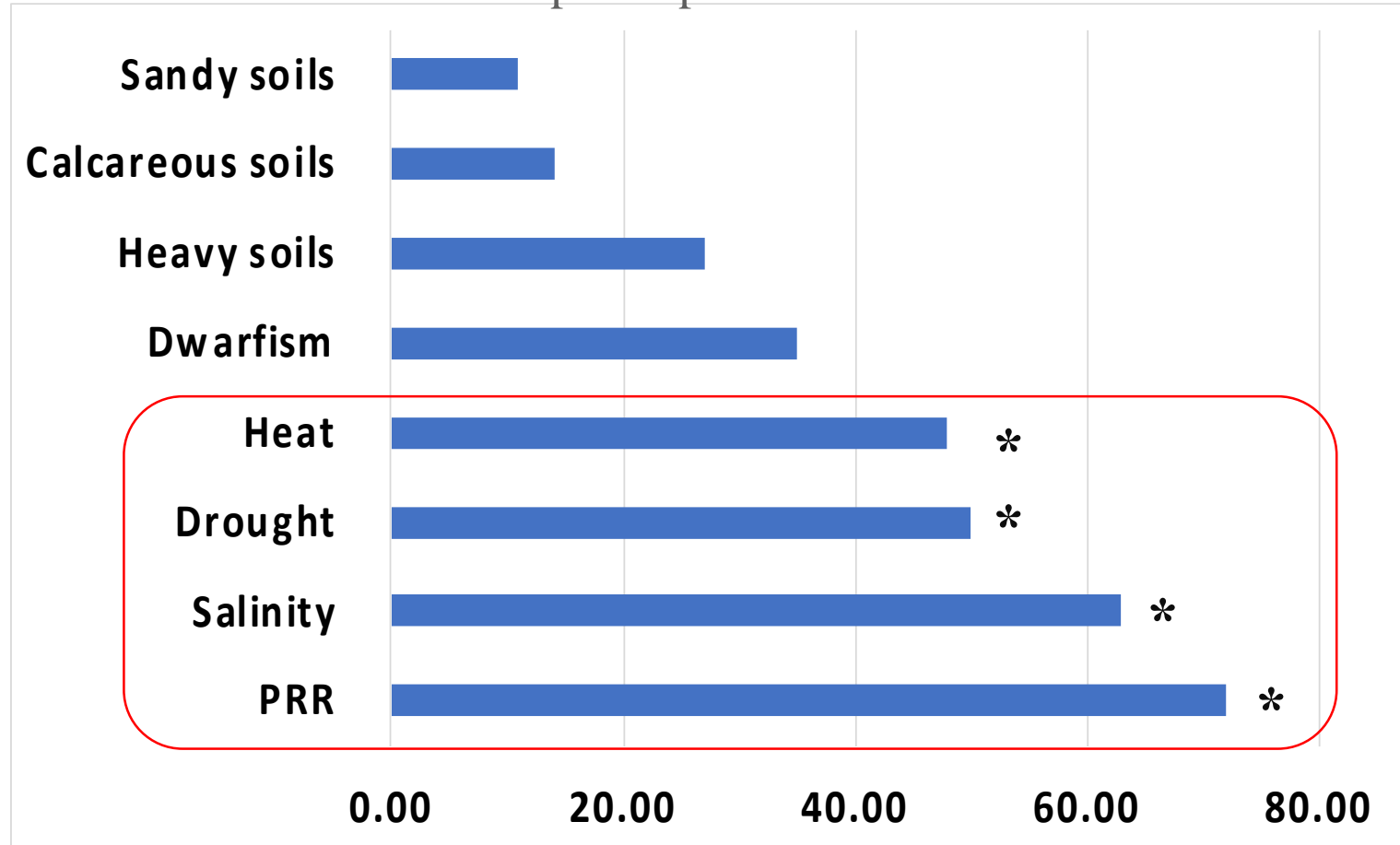
Co-PIs: Mary Lu Arpaia and Peggy Mauk (Botany and Plant Sciences Dept.)

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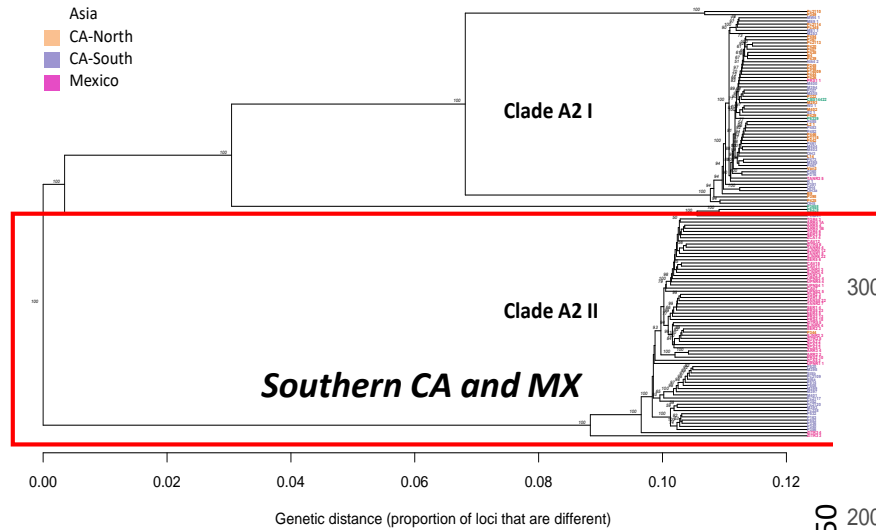


"Avocado growers face major constraints that negatively affect profitability and sustainability"

