PD & GWSS:
Risk Factors, Research, Sustainable Management

Kris Lowe, Research Coordinator, PD/GWSS Board

cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

GWSS Spread Incident

bit.ly/GWSS-Costco

- 24 counties with Costcos & 15 neighboring counties
- 7,000 customers with 9,900 grapevines
- Response & containment:
  - Stricter source nursery regulations
  - Finding the plants
  - Inspecting customers' yards & nearby
  - Traps near stores & customers' properties

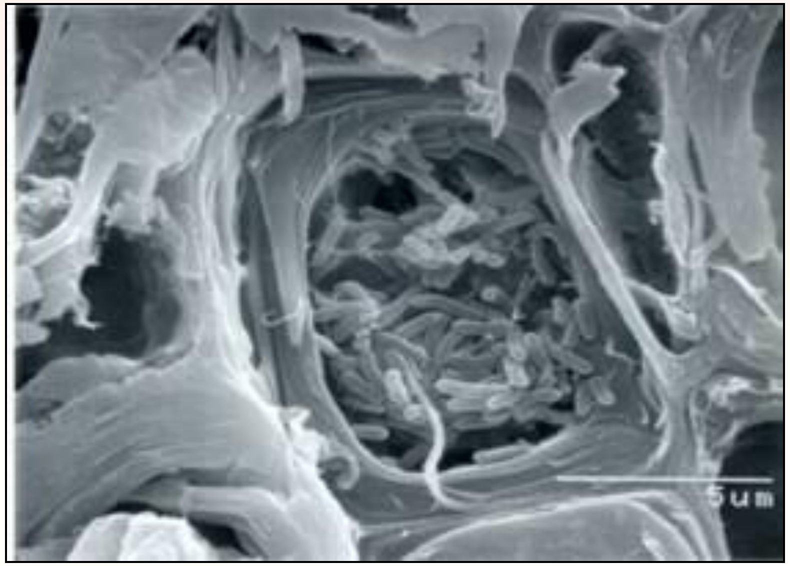
Session Overview

- ☑ PD Ecology
- ☑ Statewide Risk Factors
- ☑ Local Risk Factors
- ☑ Research
- ☑ Sustainable Management

PD Ecology

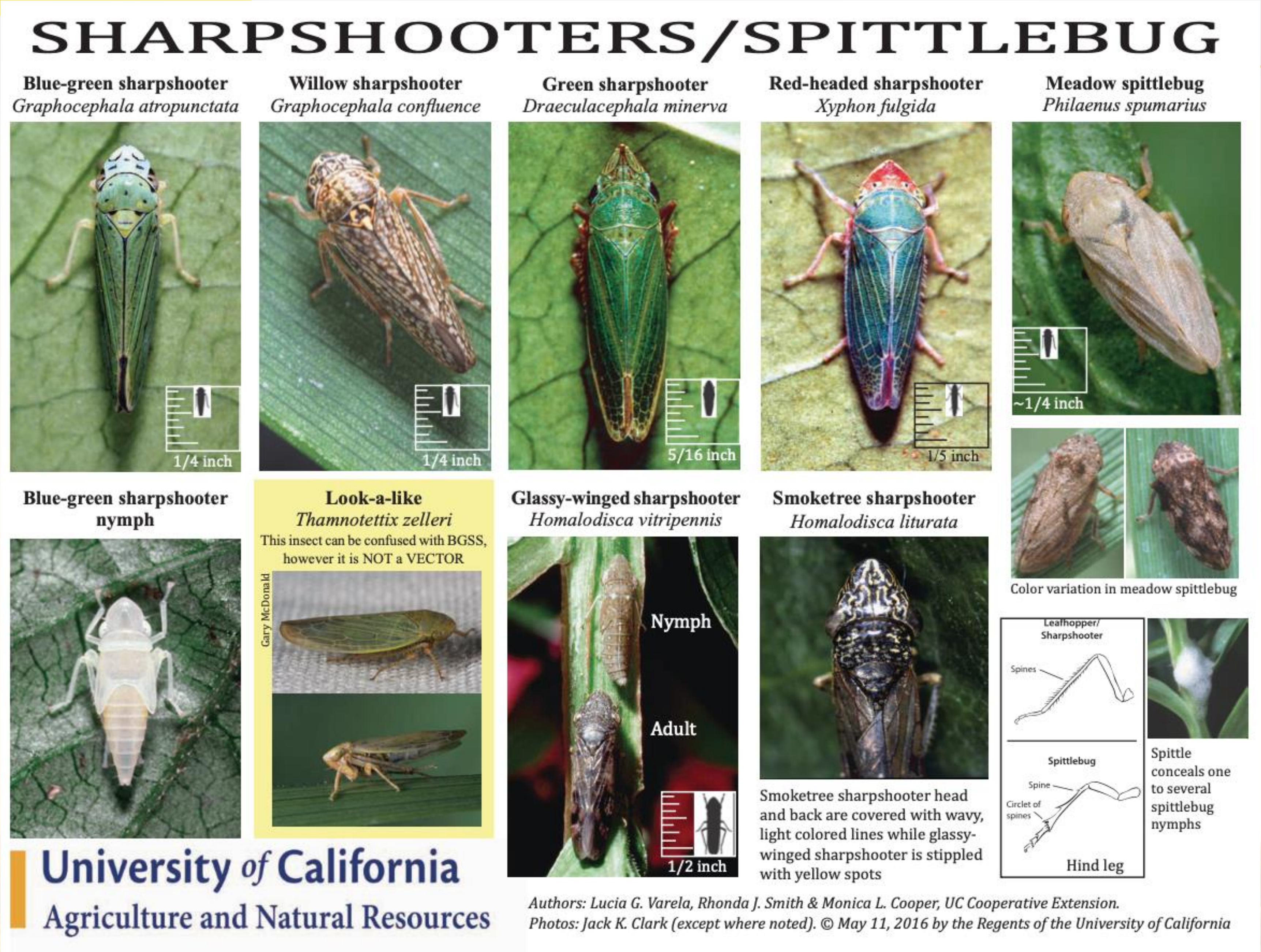
Pathogen: *Xylella fastidiosa subsp. fastodiosa*

- Xylem limited bacteria
- Negatively impacts water uptake
- Other subspecies cause disease in almond, olive, citrus, stone fruit, oleander
- First noted in CA in 1884



