Grapevine Trunk Diseases: Pruning Wounds Protection and Aspergillus Vine Canker

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University of California, Davis

Advances in Vineyard Management
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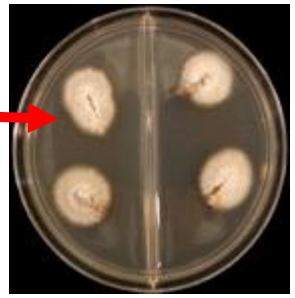
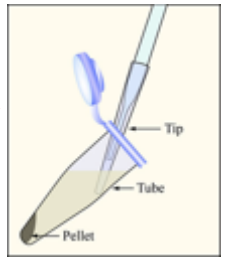
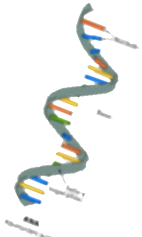
Diagnostic Service to Research Topic

Symptomatic plant tissue

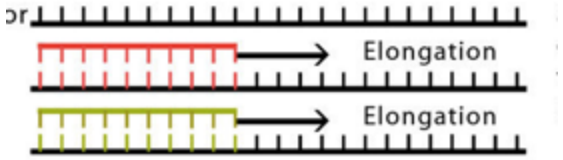


Culture Media



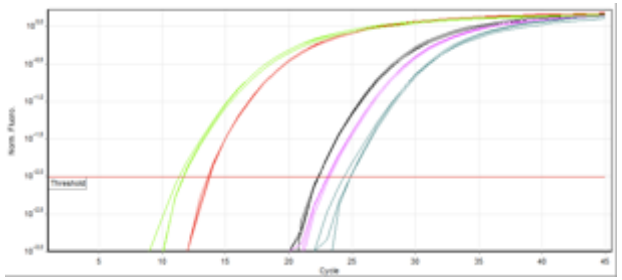


DNA Extraction

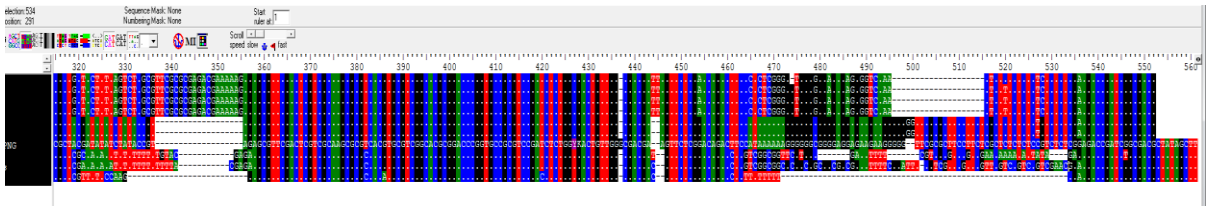


Species Specific Primers

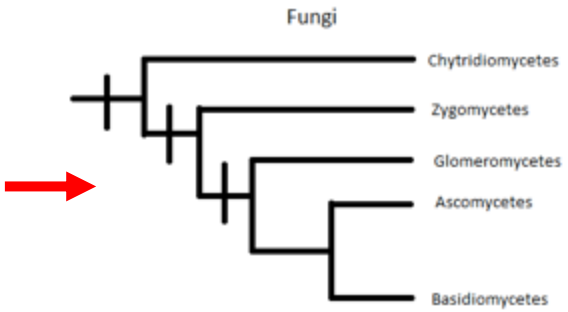
Quantitative Real Time PCR



Identification based on melting curve

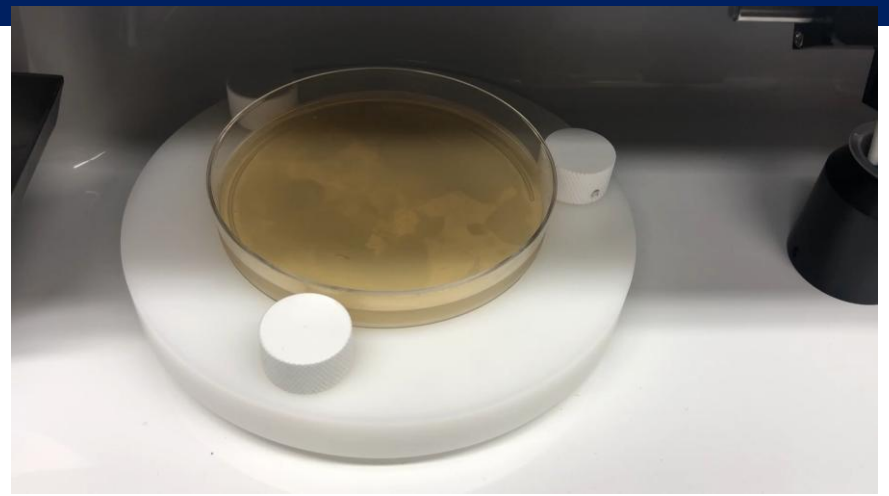


Sequencing the DNA Region

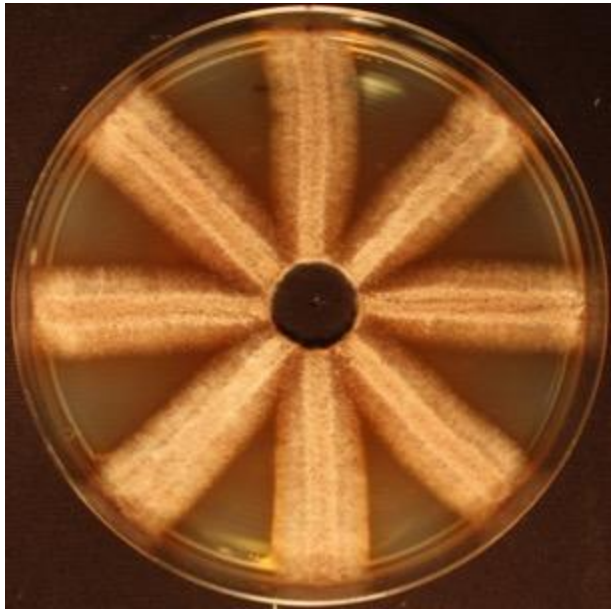


Phylogenetic Tree

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/

Advancing biopesticides for the management of Pierce's disease on grapevine

Grapevine Trunk Diseases

- Young Vine Decline
- Esca
- Fusarium canker
- Eutypa Dieback
- Botryosphaeria Dieback
- Diaporthe Canker
- Aspergillus Vine Canker
- Cytospora Canker
- Black Foot

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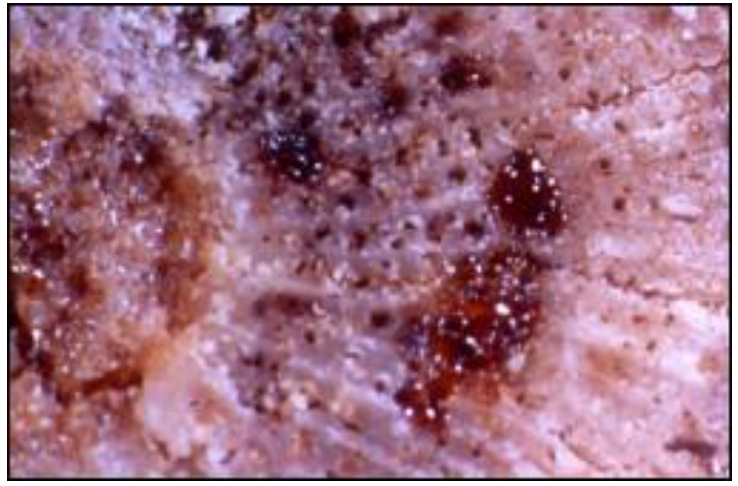
Vascular disease

