Managing Grapevine Trunk Diseases: Research Update

Akif Eskalen, Robert Blundell, Marcelo Bustamante, Karina Elfar, Rhonda Smith, Lynn Wunderlich, Mark Battany, Glenn McGourty, Carmen Gispert, Monica Cooper, Gabriel Torres, George Zhuang, Larry Bettiga

UC Davis, Agriculture and Agri-Food Canada, UCCE, Sonoma, El Dorado, Napa, Tulare and Kings, Fresno, Monterey, Riverside, San Luis Obispo and Santa Barbara, Mendocino Counties

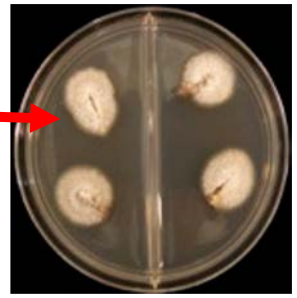
Oregon Vine Symposium
Virtual, Feb 16, 2022

Outline

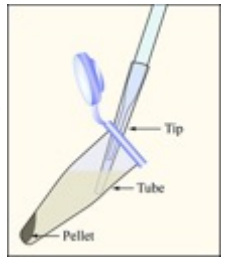
1. Introduction
2. Grapevine trunk diseases: Research Update
3. Pruning wound protection trials
4. Conclusion

Diagnostic Service to Research Topics

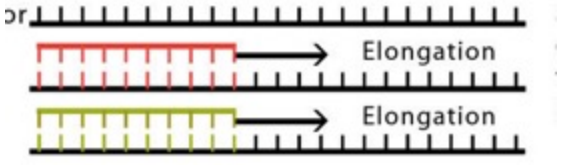
Symptomatic plant tissue



Culture Media

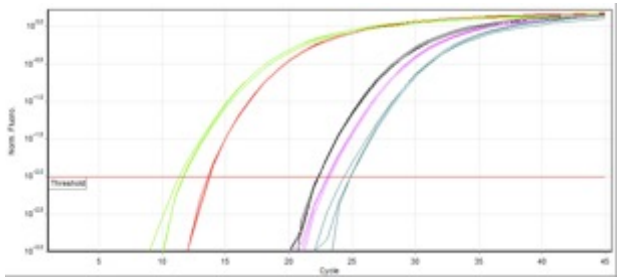


DNA Extraction

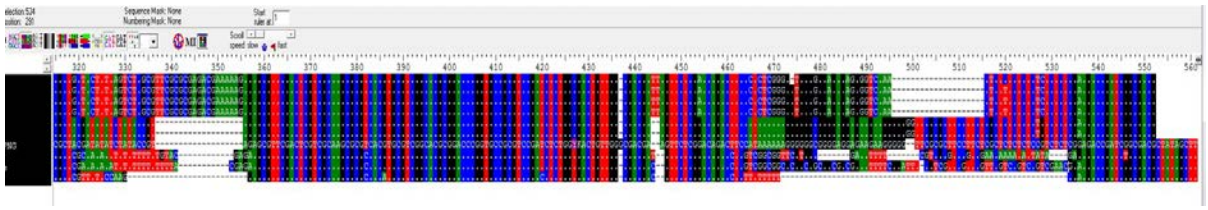


Species Specific Primers

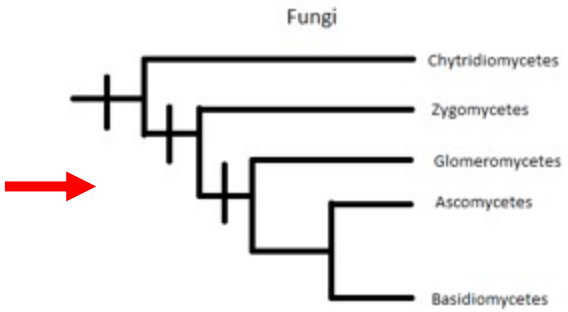
Quantitative Real Time PCR



Identification based on melting curve

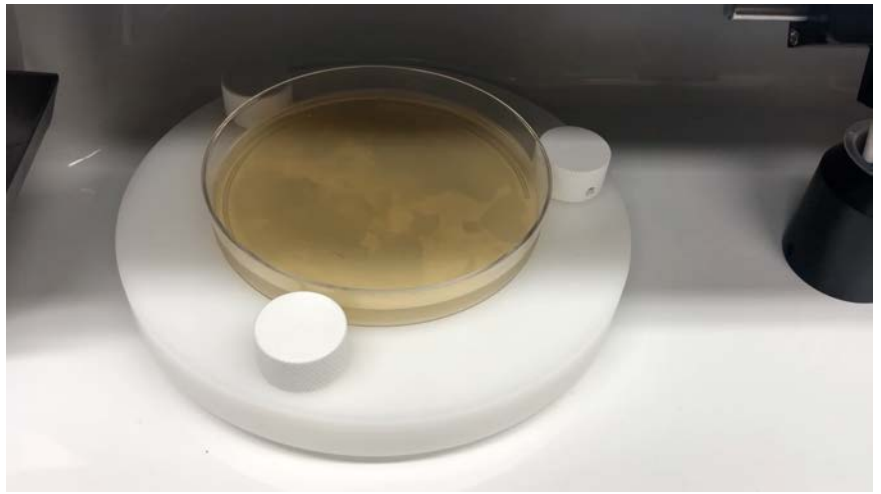


Sequencing the DNA Region

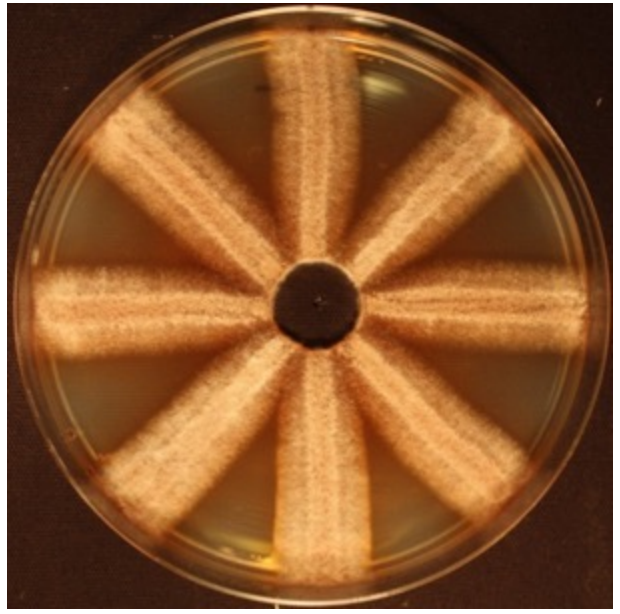


Phylogenetic Tree

Fungicide Screening Using Spiral Gradient Dilution



Fungicide



Control

Field Trial to Evaluate Fungicides to control Powdery

Grape Bunch Rot- Sour Rot Fungicide Efficacy Field Trial

https://ucanr.edu/sites/eskalenlab/Fruit_Crop_Fungicide_Trials/

Grapevine Trunk Diseases

- Young Vine Decline
- Esca
- Eutypa Dieback

Vascular diseases

- Bot Canker
- Phomopsis Dieback
- Black Foot

Canker diseases




Grapevine Trunk Diseases

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Vascular diseases

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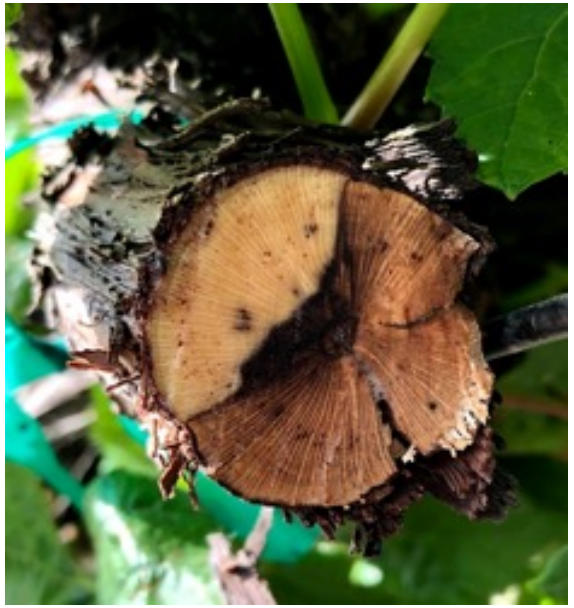


Grapevine Trunk Diseases

- Young Vine Decline
- Esca
- Eutypa Dieback
- Bot Canker
- Phomopsis Dieback
- Black Foot

