Improving nursery practices to prevent fungal contamination and biocontrol options

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DEPARTMENT OF PLANT PATHOLOGY
UC DAVIS

Outline

1. Introduction
2. Grapevine trunk diseases
3. Common nursery contamination
4. Management strategies
5. Conclusion

Grapevine Trunk Diseases

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

Vascular diseases




Grapevine Trunk Diseases

- Young Vine Decline
- Esca

Vascular diseases

- Eutypa Dieback
- Bot Canker
- Phomopsis Dieback

Canker diseases

Recent findings on other canker diseases

Aspergillus spp.

Grapevine Trunk Diseases

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

Vascular and Rot diseases

Canker diseases

Rot diseases

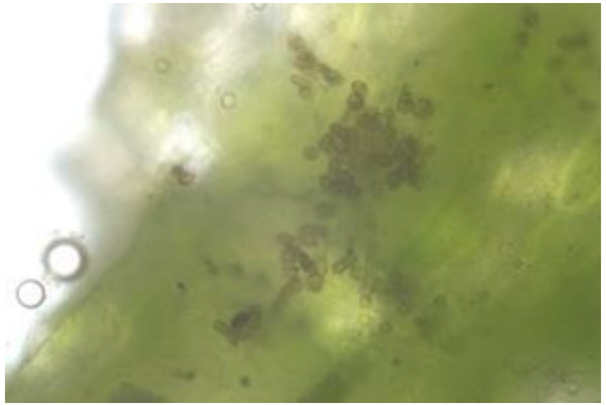



Macrophomina Charcoal Rot *(Macrophomina phaseolina)*

How do they infect their hosts?

- **Pruning wounds**

- **Latent and Endophyte**



Infection of GTD on different parts of the vine

Spurs

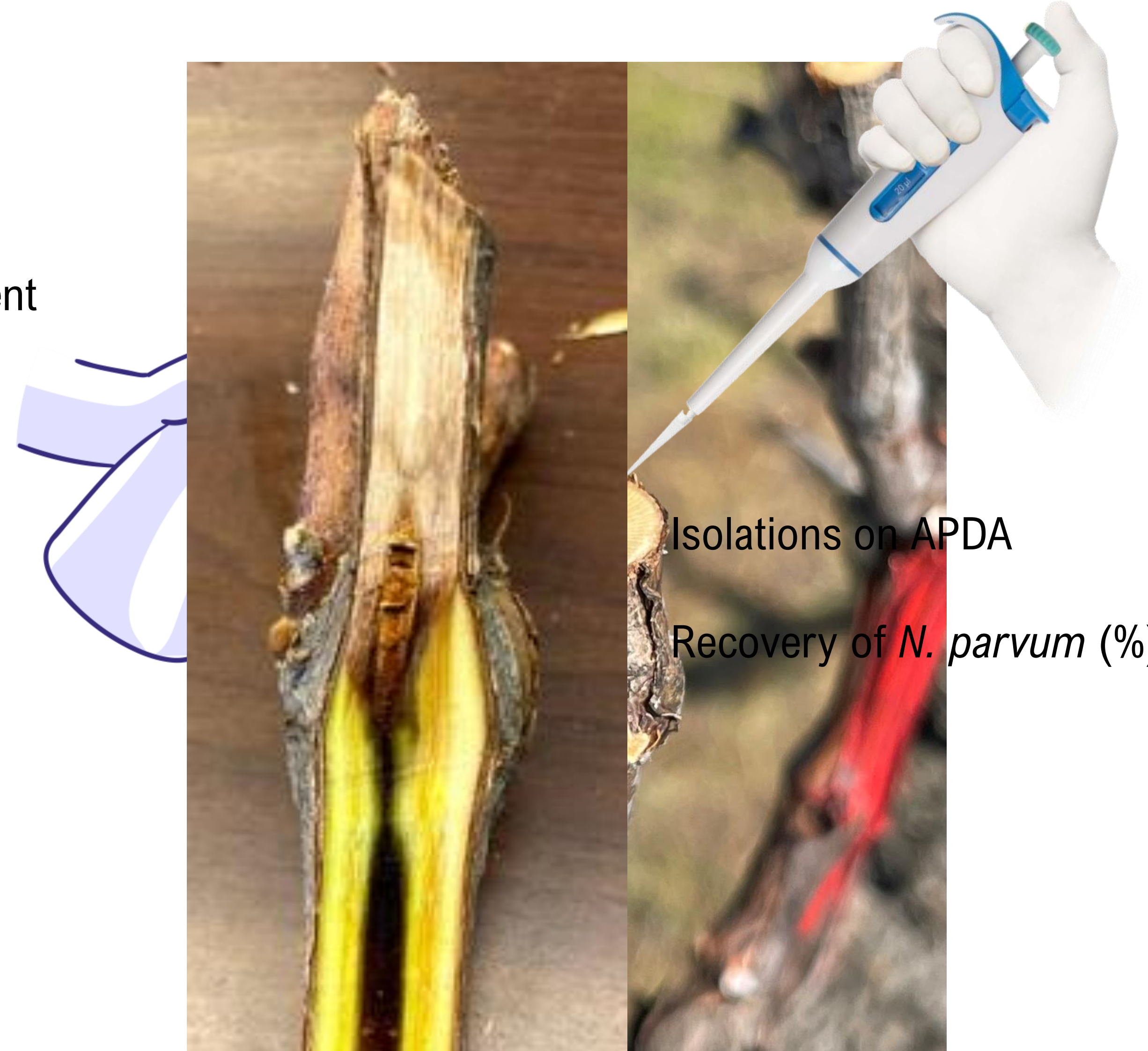
Cordon

Trunk

Rootstock

Field pruning wound protection trials

1) Treatment



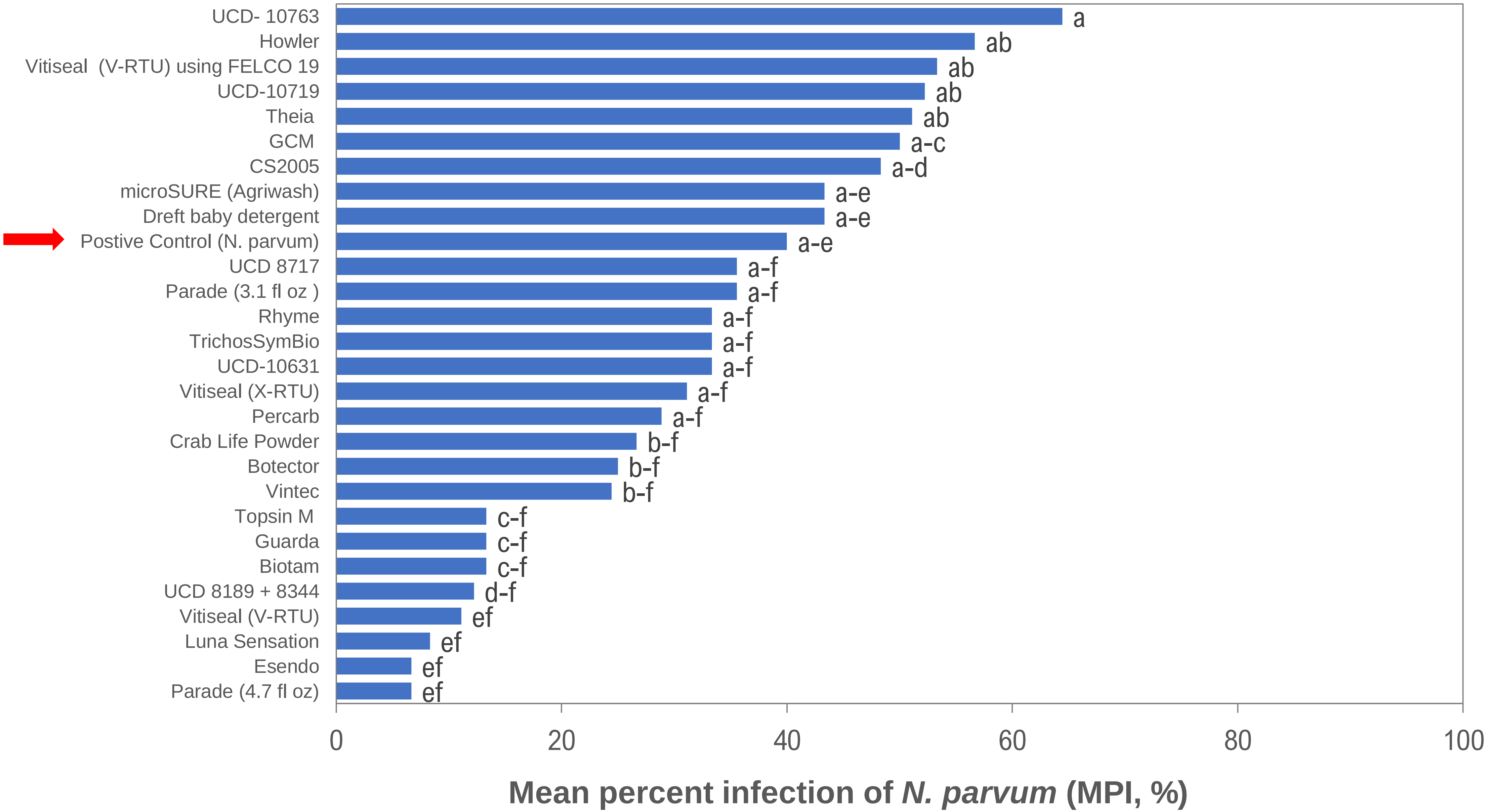
2) Inoculation
N. parvum
(2,000 conidia)

3) Evaluation of infection

Isolations on APDA

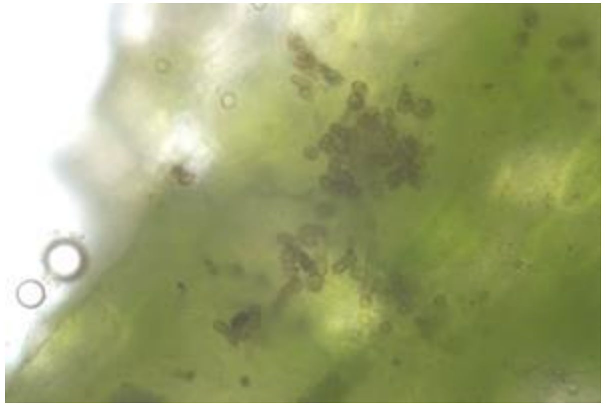
Recovery of *N. parvum* (%)

Field pruning wound protection trials results



How do they infect their hosts?