Canker disease





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Canker disease

- Black Foot

Root disease




Aspergillus Vine Canker

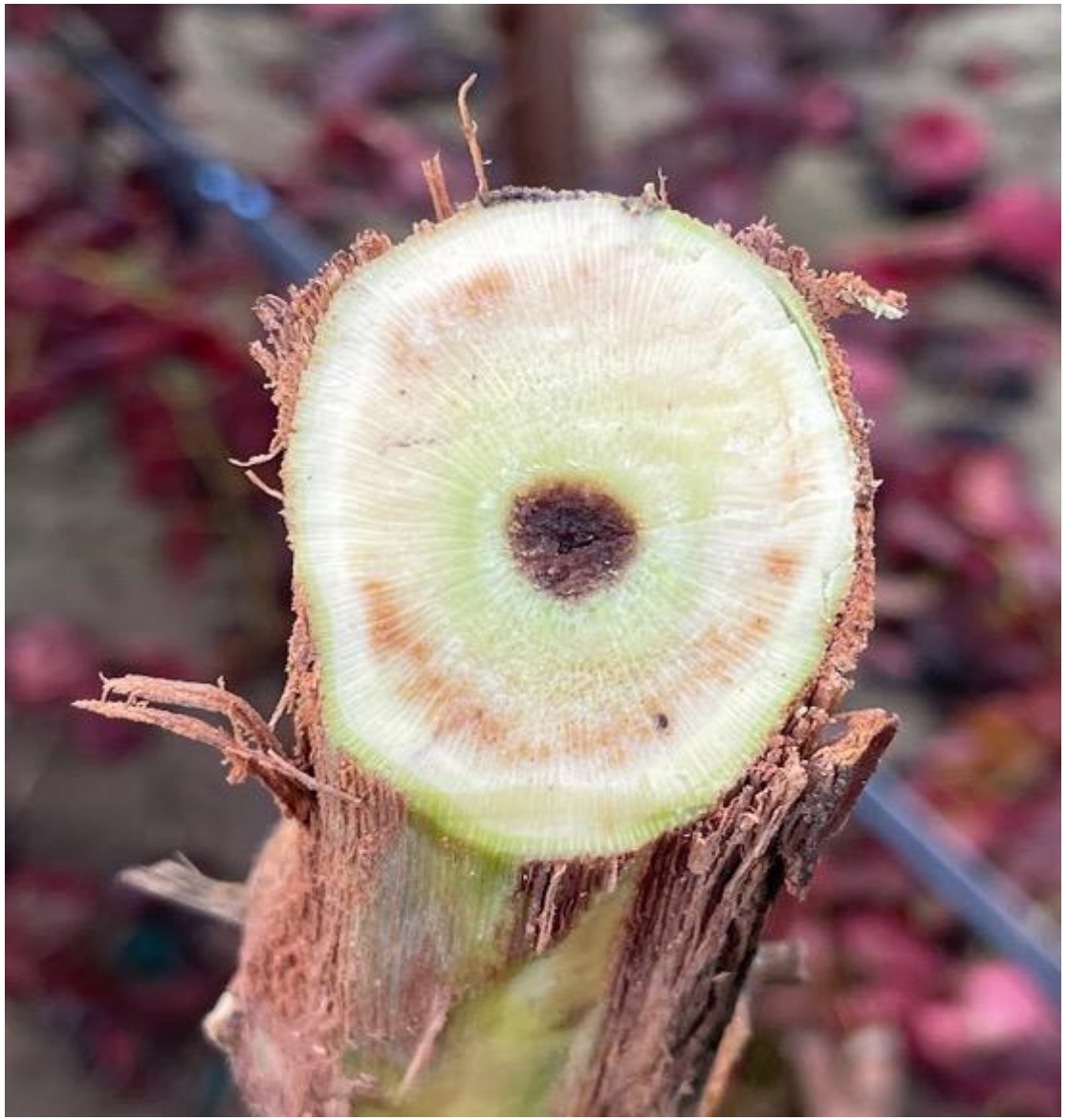
- **In California, sour rot has been attributed to a complex of microorganisms including *Botrytis cinera*, *Aspergillus niger*, *A. carbonarius*, and others (Latham et al 2008)**

Unusual fall symptoms on virus free grapevines

Grenache cv./ Freedom

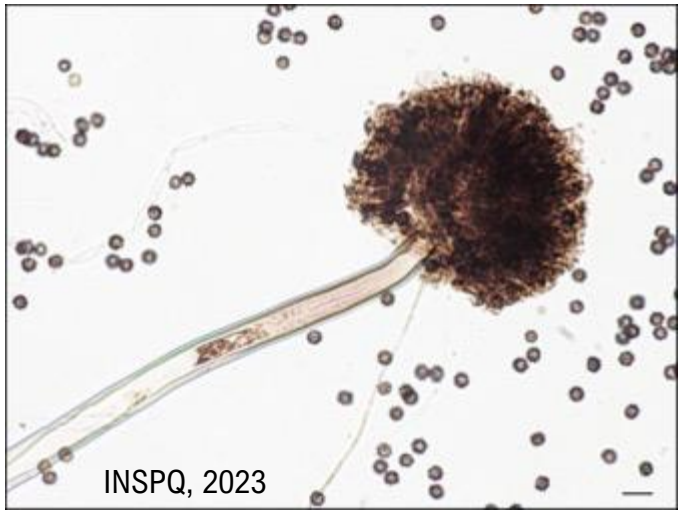
External Symptoms

Internal symptoms:



Survey of AVC- and SR-associated isolates

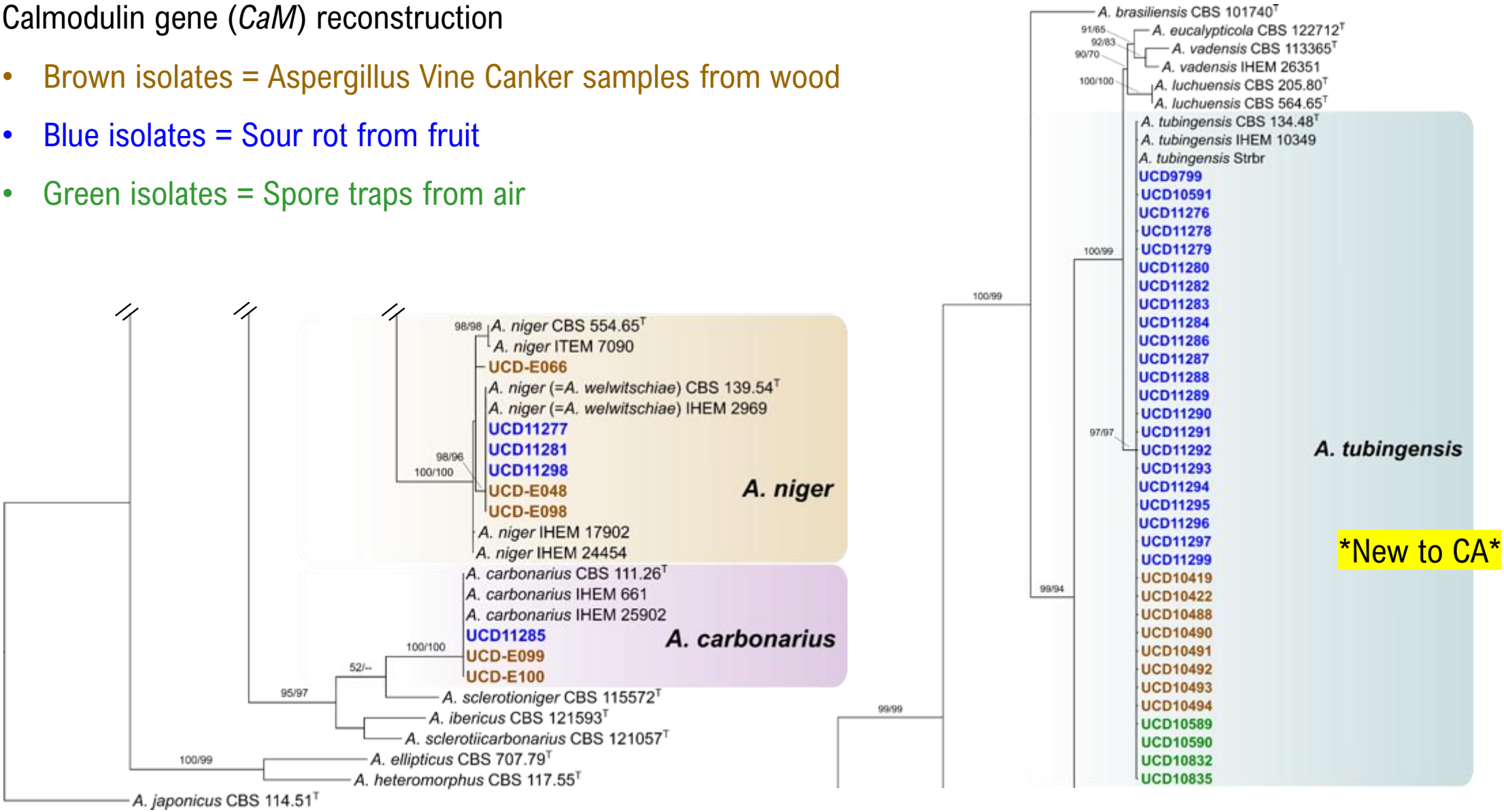
Origin	Number of isolates (*n*)
AVC samples 2021	10
AVC isolates 2000 (T. J. Michailides)	5
Sour Rot isolates	255
Spore trap isolates	20
Total	**290**