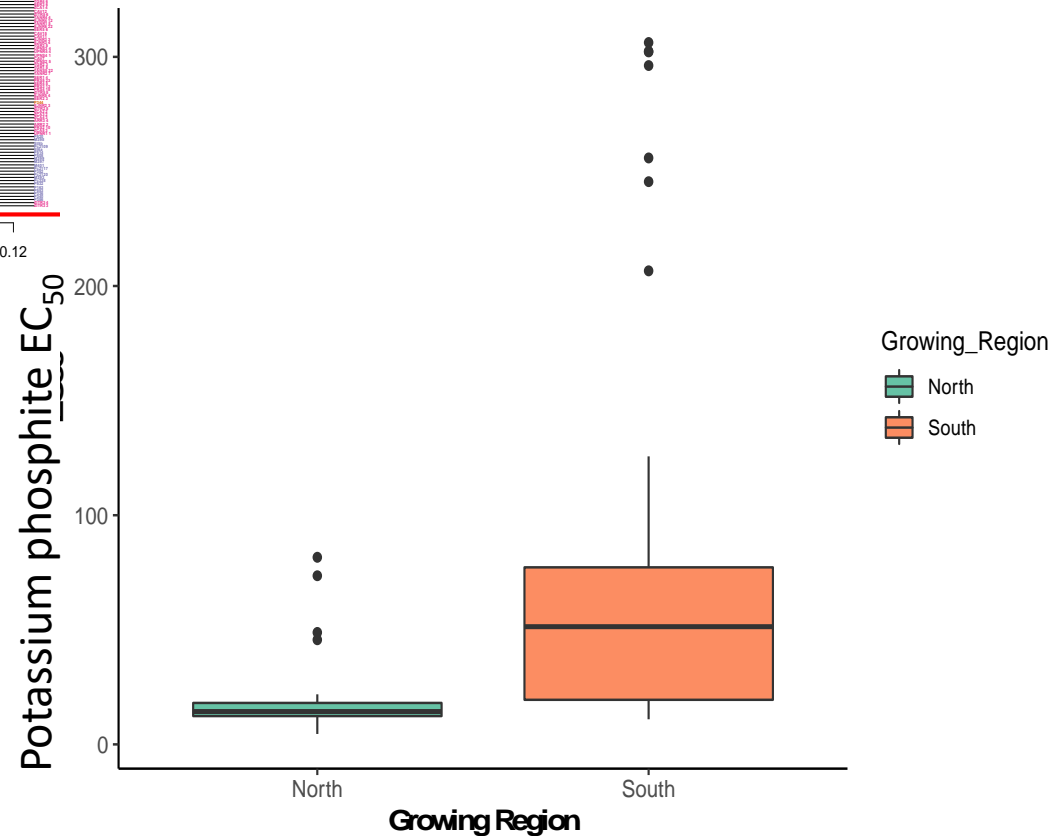
108 participants



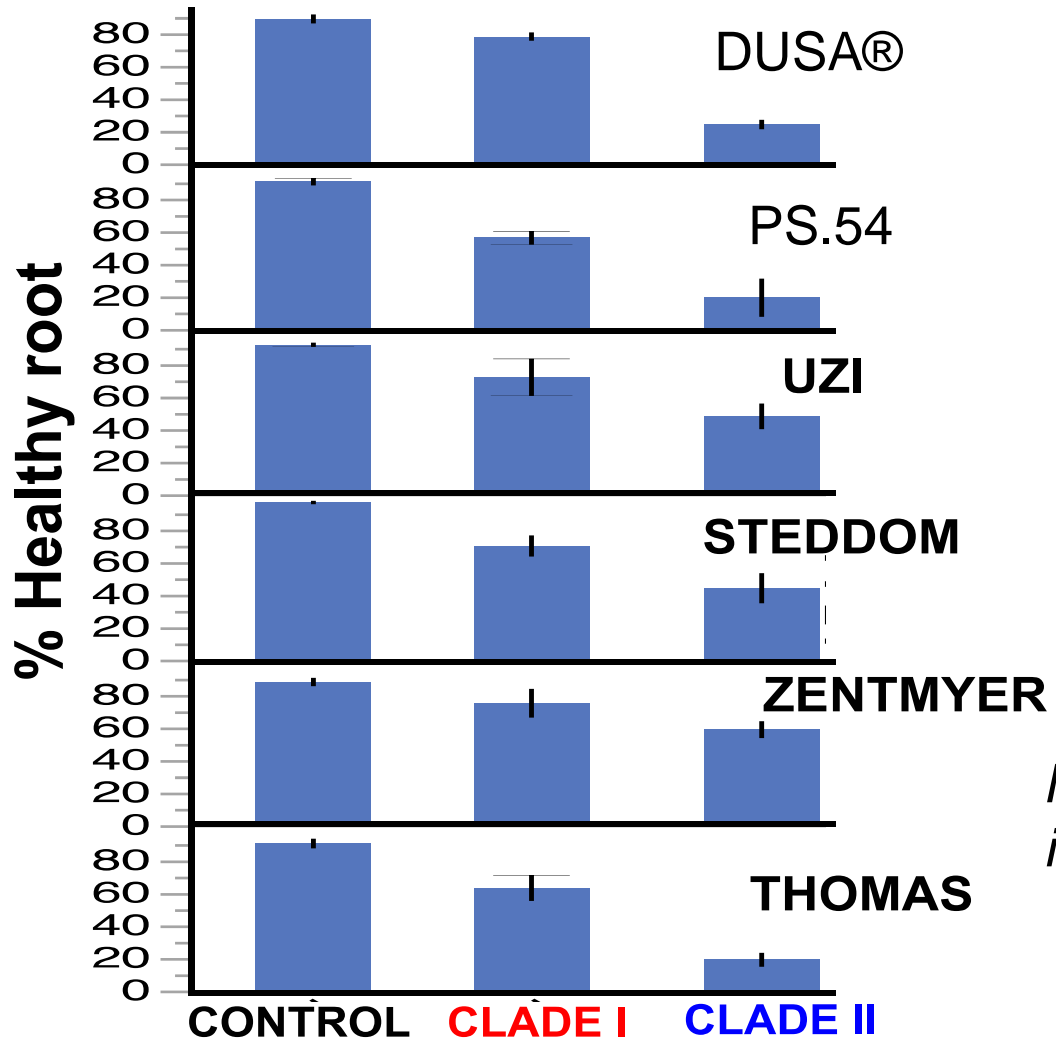
P. cinnamomi populations in CA are phenotypically and genotypically diverse



Douhan et al. 2013. *Phytopathology* 103(1):91-7
Belisle et al. 2019. *Phytopathology* 109:384.
Belisle et al. 2019. *Plant Disease* 103(8):2024.
Shands et al., 2023 in prep.



P. cinnamomi populations in CA are phenotypically and genotypically diverse



Healthy root
100% 3%



Mixture of A2 Clade II Southern isolates were more aggressive



California and Florida isolates are less sensitive (more tolerant) to potassium phosphite