- Pruning wounds



- **Latent and Endophyte**

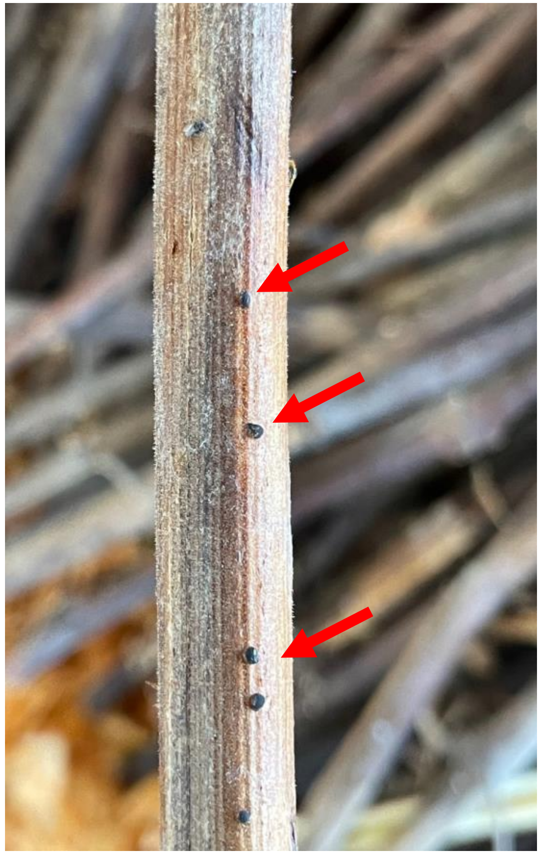
Young vine decline and latent infection

Some of the young vine decline has been associated with contaminated nursery plants

Contamination during storage of cuttings

The large number of cuts and wounds made throughout the propagation of planting material in nurseries correlate with higher infections with fungal trunk pathogens and many other opportunistic saprophytic fungi that will further express in vineyards





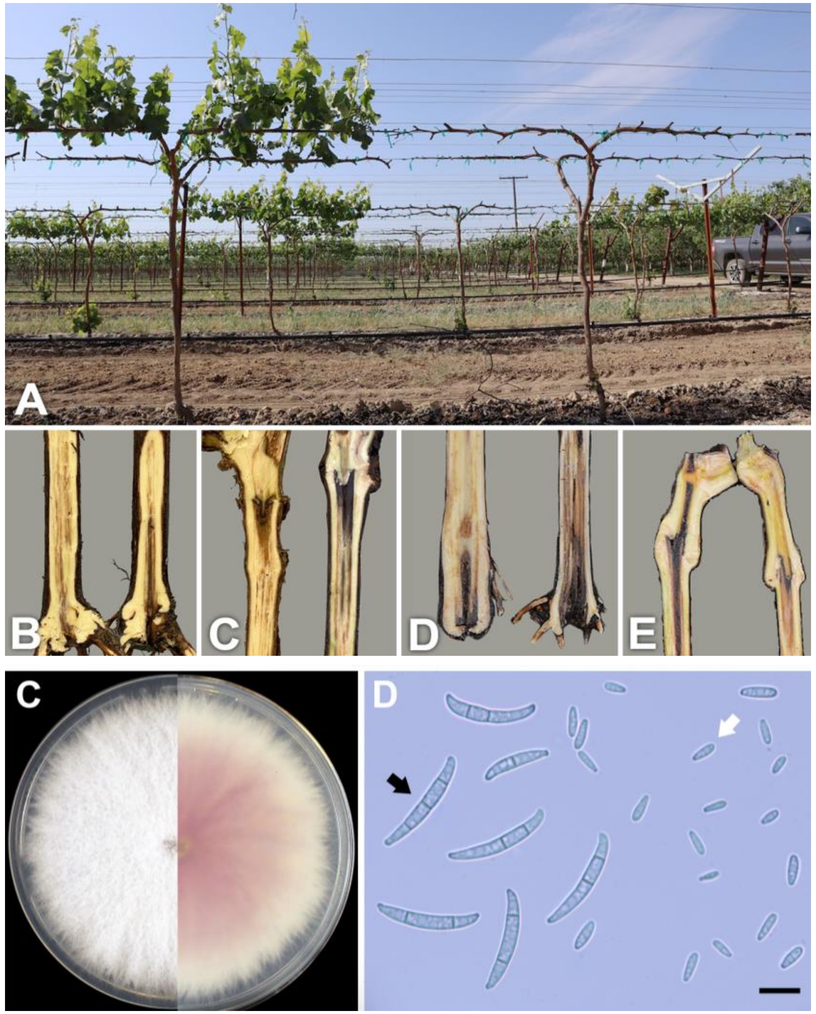

Graft failure

Graft union on a mature vine

Some of the latent infection could have originated from mother plants

Survey in nurseries and young vineyards

1. Isolation → 2. Identification → 3. Pathogenicity tests

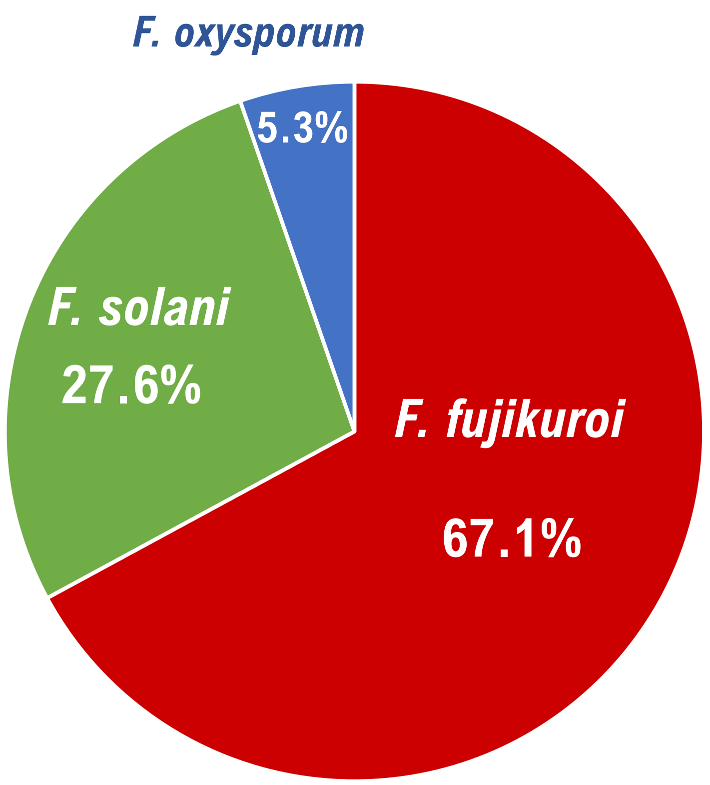


Origin	Number of vines (n)	Fusarium positives (n)	Fusarium incidence (%)
Vineyards sampled by UCCE farm advisors (n = 21)	62	54	87.1
Experimental vineyard in Yolo Co.	225	72	32.0
Commercial vineyard in Sacramento Co.	60	11	18.3
Nursery 1	523	47	8.9
Nursery 2	485	217	44.7
Nursery 3	100	89	89.0
Nursery 4	75	6	8.0
Nursery 5	50	32	64.0
Total vineyard samples	**347**	**137**	**39.5**
Total nursery samples	**1,233**	**391**	**31.7**