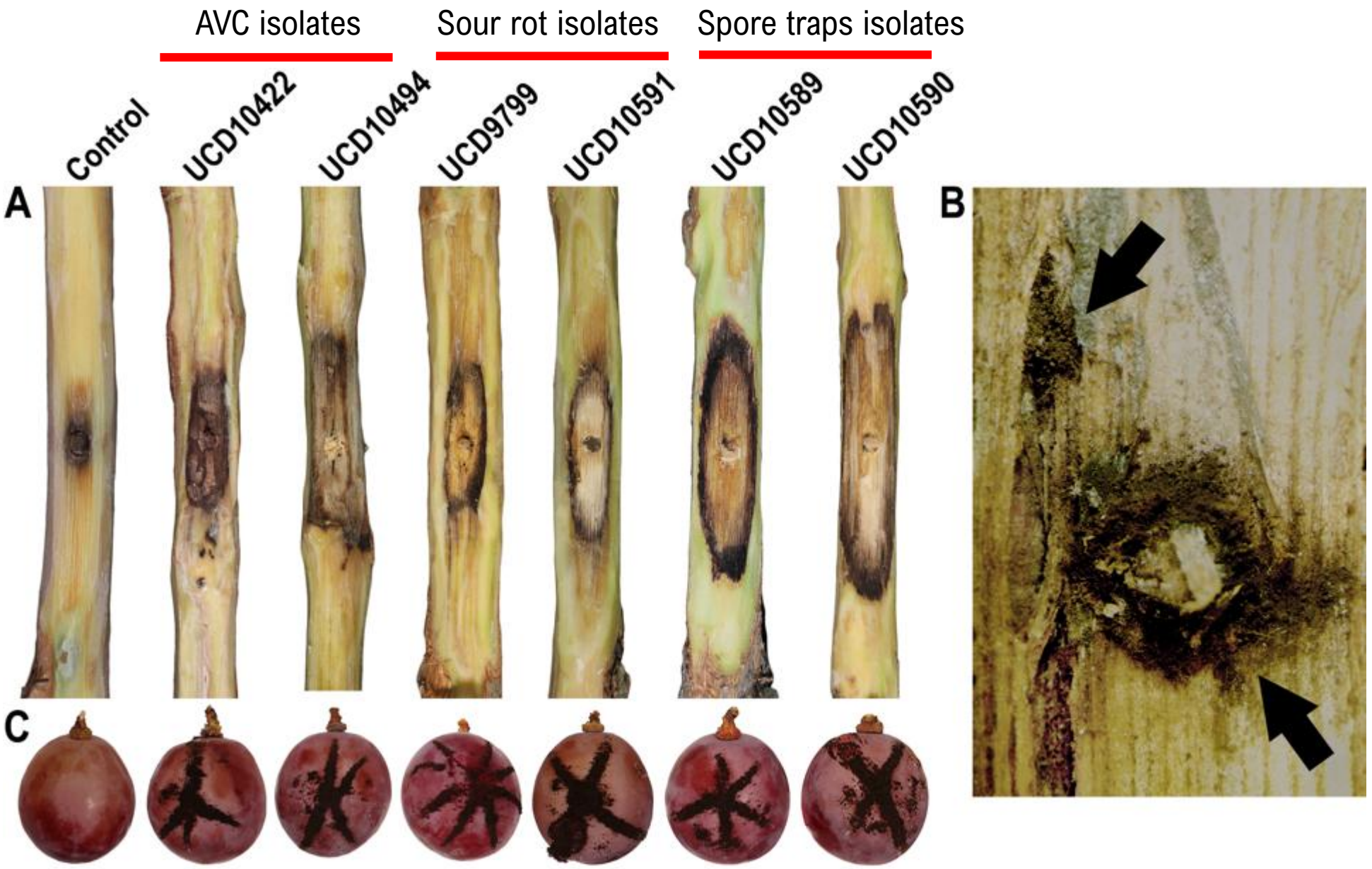
Identification of *Aspergillus* spp.

Calmodulin gene (*CaM*) reconstruction

- Brown isolates = Aspergillus Vine Canker samples from wood
- Blue isolates = Sour rot from fruit
- Green isolates = Spore traps from air