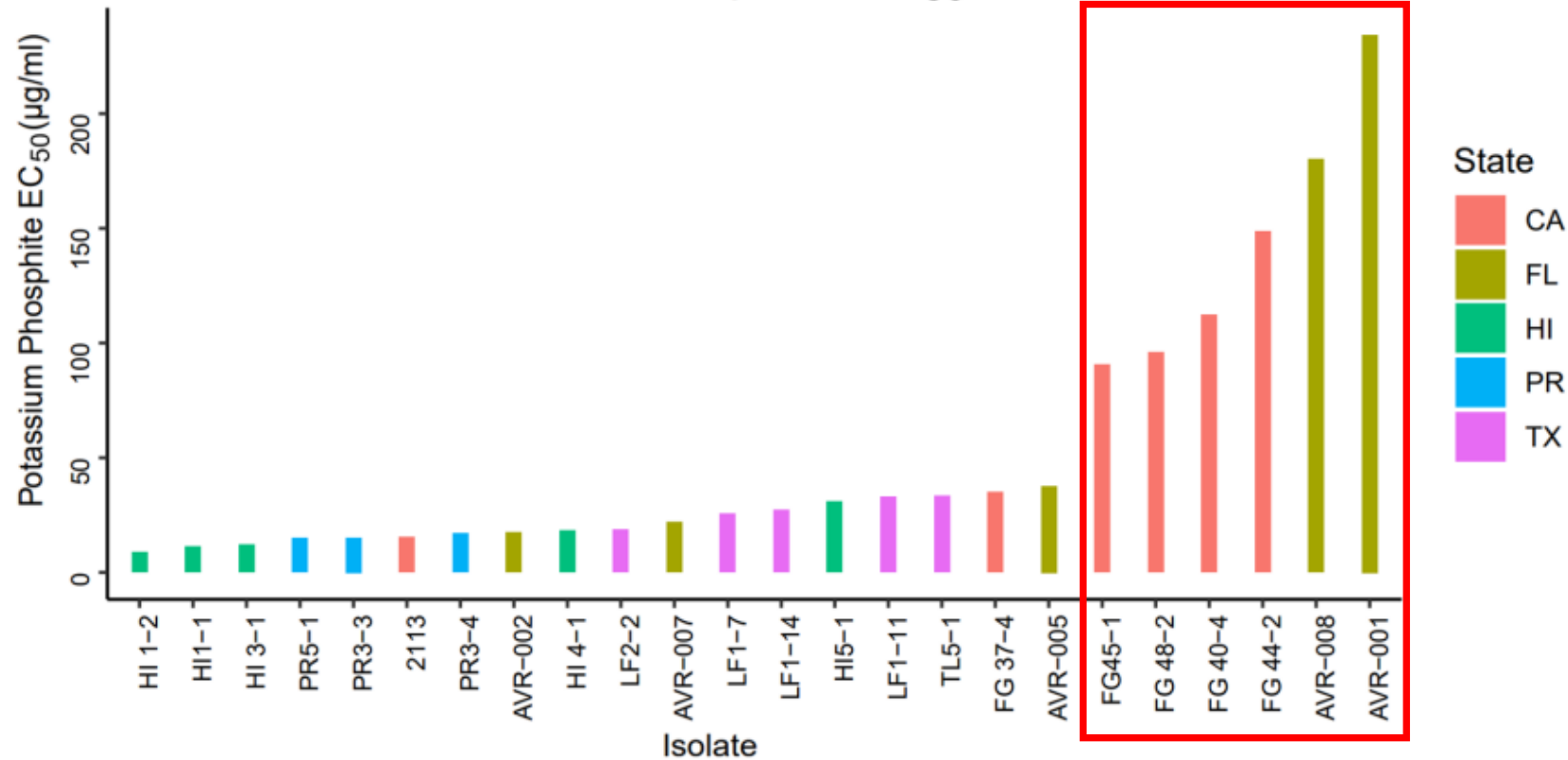


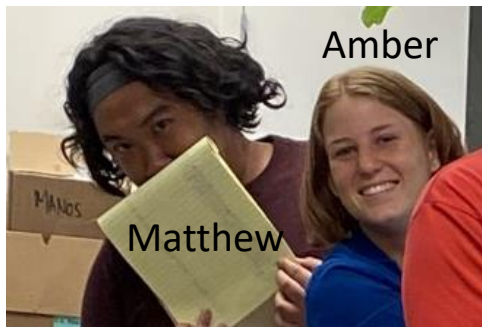
Jim Adaskaveg

Professor & Plant Pathologist

Microbiology & Plant Pathology

Potassium Phosphite EC₅₀ Values

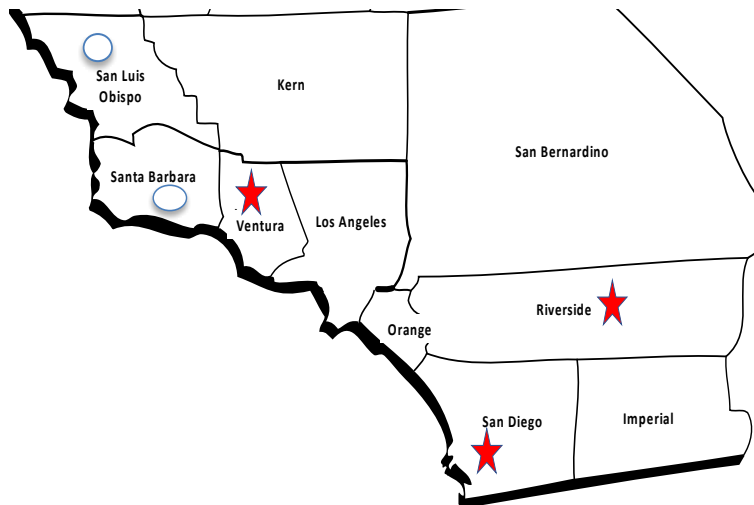




California small and larger scale rootstock trials

Current small and large rootstock trials in California

11 Small active regional trials (10 -20 trees/accession) Hass



Field location (# plots)	County	Conditions
Santa Paula (5)	Ventura	<i>Phytophthora cinnamomi</i> , high pH (7.9-8.7), alkalinity (as CaCO ₃), high salinity and chloride.
Temecula (3)	Riverside	<i>P. cinnamomi</i> , high pH and alkalinity (as CaCO ₃), high salinity and chloride.
Ramona (2)	San Diego	High pH, alkalinity (as CaCO ₃), high salinity and chloride.
Fallbrook (1)	San Diego	<i>P. cinnamomi</i> , high salinity and chloride.

10 large- trials (75-100 trees/accession) Hass

Field location (# plots)	County	Field conditions
Temecula (3)	Riverside	PRR, high salinity, high chloride
Camarillo (2)	Ventura	Salinity, high chloride
Goleta (1)	Santa Barbara	PRR, high salinity, chloride, and soil saturation
Ventura (3)	Ventura	PRR, high salinity, chloride, and alkalinity
Cal Poly SLO (1)	San Luis Obispo (SLO)	Colder temperatures.

- Tree height and canopy measurements
- Overall tree health (0 best - 5 dead).
- Salinity, heat, and cold damage (0 best - 5 dead).
- Blooming and fruit set (0 none - 5 best).
- Tree mortality.
- Individual tree yield data (weight and fruit number).
- Yield data and packing data/rootstock
- *Botryosphaeria* branch canker

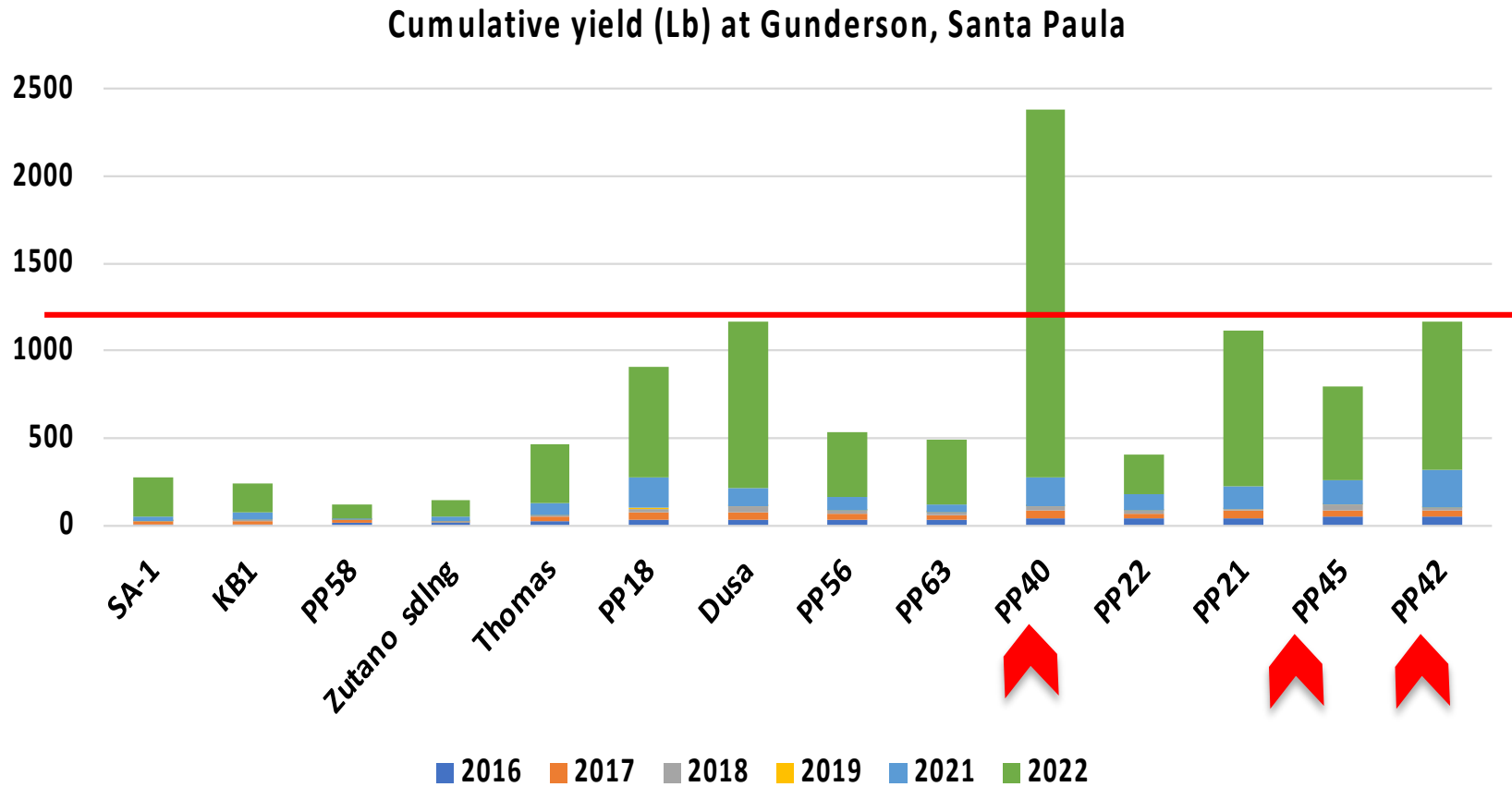
2 Rootstock x Scion trials (2022) (Temecula and Santa Barbara with high PRR, salinity, and chloride)