Vascular and Rot diseases

Canker diseases

Rot diseases




Macrophomina Charcoal Rot *(Macrophomina phaseolina)*

Chardonnay/1103P

Macrophomina Charcoal Rot *(Macrophomina phaseolina)*

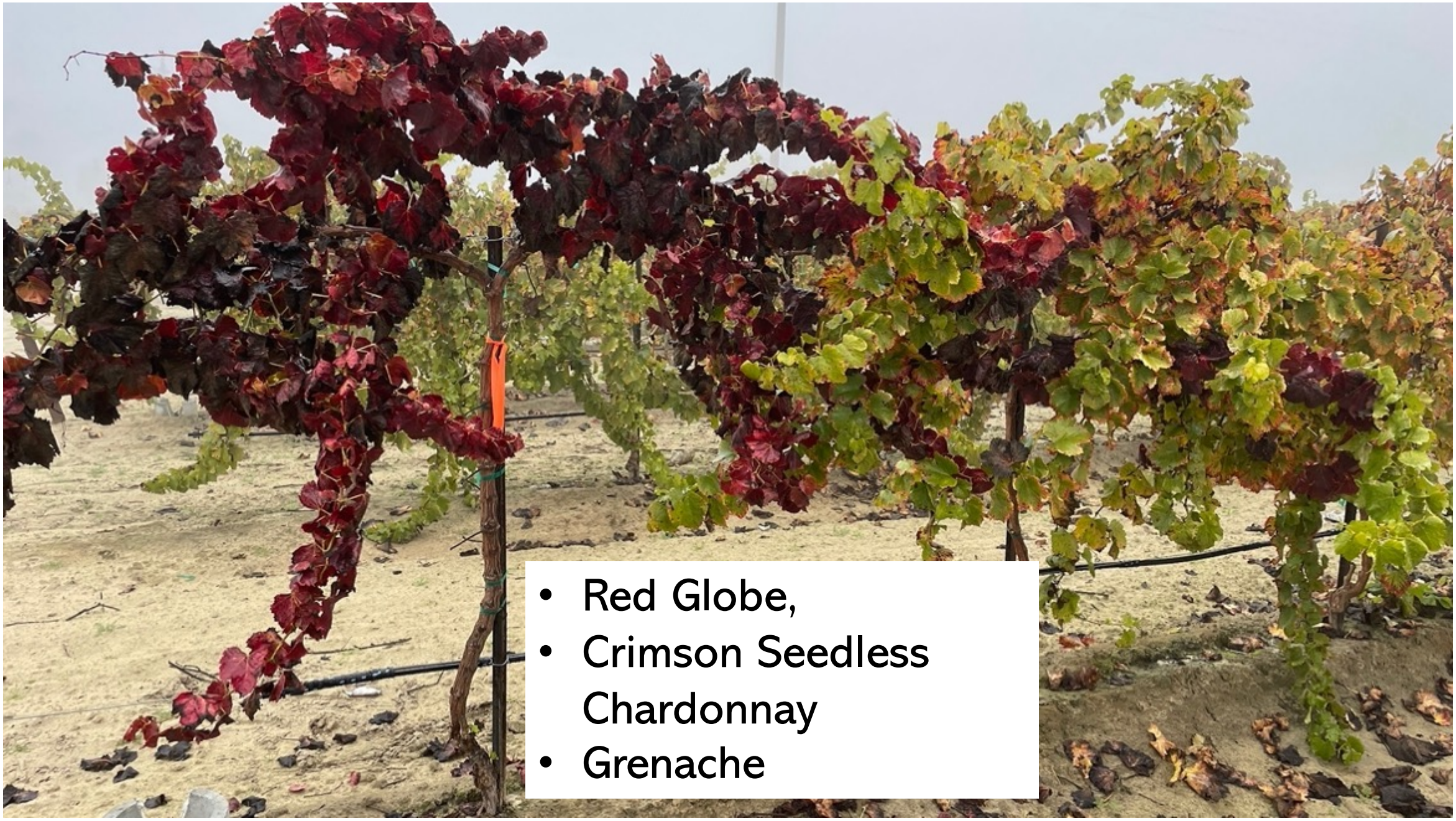
Chardonnay/1103P

Aspergillus vine Canker (*Aspergillus niger)*

George Zhuang

Grenache cv./ Freedom

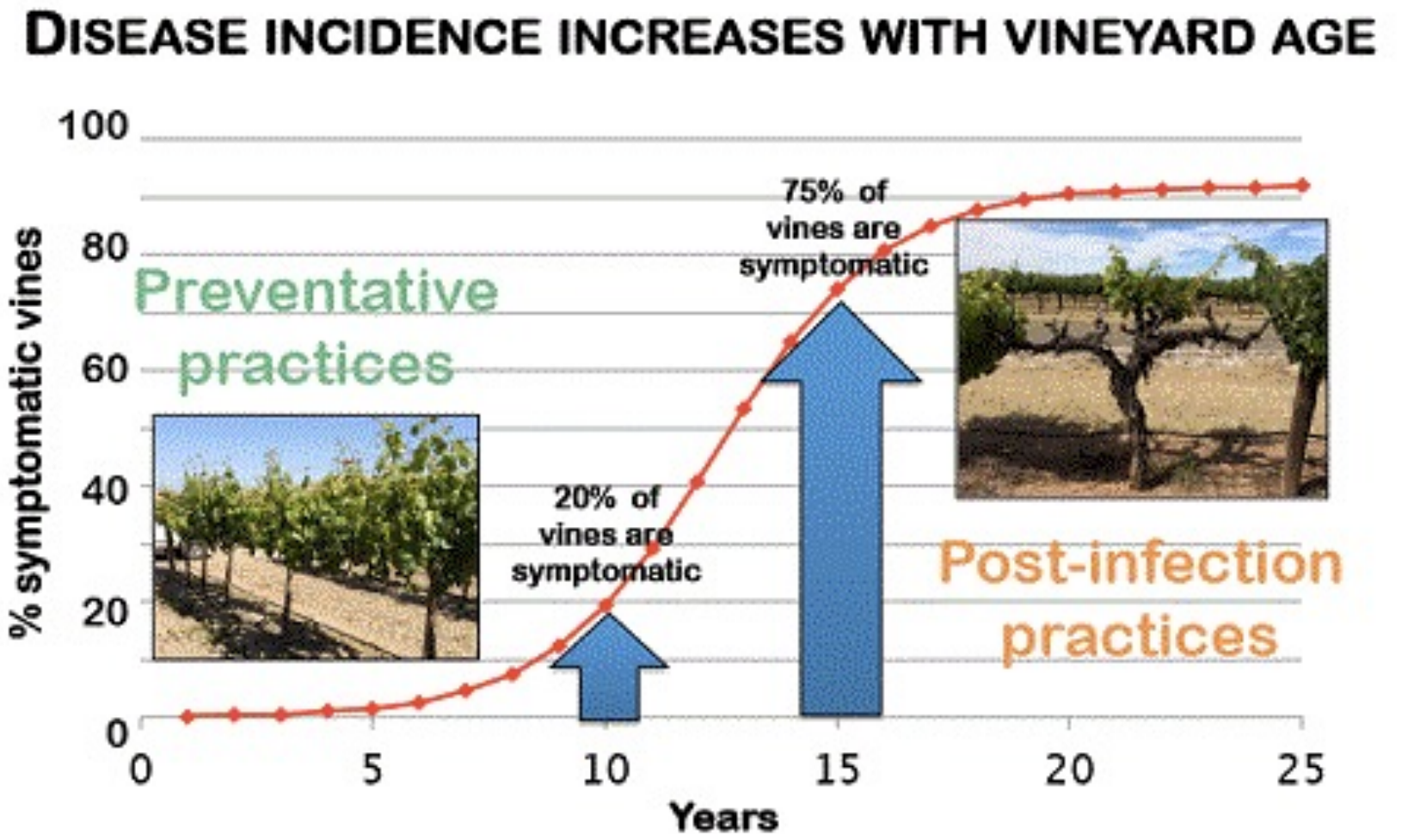
Aspergillus vine Canker (*Aspergillus niger*)



- Red Globe,
- Crimson Seedless
- Chardonnay
- Grenache

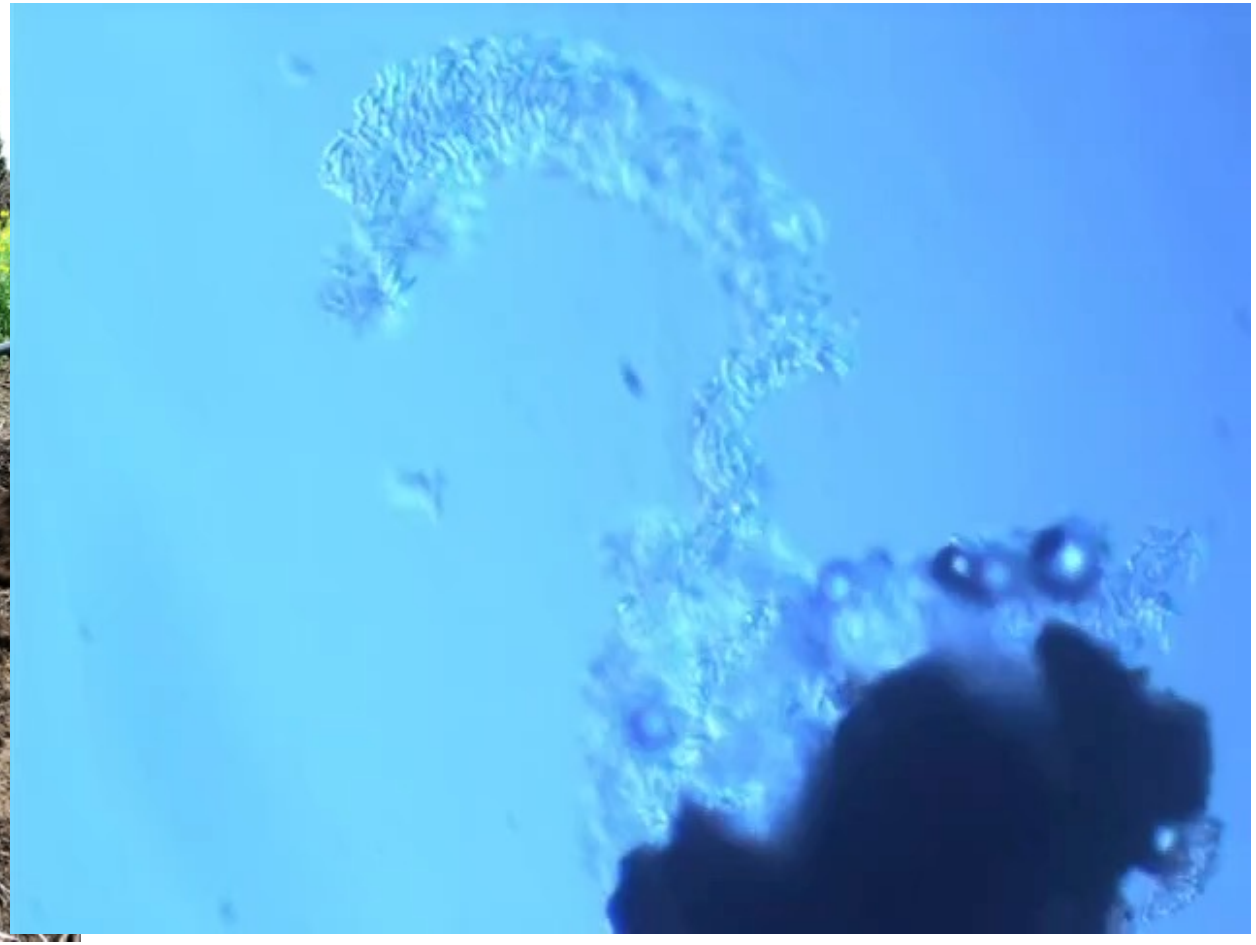
GTD Examples Oregon

Economical Impact



From Duthie et al. 1991 (Colombard vineyards ranging from 5 to 34 years)