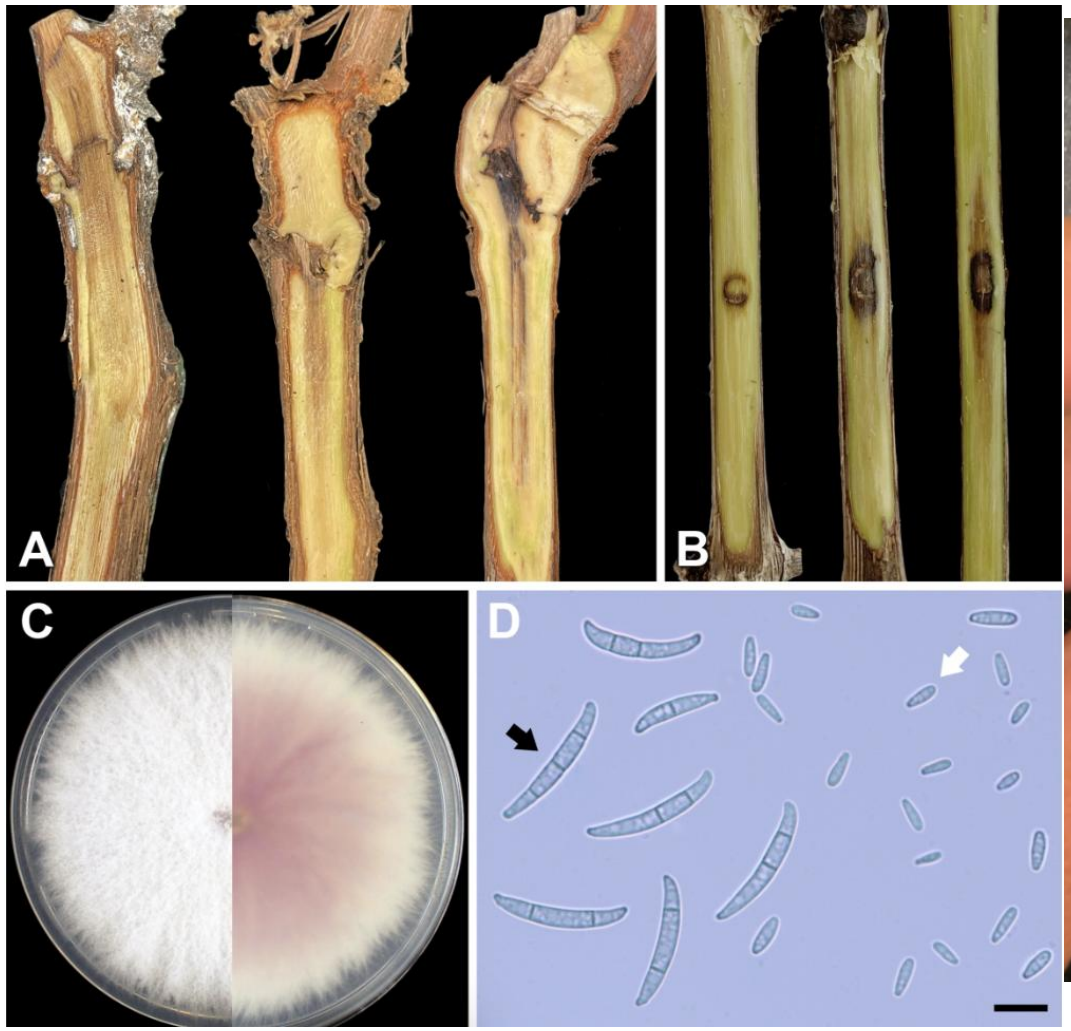


Pathogenicity of *Aspergillus tubingensis*



Macrophomina Charcoal Rot *(Macrophomina phaseolina)*

Young vine decline and *Fusarium annulatum*

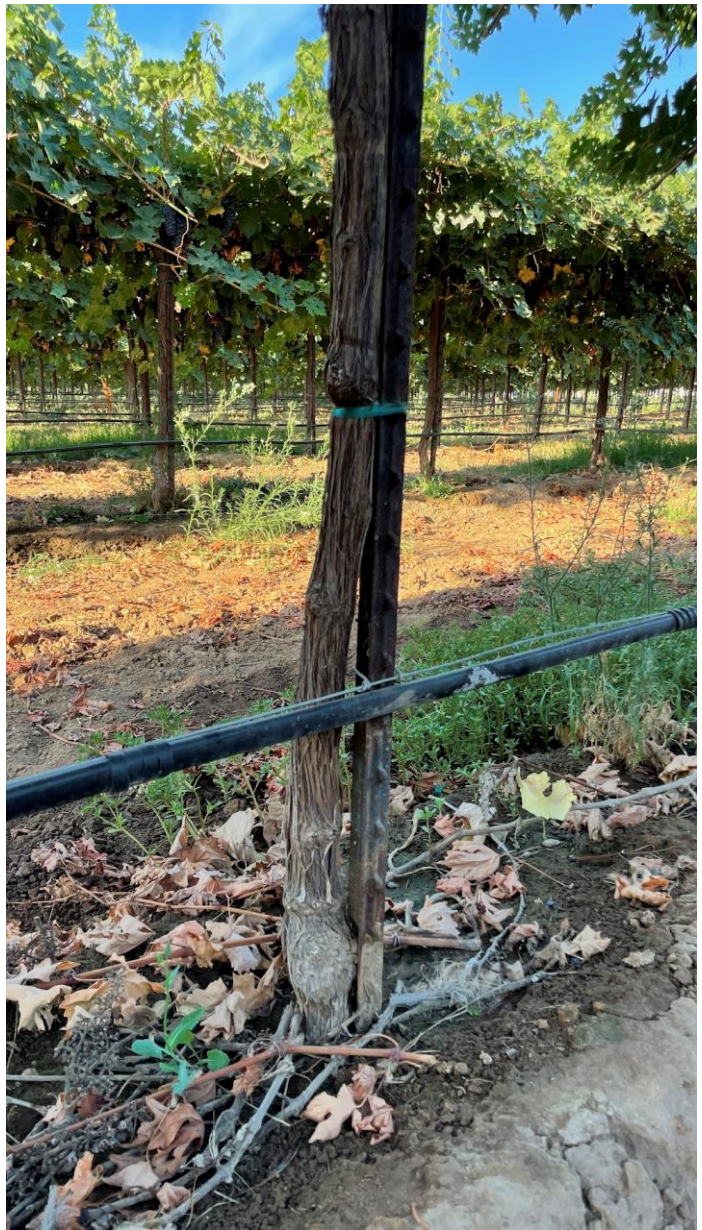


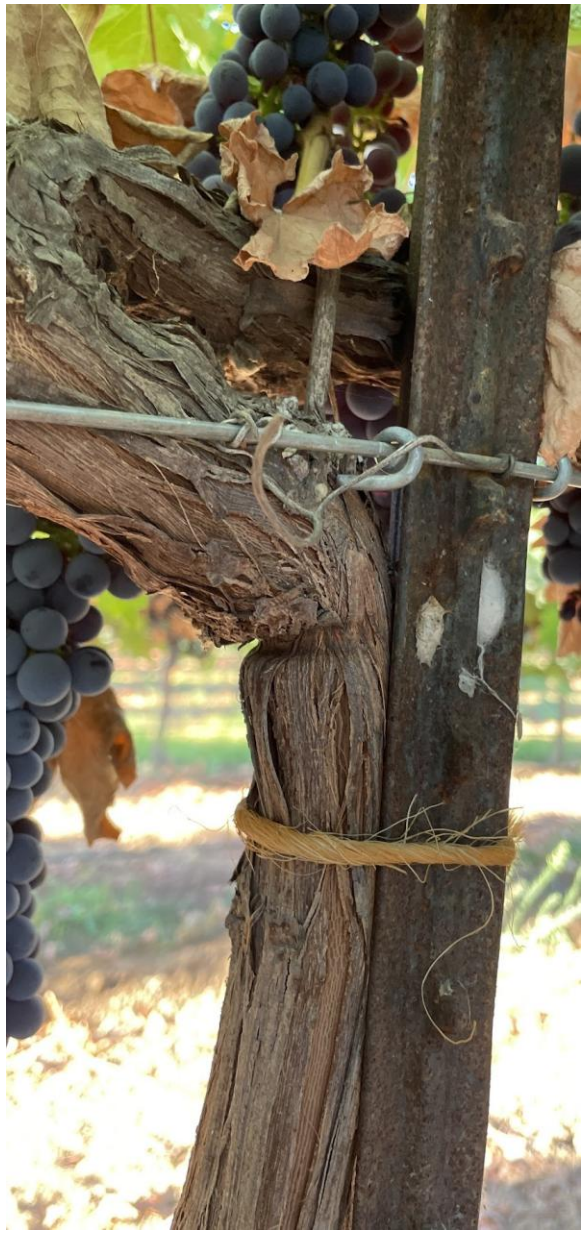
Bustamante et al. 2022 First Report of *Fusarium annulatum* Associated with Young Vine Decline in California. Plant Disease.

