University of California
Agriculture and Natural Resources

Managing Trunk Diseases in Plant Nursery Stock

Fruit Tree Nut Tree and Grapevine Improvement Advisory Board

Philippe Rolshausen – Professor of Cooperative Extension

UC RIVERSIDE UNIVERSITY OF CALIFORNIA

Project Overview

- Project Period 2020-2025
- Total funding: $625,528
- Collaborative Project – Co-PI Dario Cantu, Professor of Enology and Viticulture, UC Davis

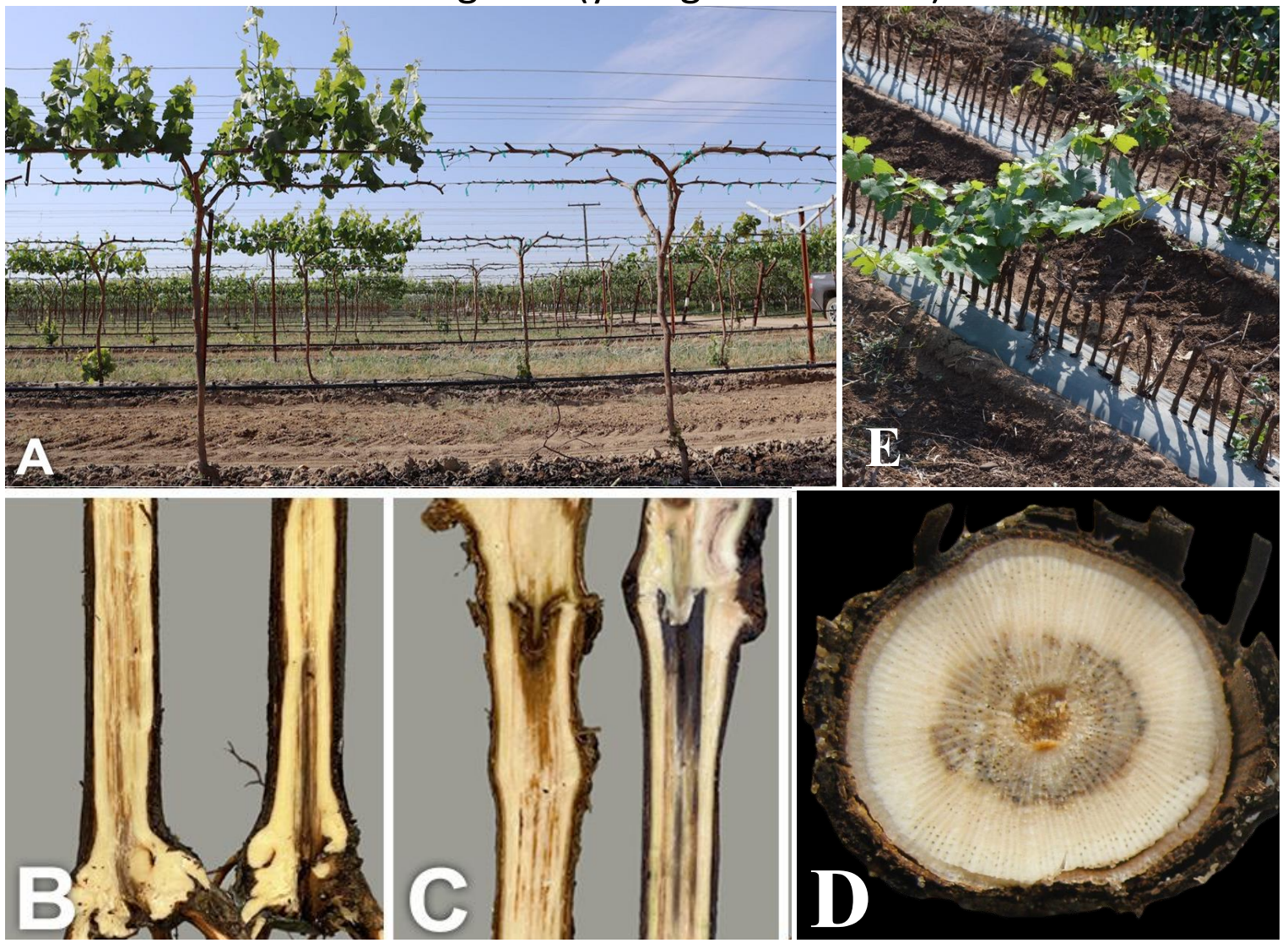
- 2020-2024
  - Period Funding: $567,304
  - Objectives
    - 1- Identify fungal trunk disease infection routes in nursery.
    - 2- Profile trunk disease pathogens in nursery stock to improve accuracy of diagnostic tools.
    - 3- Provide industry guidelines and training for best management practices and disease diagnostic.

- 2024-2025
  - Period Funding: $58,224
  - Objectives
    - Objective 1- Evaluate the efficacy of biological control treatments for management of GTDs
    - Objective 2- Assessment of plant material source and training practices on the GTD-status of mother vines.
    - Objective 3- Develop guidelines to improve the quality of grapevine nursery stock.