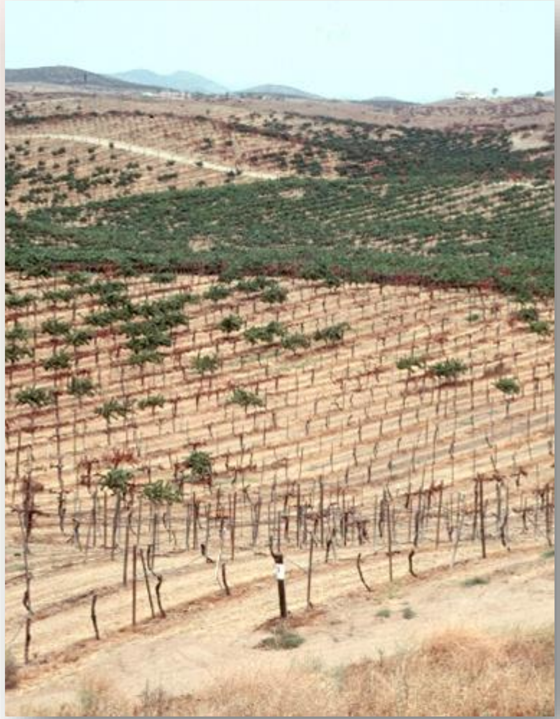
Vectors

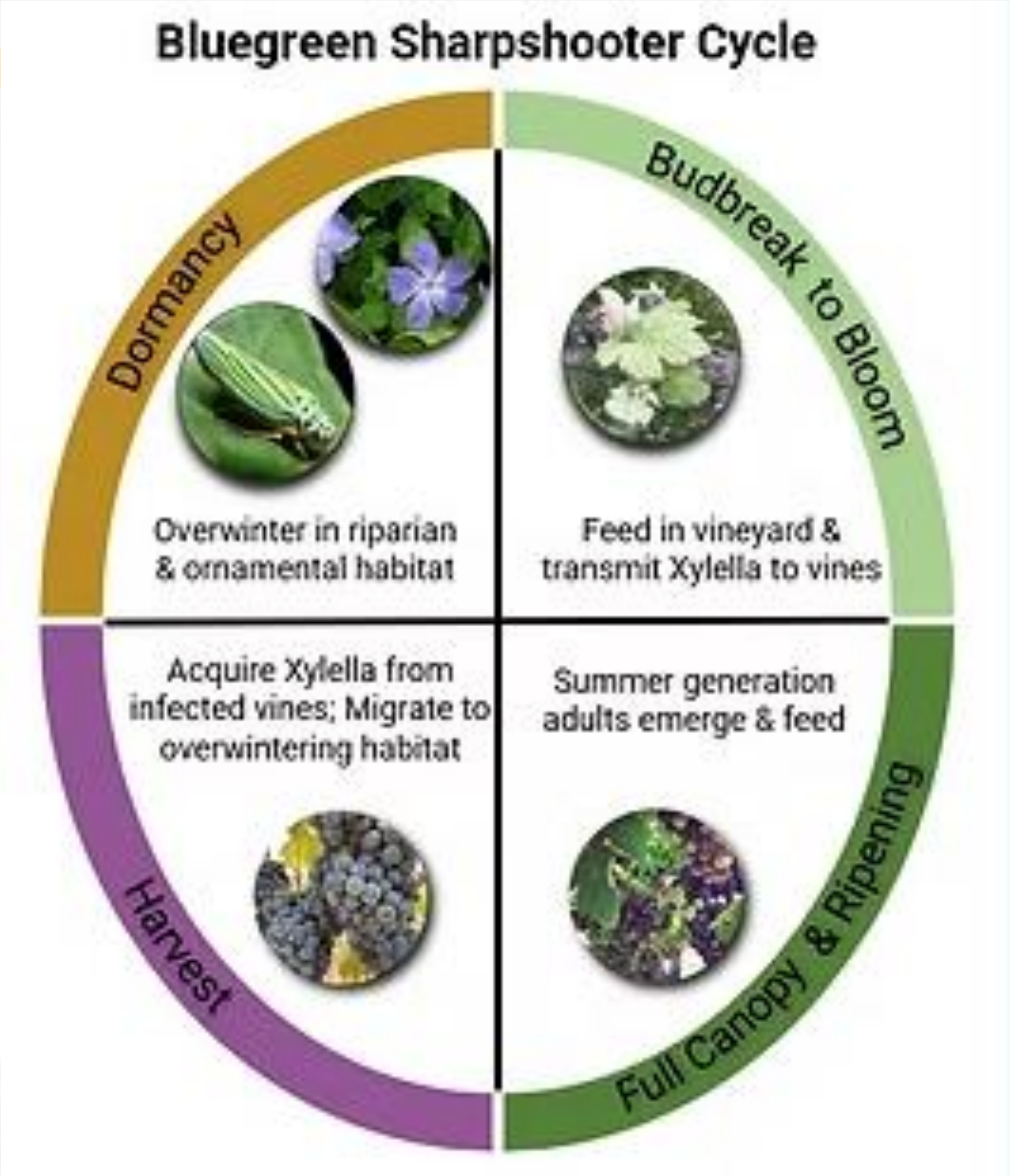
Family Cicadellidae and Aphrophoridae



Source: https://ucceviticulturenapa.wixsite.com/uccevitnapa/pierces-disease

Pierce’s Disease Symptoms





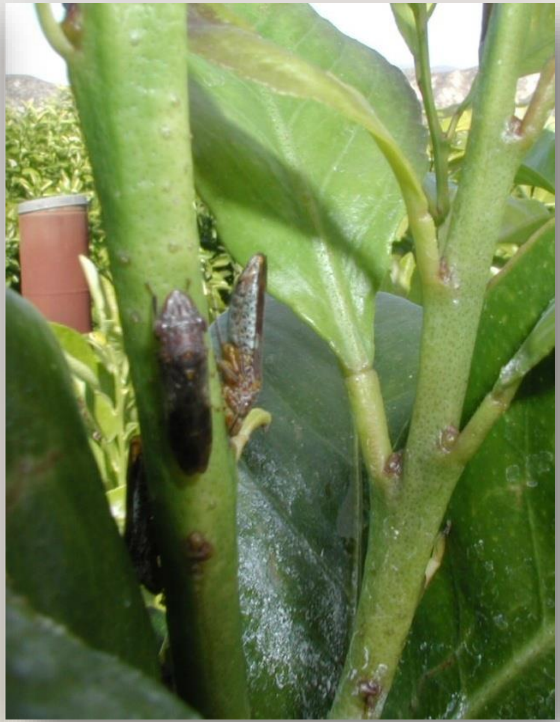
Source: https://uccevitculturenapa.wixsite.com/uccevitnapa/pierces-disease

Statewide Risk Factors

PD & GWSS costs $110M annually in CA

bit.ly/pdcost

Impact of Glassy-Winged Sharpshooter

Protecting California Vineyards

- ☑ Contain the Spread
- ☑ Statewide Survey & Detection
- ☑ Rapid Response
- ☑ Outreach & Education
- ☑ Research

GWSS IN CA

- Contained to southern San Joaquin Valley
- Eradicated 18 GWSS infestations
- Control projects: 5 counties
- Suppression projects: 3 counties