Other diseases and disorders

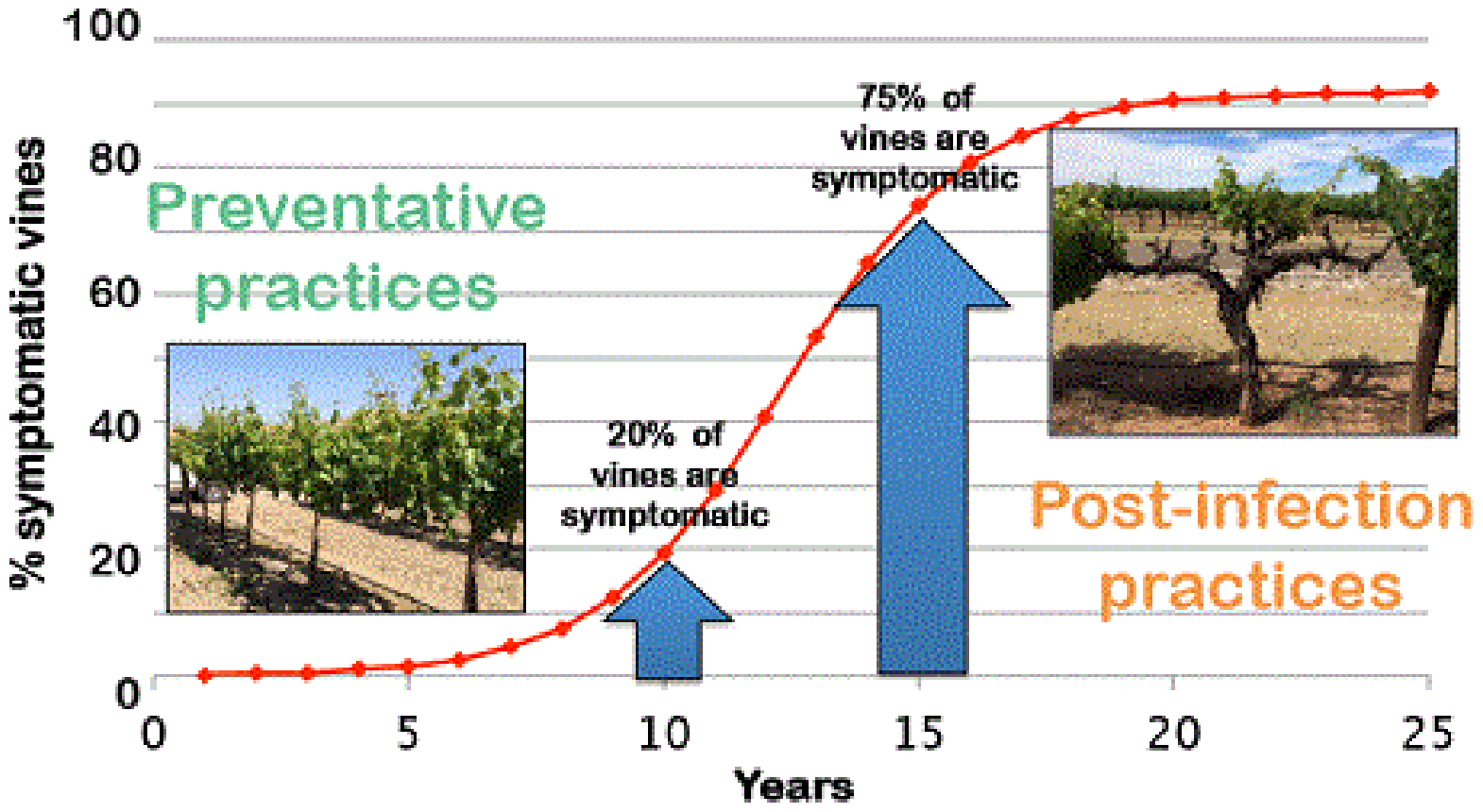
Trunk roots

Other diseases and disorders



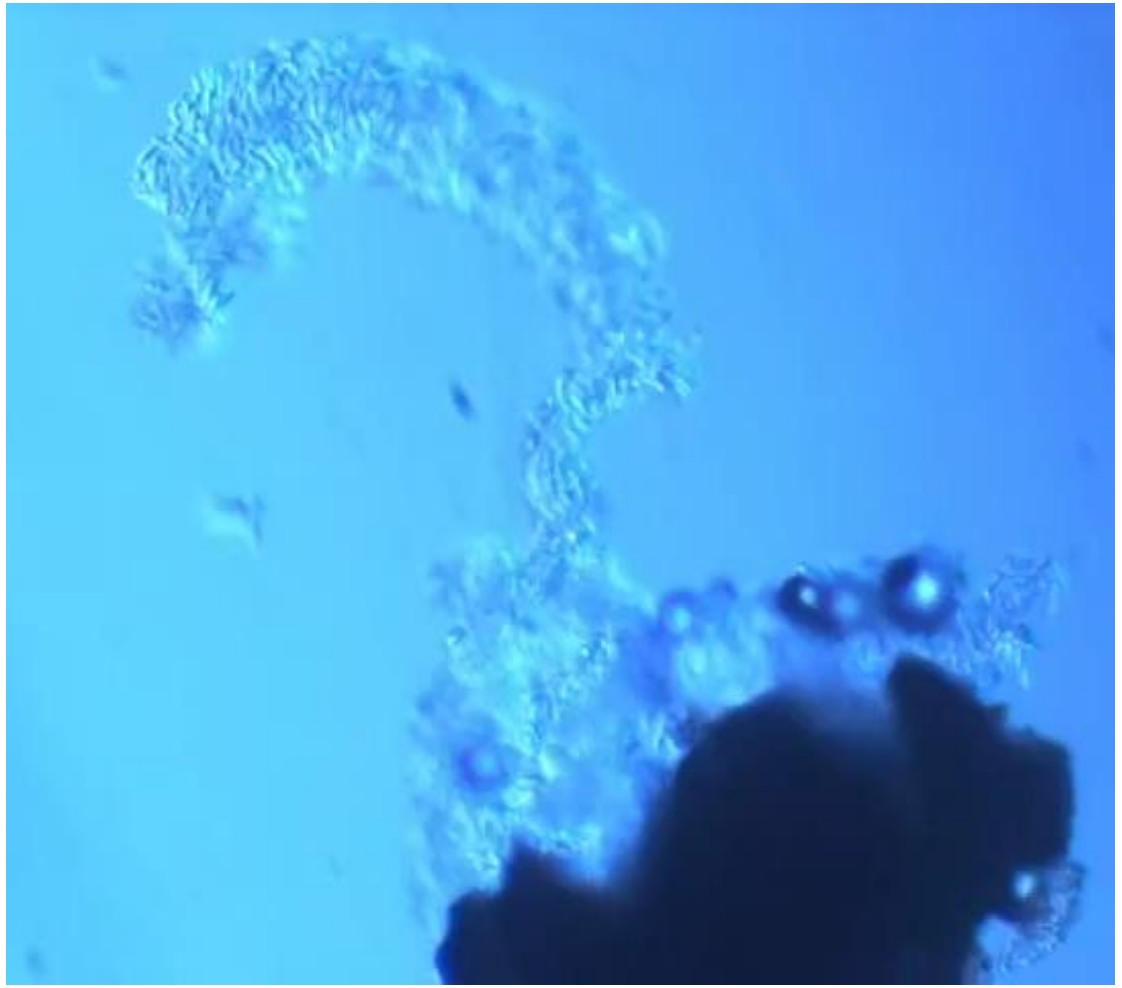


Disease incidence increases with vineyard age



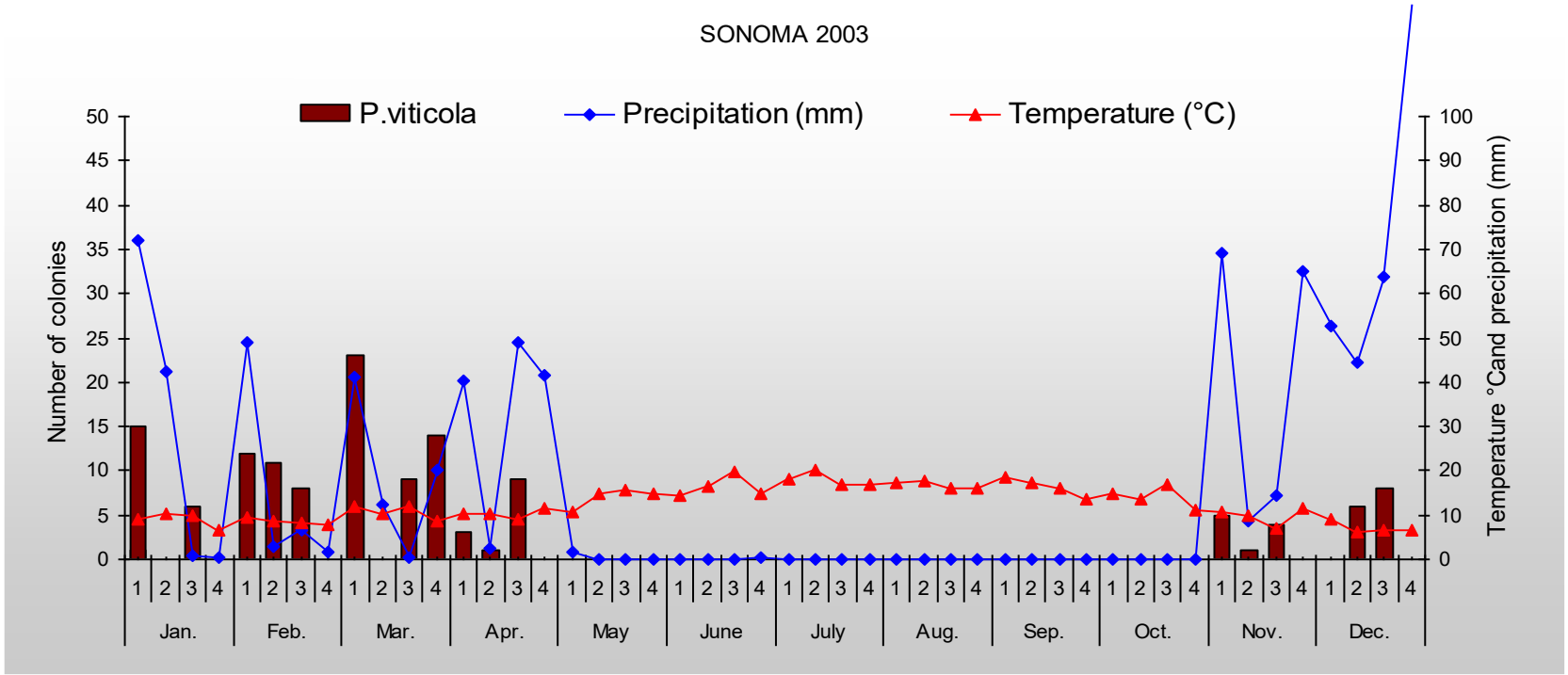
From Duthie et al. 1991 (Colombard vineyards ranging from 5 to 34 years)

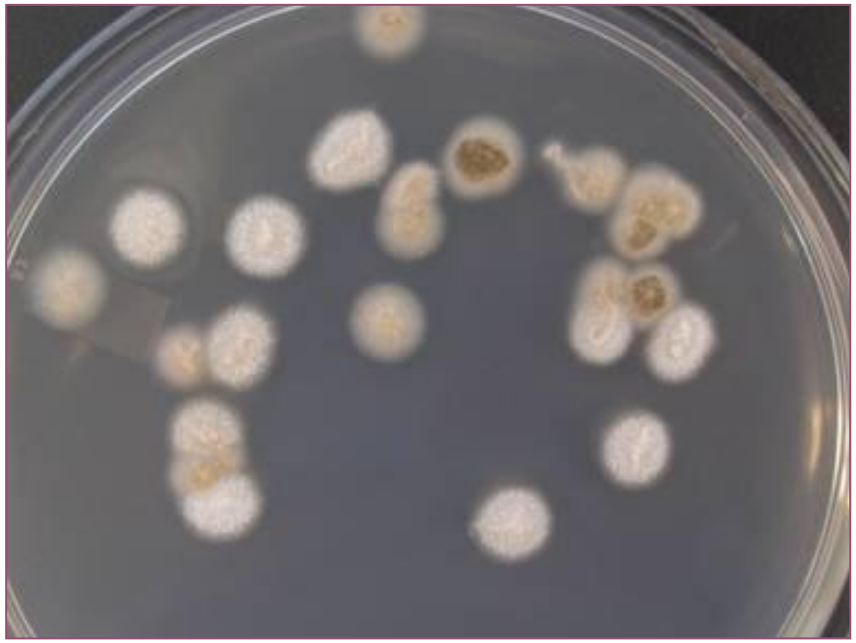
Pycnidia: Asexual Structures and Inoculum Source



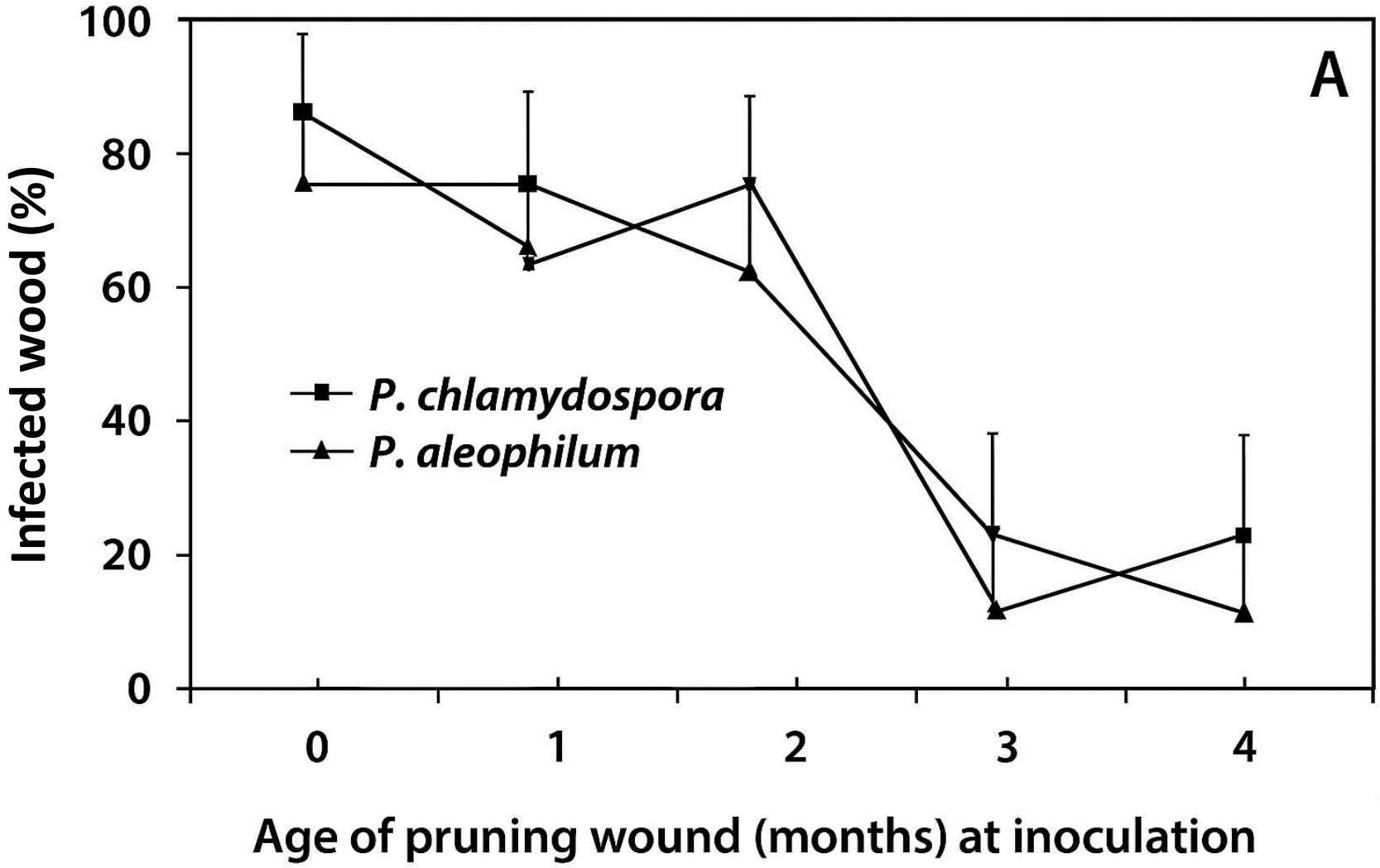
Perithecia: Sexual Structures and Inoculum Source