2020-24

Grapevine Trunk Diseases - GTD

Complex of fungal pathogens
causing GTD (young vine decline)



Allorhizobium vitis
the causal agent of crown gall

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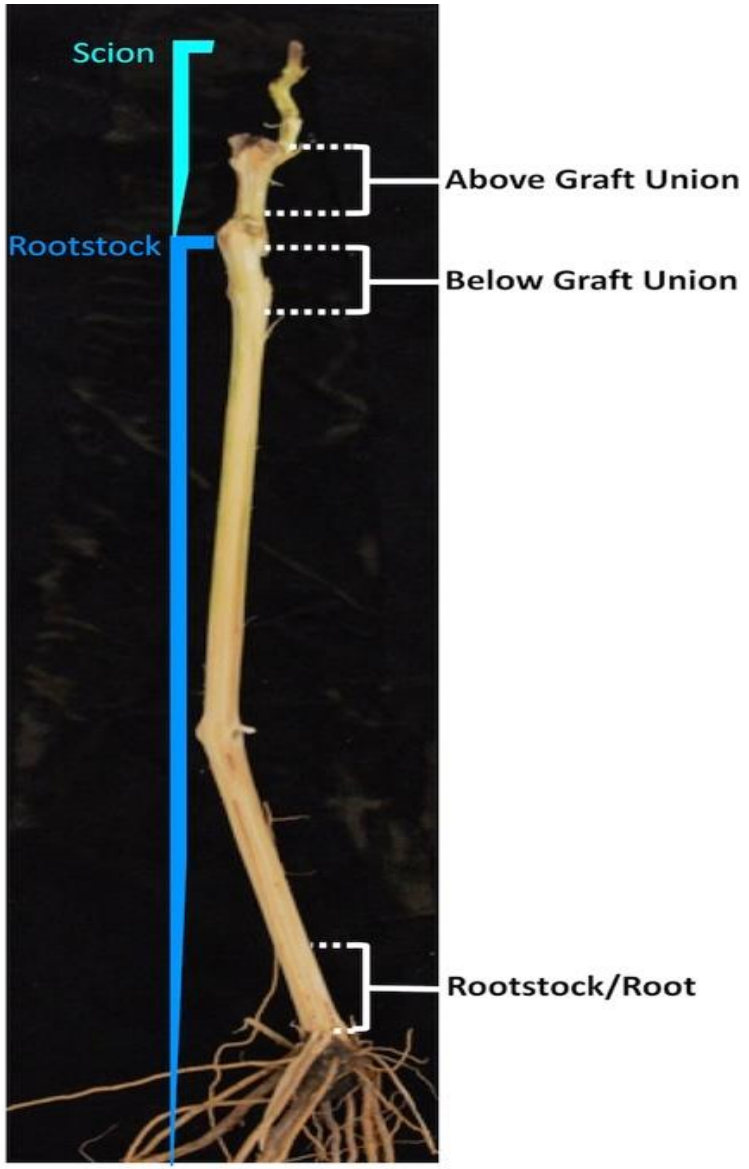
Experimental Design

- 4 California nurseries, 2 years of sampling.
- 1509 Plant materials cvs. Cabernet Sauvignon 08 and Chardonnay 04 grafted on 1103P rootstock.
- Sampling at four stages of grapevine propagation [420 field cuttings, 180 callusing vines, 599 green vines, 310 dormant vines].
- 132 environmental samples [78 from water tanks, 31 from callusing substrates, 23 from potting soil].
- Each vine is split in three 2cm wood segments; Above graft union, below graft union, crown.
- Diagnosis by culturing from all 3 segments.
- Diagnosis from all 3 segments by microbiome profiling using amplicon-based sequencing.