Asexual Fruiting body-Pycnidia

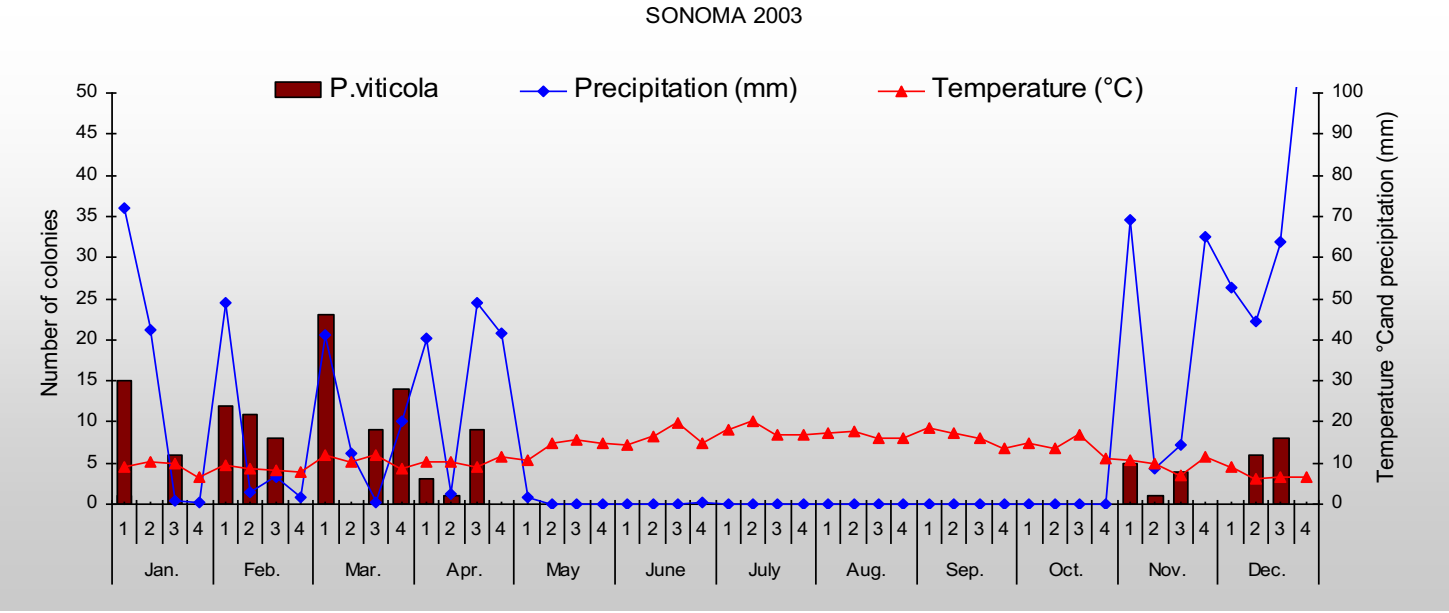


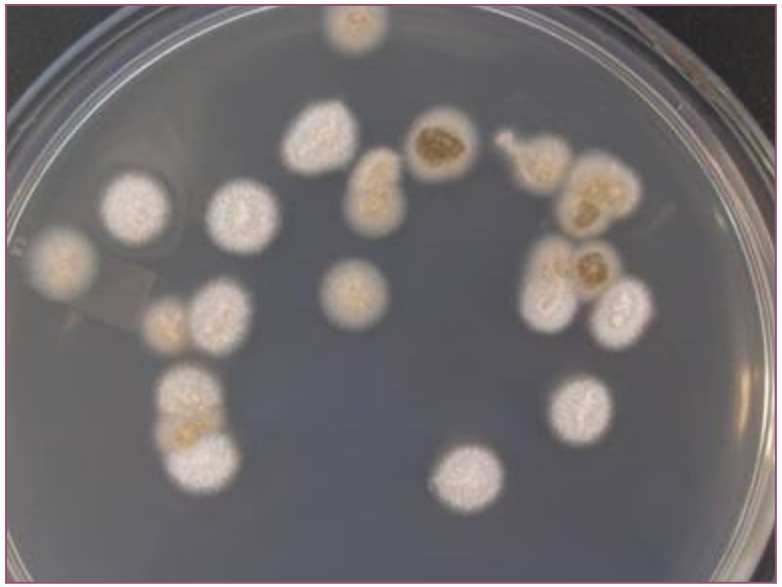
Source of inoculum

Sexual Fruiting body-Perithecia

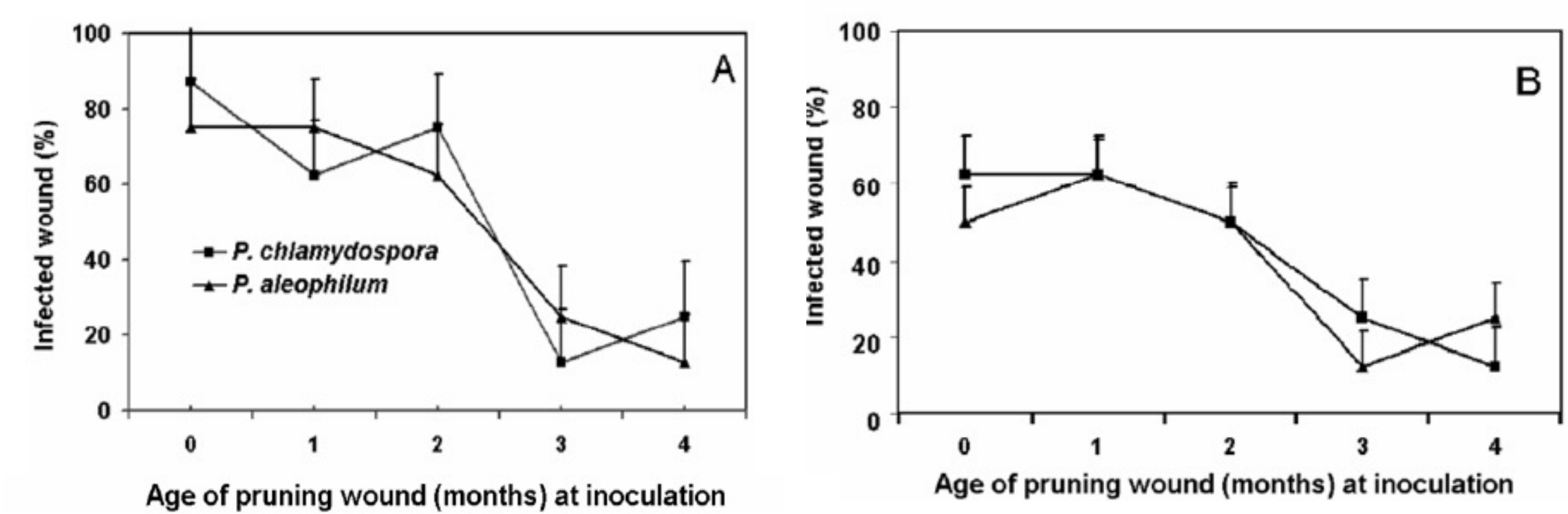
Source of inoculum

Spore dispersal pattern of GTD pathogens





Pruning wound susceptibility for Esca Pathogens



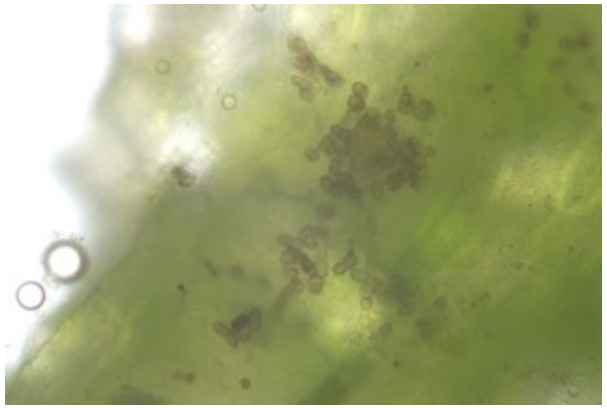
Eskalen et al. Plant Disease, 2007, 91:9, 1100-1104.

How do they infect grapevine?

- Pruning wounds

- Latent Infection

- Endophyte



Infection of GTD on different part of the vine

Spurs

Cordon

Trunk

Rootstock

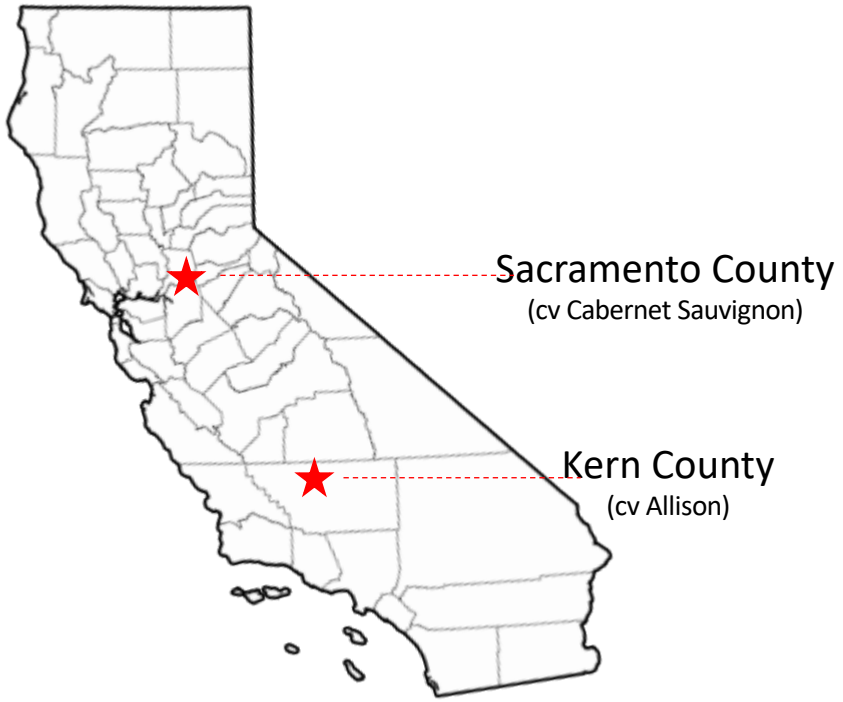
Pruning wound protection trials

Robert Blundell

Treatment or Trade Name	Active Ingredient(s)
Negative Control - Not inoculated	N/A
Positive Control - Inoculated with pathogen	N/A
Terramera (Exp B)	N/A
Luna Sensation	Fluopyram and Trifloxystrobin
Topsin M 70WP + Rally 40WSP	Thiophanate-methyl + Myclobutanil
BioTam + Crab Life-Powder	*T.asperellum* + *T. gamsii* + CLP
Crab Life Powder	A blend of crab and lobster shell powder
Biotam	*Trichoderma asperellum* + *Trichoderma gamsii*
GCM	*Bacillus velezensis* C100
Vintec	*Trichoderma atroviride*
Serenade ASO	*Bacillus subtilis* strain QST713
Botector	*Aureobasidium pullulans*
UCD 8717	*Trichoderma hamatum*
UCD 8189	*Aureobasidium* sp.
UCD 8745	*Bacillus* sp.