When and How GTD Spores Spread in Vineyards





Susceptibility of pruning wounds



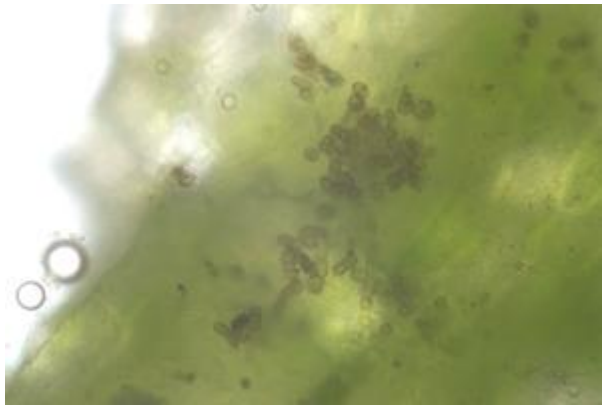
Eskalen et al. Plant Disease, 2007, 91:9, 1100-1104.

Pathways of Grapevine Trunk Disease Infection

- Pruning wounds

- Latent Infection

- Endophyte



Infection of GTD in various parts of the vine

Spurs

Cordon

Trunk

Rootstock

Why Is It So Hard to Manage Grapevine Trunk Diseases?

- Infections happen silently and early—**no symptoms for years**
- Once inside the wood, **pathogens are hard to reach**
- Vines are often infected by **multiple pathogens at once**
- **No single "cure"**—management is complex and long-term
- Pruning wounds: **annual entry points**
- **Replanting doesn't solve it** if the inoculum stays in the soil or ai

Vineyard Sanitation and Remedial Surgery

- 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

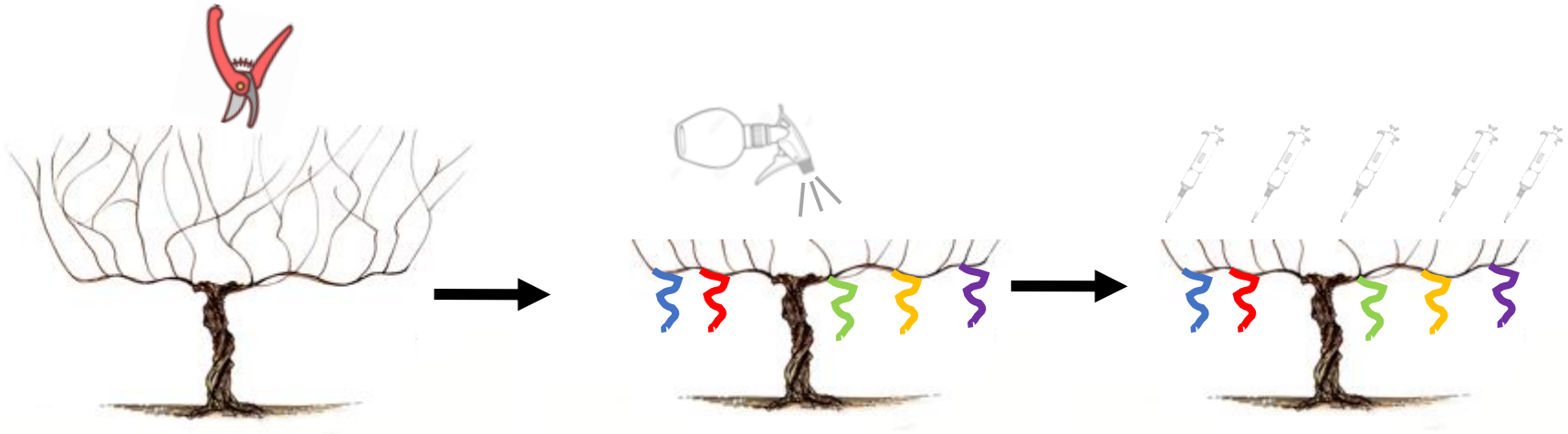
Double pruning

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

Pathways of Grapevine Trunk Disease Infection

- Pruning wounds

Field trial in 2019-2025 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 for *Neofusicoccum parvum* in 2022

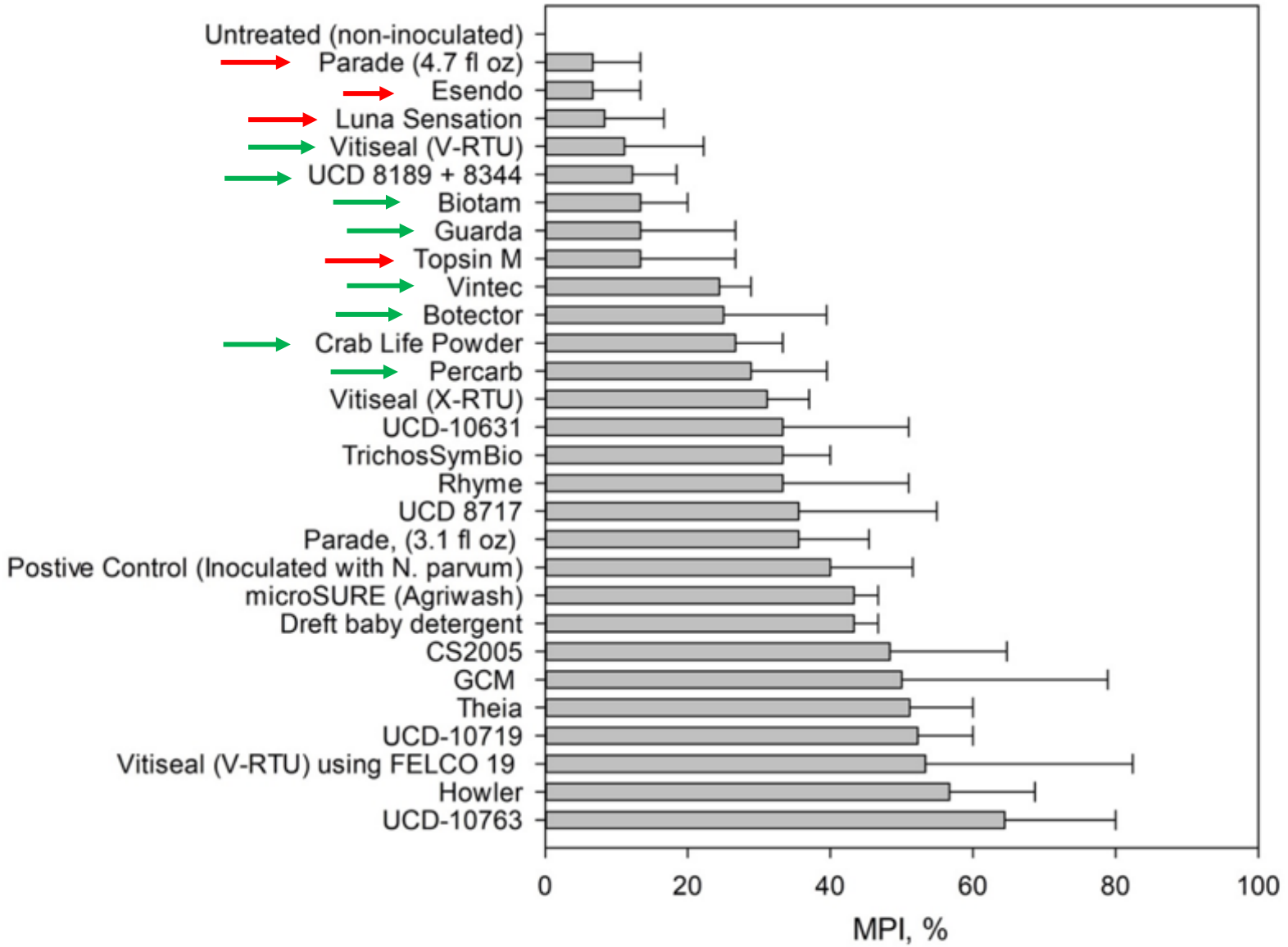


Figure 2. Evaluation of pruning wound treatments mean percent infection (MPI) rates with *N. parvum* located at UC Davis Plant Pathology Field Station, 2022. Bars = standard errors.