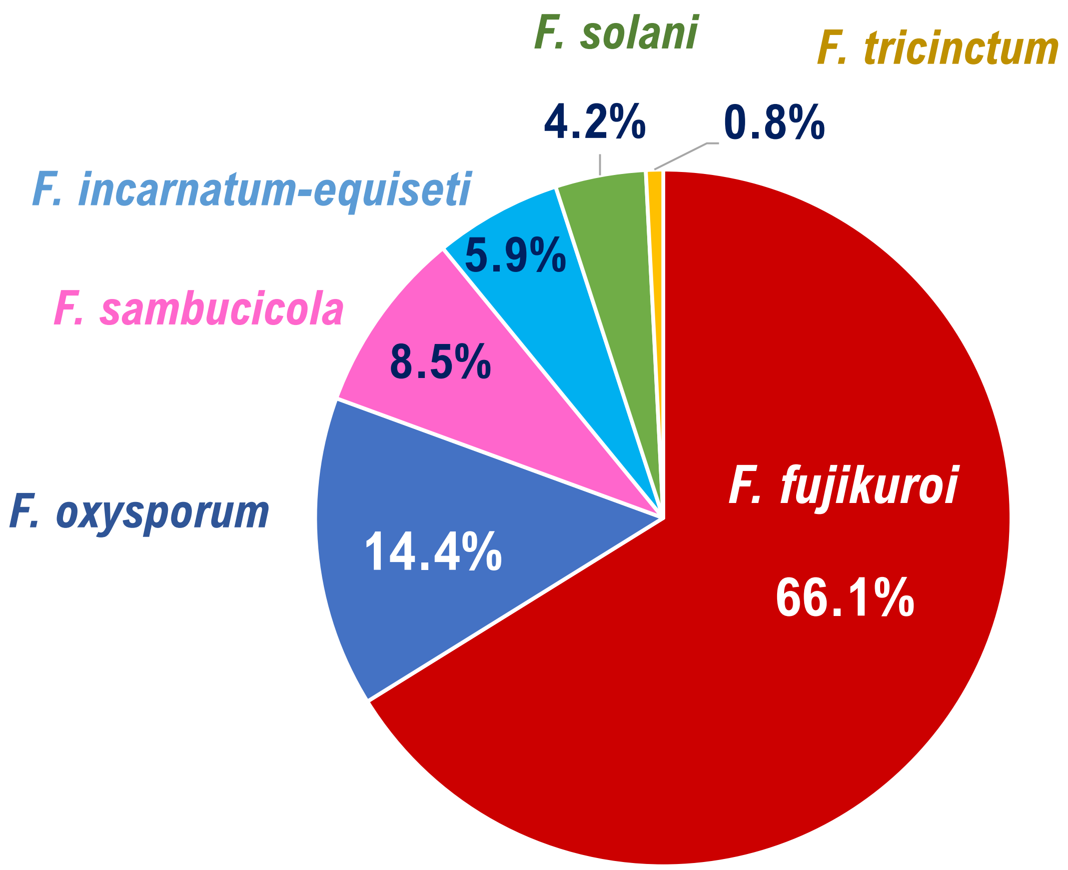
Results

1. Isolation → **2. Molecular identification** *tef1* → 3. Pathogenicity tests

NURSERY POPULATION



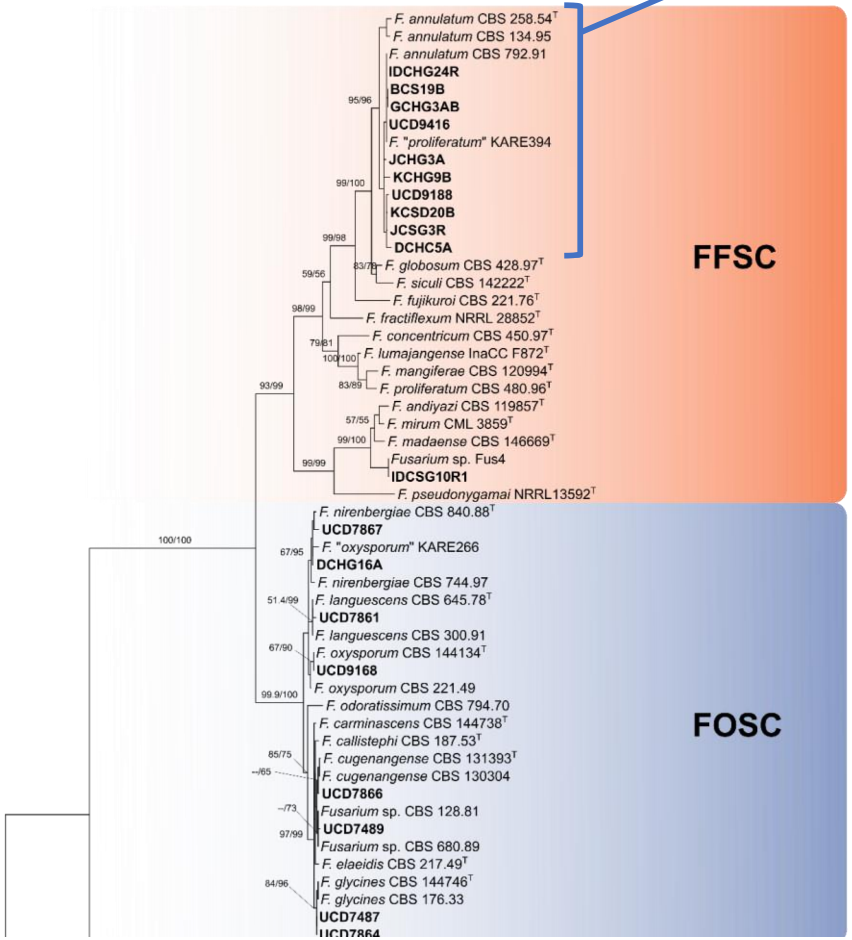
VINEYARD POPULATION

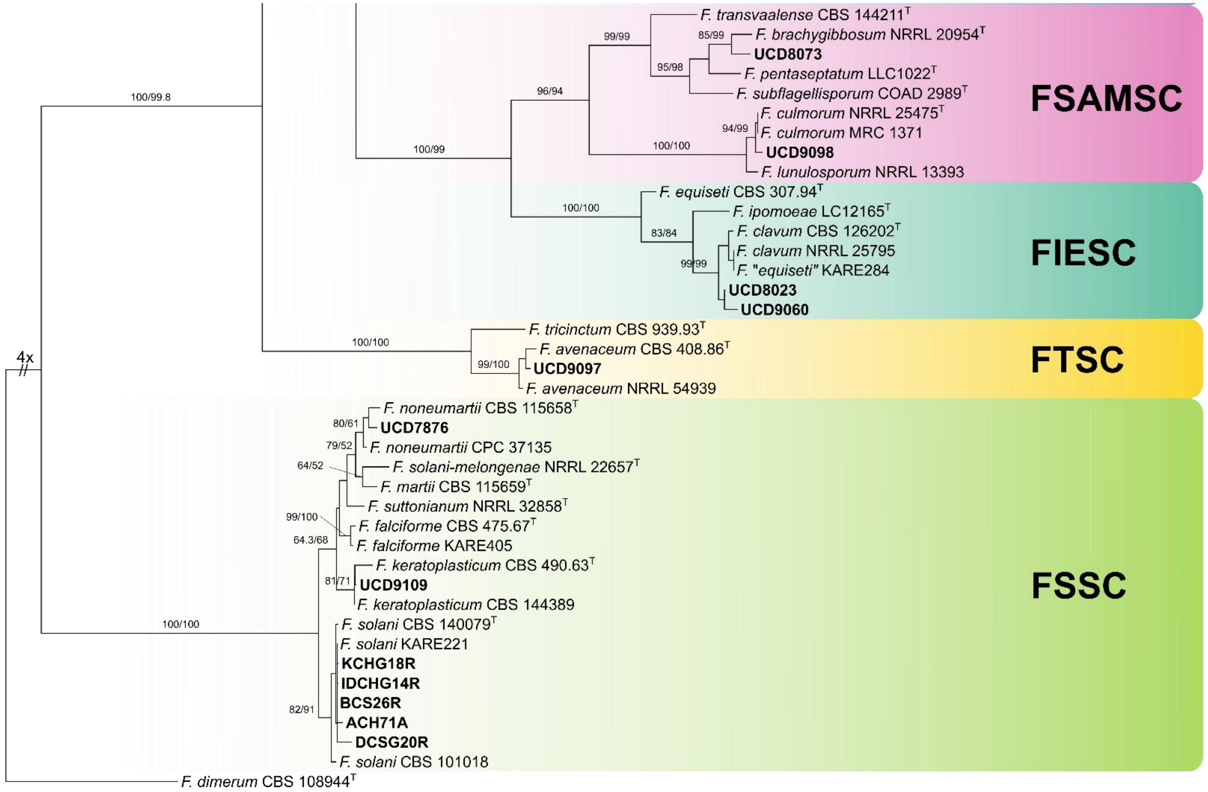


Results

1. Isolation → **2. Molecular identification** *tef1 + rpb2* → 3. Pathogenicity tests

F. annulatum: 23.2% (nursery) and 38.6% (vineyard)





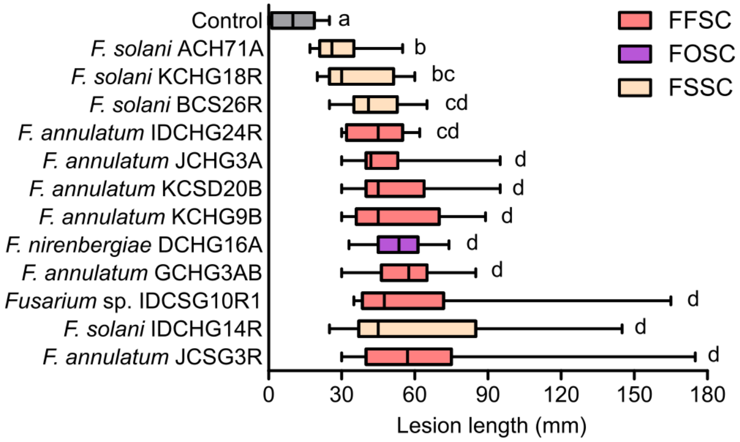
Results

1. Isolation

2. Morphological and molecular identification

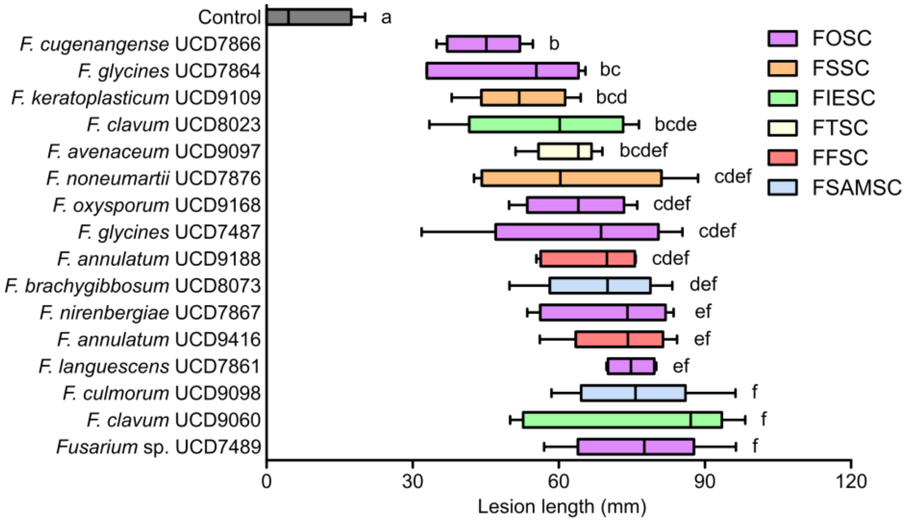
3. Pathogenicity tests

Nursery isolates Rootstocks



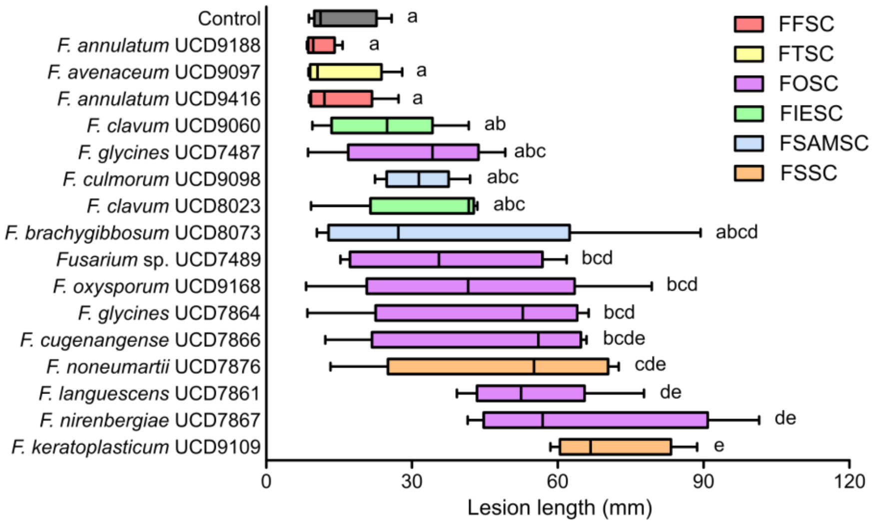
100% recovery of isolates

Vineyard isolates Rootstocks



F. clavum (FIESC), *F. brachygibbosum* (FSAMSC) and *F. avenaceum* (FTSC) not recovered.

Vineyard isolates Chardonnay



F. keratoplasticum (FSSC), and 2 FOSC isolates (*F. glycines* and *F.* sp.) not recovered.

Conclusions

1. Multiple species of *Fusarium* are pathogenic to grapevine vascular tissue.

2. Most frequent groups: *F. fujikuroi*, *F. solani* and *F. oxysporum* species complexes.

3. Differential virulence among species and isolates of the same species.

4. High incidence in nursery and vineyard samples + pathogenicity results suggest that *Fusarium* plays an important role in developing Young Vine Decline.