Blundell and Eskalen, 2021, Plant Health Progress, APS

Field trial in 2019-2020 to prevent and control GTD pathogens with synthetic, organic and biological fungicides



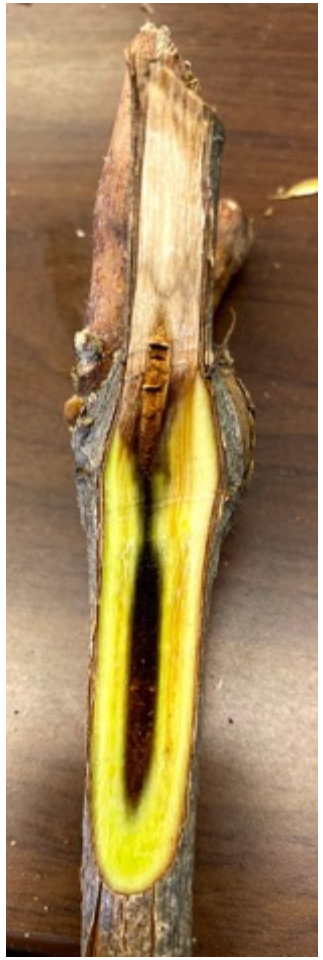
Field trial in 2019-2020 to prevent and control GTD pathogens with synthetic, organic and biological fungicides

Pruning
(February)

Application of protectant

Inoculation of GTDs ($5x10^5$) spores

Evaluation of field trial for pruning wound protection

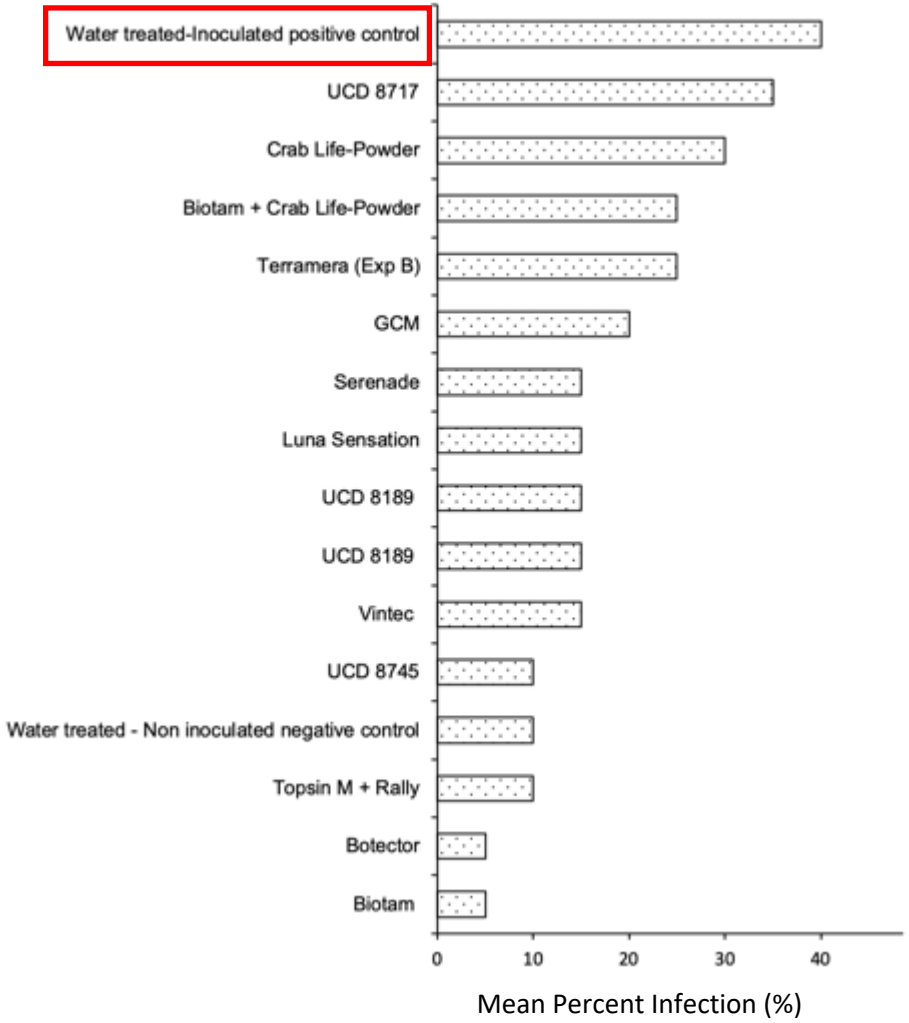


3 isolations made from pith
+
3 isolations made from areas exhibiting discoloration