https://ucanr.edu/sites/eskalenlab/files/378928.pdf

Protecting pruning wound is essential

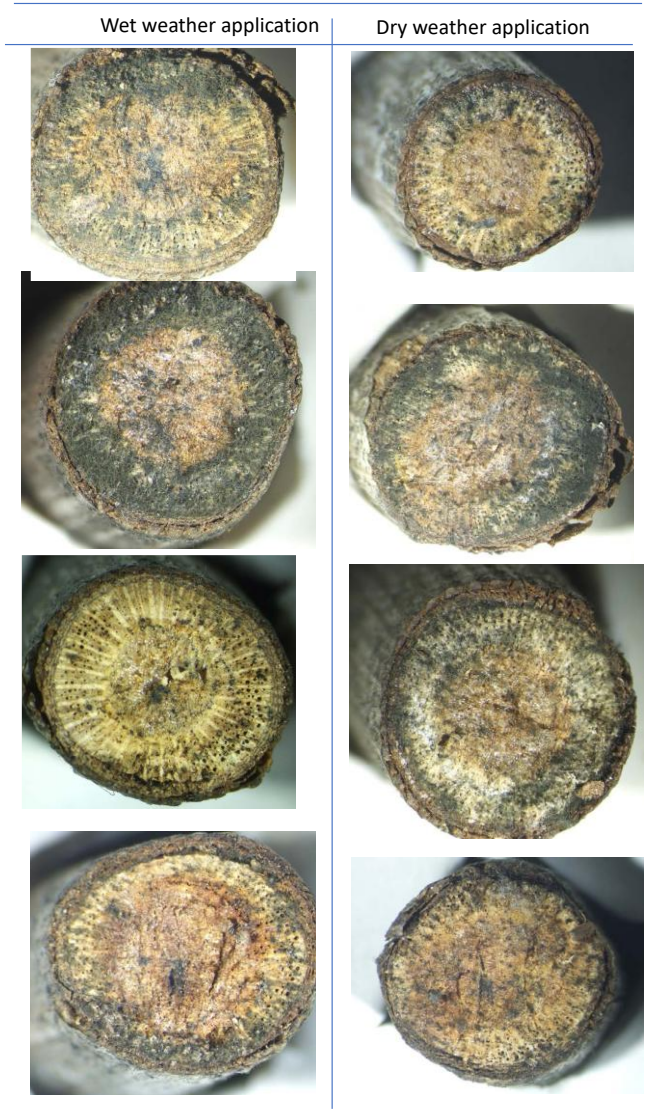
	Commercial name	Active ingredient	Manufacturer
Biocontrol	Biotam (Frac BM2)	(*Trichoderma asperellum* + *T. gamsii*	SepRo
	Vintec (Frac BM2)	*Trichoderma atroviride* SC1	BI-PA
	Botector (Frac BM2)	*Aerobasidium pullulans*	Westbridge
	Bacillus velezensis UCD	*Bacillus velezensis CE100*	BSR
Plant extract	Guarda	Thyme oil	Biosafe System
Synthetic fungicides	Topsin-M (FRAC1)	Triophanate-methyl	United Phosphorous
	Luna sensation (FRAC-7)	Fluopyram/Trifloxystrobin	Bayer CropScience
	Esendo (FRAC 11)	Azoxystrobin + Pseudomonas chlororapsis	Agbiome
	Rhyme (FRAC 3)	Flutriafol	FMC
	Parade	Pyraziflumid	Nichino America
Sealant	Vitiseal Spur Shield	Acrylic Co-Polymer; Polymer of Cyclohexane, 1 methyl-4 (1-methylethyl)	Vitiseal International Miller Huber Company
Disinfectant	PerCarb	Sodium carbonate peroxyhydrate (85%)	Biosafe Systems