Plant Disease 2023 (published)

Identification and Pathogenicity of *Fusarium* Species Associated with Young Vine Decline in California

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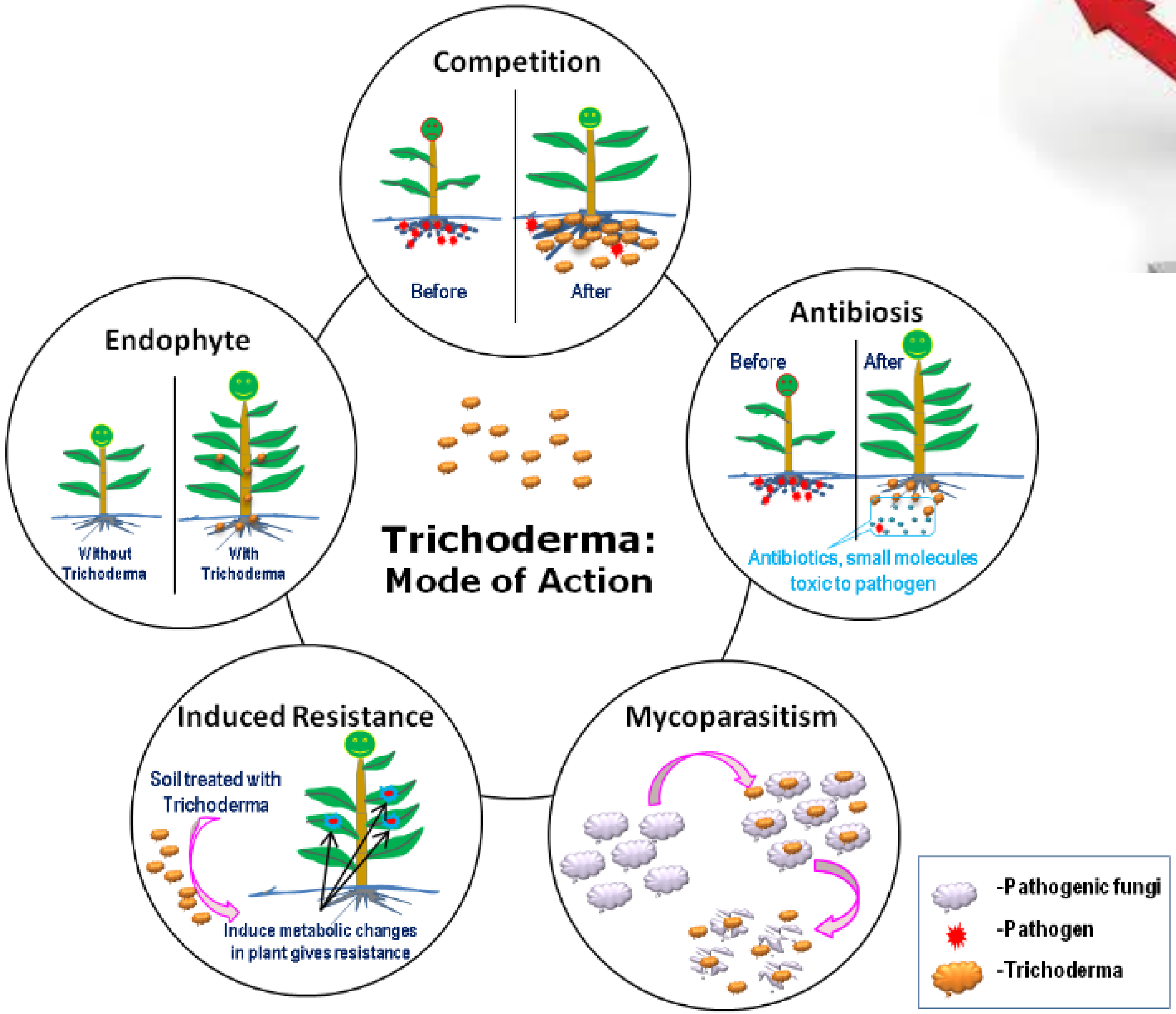
Abstract

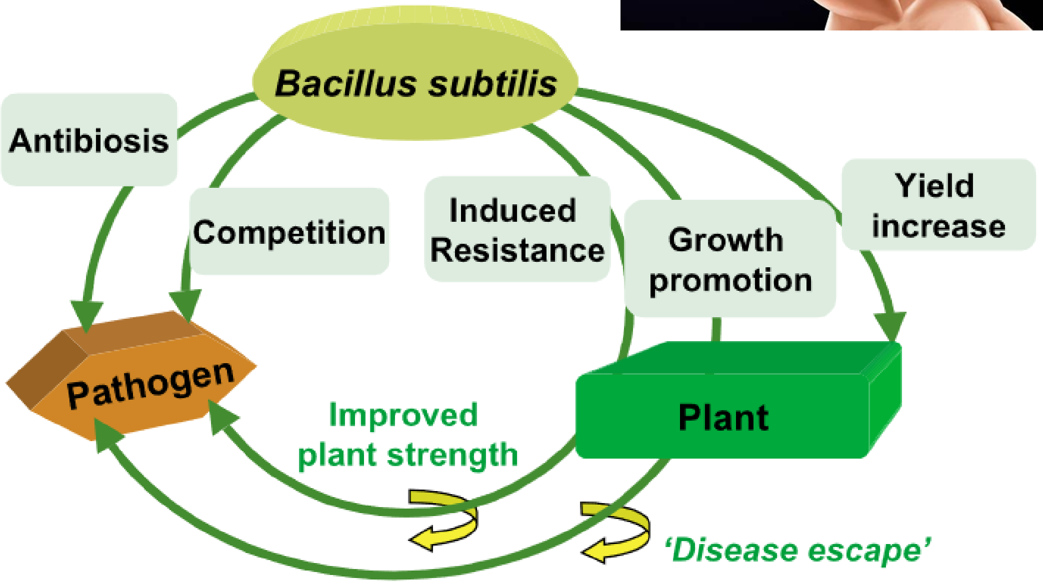
Grapevine trunk diseases (GTDs) are caused by a broad range of fungal taxa that have serious impacts on the worldwide viticulture industry due to significant reductions in yield and lifespan of vineyards. The subgroup of GTDs occurring in vines at early stages of their life cycle has been collectively known as Young Vine Decline (YVD), which has been described to be caused by black foot, Petri disease and Botryosphaeria dieback. Field surveys carried out from 2018 to 2022 in California nurseries and young vineyards revealed a high incidence of *Fusarium* species. However, this fungal genus is not currently considered as a causal agent of GTDs. Since *Fusarium* spp. are well known to cause trunk diseases in other perennial crops, the present study aimed to identify and determine the pathogenicity of the *Fusarium* species associated with young

Objective

Evaluate the efficacy of BCAs in nursery settings.