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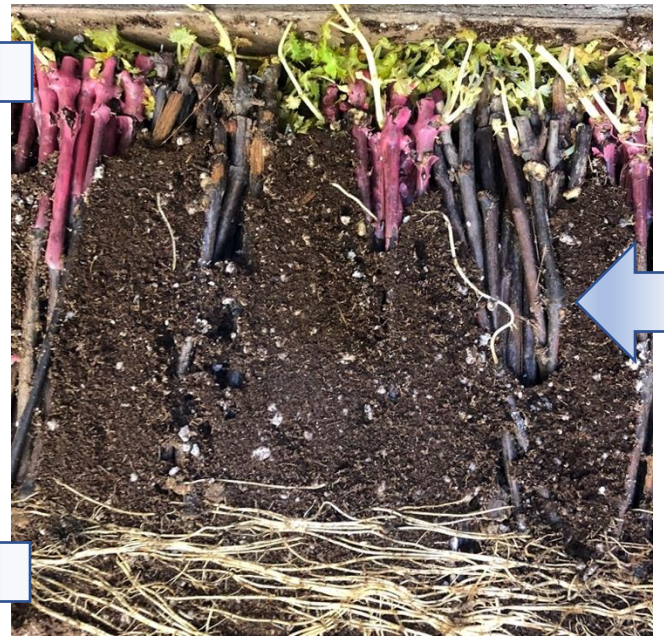
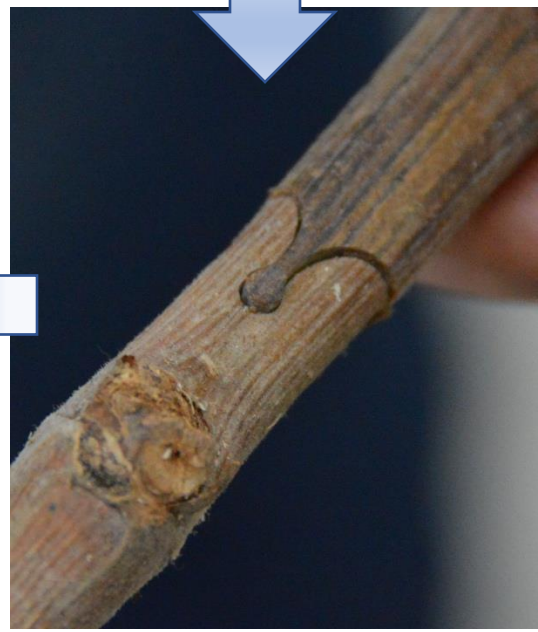
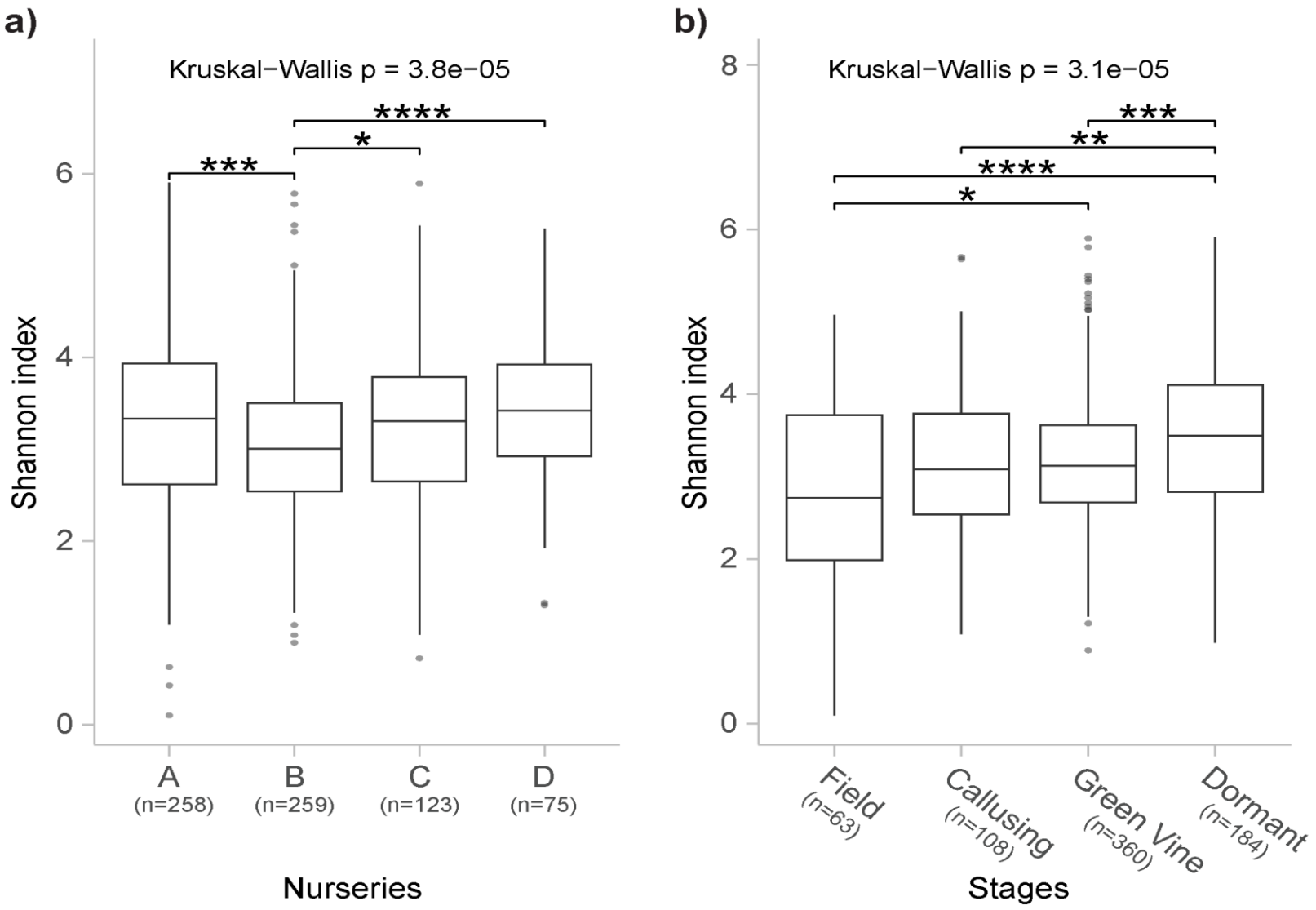