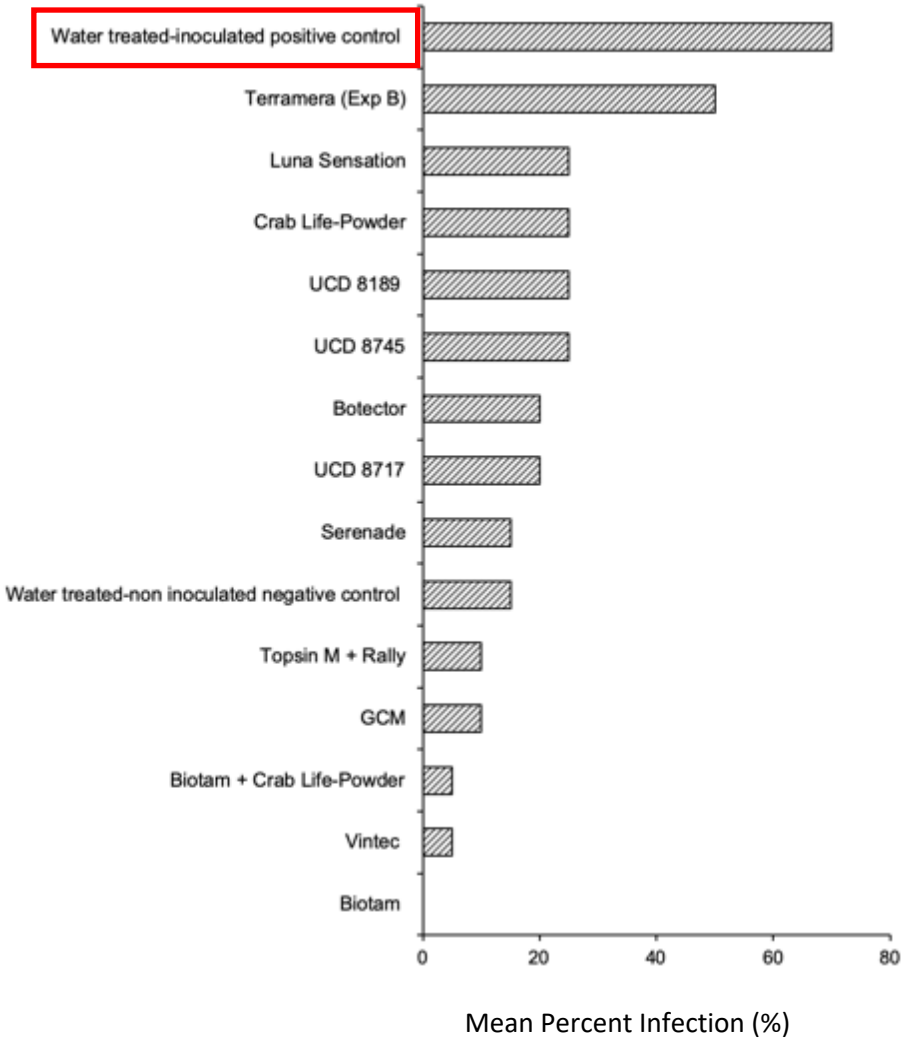
PDA-t

Results of pruning wound protection trial in Sacramento County 2020

Eutypa Lata



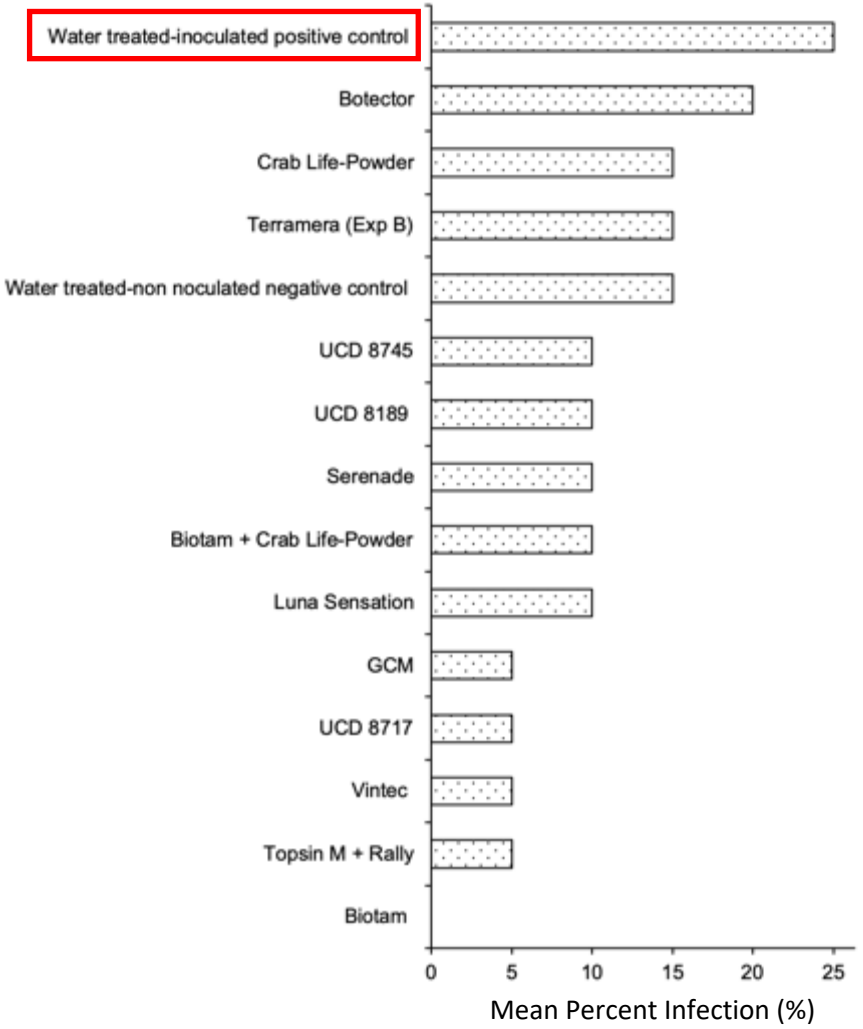
Neofusicoccum parvum



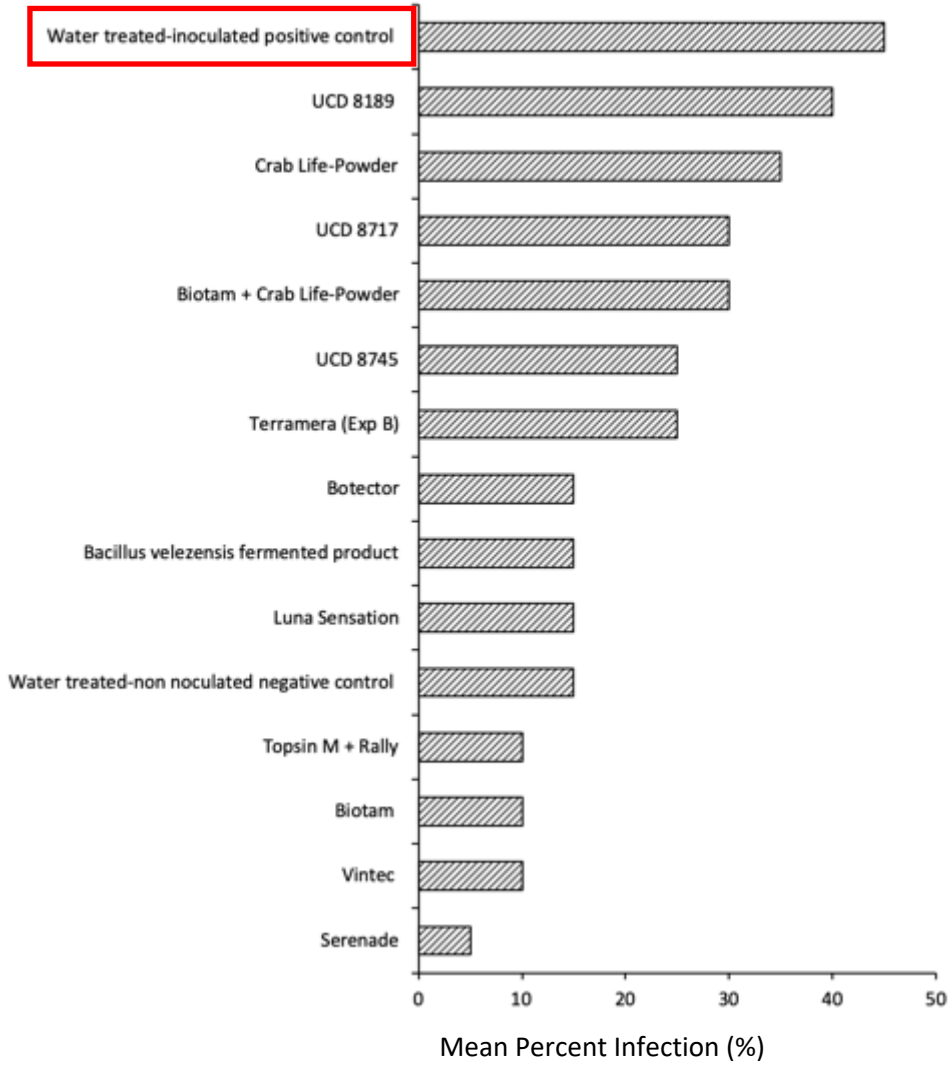
https://ucanr.edu/sites/eskalenlab/

Results of pruning wound protection trial in Kern County 2020

Eutypa Lata



Neofusicoccum parvum

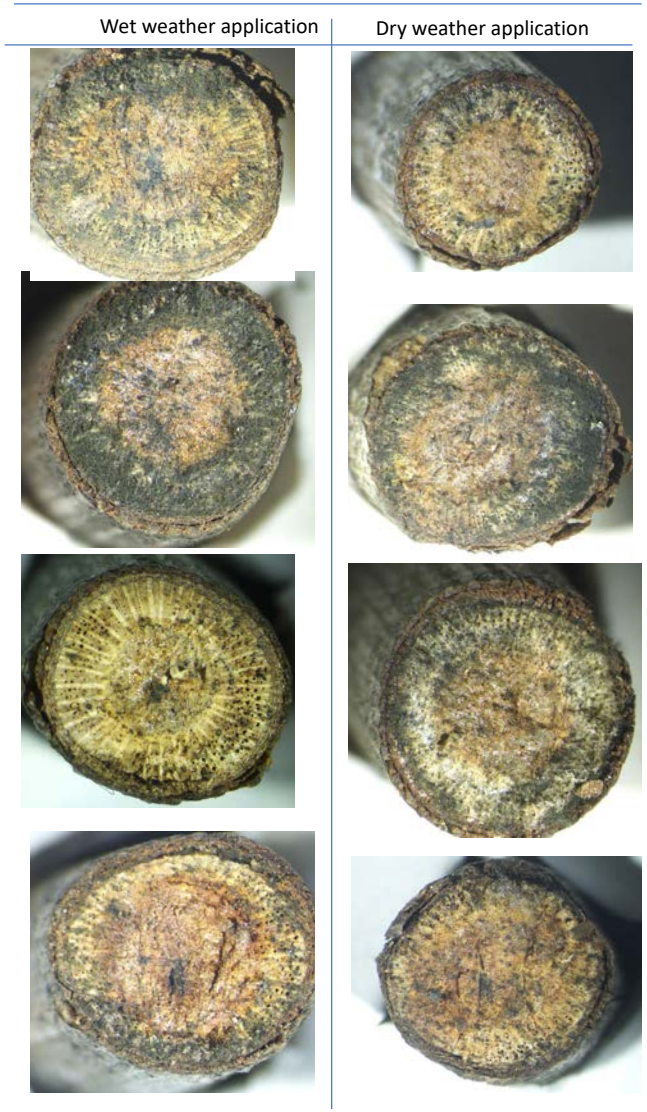


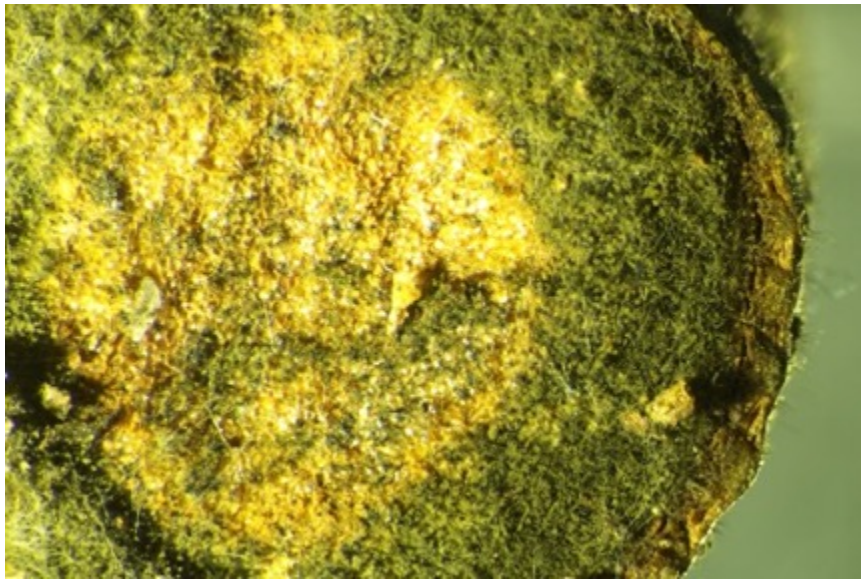
https://ucanr.edu/sites/eskalenlab/

Recovery of biological treatments from inoculated canes in October 2020

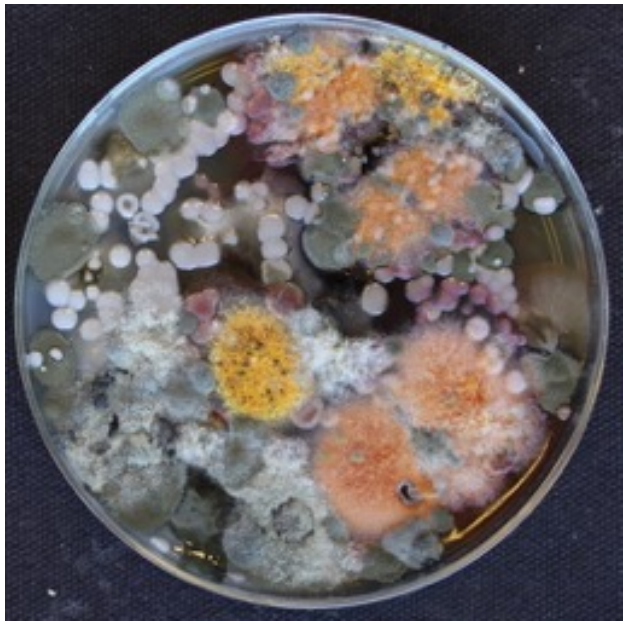
	Recovery %			
	Sacramento County		Kern County	
Treatment	***E. lata***	***N. parvum***	***E. lata***	***N. parvum***
Bacillus velezensis	0	25	25	5
Bacillus subtilis strain QST 713	0	5	0	0
Bacillus sp.	0	5	10	0
Trichoderma hamatum	0	20	20	15
Trichoderma asperellum and *Trichoderma gamsii* + a blend of crab and lonbster shell powder	35	10	30	30
Trichoderma asperellum and *Trichoderma gamsii*	60	45	20	30
Aureobasidum pullulans strain DSM14940/14941	65	100	25	30
Trichoderma atroviride	70	100	45	80
Aureobasidum pullulans	100	100	25	60