Multiple modes of actions of biocontrol agents





Kilian *et al*. 2000

Waghunde *et al*. 2016

Evaluate the effect of locally systemic pesticides and biocontrol agents at the different steps of the propagation process to control/prevent grapevine trunk diseases.

- Treat dormant propagation material in the nursery using soaking/vacuum infiltration

Soaking/Dipping

Treatment of dormant cuttings before grafting

Pressurized and soaked for 10 min

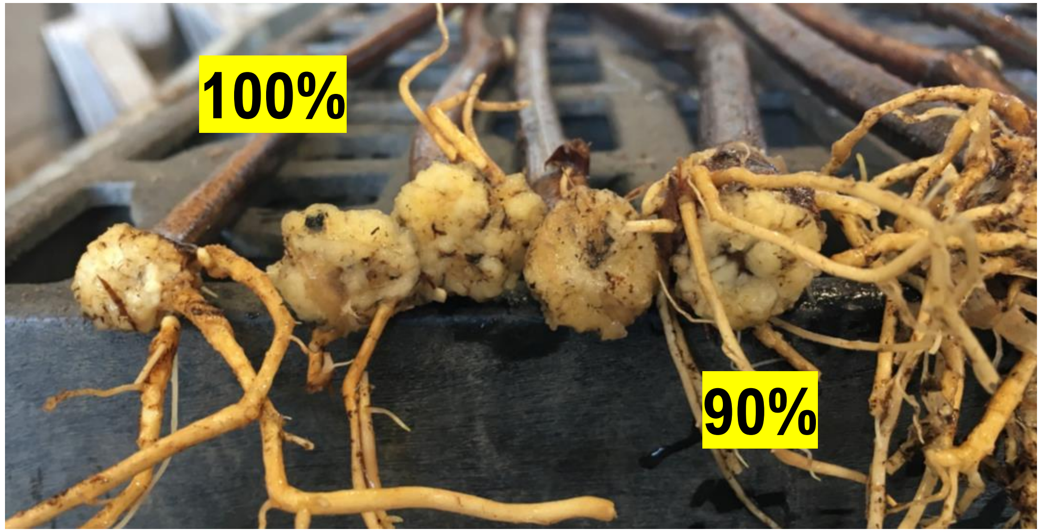
Vacuum infiltration

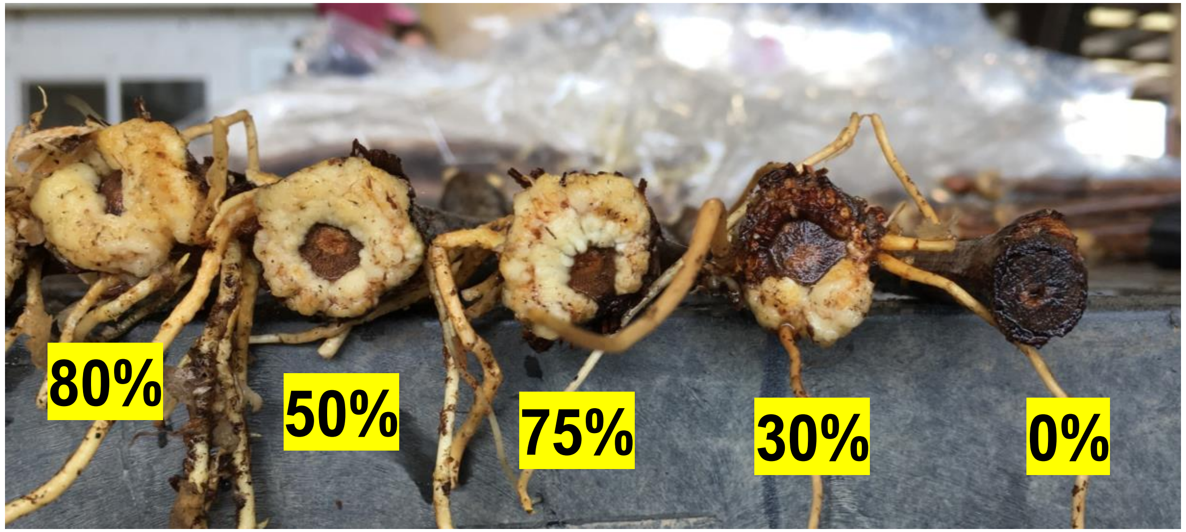
Effect on callusing after grafting

Graft union

Basal end of rootstocks

Rating of callusing