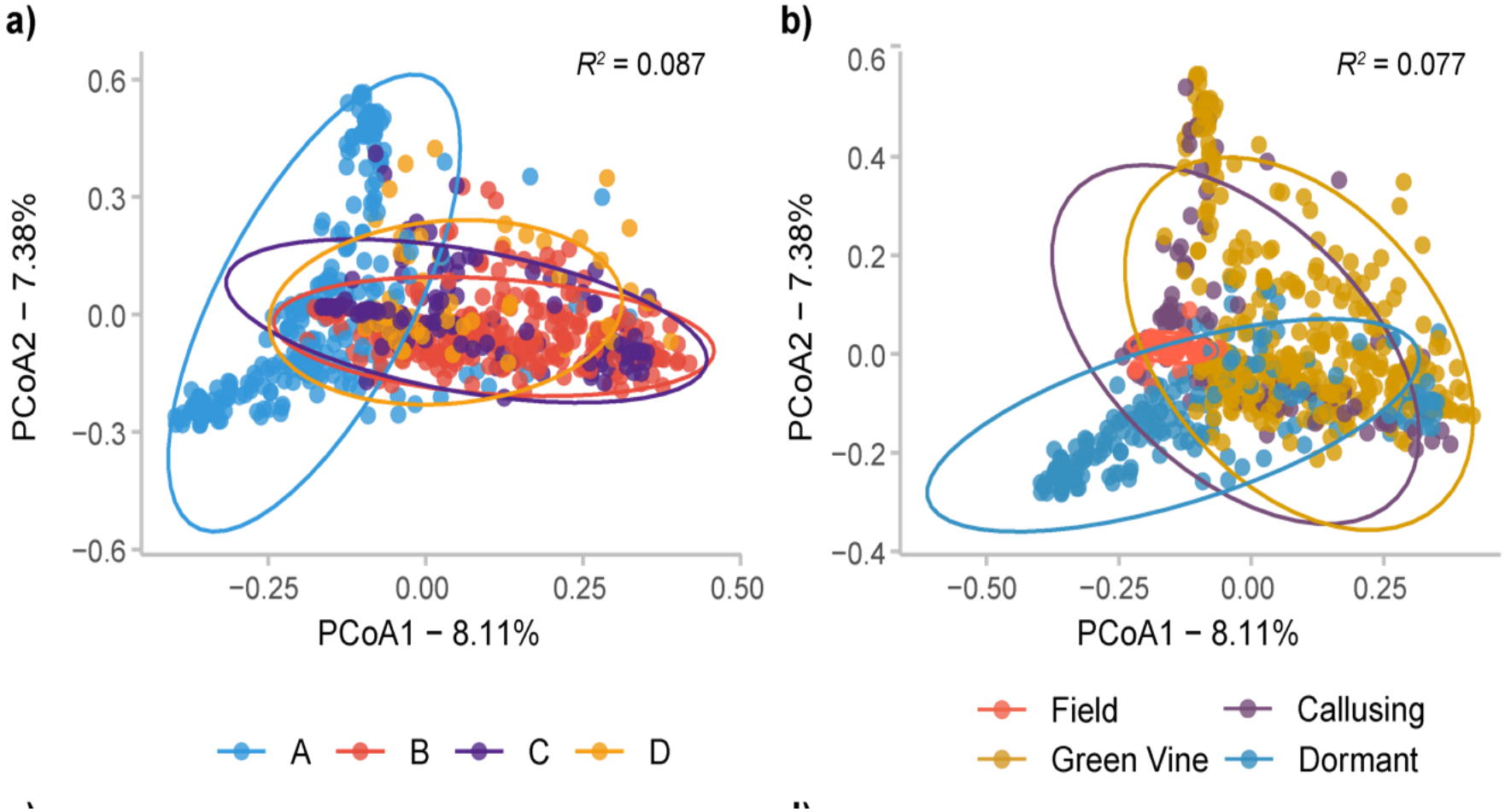
Fungal Richness in Vine Samples Based on Shannon Index



- Fungal community richness is driven by nursery origin.
- Fungal community richness increases during grapevine propagation.

Significant differences were determined using the Dunn's test after a significant Kruskal-Wallis test. (*$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$, ****$P \leq 0.0001$).

Fungal Community Similarities in Vine Samples based on the Bray-Curtis Distance Matrix



- Taxa variability among wood samples could be attributed to nursery (8.7%) and propagation stage (7.7%).
- Fungal community composition is driven by the nursery origin and stage of propagation.

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Occurrence of GTD-taxa and *Trichoderma* in CA Nursery Stock

Lifestyle	Fungal genera	Percent incidence (n = 715*)	Relative abundance (n= 715*)	Isolation frequency (n=1509**)	Disease
Beneficial	*Trichoderma*	71.9	4.8	33.6	N/A
Pathogenic	*Phaeoacremonium*	75.1	5.6	2.0	
	Pleurostoma	42.6	0.8	0.9	Petri Disease
	Cadophora	28.9	0.6	1.9	Young Vine Decline
	Phaeomoniella	16.7	0.5	0.1	
	Fusarium	91.3	14.5	22.1	Young Vine Decline
	Diaporthe	23.5	0.2	0.3	Phomopsis Dieback
					Phomopsis Cane and Leaf Spot
	Neofusicoccum	9.5	0.1	0.1	
	Diplodia	6.4	0.01	0.1	
	Botryosphaeria	1.6	0.001	0.03	Botyosphaeria canker
	Lasiodiplodia	0.7	0.001	0.2	Young Vine Decline
	Neoscytalidium	0.7	0.002	0.03	
	Dothiorella	0.5	0.0001	0.0	
	Eutypa	7.8	0.1	0.0	Eutypa dieback
	Cylindrocladiella	3.9	0.1	0.0	
	Campylocarpon	1.9	0.01	0.0	
	Dactylonectria	1.1	0.0004	0.0	Black Foot
	Ilyonectria	0.4	0.0004	0.03	Young Vine Decline
	Neonectria	0.2	0.0002	0.0	
	Pestalotiopsis	9.8	0.03	0.0	
	Truncatella,	1.3	0.0004	0.0	Others
	Rhizoctonia	N/A	N/A	5.3	