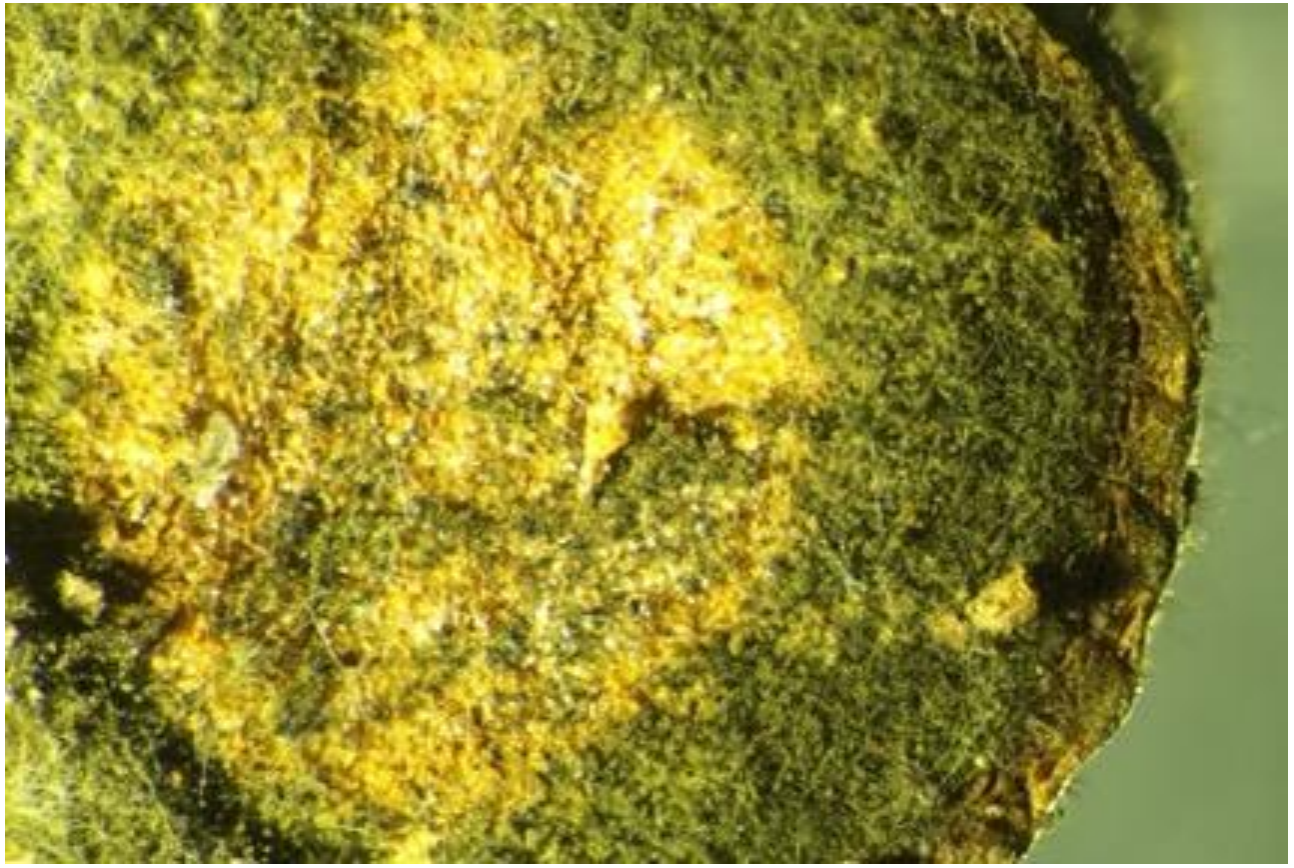
https://ucanr.edu/sites/sukalelab/

Recovery of biological treatments after 6 months

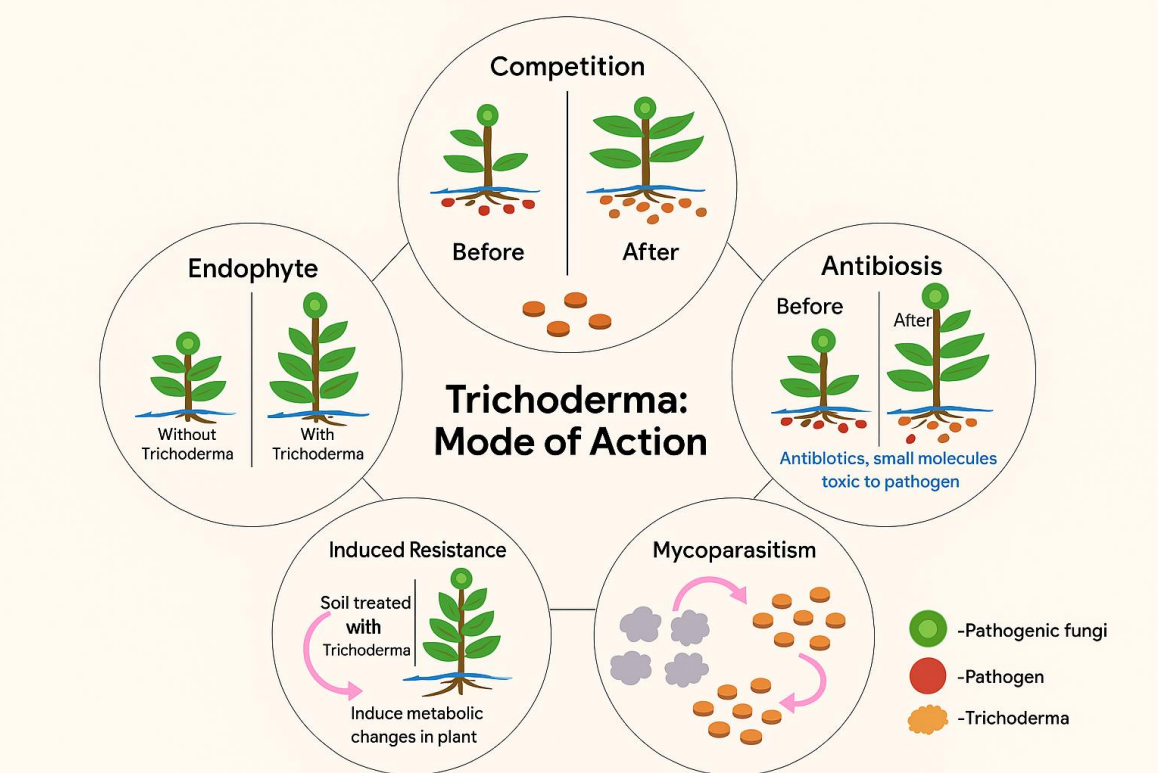
	Recovery %			
	Sacramento County		Kern County	
Treatment	***E. lata***	***N. parvum***	***E. lata***	***N. parvum***
Bacillus velezensis	0	25	25	5
Bacillus subtilis strain QST 713	0	5	0	0
Bacillus sp.	0	5	10	0
Trichoderma hamatum	0	20	20	15
Trichoderma asperellum and *Trichoderma gamsii* + a blend of 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

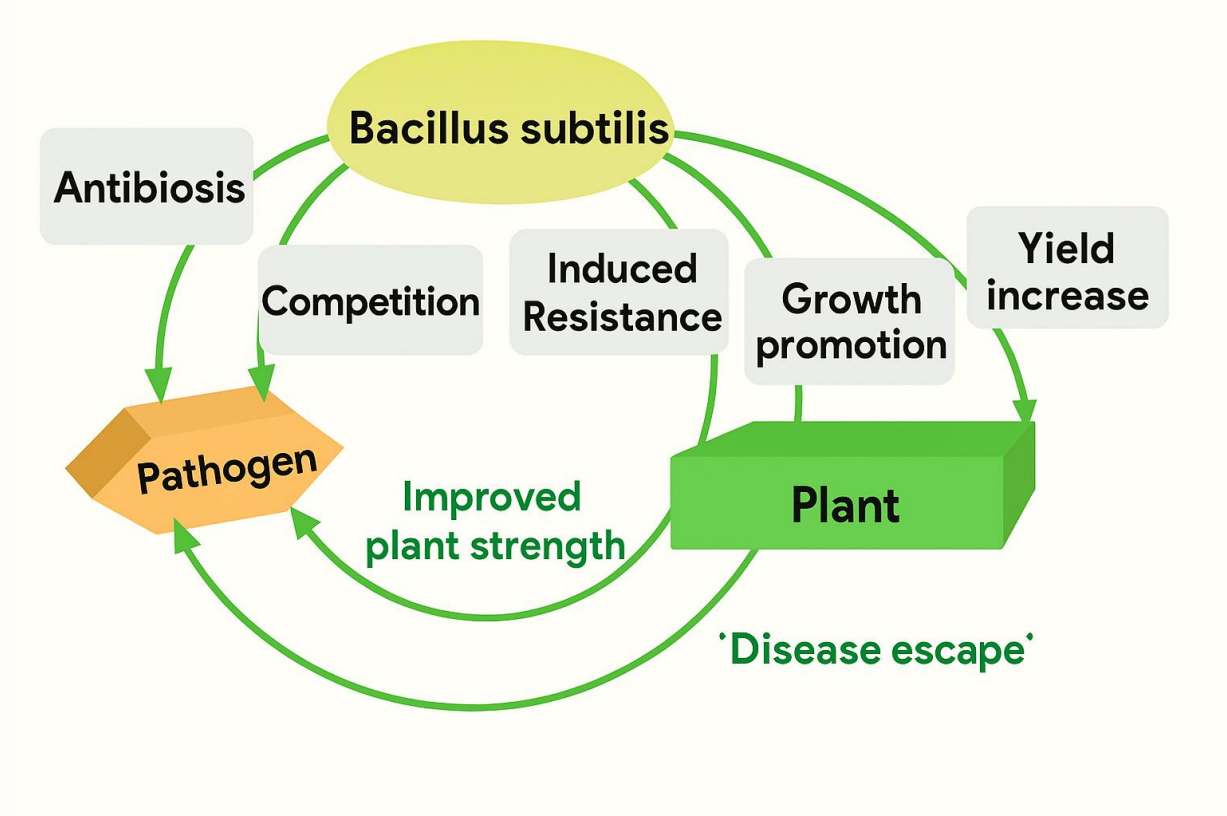




Multiple modes of actions of biocontrol agents

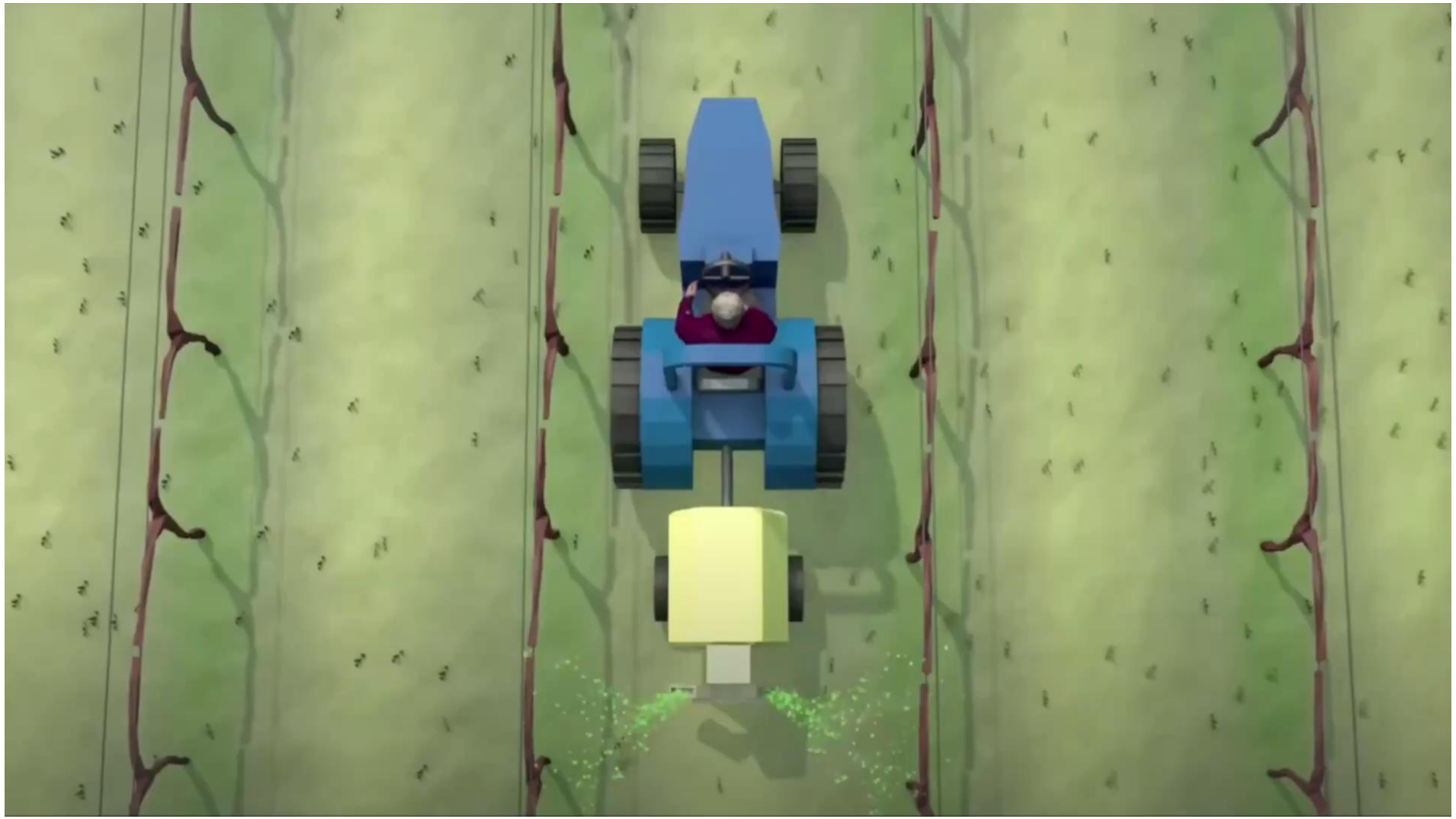


Waghunde *et al*. 2016



Kilian *et al*. 2000

Trichoderma application



infowine

Thank you !

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