Epidemiology and management of PD in the USA - present and future -

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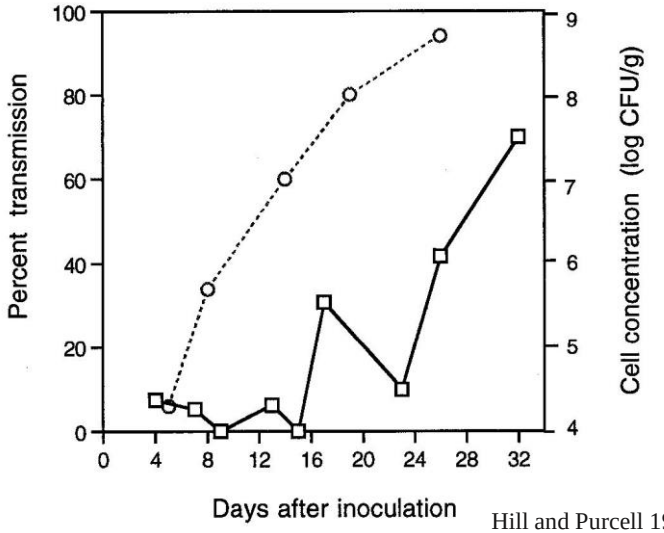
Berkeley Rausser
College of Natural Resources

Seasonality is key to Pierce's disease

Seasonal acquisition efficiency

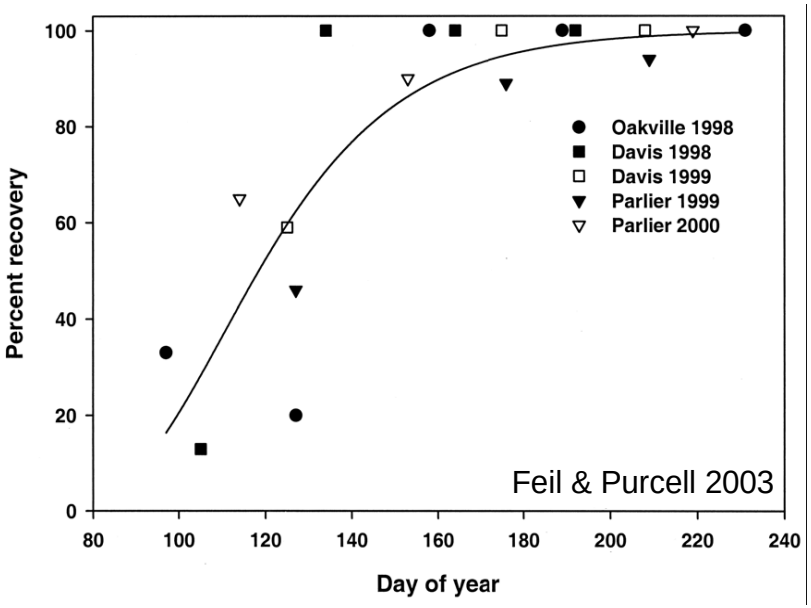
- -low *X. fastidiosa* populations early in the year
- -threshold population for vector acquisition
- -minimal transmission early on?



Hill and Purcell 1997

Vine recovery

- -vines lose infection over winter
- -mechanism not well understood (pruning, infection level)
- -recovery rate dependent on infection date



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What is the first PD symptom to develop?