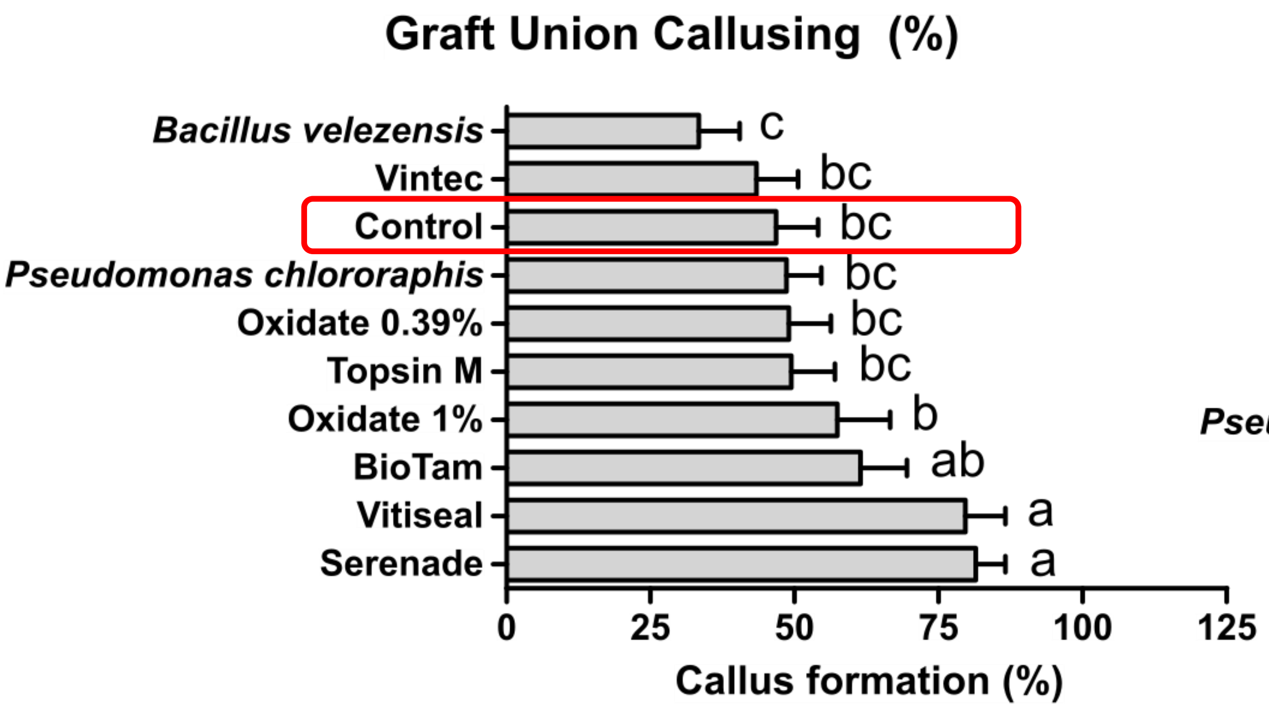
Rating scale

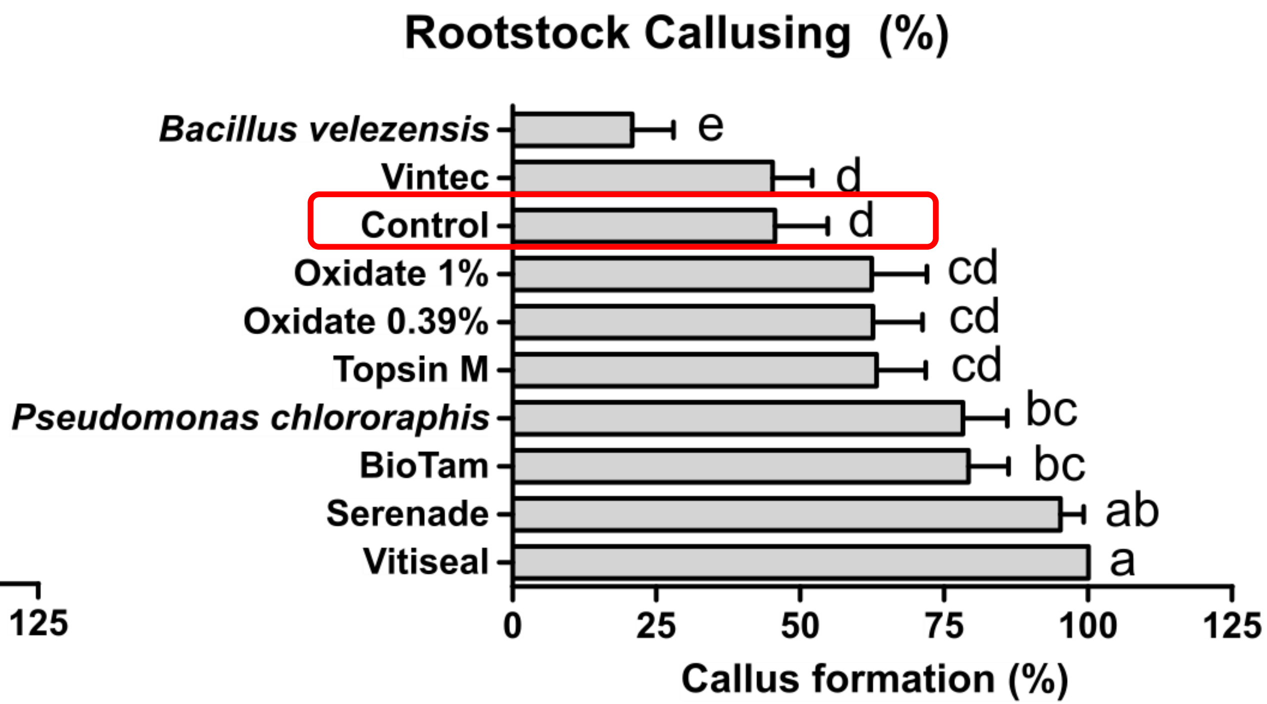
- 100%
- 80-99%
- 60-79%
- 40-59%
- <40%

Good callusing

- Better physiological performance (root/shoot formation).
- Less exposure to infections.

Effect of soaking treatments prior to grafting on callusing

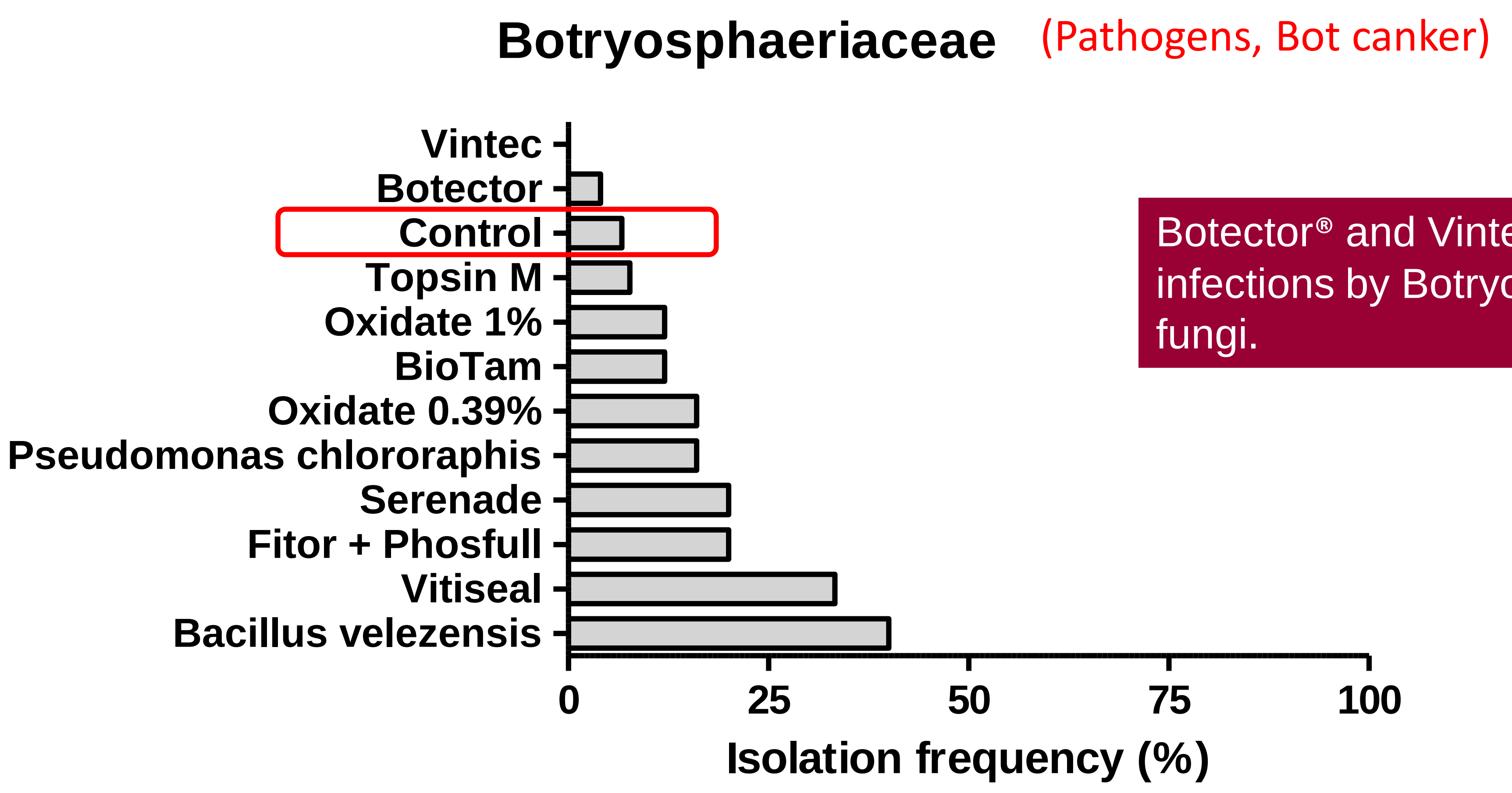




VitiSeal® and Serenade® significantly improve the callus formation at **graft union** level.

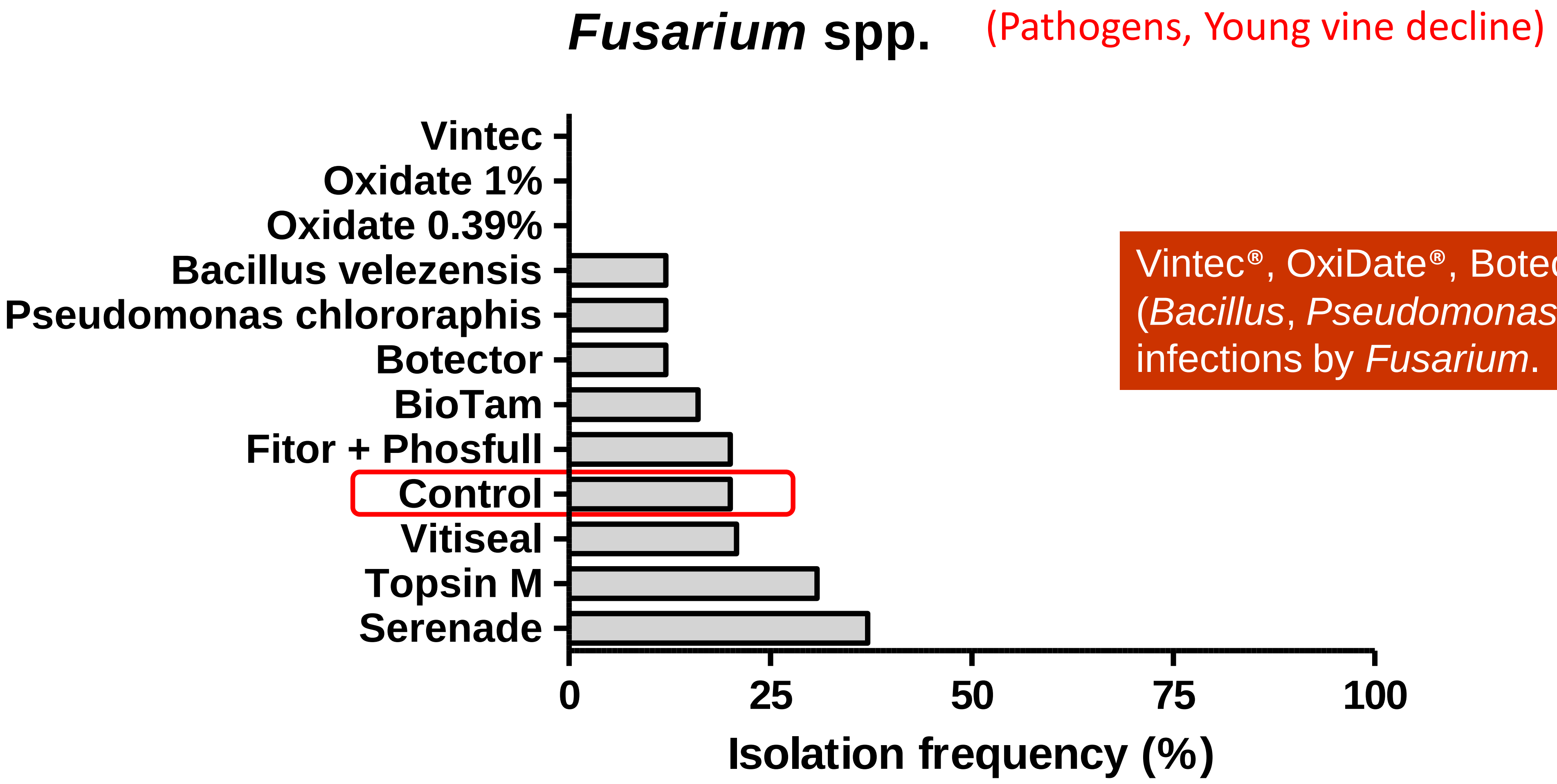
VitiSeal®, Serenade®, Bio-Tam®, and *Pseudomonas chlororaphis* (experimental) significantly improve the callus formation at the **rootstock** end.