Statewide Challenges

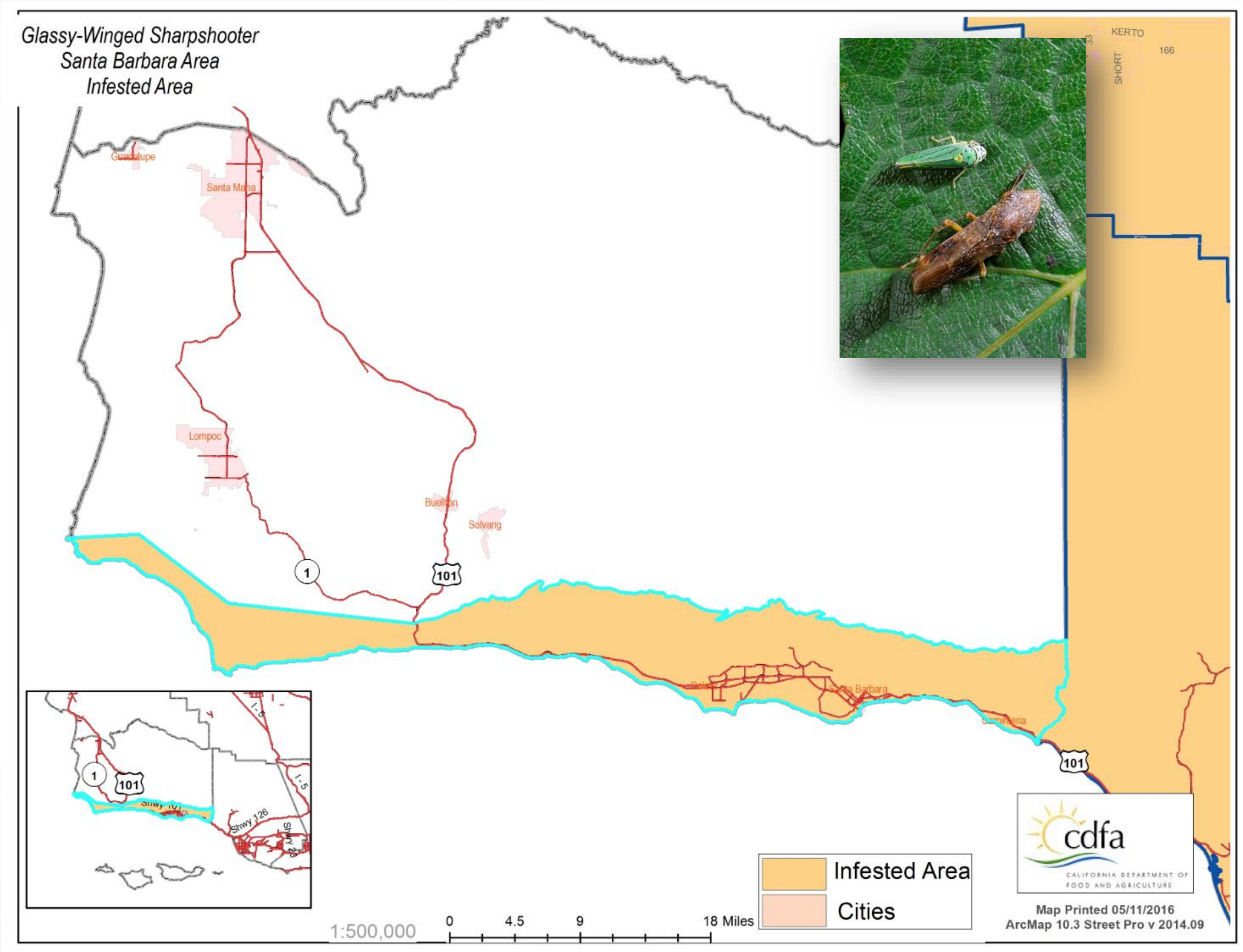
bit.ly/GWSS-Control

- Burchell Nursery/Costco GWSS Spread incident
- 5 eradication projects: Solano ('21), Stanislaus ('24), El Dorado ('24), Kings ('25), Santa Clara ('25)
- Eradication= no GWSS finds 2 years since last treatment
- Trap, survey, treat & biological control
- Coordination between PDCP & county ag officials
- How do they start?

Local Risk Factors

Central Coast Vector - GWSS?

- 2+ gen/year
- Low transmission efficiency, long distance flyer/hitchhiker
- ½" long
- Distinctive egg masses



GWSS: 360+ Known Hosts

bit.ly/GWSS-hosts

- Citrus (overwintering host)
- Landscaping
- Crepe myrtle
- Photinia
- Boxwood
- Native woodlands

GWSS: Monitoring

- Yellow sticky cards
- 100-200 feet around block perimeter
- Wooded areas, riparian borders, landscape
- Check weekly
- Coordinate with local Ag Commissioner activities
- Inspect plant shipments

Central Coast Vector - BGSS

- 1 generation/year
- High transmission efficiency
- Blue to green head/thorax
- Distinct markings

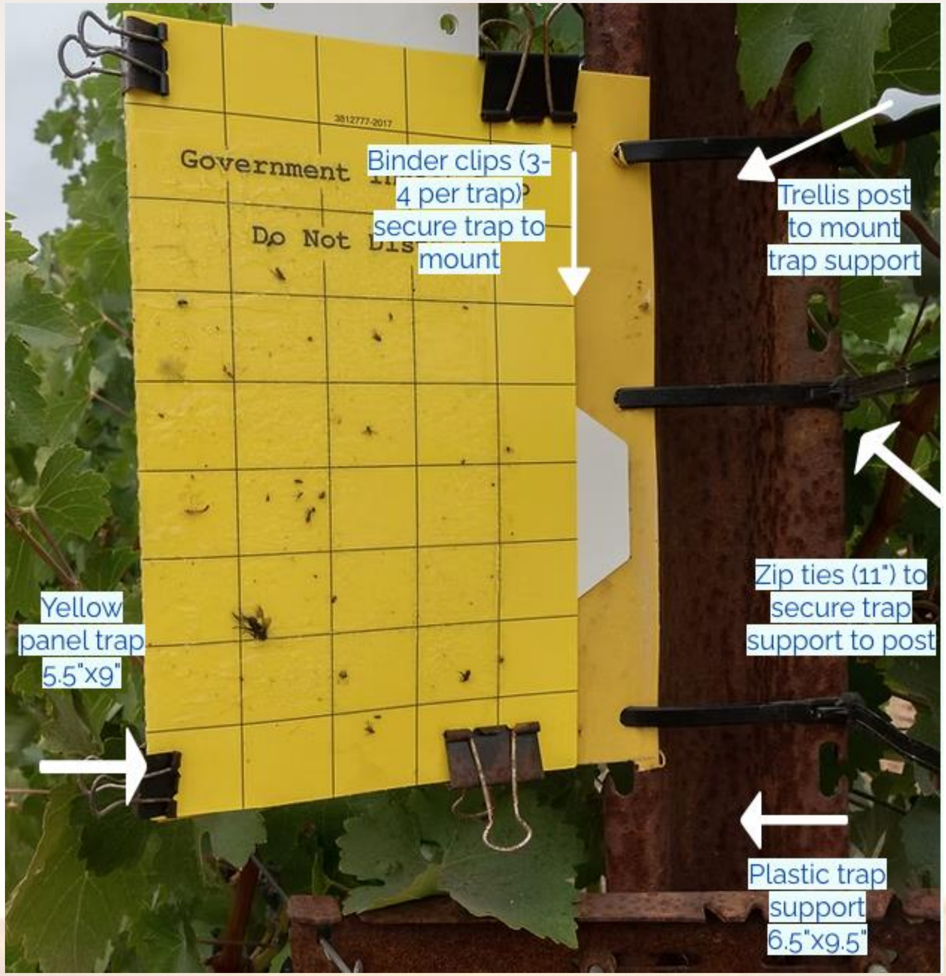
Look alike alert!
T. zelleri not a vector

BGSS: Habitat

- Blackberry
- Mugwort
- Elderberry
- Nettles
- Wild grapevines

BGSS: Monitoring

- Yellow sticky traps
- 100-200 feet apart
- Along riparian border or habitat
- Check weekly
- Main flights: March - May & July - Aug