Colonization of Trichoderma species on the pruning wound

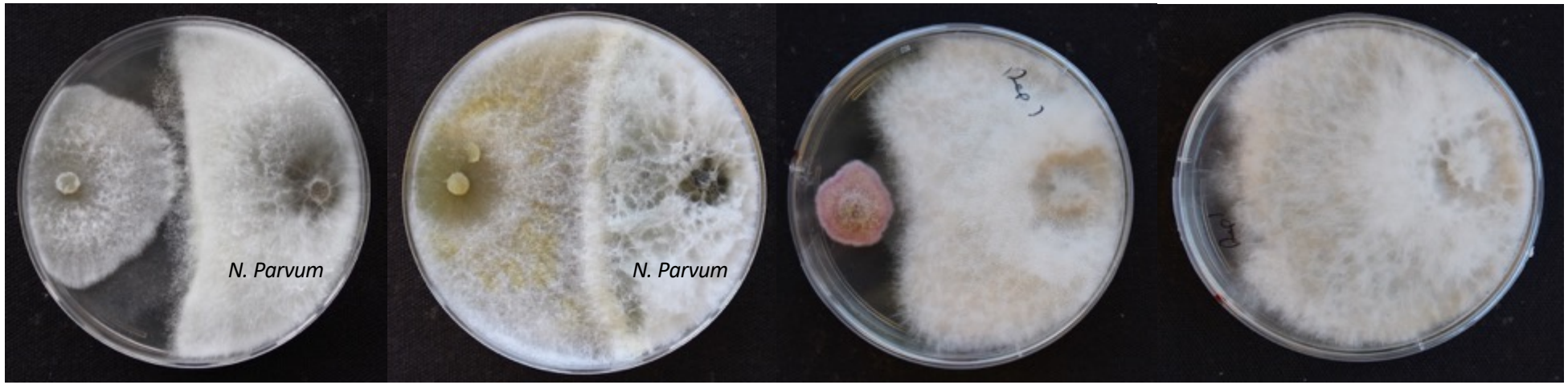




Identification of Naturally Occurring Biological Control Agents in California Vineyards



In vitro inhibition bioassays:



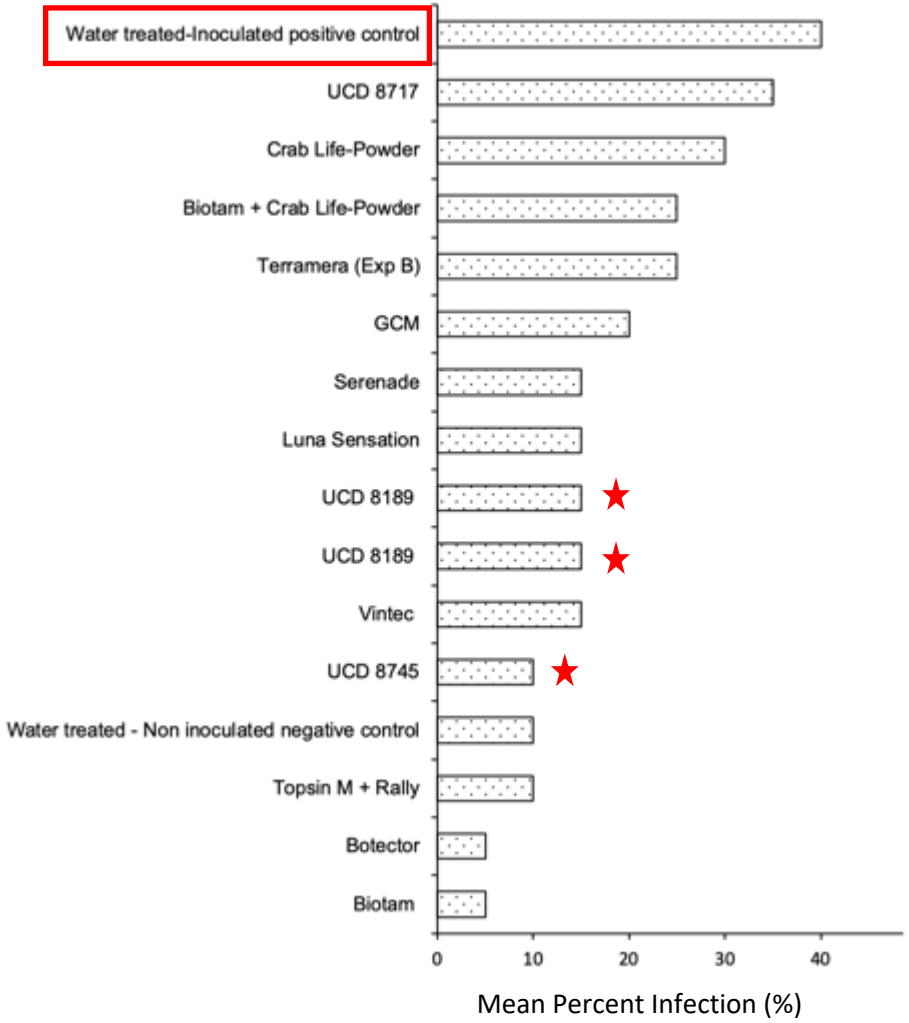
Trichoderma sp -1 | *Trichoderma* sp -2 | *Fusarium* sp. | *N. parvum* control