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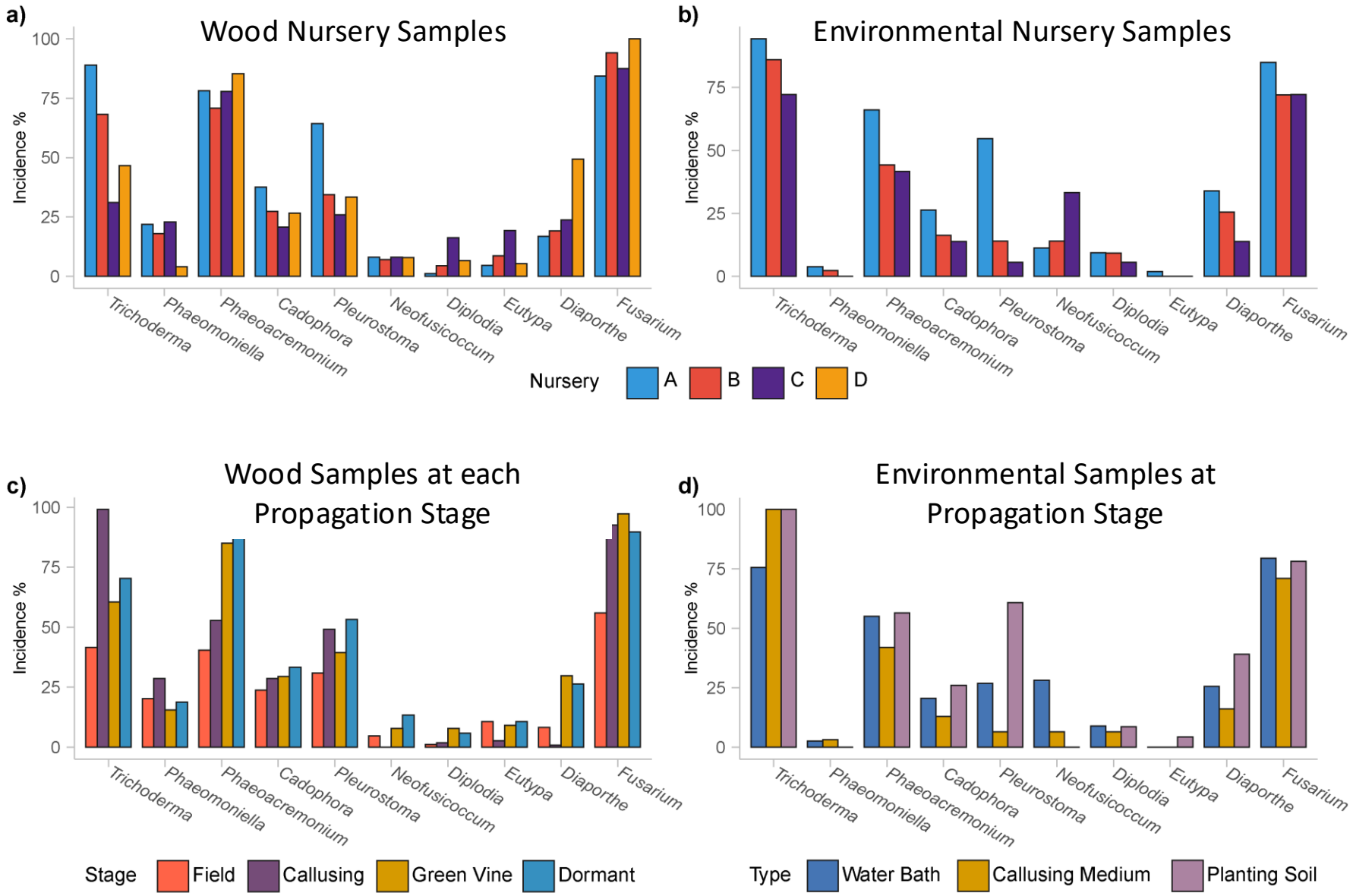
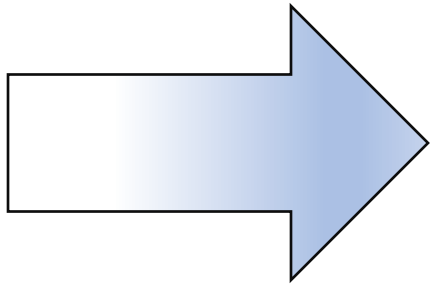
Incidence of GTD-Taxa in Wood and Environmental Samples