Isolation frequency from graft union



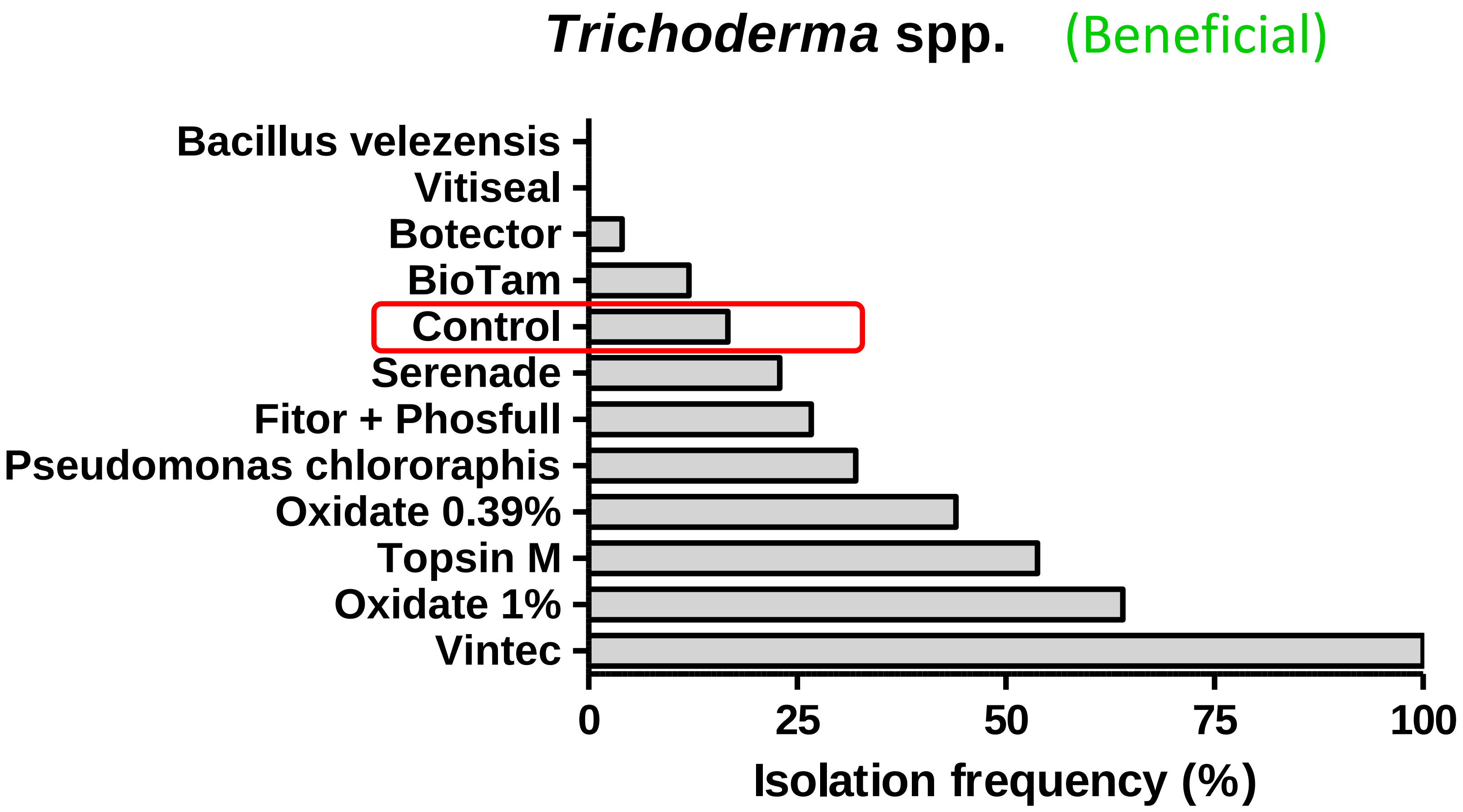
Botector® and Vintec® reduced the infections by Botryosphaeriaceae fungi.

Isolation frequency from graft union

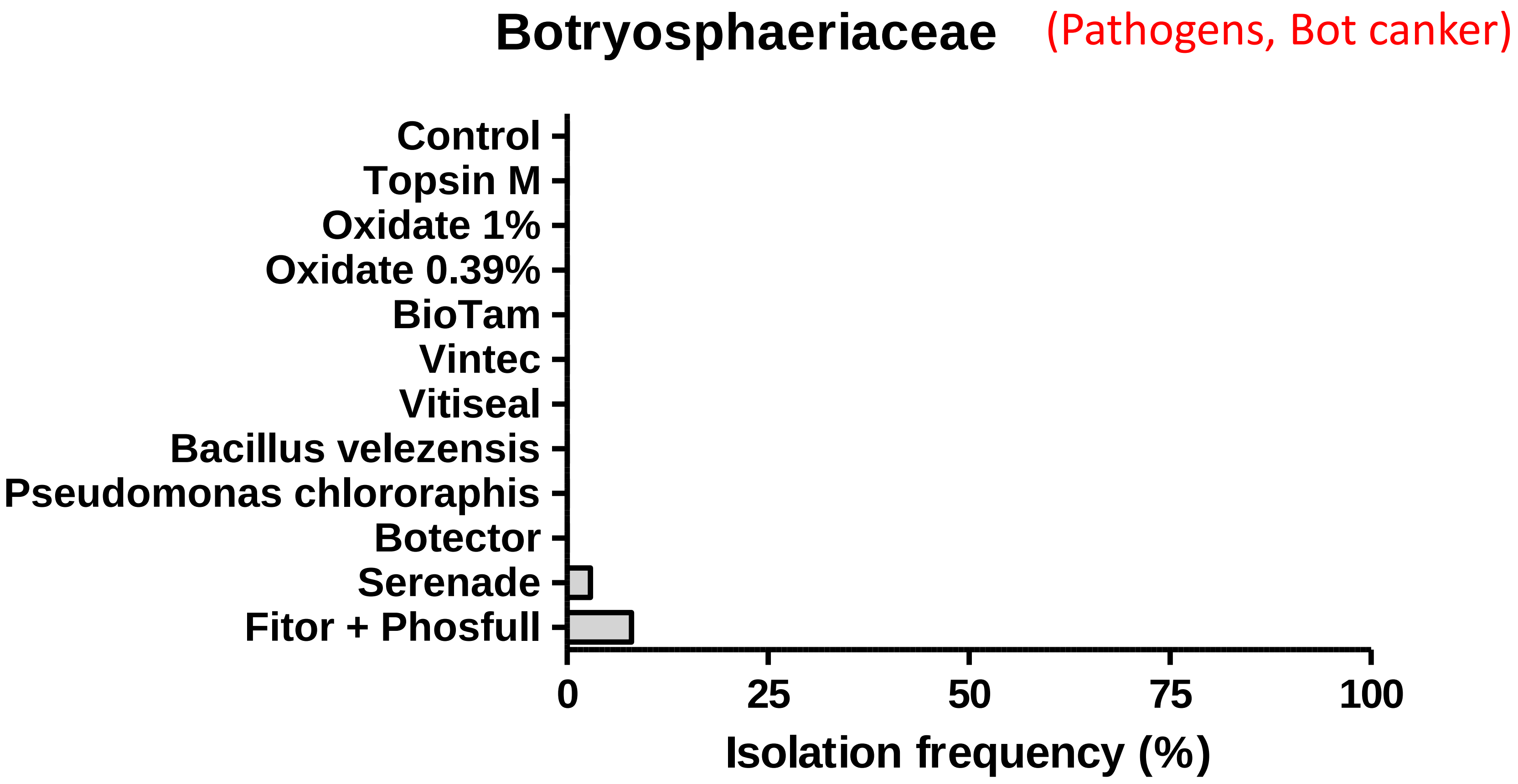


Vintec®, OxiDate®, Botector® and bacteria (*Bacillus*, *Pseudomonas*) reduced the infections by *Fusarium*.