Radial growth of pathogen measured in presence and absence of biocontrol

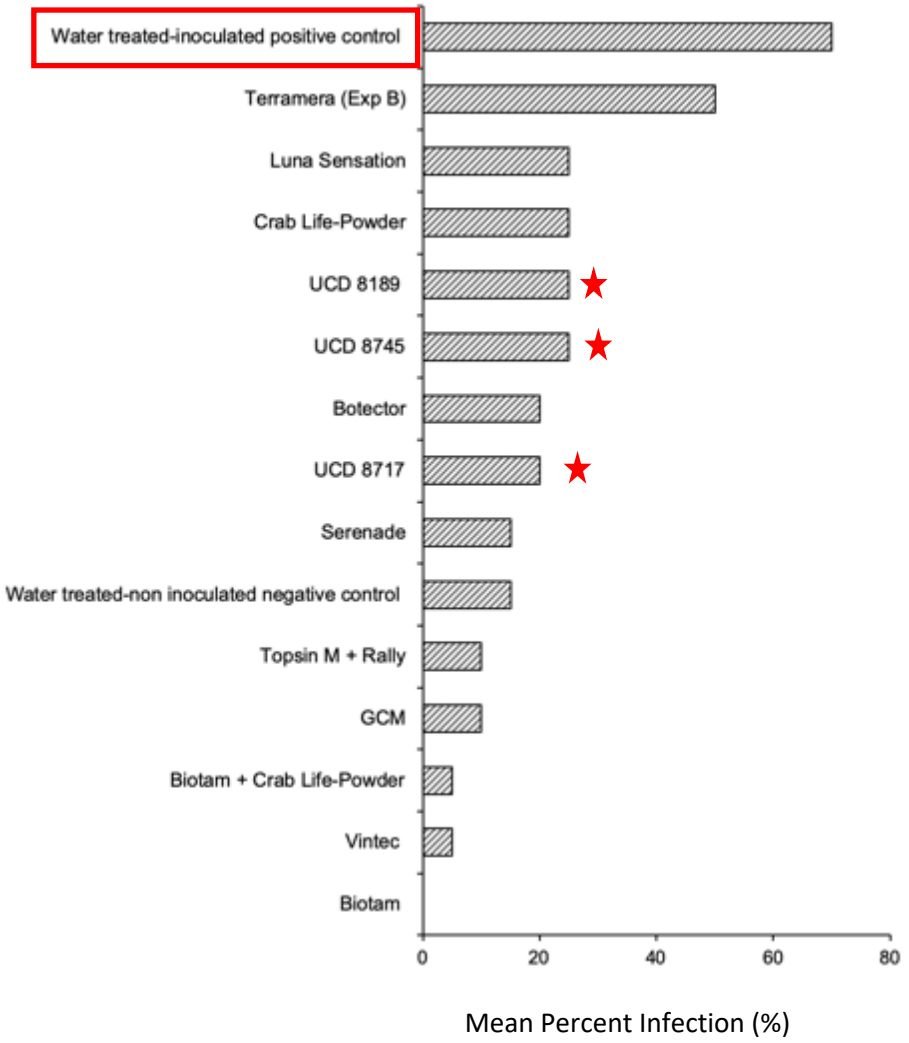
Mean % inhibition = (B-A) x 100

Results of pruning wound protection trial in Sacramento County 2020

Eutypa Lata



Neofusicoccum parvum



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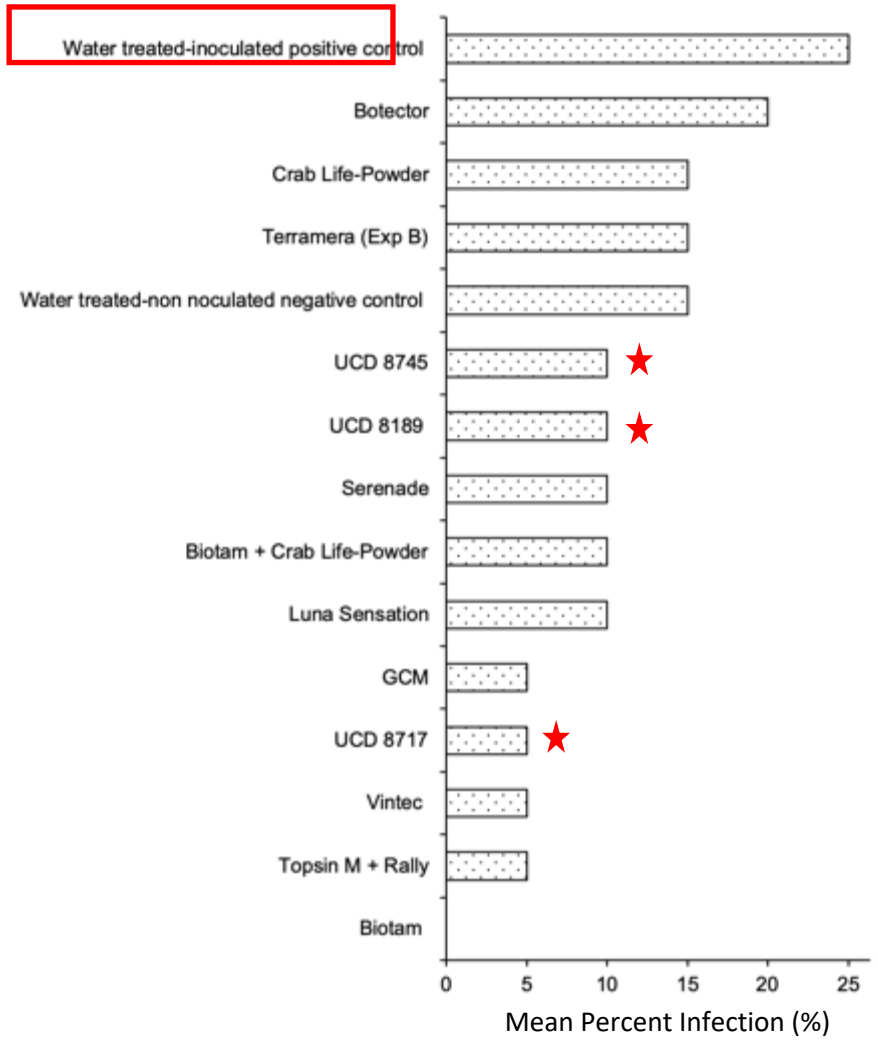
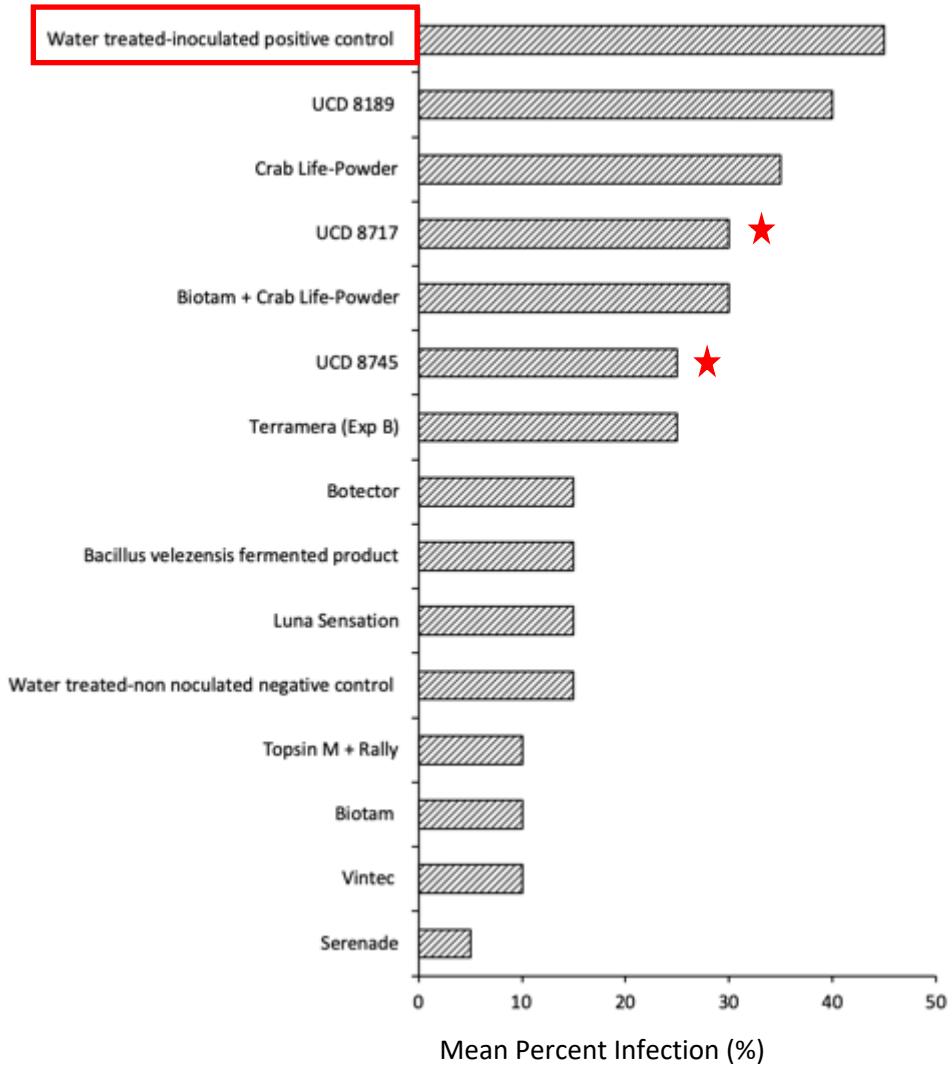
Results of pruning wound protection trial in Kern County 2020

Eutypa Lata



Neofusicoccum parvum



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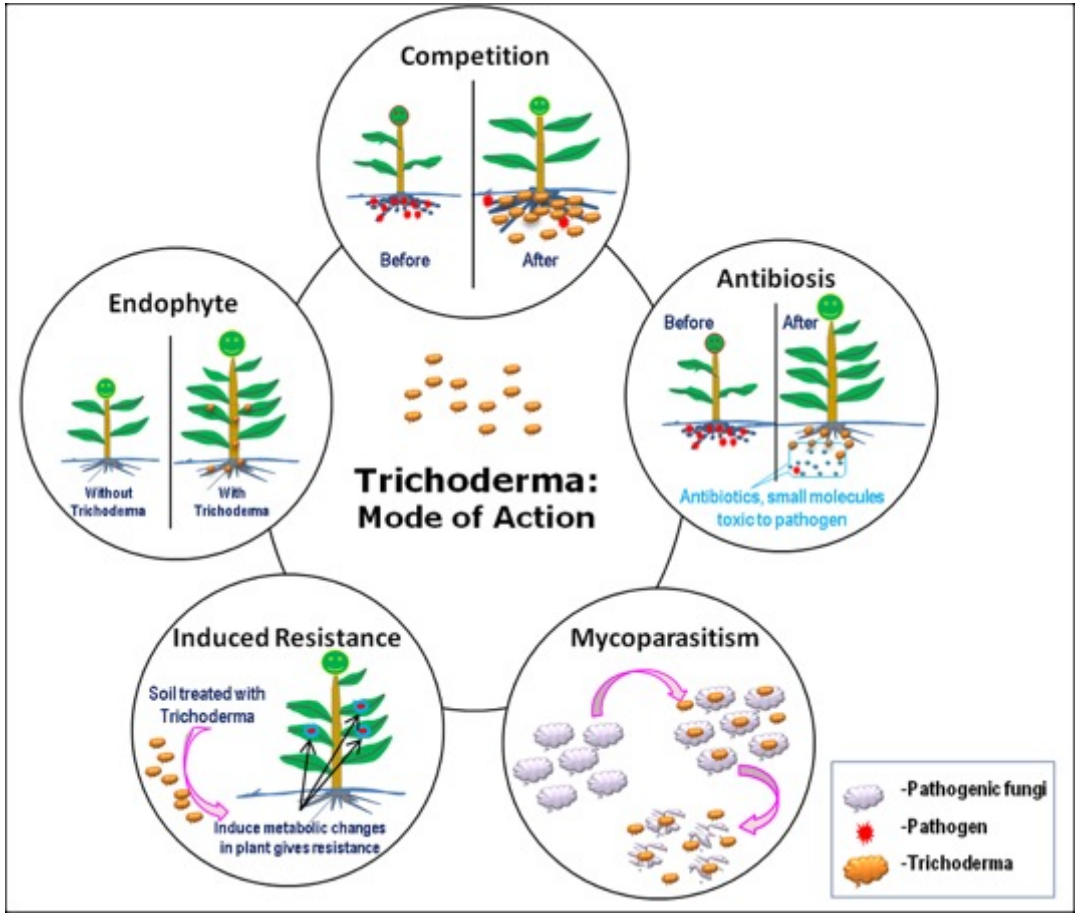
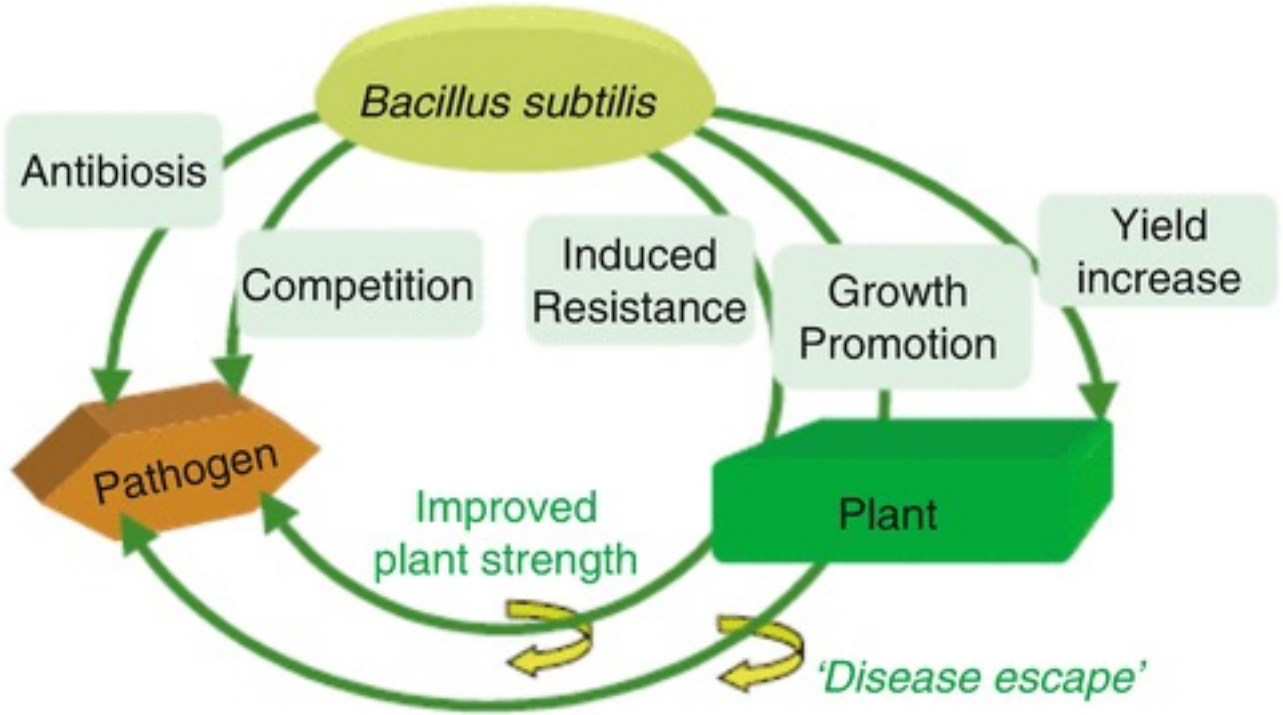
Mode of Action of Biologicals

Trichoderma spp.