Central Coast Vector - Spittlebugs

- 1 generation/year
- Low transmission efficiency
- Color variation
- Nymphs cause “spittle” on host plants

Spittlebugs: Habitat

- Riparian areas
- Ornamental landscapes
- Species with taproot (wild carrot, soap plant, bristly oxtongue)
- Vetch
- Pine (*aphrophora* spittlebug species)

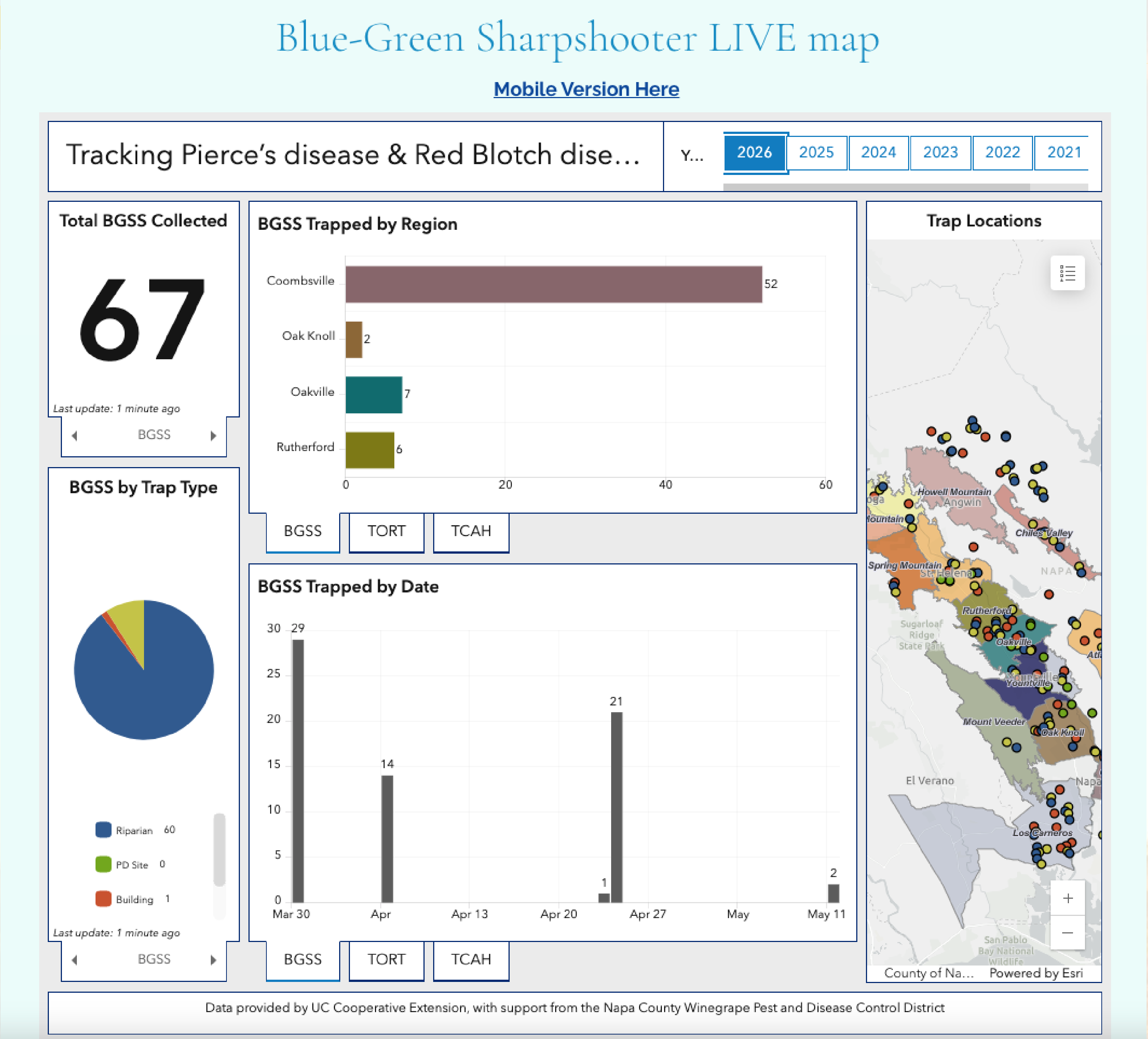
Spittlebugs: Monitoring

- Monitor vineyard weeds and landscape (March-April)
- Sweep net vineyard groundcover (April-May)

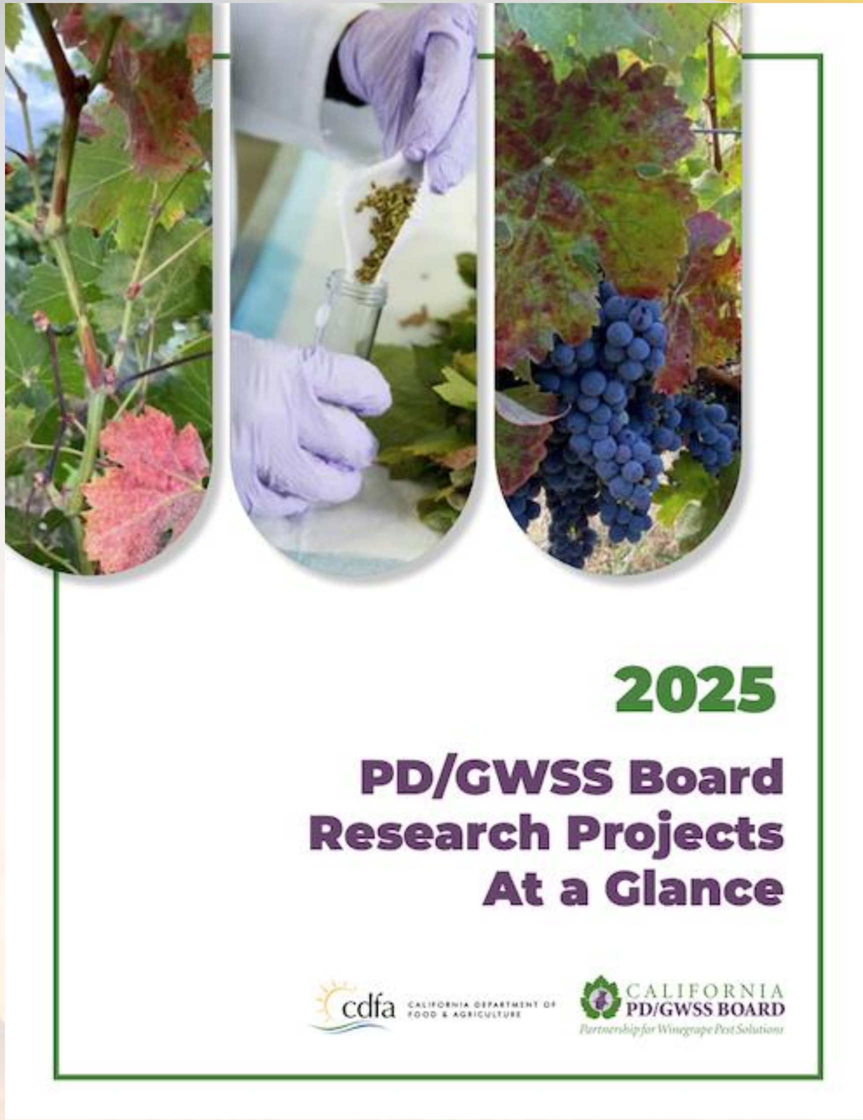
Regional data sharing

Napa, Sonoma county through UCCE

https://ucceviticulturenapa.wixsite.com/uccevitnapa/data-dashboards



PD & GWSS RESEARCH



bit.ly/PDGWSSboard

PD Research Highlights

- PD resistance breeding and genetics
- Wintery recovery
- Biocontrol trials

Topic: PD Resistance Breeding

- UC Davis grape breeding program
- PDR 1 locus (*V. arizonica*)
- Multiple alleles and sources
- Traditional breeding
- CRISPR gene editing