Increase in Pathogen Incidence and Numbers During Propagation



0 GTD-pathogen	11.1%	0.3%
1 GTD-pathogen	17.5%	5.8%
2-4 GTD-pathogens	58.8%	71.4%
>4 GTD-pathogens	12.7%	22.5%

Callusing is the Most Susceptible Stage During Propagation

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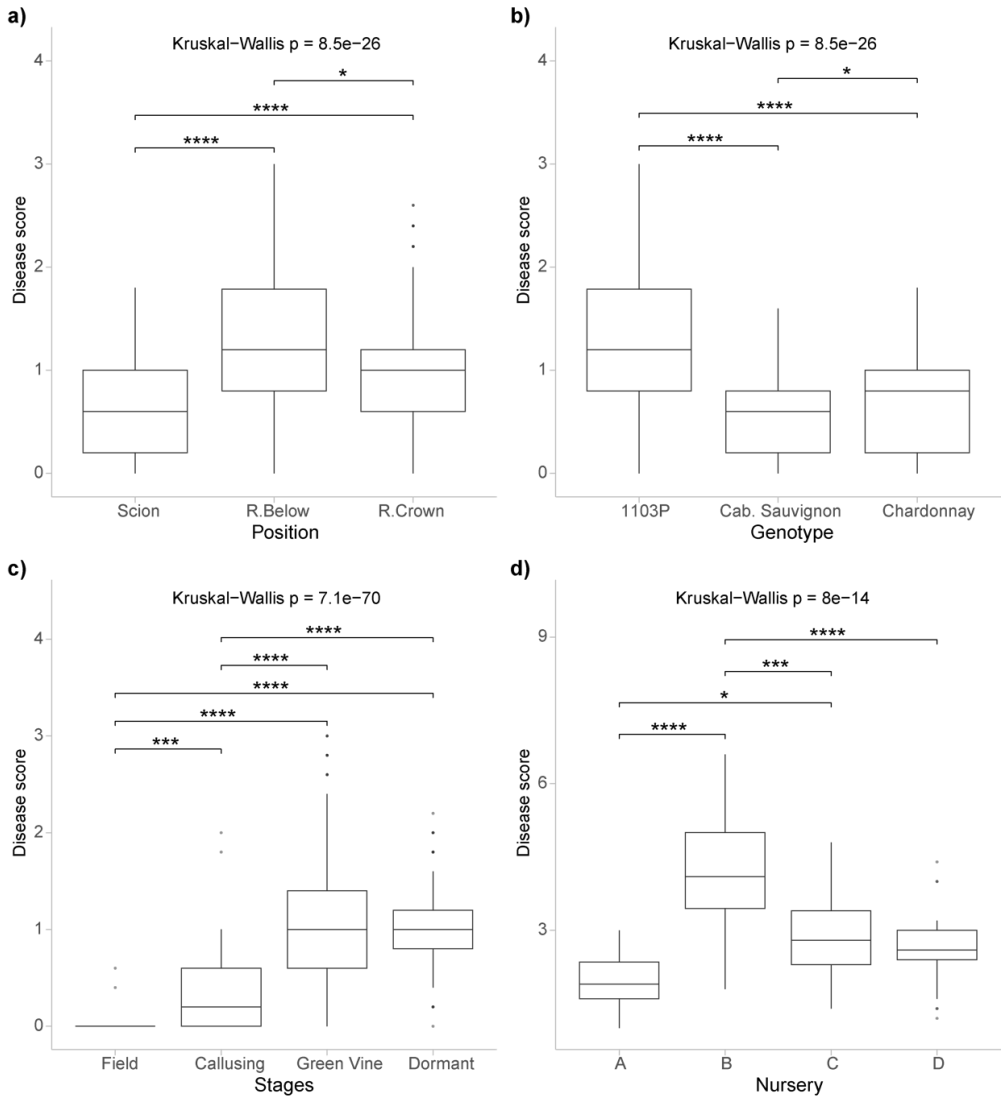
Wood Health Ratings



Significant differences were determined using the Dunn's test after a significant Kruskal-Wallis test. (* $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$, **** $P \leq 0.0001$).

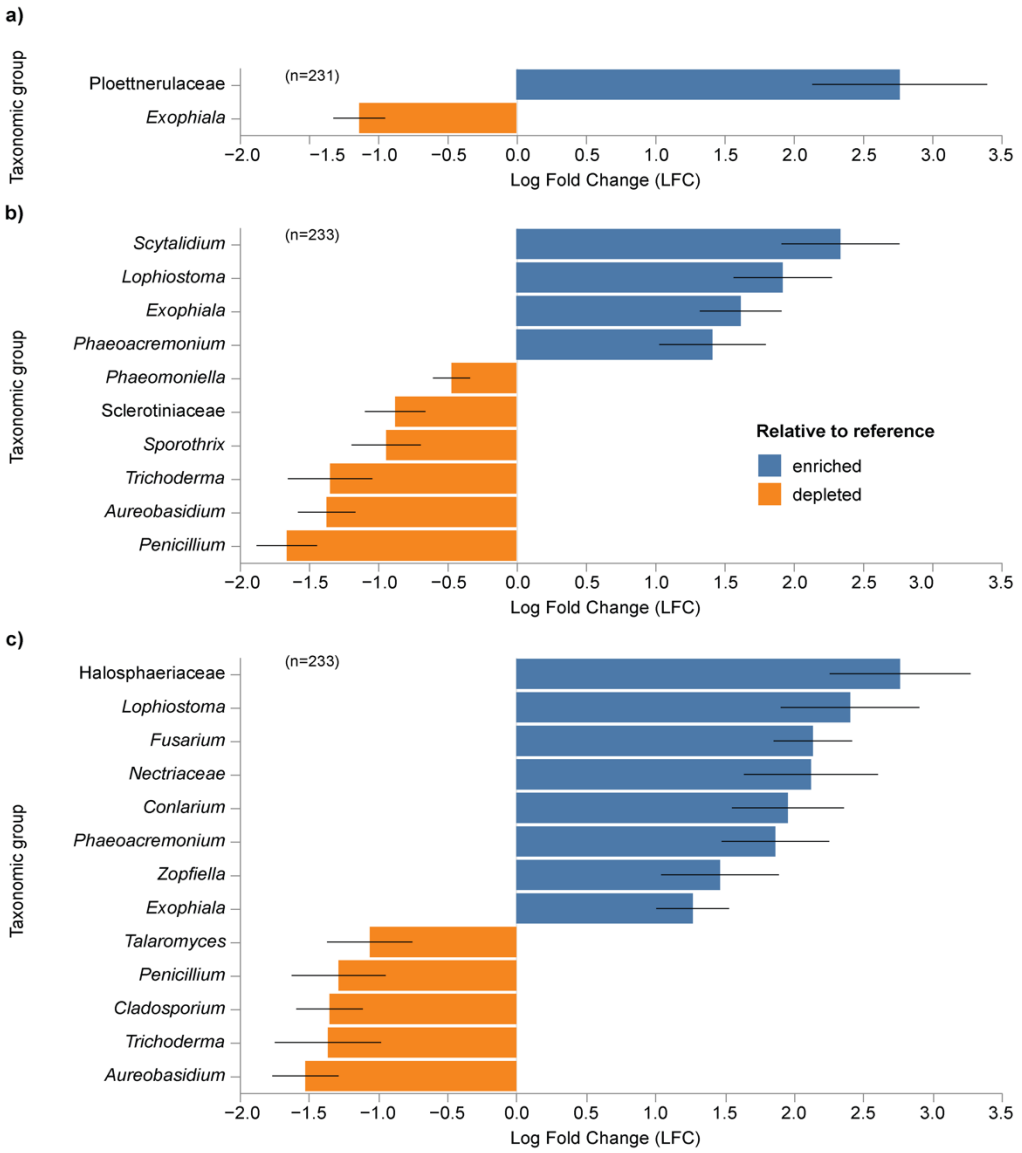
- Rootstock at both below the graft union and crown shows more wood necrosis.
- Wood necrosis increases during plant propagation.