PP40 UCR rootstock summary:

Race	Field conditions	Field phenotypic characteristics	Tree health and harvest data
M x G	High Phytophthora Root Rot High salinity High levels of chloride, high pH, alkalinity (as CaCO ₃), and waterlogging conditions.	<ul style="list-style-type: none">• Good PRR resistance• Good salinity tolerance, vigorous trees, low tree mortality and in some fields less than Dusa.• Moderate heat tolerance.• Good yield comparable to Dusa.• Low alternate bearing when grafted to Hass.	8 years Expected to be released early 2024

PP40:

Small trial, Gunderson: ~50% PRR incidence, high salinity, high pH, high alkalinity as CaCO₃ and moderately heavy soils. VENTURA



PP35 UCR rootstock summary:

Race	Field conditions	Field phenotypic characteristics	Tree health and harvest data
M x G	High PRR High salinity High levels of chloride High pH & alkalinity (as CaCO ₃), and Waterlogging conditions.	<ul style="list-style-type: none">• Good PRR resistance• Good salinity tolerance.• More compact tree. Sometimes smaller than Dusa with similar yield efficiency.• More ideal for high density planting.• Yield similar to Dusa.• Low alternate bearing when grafted to Hass.• Low tree mortality; survival at some sites less than Dusa.• Some level of heat tolerance.	8 years Expected to be released early 2024

PP35 & PP45:

High PRR incidence with the most virulent races of pathogen, chloride level is slightly high 102 mg/L indicating a possible problem with chloride toxicity. High pH (7.9) and alkalinity (as CaCO₃).

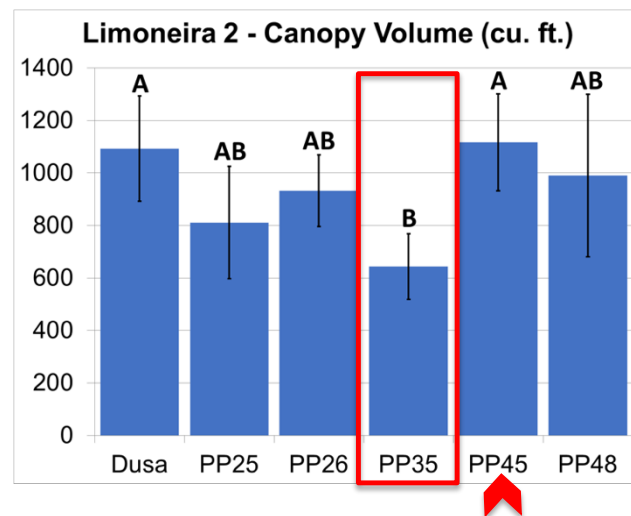
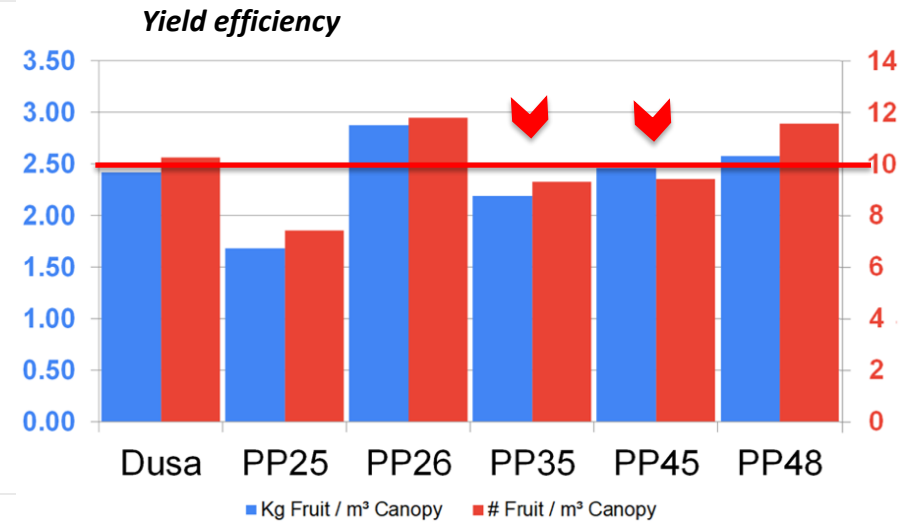
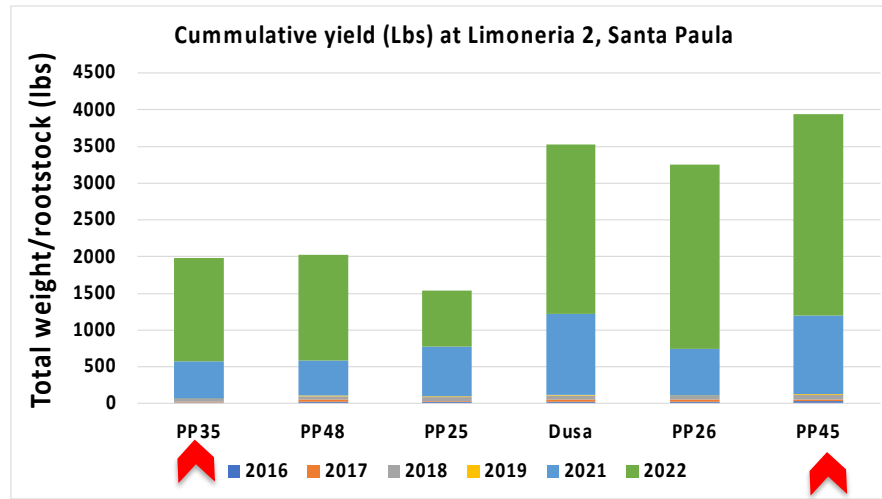
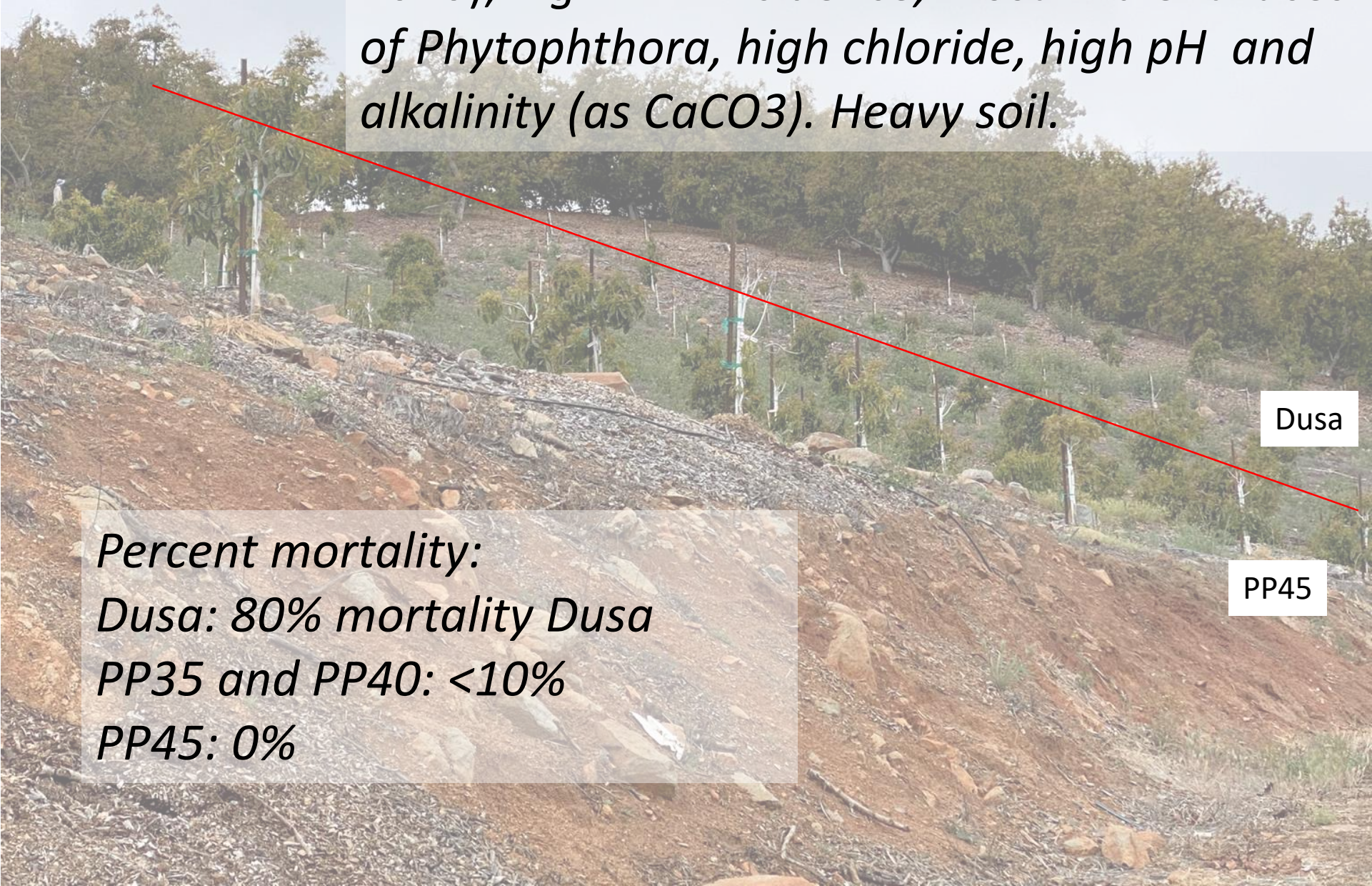