PD Resistance Breeding

- Camminare Noir (50% Petite Sirah, 25% Cab Sauv)
- Paseante Noir (50% Zindanfel, 25% Petite Sirah, 12.5% Cabernet Sauvignon)
- Errante Noir (50% Sylvaner, 12.5% Cab Sauv, 12.5% Carignane, 12.5% Chardonnay)
- Ambulo Blanc (62.5% Cab Sauv, 12.5% Carignane, 12.5% Chardonnay)
- Caminante Blanc (62.5% Cab Sauv, 12.5% Chard, 12.5% Carignane)

PD Resistance Genetics

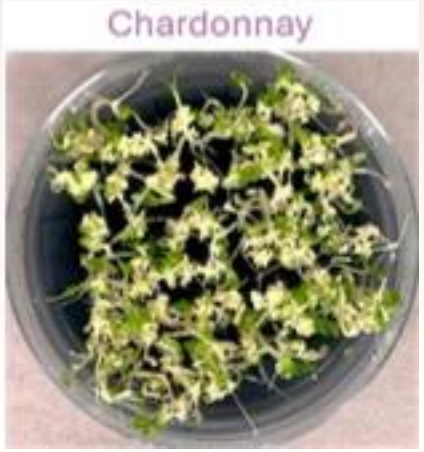
- Dario Cantu (UC Davis), Dr. Summaira Riaz (USDA-Parlier)
- Multiple alleles of PDR1
- Different species
- Fine map the genome
- Develop new markers
- Identify gene function

Table 2: List of grape accessions carrying a *PdR1* haplotype. The genome of the accessions highlighted in blue were produced during our previous project (grant 22-0555-000-SA) and published in Massonnet *et al.* (Massonnet et al. 2025b). * No allele code assigned yet.

				Amplicon size		
Accession	**Species**	**Collection site**	***PdR1* haplotype composition**	**Ch14-78**	**Ch14-77**	**UDV025**
b43-17	*V. arizonica-candicans* hybrid	Monterrey, Mexico	*PdR1a*$^{+}$/*PdR1b*$^{+}$	**231 - 231**	**202 - 204**	**145 - 167**
b40-14	*V. arizonica glabrous*	Chihuahua, Mexico	*PdR1c*$^{+}$/*PdR1d*$^{+}$	**225 - 231**	**165 - 185**	**125 - 136**
b46-43	*V. arizonica glabrous-monticola* hybrid	Big Bend National Park, Texas, USA	*PdR1e*$^{+}$/*PdR1f*$^{+}$	**235 - 235**	**178 - 178**	**144 - 145**
b42-26	*V. arizonica-girdiana* hybrid	Loreto, Mexico	*PdR1*$^{-}$/*PdR1*$^{-}$	223 - 231	180 - 185	138 - 138
ANU5	*V. girdiana*	Mohave, Arizona, USA	*PdR1*$^{+*}$/*PdR1*$^{-}$	**231** - 244	**185** - 203	**132** - 132
SC36	*V. girdiana*	San Diego, California, USA	*PdR1*$^{+*}$/*PdR1*$^{-}$	**229** - 242	**191** - 206	128- **128**

PD Resistance - Gene Editing

- Dario Cantu (UC Davis), Juan Debernardi (UC Davis)
- CRISPR-Cas9 gene editing
- "Knock-in" specific DNA sequence
- No foreign DNA
- *V. vinifera* background plus resistance gene(s)



Topic: Winter Curing (Dr. Rodrigo Almeida, UC Berkeley)