Differential Abundance of Fungal Taxa in Grafted Vines

Above Graft Union

Below Graft Union

Crown



- The most commonly GTD-pathogens (*Phaeoacremonium* and *Fusarium*) are enriched in vines with high wood necrosis.
- The most common beneficial fungi (*Trichoderma*) are enriched in vines with low wood necrosis.

The length of the bars represents the magnitude of the log fold change (LFC). Taxa with positive and negative LFC values are enriched and depleted in the high disease group, respectively.

Objectives 2024-2025

- **Objective 1-** Evaluate the efficacy of biological control treatments for management of GTDs

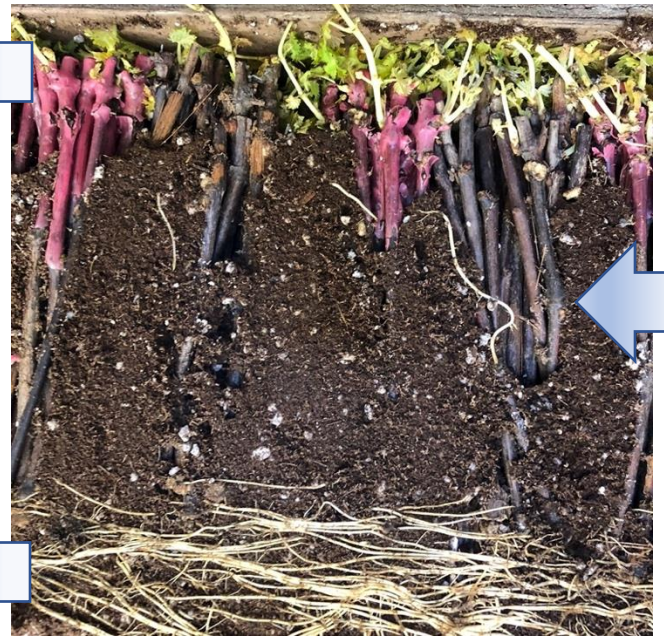
- **Objective 2-** Assessment of plant material source and training practices on the GTD-status of mother vines.

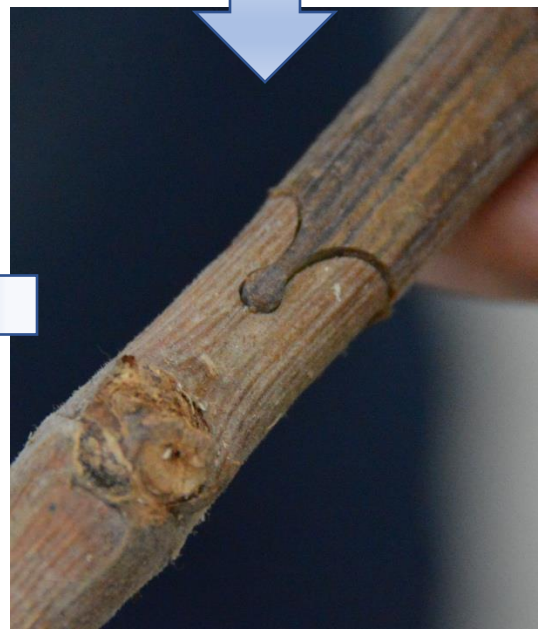
- **Objective 3-** Develop guidelines to improve the quality of grapevine nursery stock.

Experimental Design

- 3 California nurseries, 2 years of sampling.
- Biological treatments to evaluate are selected and applied by nurseries.
- Evaluation of green vines at 3 months and 18 months post treatment.
- Each vine is split in three 2cm wood segments; Above graft union, below graft union, crown.
- Microbiome profiling of all 3 wood segments using amplicon-based sequencing.
- Plant biomass.
- Wood health rating