Photo taken from Mauk rootstock production trial, 2.5 years after planting.

PP45 UCR rootstock summary:

Race	Field conditions	Field phenotypic characteristics	Tree health and harvest data
M	High PRR High salinity High levels of chloride High pH & alkalinity (as CaCO ₃) Waterlogging conditions.	<ul style="list-style-type: none">• High resistance PRR better than Dusa and other available rootstocks. More ideal for replanting.• Very vigorous trees similar size Dusa.• Susceptible to salinity (esp. when no PRR). Performs well under combined PRR and salinity conditions.• Good heat tolerance; better than Dusa.• Good yield, similar to Dusa.• Low alternate bearing when grafted to Hass.	8 years Expected to be released early 2024

Large trial, Temecula, 2021 (Planted, June 2020), *high PRR incidence, most virulent races of Phytophthora, high chloride, high pH and alkalinity (as CaCO₃). Heavy soil.*



Dusa

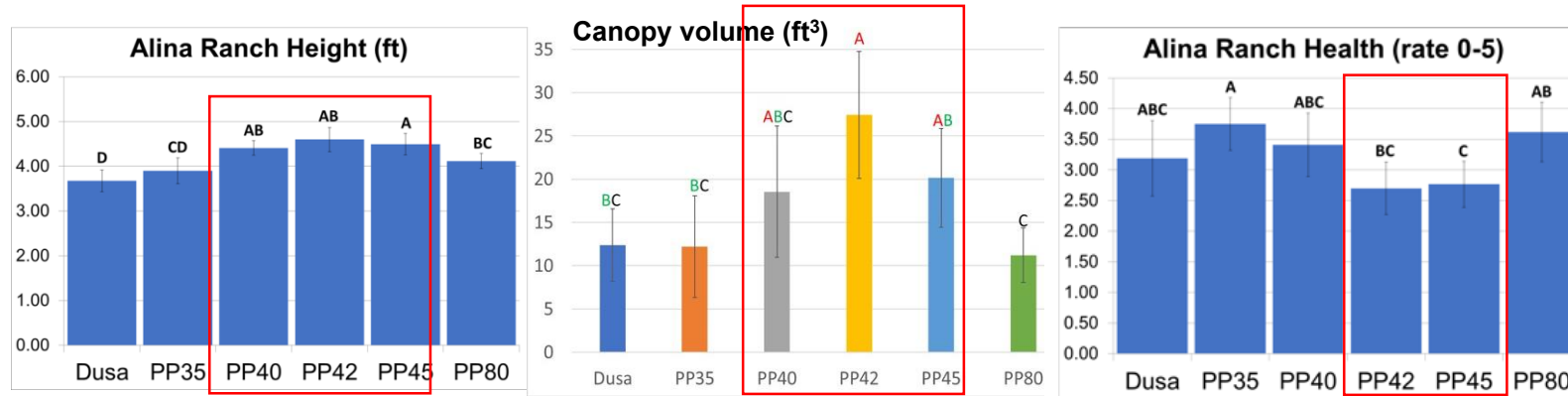
PP45

*Percent mortality:
Dusa: 80% mortality Dusa
PP35 and PP40: <10%
PP45: 0%*

PP45 best rootstock under high PRR incidence conditions (large trial, Ventura, 2020)

Data 2022

High PRR incidence (100%), high limestone. No salinity or high chloride



- **PP45 best rootstock and the first to produce fruit.**
- **PP42 is the next best rootstock at this site**



UCR Rootstock GH salinity screening

HORTSCIENCE 53(12):1737–1745. 2018. <https://doi.org/10.21273/HORTSCI13198-18>

Salt Tolerance and Growth of 13 Avocado Rootstocks Related Best to Chloride Uptake

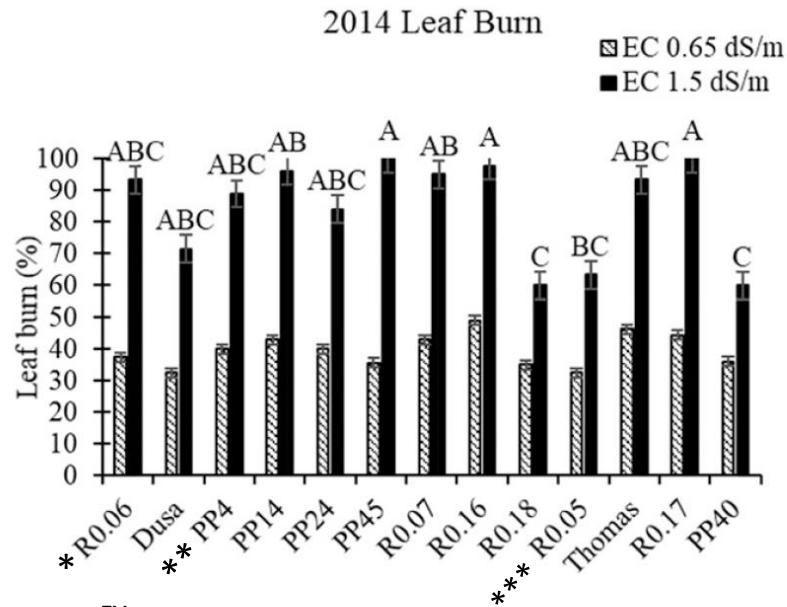
Nydia Celis¹ and Donald L. Suarez

U.S. Department of Agriculture–Agricultural Research Service, U.S. Salinity Laboratory, 450 W. Big Springs Road, Riverside, CA 92507