leaf chlorosis & scorch

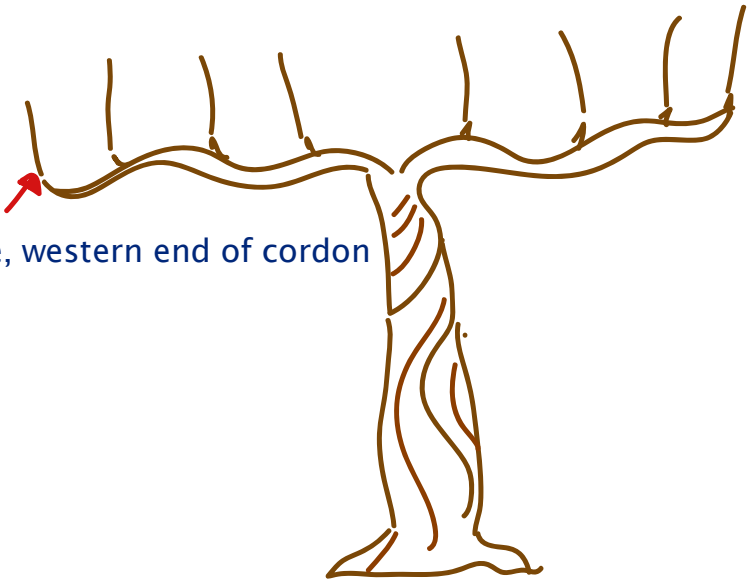
petioles & uneven lignification

stunting & vine decline

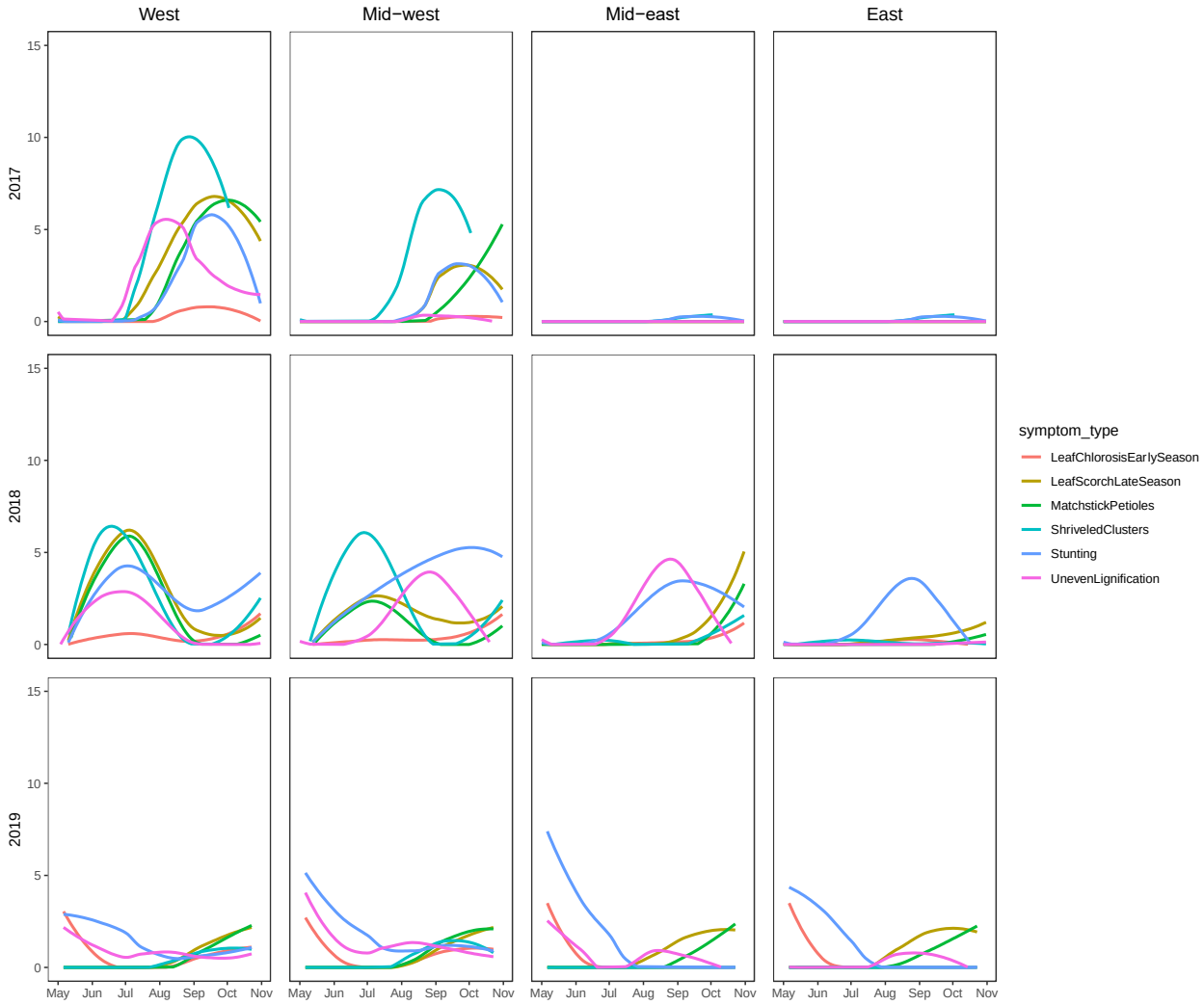
shriveled clusters

PD progression in the field

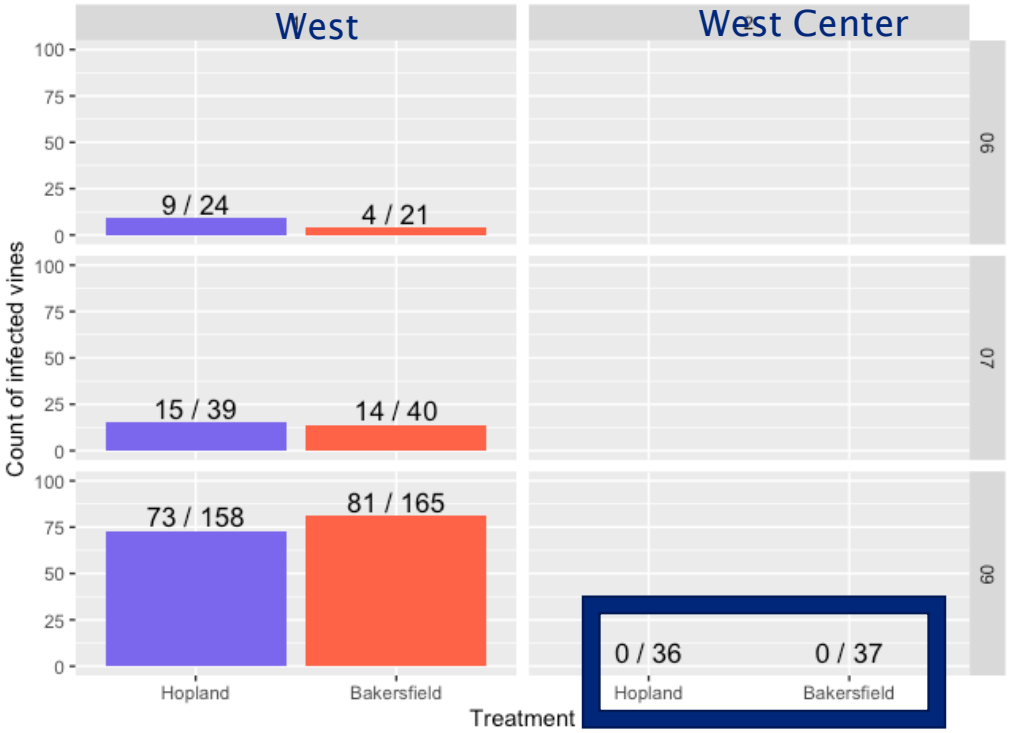
Needle inoculation of each vine with *X. fastidiosa*



Small plot in Napa Valley – finished
Large plot in Mendocino Co - ongoing


West
Mid−west
Mid−east
East
2017
2018
2019
0
5
10
15
May
Jun
Jul
Aug
Sep
Oct
Nov
symptom_type
LeafChlorosisEarlySeason
LeafScorchLateSeason
MatchstickPetioles
ShriveledClusters
Stunting
UnevenLignification