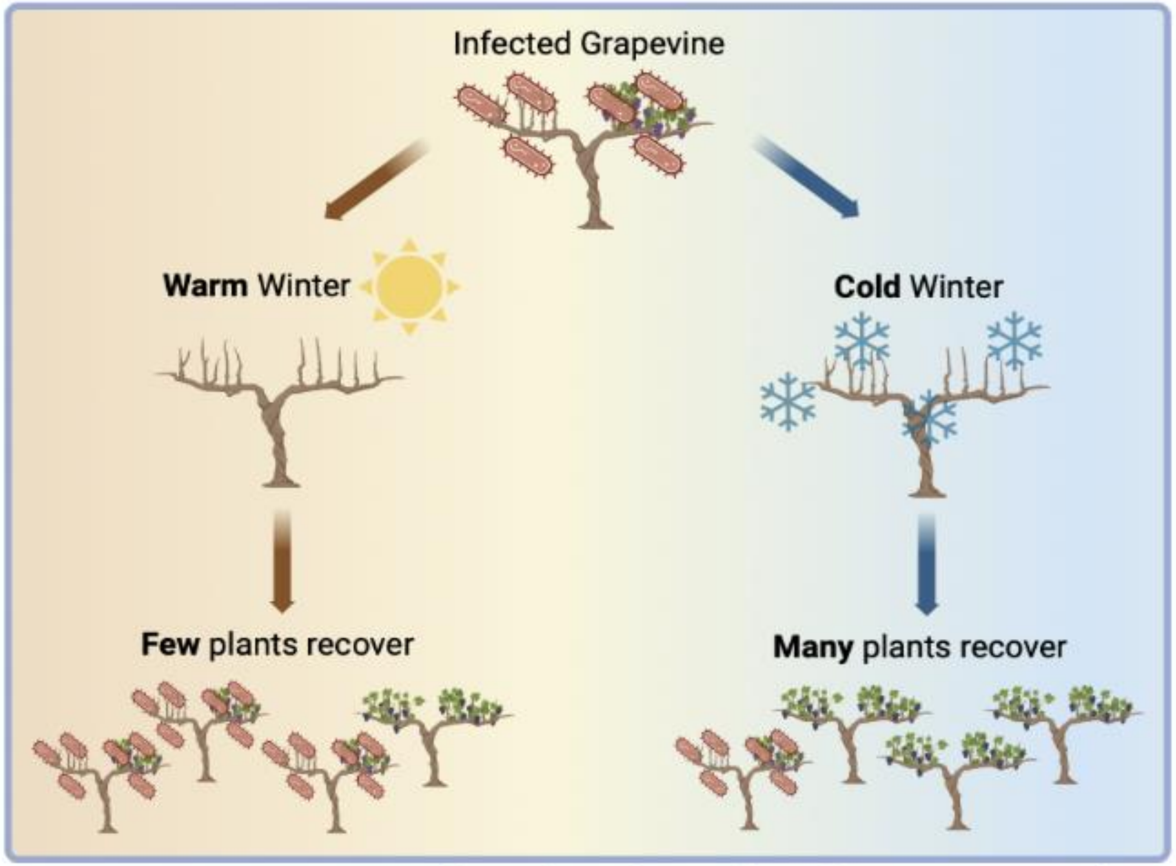
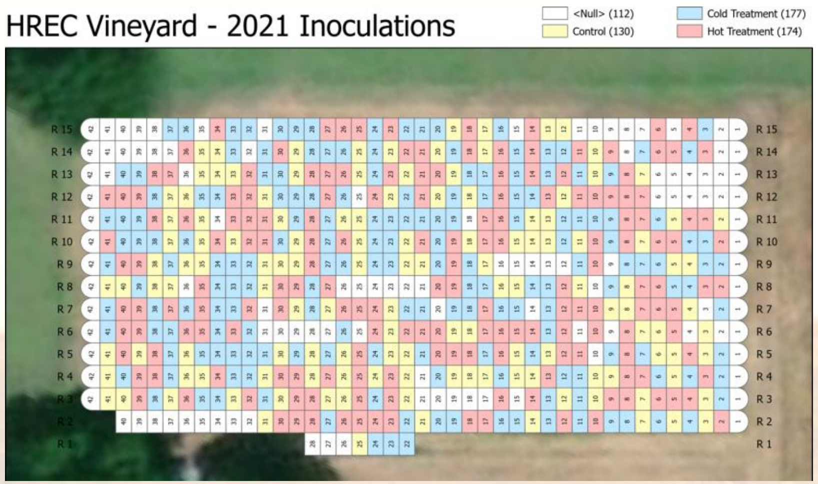
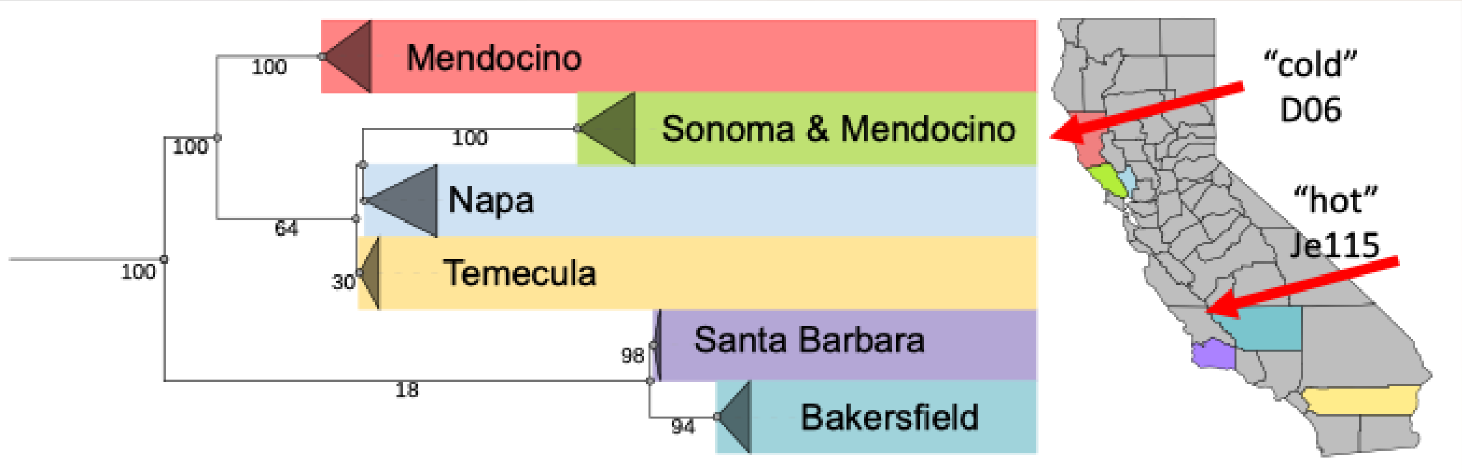


Figure 1: Grapevines infected with *X. fastidiosa* recover from their infections over cold winters. Vineyards in cooler regions therefore avoid chronic infections, whereas in warmer climates the bacteria persist through winter. Created with BioRender.com.