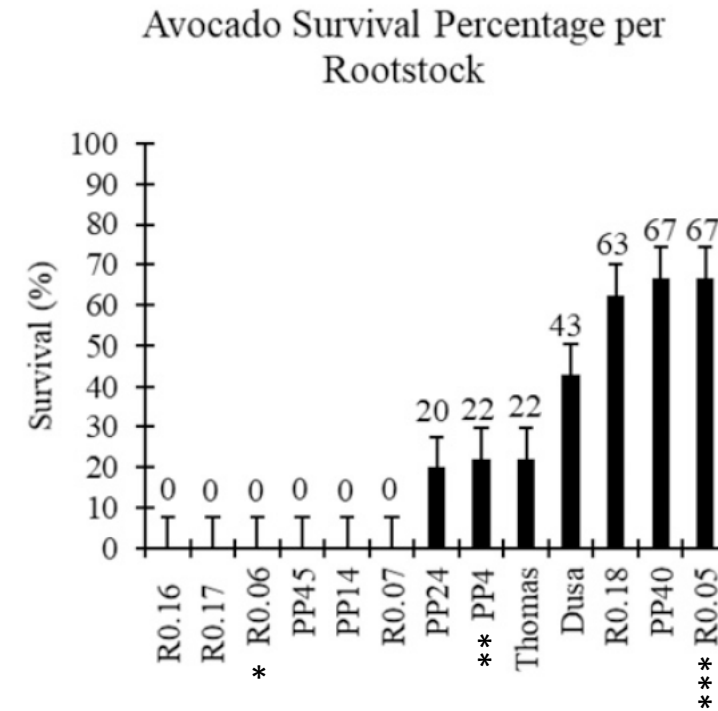
Laosheng Wu, Rui Li, Mary Lu Arpaia, and Peggy Mauk

University of California, Riverside, 900 University Avenue, Riverside, CA 92507

Additional index words. abiotic stress, Hass, salinity, ion toxicity, irrigation



* R0.06=Leola™
 ** PP4=Zentmyer
 *** R0.05=Zerala™.

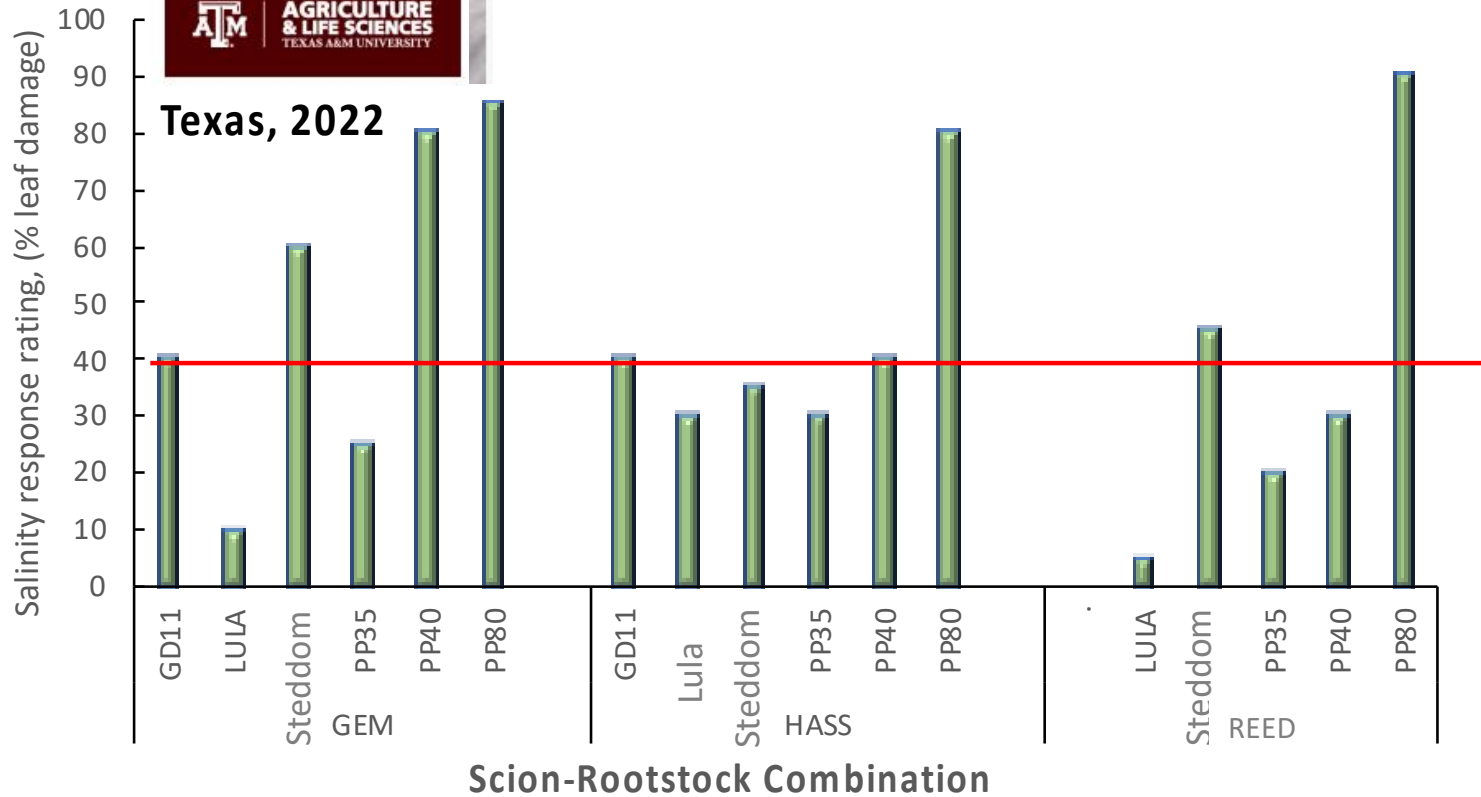




John Jifon



Salinity damage is influenced by Scion
GD11, Lula, and PP35 best response independent of Scions



AVOCADOS IN DANGER!!