At a colder site, movement in vine is slower

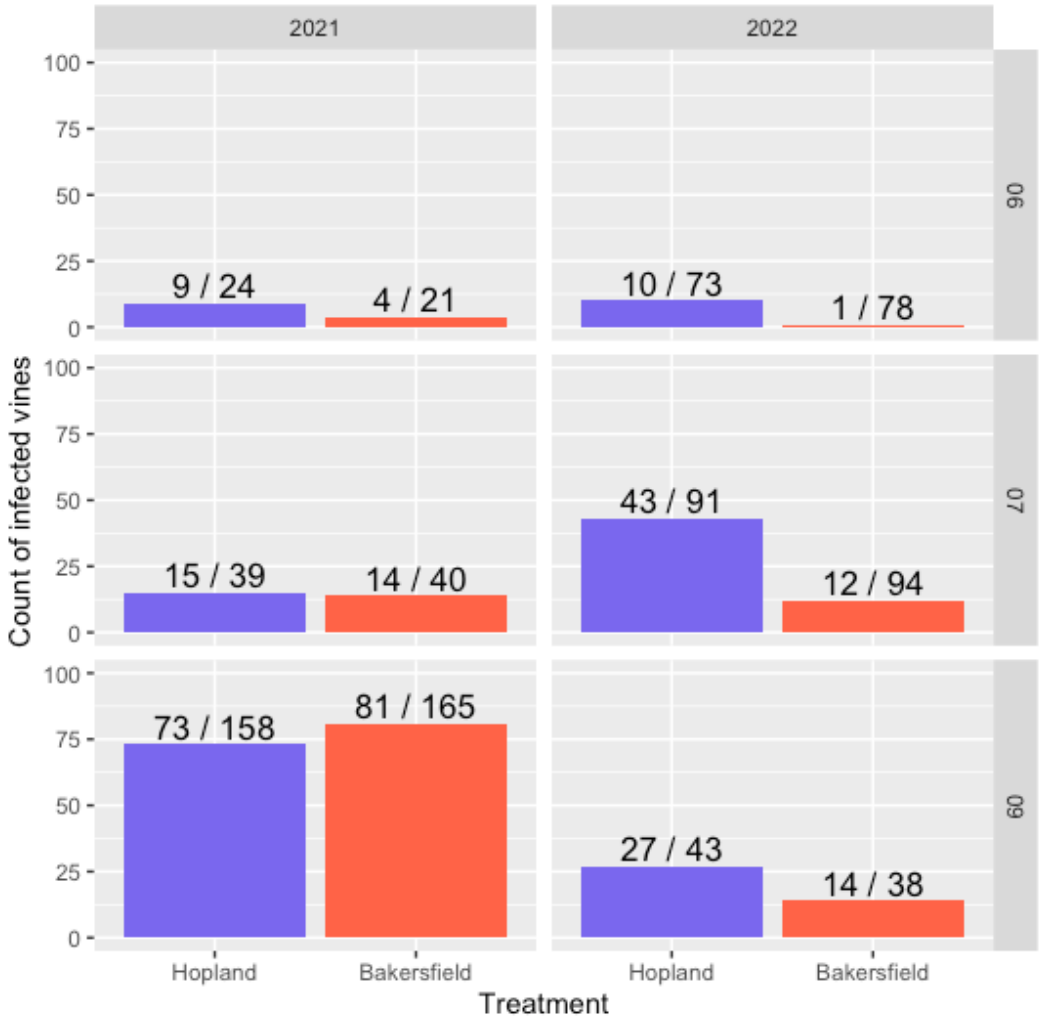


Side x Month in 2021

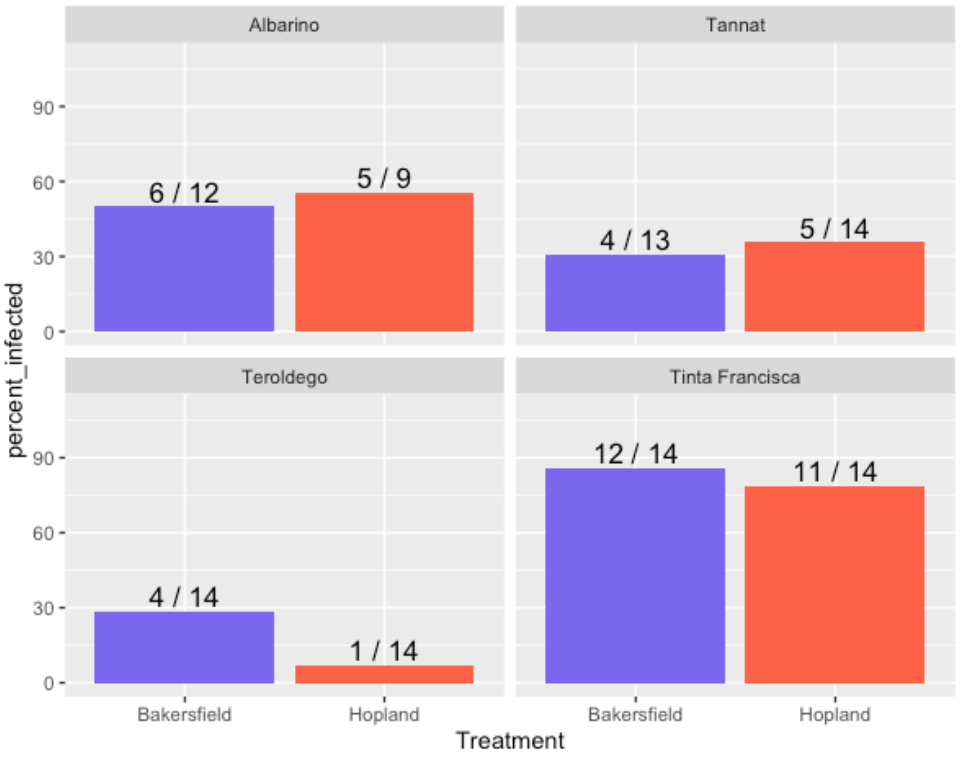
- Detection rates increased throughout the season
  - June → July → Sept
- For both strains, overall positivity rate was ~50% in September.
- No movement from Western shoot (side #1, tested across cultivars)