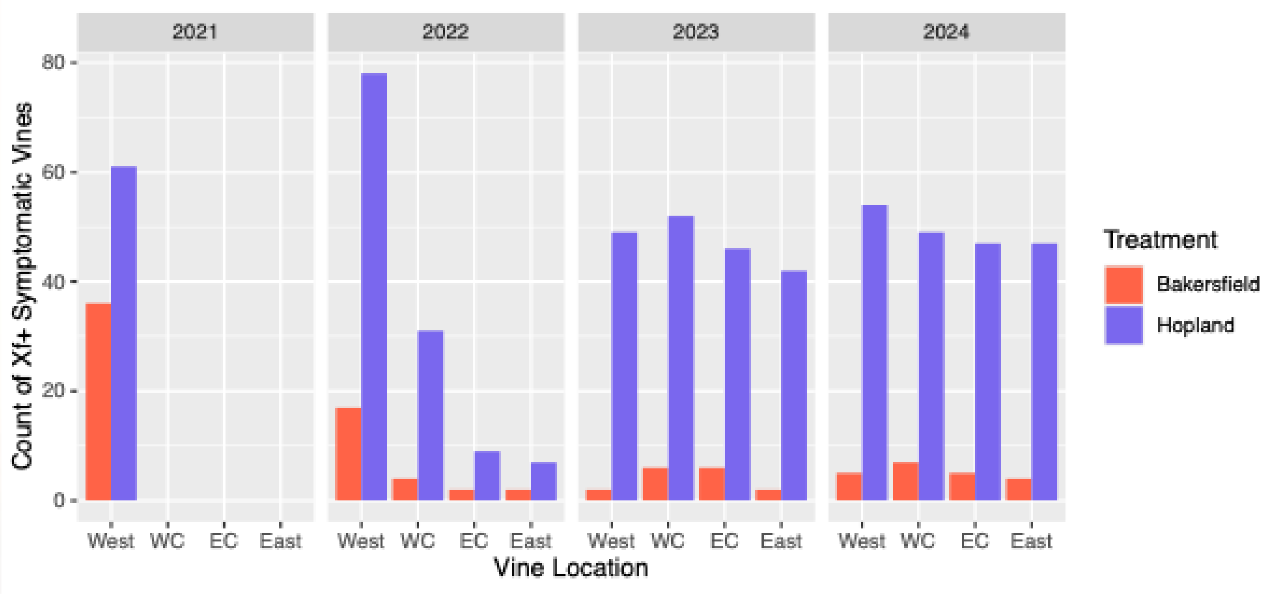


Winter Curing



Genetic variability between Xylella strains across the state

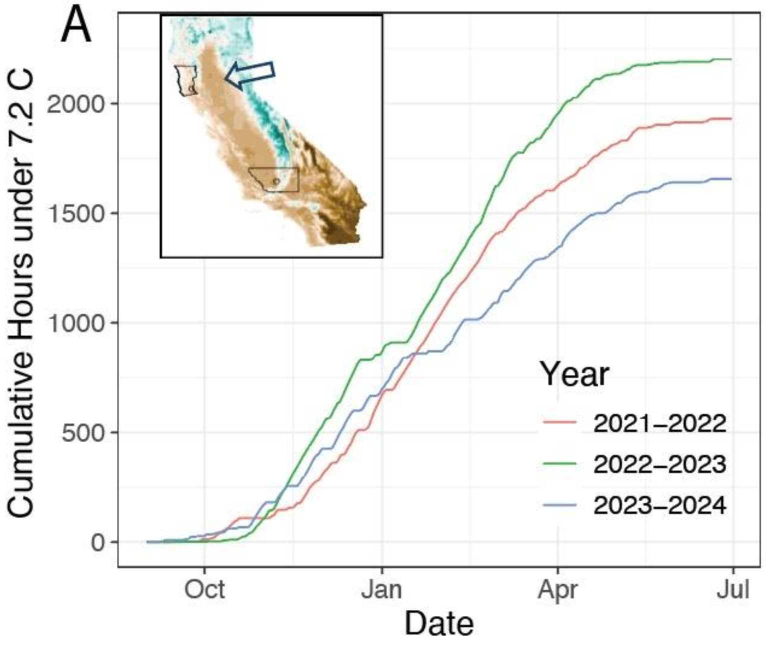
Summary of pathogen movement and disease symptoms in 4 varieties closely monitored

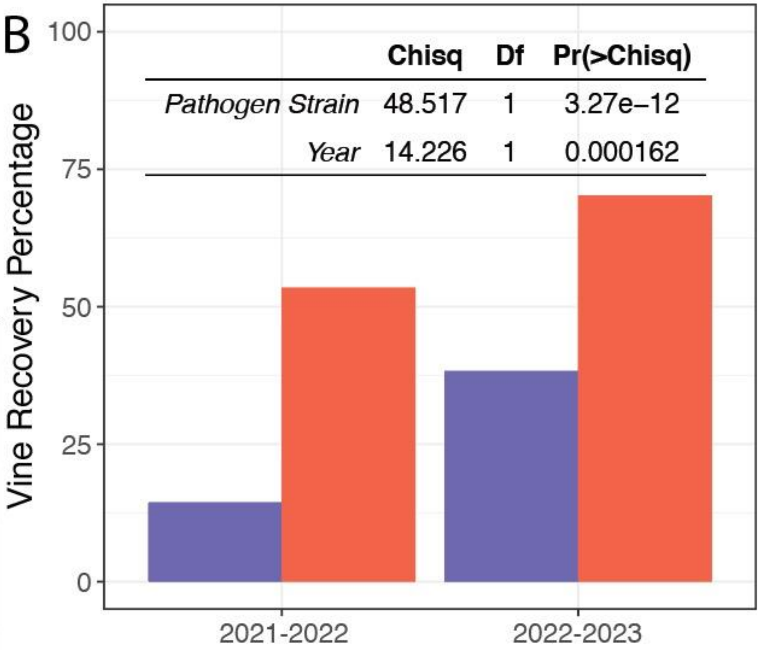


Winter Curing

Not all PD-causing *X. fastidiosa* is created equal

We inoculated an experimental vineyard of ~450 vines in Hopland, CA with the local strain (D06) and a non-local strain (Je115, Bakersfield) in May 2021. Vines were monitored from 2021-2023.





Vines infected with:

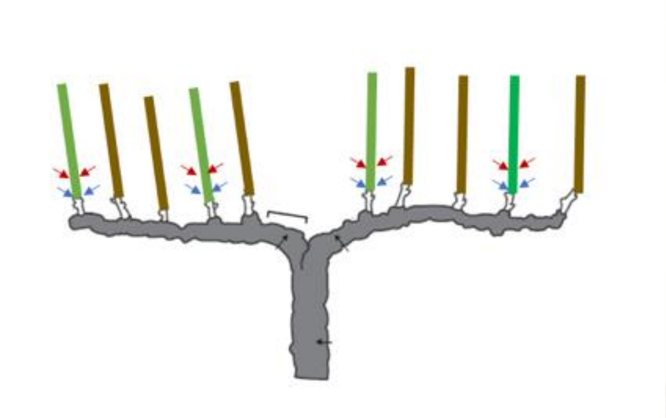
Year	D06	Je115
2021	111	101
2022	95	47
2023	58	14

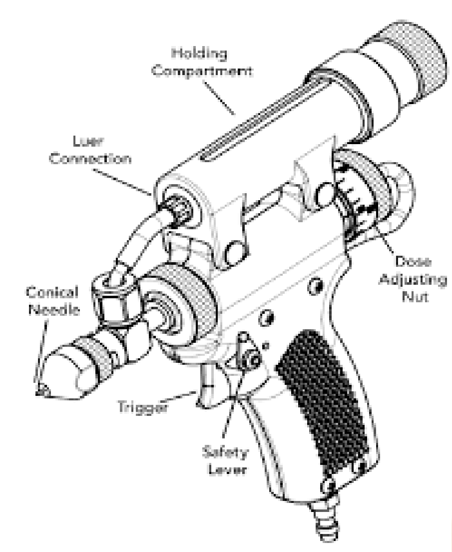
Winter Curing

- Recovery is probably <u>the</u> factor limiting PD outbreaks in Coastal/Northern California
- Can we *enhance* winter curing?
  - Pre-treatment to reduce Xf prior to winter
    - Biocontrol, ZnSO4, N-acetylcysteine
  - Studying genes involved (pathogen, host)

Topic: Biocontrol for PD

- Stag's leap strain of *Xylella fastidiosa*
- Randomized Block Design
- 10 vines/treatment, 4 shoots/treatment
- Pinprick inoculation with Xf
- Treatments applied with XylPhi-PD injection device