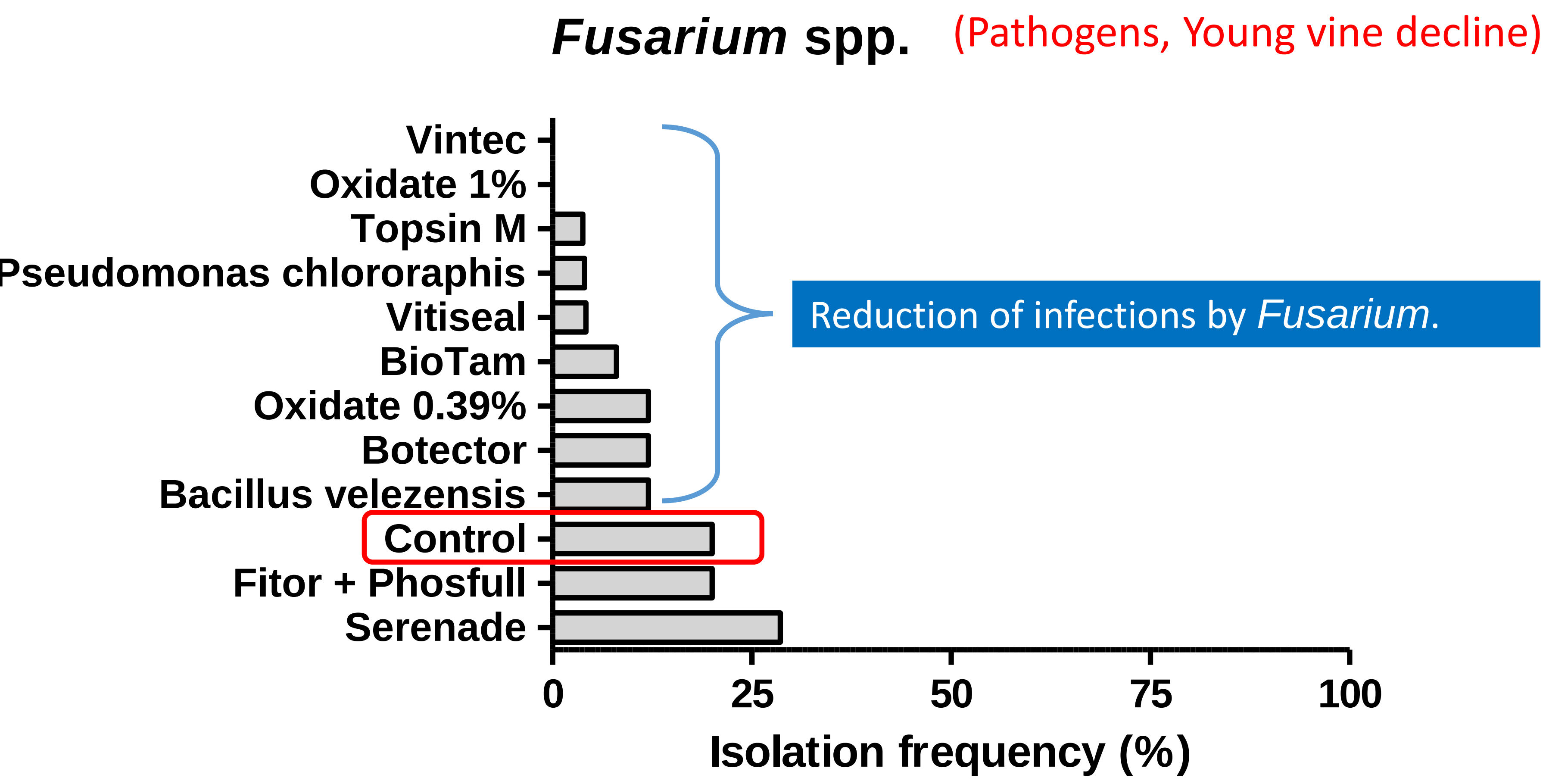
Isolation frequency from graft union



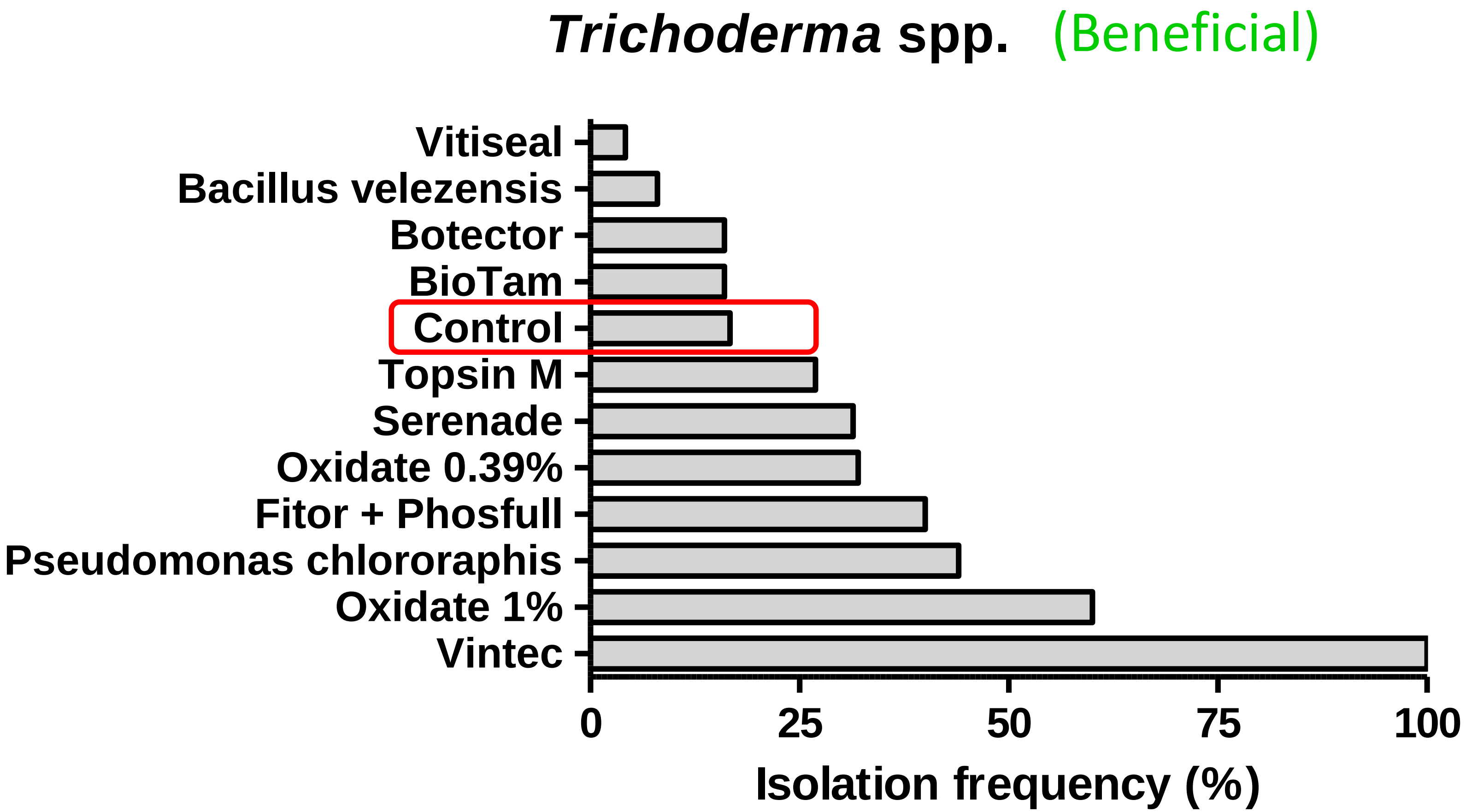
Isolation frequency from the root crown



Isolation frequency from the root crown



Isolation frequency from the root crown



Preventative management in vineyards

- Use disease-free, clean plant materials when establishing new vineyards
- Protect pruning wounds
- Apply good cultural practices to minimize stress on vines
- Delay dormant pruning to reduce the susceptibility
- If applicable, consider doing double pruning to reduce fungal spore infection during winter moths

Eskalen lab website

Flag 18-YKC-2022- Powdery Mildew Trial

Jul 25 – 26, 2022 · Shared

G. Results

Trial I

Table 1. Disease incidence and severity of synthetic fungicides and combinations of soft chemistry and synthetic products. Product names are followed by rate (per acre). Treatment means followed by the same letter are not significantly different according to Fisher's LSD at α=0.05;

Treatment			Application date (Julian day)	Powdery mildew on the cluster [y]	
Pictures	- Flag	Rate/A [z]		Incidence, %	Severity, %
18	YKC	Abound 15.5 fl oz + Syl-Coat 4 fl oz Prolivo 5 fl oz + Syl-Coat 4 fl oz Kenja 22 fl oz + Rally 4 oz + Syl-Coat 4 fl oz Quintec 4oz + Syl-Coat 4 fl oz Torino 3.4 oz + Syl-Coat 4 fl oz Merivon 4oz + Syl-Coat 4 fl oz Vivando 15.4 oz + Syl-Coat 4 fl oz	105 119 132 147 161 178 193	0.0 a	0.00 a
37	BC	PureSpray Green 1 gal Luna Experience 8.6 fl oz Pristine 23 oz Elevate 16oz Parade 3.1 fl oz	103, 110, 117 124, 182 138 152 166	0.0 a	0.00 a
41	Pu	Parade 3.1 fl oz + Dyne-Amic 0.25% v/v	108, 122, 136, 150, 165, 179, 194	0.0 a	0.00 a
62	Y+O	Aprovia Top 13.3 fl oz +Syl-Coat 0.125% v/v Quintec 6.6 fl oz + Syl-Coat 0.125% v/v Miravis Prime 13.4 fl oz +Syl-Coat 0.125% v/v Inspire Super 20.0 fl oz +Syl-Coat 0.125% v/v	122, 179 136, 194 165 150	0.0 a	0.00 a
63	Y+W	Aprovia Top 13.3 fl oz + A9180B 0.5 oz +Syl-Coat 0.125% v/v Quintec 6.6 fl oz + A9180B 0.5 oz + Syl-Coat 0.125% v/v	122, 179 136, 194	0.0 a	0.00 a

Look out for Downy mildew (*Plasmopara viticola*)

Acknowledgements

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Rhonda Smith – UCCE Sonoma
Gabriel Torres – UCCE Tulare
Jose Ramon Úrbez-Torres – Agriculture and Agri-Food Canada
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George Zhuang – UCCE Fresno

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California Grape Rootstock Commission

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

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