Laurel Wilt Disease

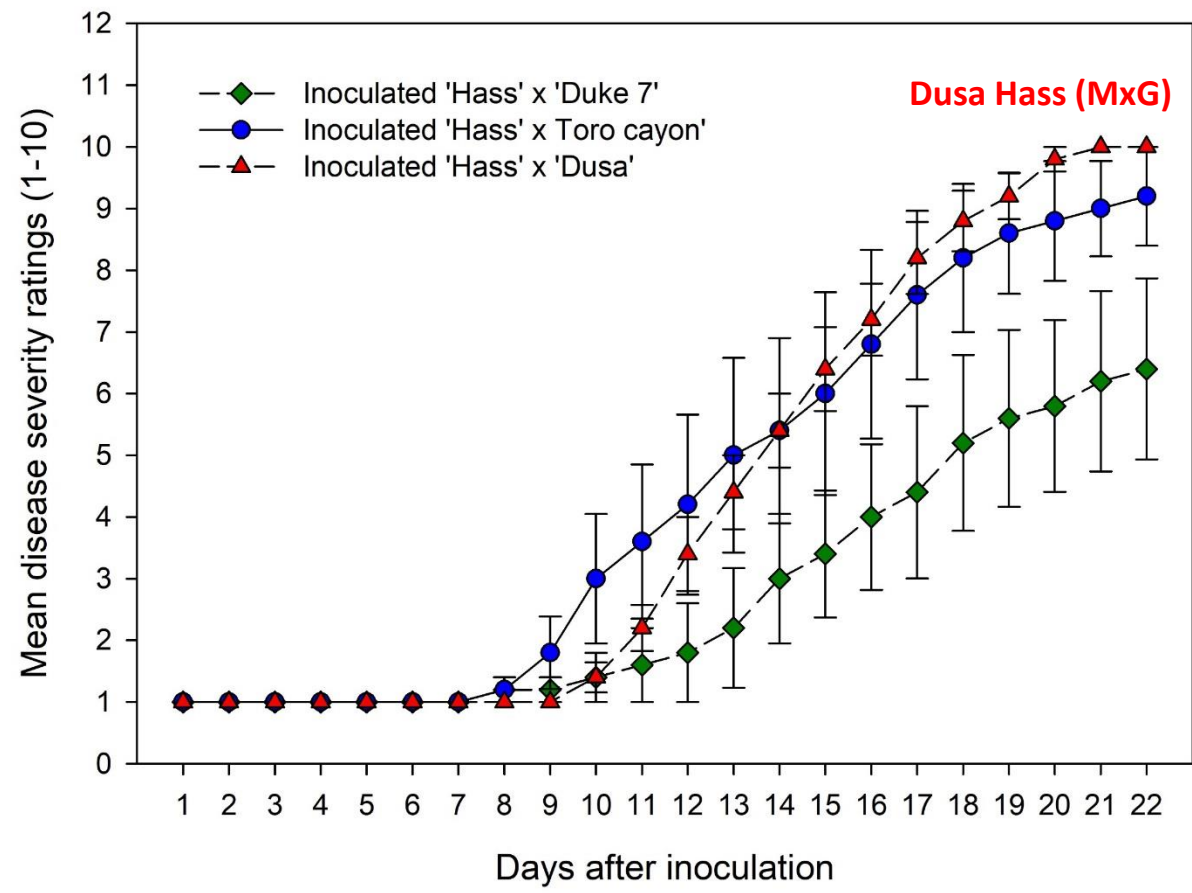
Ambrosia beetle-*Raffaelea lauricola*

60% avocado crop lost in FL



<http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Agriculture-Industry/Pests-Diseases/Laurel-Wilt-Disease>

Rootstock/Scion combinations and LW



Preliminary data
Bruce Schaffer and Ana Vargas (UF)

Duke7 Hass (MX)

Disease severity of three PRR semi-resistant rootstocks grafted with 'Hass' after the LW pathogen inoculation. Disease severity is based on a visual rating scale where 1=no symptoms and 10=total defoliation and wilting.

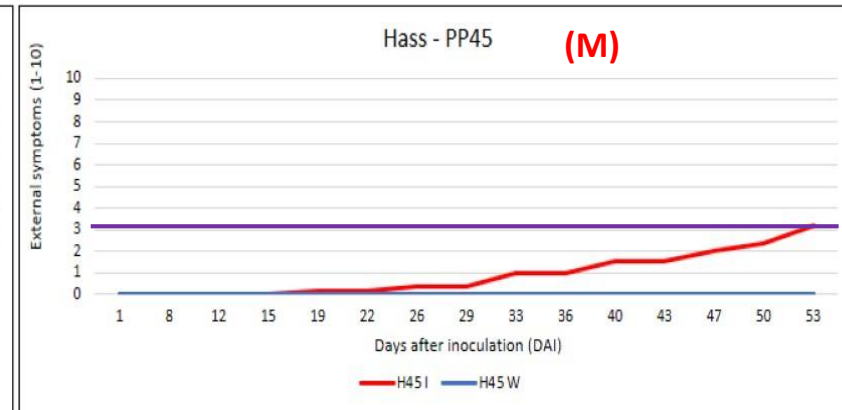
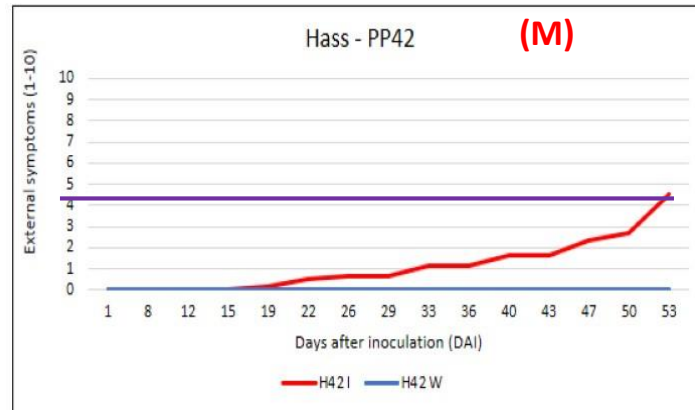
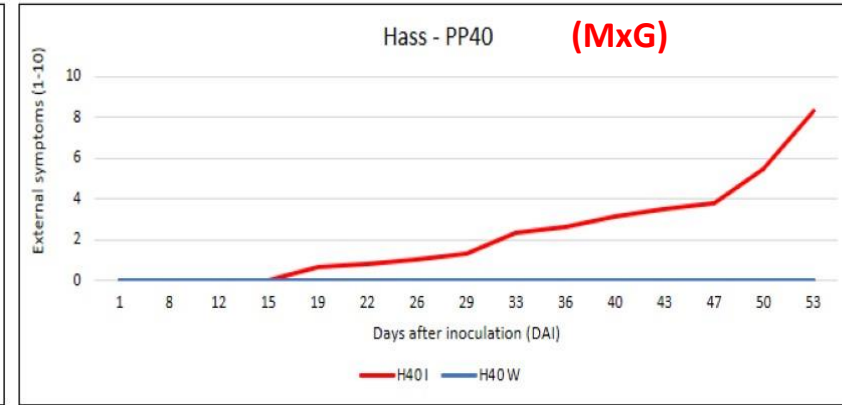
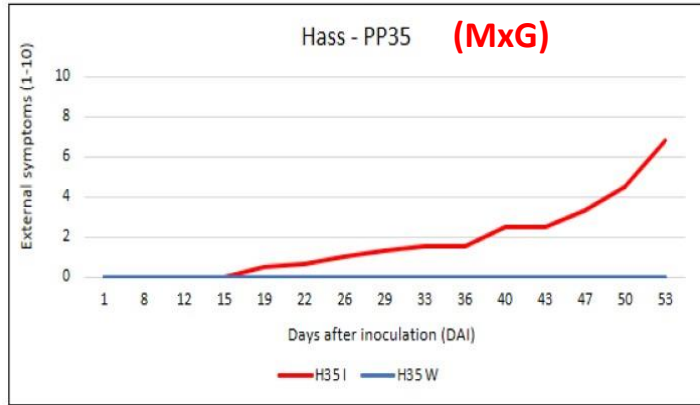


PP45 grafted with Hass slows progression of LW in greenhouse

Dr. Edwin Gutierrez



Progression of external symptom development of 'Hass' Scion on different rootstocks
From greenhouse experiments with potted plants at UF-TREC



- Based on a visual scale (1 = no symptoms, 10 = 100% of the canopy affected)