[Rahul Mahadev Shelake, 2016]

Bacillus subtilis



Bohne and Helmut Junge, 2017

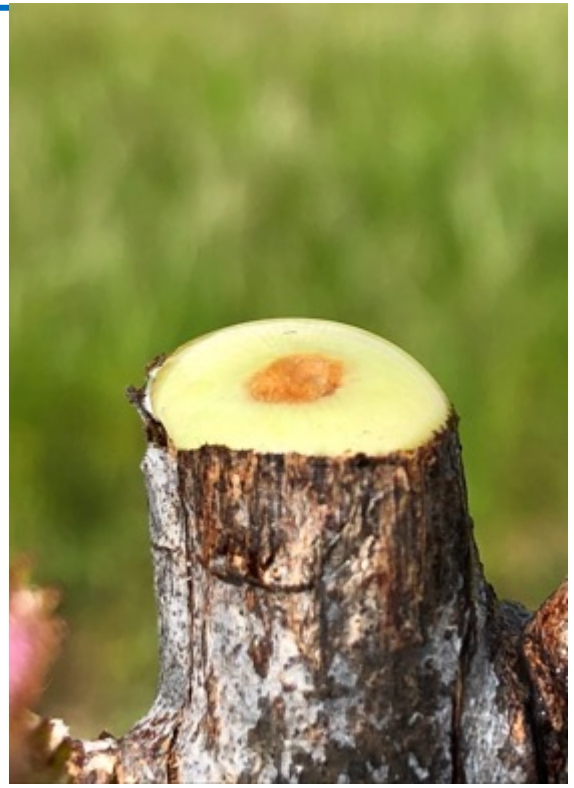
Preventative Management in Vineyards

- Protect pruning wounds
- Use disease free, clean plant materials when establish new vineyards
- Apply good cultural practices to minimize stress on young and mature vines
- Delay dormant pruning to avoid potential pathogen dissemination during winter precipitation and to reduce the susceptibility
- If applicable, consider doing double pruning to reduce fungal spore infection during winter moths

Double Pruning

- Pre pruning about 1-foot-long dormant season (December-February)
- Second prune is late pruning before budbreak

Mechanical Pruning



Controlling Options in Vineyards Cont.

- Prune dead shoots, spurs and cordons below the symptomatic tissue (at least a few inches below)
- Make a clean and smooth pruning cut to speed up the callusing process at the pruning wound
- Remove pruned plant materials away from the vineyard to prevent fungi to form pycnidia and perithecia

Conclusions:

Protecting pruning wound is essential

Options:

Biocontrol: Biotam, Vintec, Serenade, and Botector

Fungicide: Topsin-M + Rally, Luna sensation, Rhyme

Sealant: EMP polymer and Spur shield

Controlling Grapevine Trunk Diseases

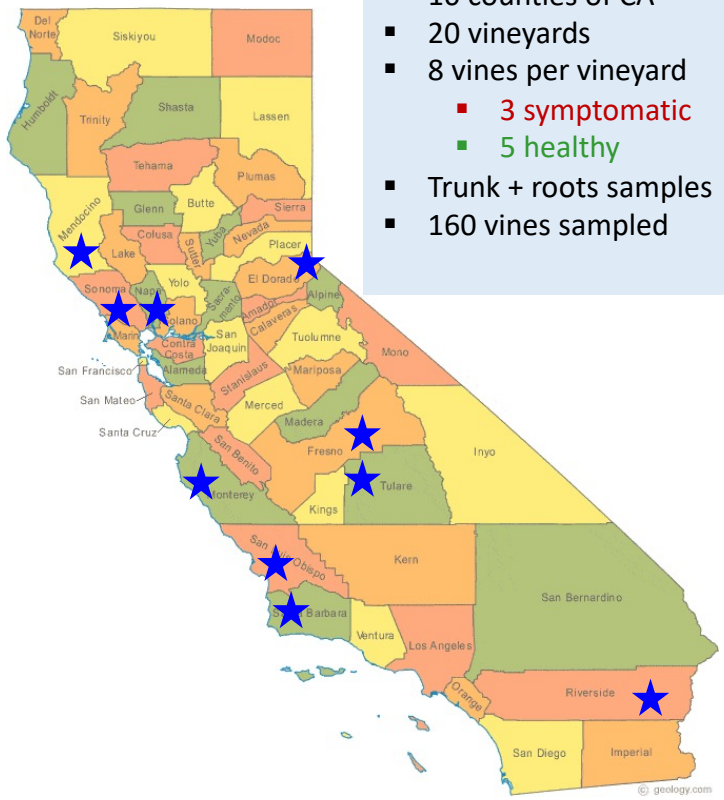
Marcelo Bustamante

Objective:

- **Screening for grapevine endophytic bacteria as potential biocontrol agents of fungal pathogens of grapevine trunk diseases**

Endophytic Beneficial Microorganisms

Vineyard Sampling for potential BCAs



1. Sampling

- 10 counties of CA
- 20 vineyards
- 8 vines per vineyard
  - 3 symptomatic
  - 5 healthy
- Trunk + roots samples
- 160 vines sampled

	County	Location	Cultivar
1	Fresno	Fresno	Thompson Seedless
2	Fresno	Fresno	Pinot Gris
3	Mendocino	Ukiah	Cabernet Sauvignon
4	Mendocino	Ukiah	Merlot
5	El Dorado	Placerville	Zinfandel
6	El Dorado	Fair Play	Syrah
7	Santa Barbara	Santa Maria	Pinot Noir
8	Santa Barbara	Los Alamos	Chardonnay
9	San Luis Obispo	Paso Robles	Cabernet Sauvignon
10	San Luis Obispo	Paso Robles	Cabernet Sauvignon
11	Tulare	Dinuba	Thompson Seedless
12	Tulare	Hanford	Pinot Gris
13	Monterey	Soledad	Chardonnay
14	Monterey	Santa Lucia Highlands	Chardonnay
15	Napa	Napa	Chardonnay
16	Napa	Napa	Cabernet Sauvignon
17	Sonoma	Geysersville	Tempranillo
18	Sonoma	Geysersville	Sauvignon Blanc
19	Riverside	Mecca	Scarlet Royal
20	Riverside	Mecca	Scarlet Royal

UCCE Farm Advisors

Rhonda Smith
Lynn Wunderlich
Mark Battany
Glenn McGourty
Carmen Gispert
Monica Cooper
Gabriel Torres
George Zhuang
Larry Bettiga

Methodology: Obtaining a bacterial endophyte collection

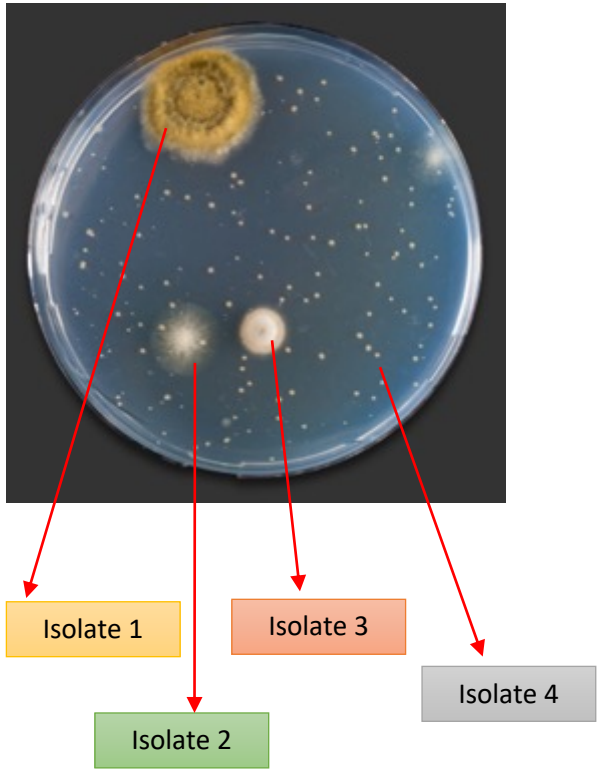
Sampling of grapevine material
- Trunk + roots samples
- 160 vines sampled total
- Non-destructive methodology

Isolation of bacteria (semi-selective media)

Screening against trunk pathogens

Trunk and cordon sampling

Feeder roots sampling



Fruit Crop Fungicide Efficacy Trials

Fungicide efficacy trials have been conducted using conventional/novel programs to treat various fungal diseases of grapevine, apple, pear, cucurbit, and other small fruit crops. Viewers will be able to access information on trial design, treatment list, weather data, final result, and other relevant trial details.

The crossed-out reports mean the trials were conducted but the environmental conditions that year were not conducive to the studied disease. The treatments described in these reports were conducted for experimental purposes only and crops treated in the same manner may not be suitable for commercial or other use or consumption.

2021 Trials

- **2021 Grape Powdery Mildew Fungicide Efficacy Trial Report**
- **2021 Grape Bunch Rot Fungicide Efficacy Trial Report**
- **2020 Pear Scab Fungicide Efficacy Trial Report**

2020 Trials

- 2020 Grape **Powdery Mildew** Fungicide Efficacy Trial Report (Sacramento County)
- 2020 Grape **Bunch Rot** Fungicide Efficacy Trial Report (Yolo County)
- 2020 **Pear Scab** Fungicide Efficacy Trial Report (Lake County)
- 2020 Evaluation of **Pruning Wound** Protectants for Grape Trunk Diseases (Sacramento County)
- 2020 Evaluation of **Pruning Wound** Protectants for Grape Trunk Diseases (Kern County)
- 2020 Evaluation of **Pruning Wound** Protectants for Grape Trunk Diseases (Yolo County)
- ***In vitro* Test to Evaluate the Efficacy of Flutriafol (Rhyme) for Selected Fungal Pathogens Using Spiral Plate Gradient Dilutions**

2019 Trials

- 2019 Grape Powdery Mildew Final Report
- 2019 Grape Botrytis Bunch Rot Report
- 2019 Evaluation of Biological and Chemical Pruning Wound Protectants Against Selected Fungi Associated with Grape Trunk Diseases
- 2019 Grape Pruning Wound Protection Trial with Biotam
- 2019 Grape Pruning Wound Protection Trial with Vintec

Acknowledgements

Cooperators and UCCE Farm Advisors

Mark Battany – UCCE San Luis Obispo, Santa Barbara
Larry Bettiga – UCCE Monterey
Monica Cooper – UCCE Napa
Carmen Gispert – UCCE Riverside
Glenn McGourty – UCCE Mendocino
Rhonda Smith – UCCE Sonoma
Gabriel Torres – UCCE Tulare
Jose Ramon Urbez-Torres – Agriculture and Agri-Food Canada
Lynn Wunderlich – UCCE Central Sierra
George Zhuang – UCCE Fresno

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AMERICAN VINEYARD FOUNDATION

Eskalen Lab, Department of Plant Pathology, UC Davis