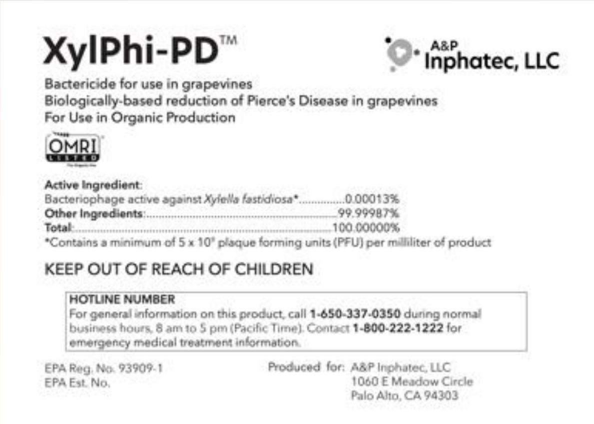




Vine	4	3	2	Vine
V1	0	0	0	V1
V2		x	x	V2
V3		x	2-Y	V3
V4		5-PKC	10-BC	V4
V5		6-GKS	6-GKS	V5
V6		8-PKS	7-YRS	V6
V7		7-YRS	1-B	V7
V8		2-Y	3-O	V8
V9		3-O	4-R	V9
V10		1-B	9-RKC	V10
V11		4-R	8-PKS	V11
V12		2-Y	5-PKC	V12
V13		5-PKC	4-R	V13
V14		9-RKC	x	V14
V15		8-PKS	3-O	V15
V16		7-YRS	8-PKS	V16
V17		x	9-RKC	V17
V18		3-O	1-B	V18
V19		1-B	2-Y	V19
V20		x	6-GKS	V20
V21		6-GKS	5-PKC	V21
V22		x	x	V22
V23	1-B	10-BC	10-BC	V23
V24	9-RKC	2-Y	x	V24
V25	3-O	7-YRS	x	V25
V26	8-PKS	x	x	V26
V27	2-Y	6-GKS	7-YRS	V27
V28	x	10-BC	7-YRS	V28
V29	10-BC	x	9-RKC	V29
V30	x	1-B	4-R	V30
V31	x	x	x	V31
V32	7-YRS	x	10-BC	V32
V33	6-GKS	4-R	1-B	V33
V34	5-PKC	5-PKC	2-Y	V34
V35	x	8-PKS	8-PKS	V35
V36	4-R	9-RKC	5-PKC	V36
V37	4-R	3-O	3-O	V37
V38	8-PKS	5-PKC	x	V38
V39	2-Y	7-YRS	6-GKS	V39
V40	7-YRS	10-BC	4-R	V40
V41	9-RKC	1-B	6-GKS	V41
V42	10-BC	8-PKS	3-O	V42
V43	1-B	2-Y	x	V43
V44	5-PKC	6-GKS	2-Y	V44
V45	6-GKS	9-RKC	1-B	V45
V46	3-O	x	8-PKS	V46
V47	4-R	4-R	5-PKC	V47
V48	9-RKC	x	10-BC	V48
V49	10-BC	3-O	7-YRS	V49
V50	x	x	9-RKC	V50
V51	0	0	0	V51
	4	3	2	
		Road		

Topic: Biocontrol for PD (Dr. Akif Eskalen, UC Davis)

Treatment #	Treatment Group
1	XylPhi-PD (label)
2	XylPhi-PD
3	Biocontrol -1
4	Biocontrol-2
5	Biocontrol-3
6	Bio-1 + XylPhi-PD
7	Bio-2 + XylPhi-PD
8	Bio-3 + XylPhi-PD
9	Positive control (Xf only)
10	Negative control (no Xf or biopesticide treatment)


XylPhi-PD™

A&P Inphatec, LLC

Bactericide for use in grapevines
Biologically-based reduction of Pierce's Disease in grapevines
For Use in Organic Production

OMRI LISTED

Active Ingredient:
Bacteriophage active against *Xylella fastidiosa**..............0.00013%
Other Ingredients:..........99.99987%
Total:..........100.00000%
*Contains a minimum of 5 x 10^{8} plaque forming units (PFU) per milliliter of product

KEEP OUT OF REACH OF CHILDREN

HOTLINE NUMBER
For general information on this product, call **1-650-337-0350** during normal business hours, 8 am to 5 pm (Pacific Time). Contact **1-800-222-1222** for emergency medical treatment information.

EPA Reg. No. 93909-1
EPA Est. No.

Produced for: A&P Inphatec, LLC
1060 E Meadow Circle
Palo Alto, CA 94303

Paraburkholderia phytofirmans strain PsJN is a Gram-negative bacteria

Pseudomonas viridiflava and ***Achromobacter xylosoxidans***

Topic: Biocontrol for PD

- **XylPhi-PD®** and **biocontrol agents** consistently reduced foliar symptoms over three years, especially when used in combination.
- **Symptom suppression** did not always correlate with **Xylella** levels, suggesting **additional protective mechanisms** beyond direct bacterial inhibition.
- Ongoing multi-year trials are critical to refine efficacy, optimize application timing, and understand long-term impacts.
- This approach offers a **new way to manage Pierce's Disease, focusing** on prevention with biologically tools.
- Future trials are planned in commercial vineyards across the state

Sustainable Management

Host Plant Resistance

- Planting resistant varieties
- Location, microclimate
- Trellis
- Winemaking
- Economic feasibility

Local Vector/Pathogen Control

- Consistent trapping protocols
- Identifying vector habitat
- Sharing data
- Coordinating vector treatments
- Rogue infected plants (source of inoculum)

PD Treatments

- XylPhi-PD
- Paraburkholderia

Phytopathology® • 2024 • 114:503-511 • https://doi.org/10.1094/PHYTO-06-23-0219-R

Bacteriology

Control of Pierce's Disease of Grape with *Paraburkholderia phytofirmans* PsJN in the Field

Steven Lindow,[†] Renee Koutsoukis, Kyle Meyer, and Clelia Baccari

Department of Plant and Microbial Biology, University of California, Berkeley, CA 94720

Accepted for publication 17 October 2023.

WHAT YOU CAN DO: ACTION ITEMS FOR THE FIELD

Help Keep GWSS in Check

- ☑ Regulatory activities guidelines: bit.ly/3GnPgto
- ☑ Report PD/GWSS to ag commissioner: cacasa.org/county/
- ☑ Collaborate with UCCE farm advisors: bit.ly/4luANLm

Support Research & Outreach

- ☑ Stay informed
- ☑ Participate in field trials & outreach
- ☑ Give feedback to guide research

CALIFORNIA PD/GWSS BOARD
Partnership for Winegrape Pest Solutions

2026 – ISSUE 2

bulletin

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INSIDE THIS ISSUE

PAGE 2
List of New Research Projects

PAGE 3
2025 PD/GWSS Board Research Projects at a Glance

Watch Now: New Research Video Updates

PAGE 4
Grapevine Red Blotch Virus: Understanding Vectors and Early-Season Risk

Investing Wisely in Research That Works for Growers

Each year, the Pierce's Disease and Glassy-winged Sharpshooter Board supports research focused on protecting vineyards and managing pest and disease risk. With the industry facing ongoing financial pressure, the Board continues to take a careful, targeted approach to research investments to maximize available resources.

2026 RESEARCH FUNDING
$1.99M for 9 new projects
$866K for 7 continuing projects
$62.1M invested in research since 2001

This year, the Board is investing $1.99 million in new research funding for nine research projects over the next two years. The Board is also continuing support for seven previously approved multi-year projects, with $866,277 allocated for fiscal year 2026/27.

These investments support work from early-stage studies to applied research, helping fill knowledge gaps and move solutions closer to use in the field.

Projects address key challenges, including Pierce's disease, grapevine viruses and the insects that spread them.

"We reviewed many strong proposals this year, but we had to be selective. We focused on funding a diverse set of projects that address the range of challenges growers are facing and will deliver the greatest value in the vineyard," said Trey Irwin, Board chair.

Each year, the Board issues a Request for Proposals and evaluates submissions through a multi-level review process involving outside experts, scientists and industry representatives. Final funding decisions are approved by Secretary of Agriculture Karen Ross, with funding for selected projects beginning in July.

The projects funded this year reflect both immediate needs and long-term priorities, helping ensure limited funds are used where they can have the greatest impact. View the list of new research projects on the next page.

Built to deliver value over time, the research program is supported by the PD/GWSS assessment and directed by a grower-led board. Since 2001, the Board has funded 320 research grants, investing $44.8 million in PD and GWSS research and $17.3 million in research on other pests and diseases. Learn more at bit.ly/PDBoardResearch.

bit.ly/PDGWSSboard

Thank You!

(707) 266-3286

kris@vinebalanceconsulting.com

Pierce's Disease Control Program

cdfa.ca.gov/pdcp

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