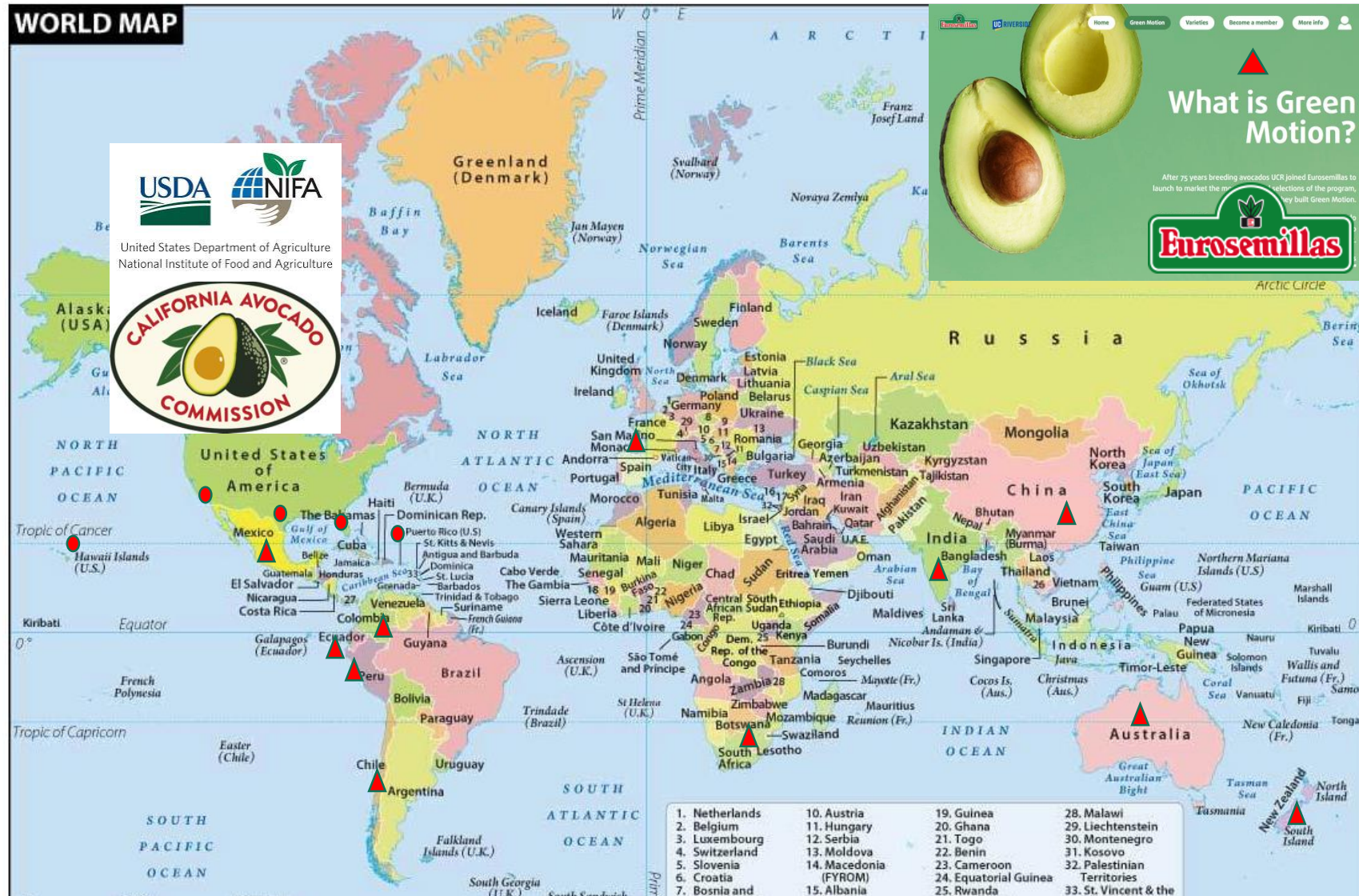
- Red line = inoculated with *H. lauricola*, Blue line = water inoculated control

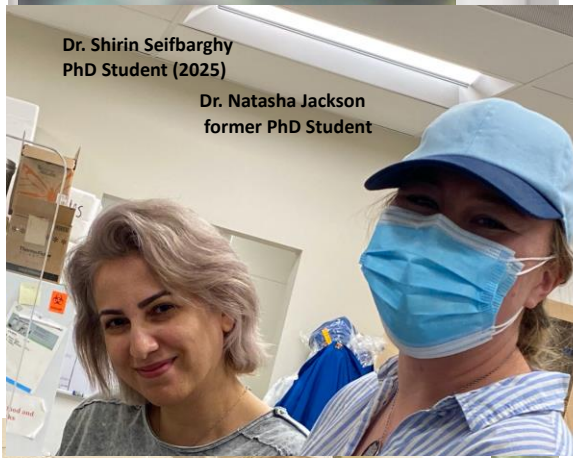
"We are working toward more resilient rootstocks, scions, and scion x rootstock combinations. It is our goal to create a competitive and sustainable avocado industry emphasizing integrated pest management that is built on biotic and abiotic resistant rootstocks."

Thank you!!

UCR Rootstock field evaluations

- Currently USA
- ▲ To be established in ~2-3 years (International Partners)





Dr. Shirin Seifbarghy
PhD Student (2025)

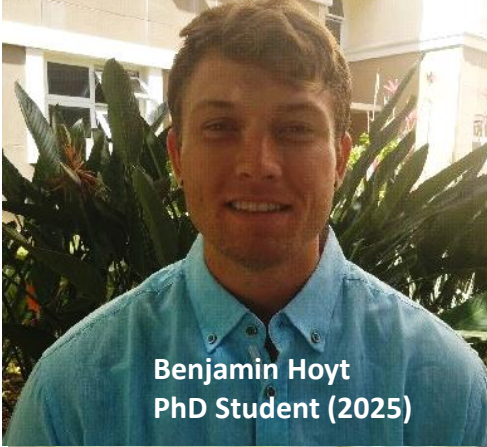
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(2021-present)



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Former Postdoc 2022



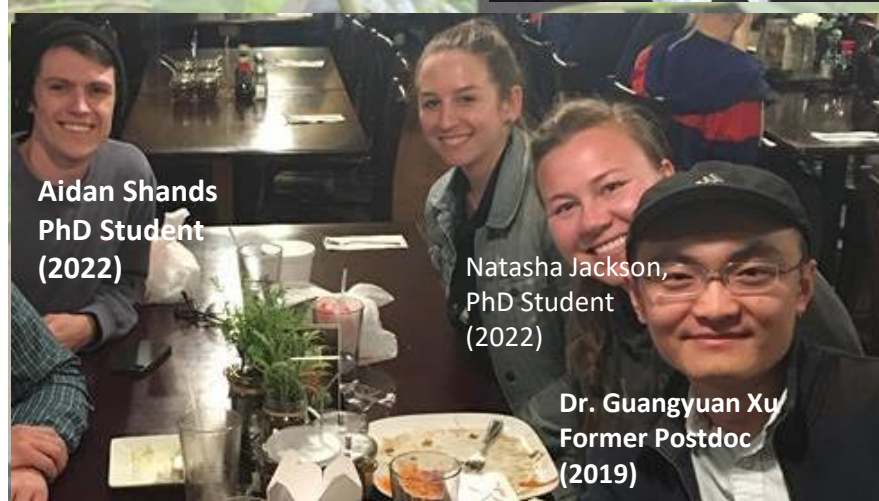
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Vanessa Hua (Undergraduate)

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Dr. Nilwalla Abeysakara (Assistant, 2019)
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Geoffrey Logan (Junior Assistant, 2017)
Olivia Johnson (undergraduate)
Shaniah Pereida (undergraduate)
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Ricardo Goenaga (USDA-ARS)
John Jifon (Texas AM)
Niklaus Grunwald – USDA-Oregon State University
David Kunh- USDA-ARS Miami
Barbara Freeman-USDA-ARS Miami
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Michoacana de San Nicolas de Hidalgo)

**CA Avocado Growers, CAS, CAC,
farm advisors,
Brokaw Nursery**



United States Department of Agriculture
National Institute of Food and Agriculture



Research Experiences
For Undergraduates



UCR CNAS Delfino funds

UC MEXUS-CONACYT