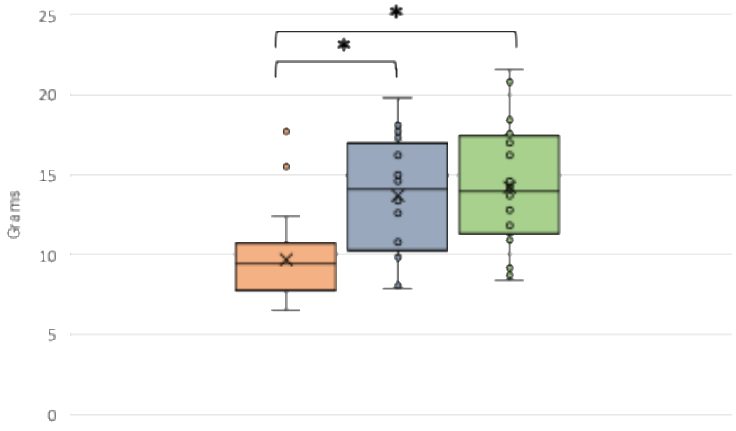
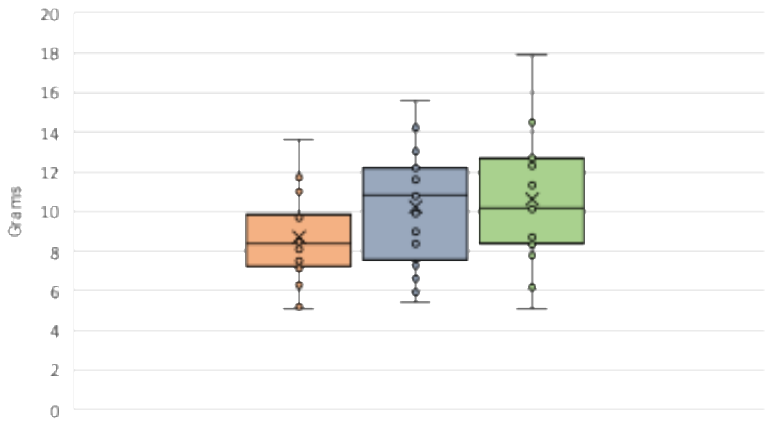
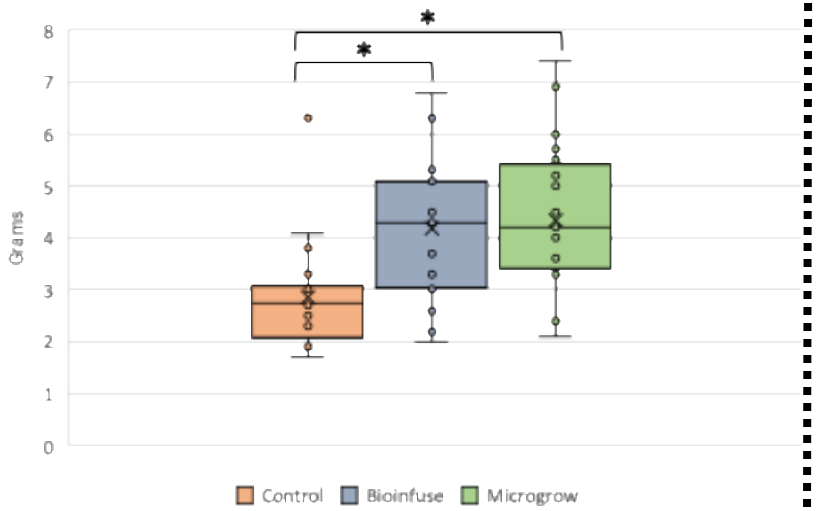
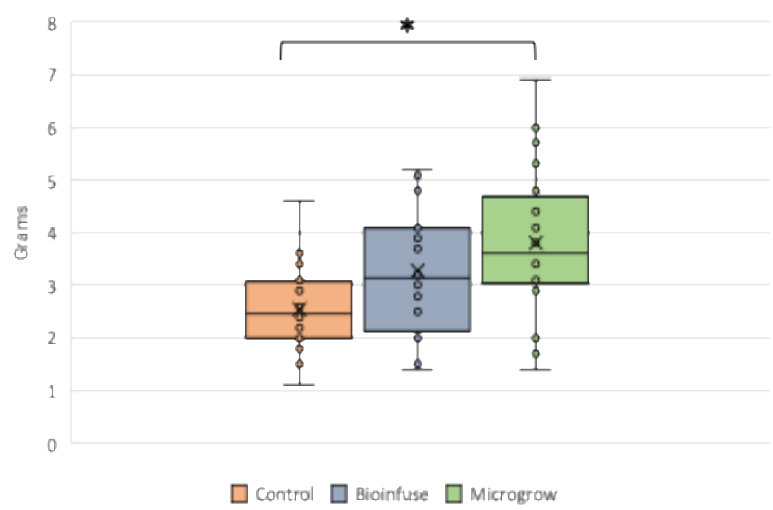
2024-25





2024-25

Objective 1- Evaluate the efficacy of biological control treatments for management of GTDs

	Shoots	Roots
Fresh Weight		
Dry Weight		

- Biological treatments applied during callusing increase plant biomass

Extension and Outreach

- Management guidelines were developed and shared with the nursery industry; available online on the PI's website (https://www.rolshausen-lab.com/copy-of-media). Updated guidelines annually with new information.
- Annual visit of nurseries to provide consulting services. Send annual report to each nursery participating in the project.

- Bustamante M.I., Todd C., Elfar K., Hamid M.I., Garcia J.F., Cantu D., Rolshausen P.E., and Eskalen A. 2023. Identification and pathogenicity of Fusarium species associated with young vine decline in California. Plant Disease 108:1053-1061.
- Todd C., Hamid M.I., Ashworth V.E.T.M., Garcia J.F., Cantu D., and Rolshausen P.E. 2024. First report of binucleate Rhizoctonia AG-G causing grapevine (Vitis vinifera) trunk diseases in California nurseries. Plant Disease 108:226.
- Garcia J.F., Todd C., Rolshausen P.E., and Cantu D. 2024. Nursery origin and propagation stage influence the endophytic fungal communities inhabiting grapevine planting stocks. Phytobiomes, In Press.

- Several scientific presentations at international conferences, national society events, and local industry meetings.

Acknowledgements

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