Year 2 – Infection status by month

- Months (06, 07, 09)
- Side #1 only
- Based on initial data, there seems to be greater curing in Bakersfield than Hopland.
- Still in progress…



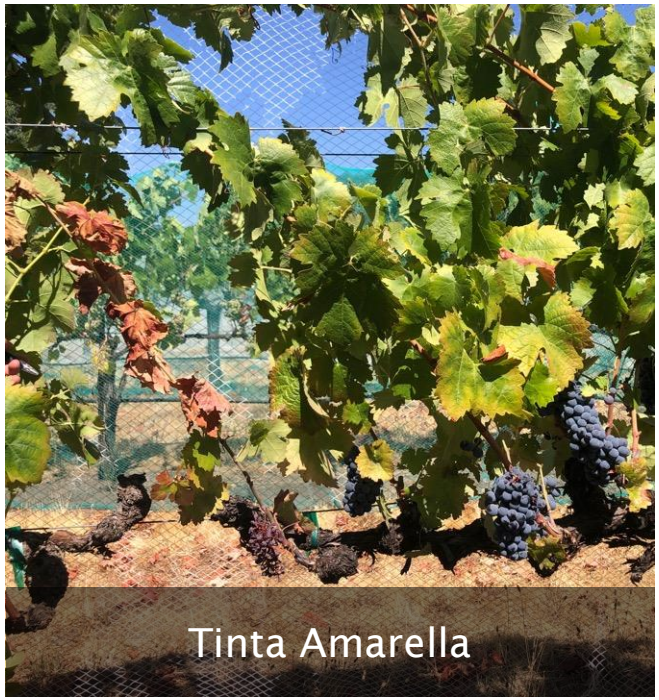
Varieties differ in Susceptibility (Sept. 2021)



Treatment x Variety in Sept. 2021

Variety	Xf +	n	% (Xf+)
Teroldego	5	28	17.9
Mencia	8	24	33.3
Tannat	9	27	33.3
Falanghina	9	23	39.1
Ciliegiolo	11	28	39.3
Periquita	14	29	48.3
Tinta Amarella	14	29	48.3
Graciano	9	18	50.0
Greco di Tufo	14	28	50.0
Albarino	11	21	52.4
Petit Manseng	16	25	64.0
Sagrantino	11	15	73.3
Tinta Francisca	23	28	82.1

Symptoms in specific cultivars



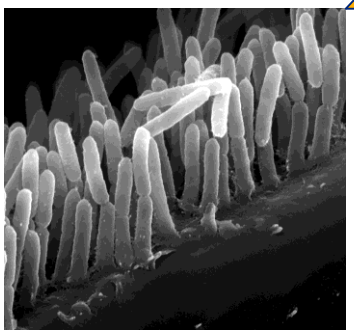
Vines in Sept. 2022
- year 2-

Periquita R14 V21

Tinta Amarella R11 V17

Mencia R6 V19

There are ‘two’ Pierce’s disease in California



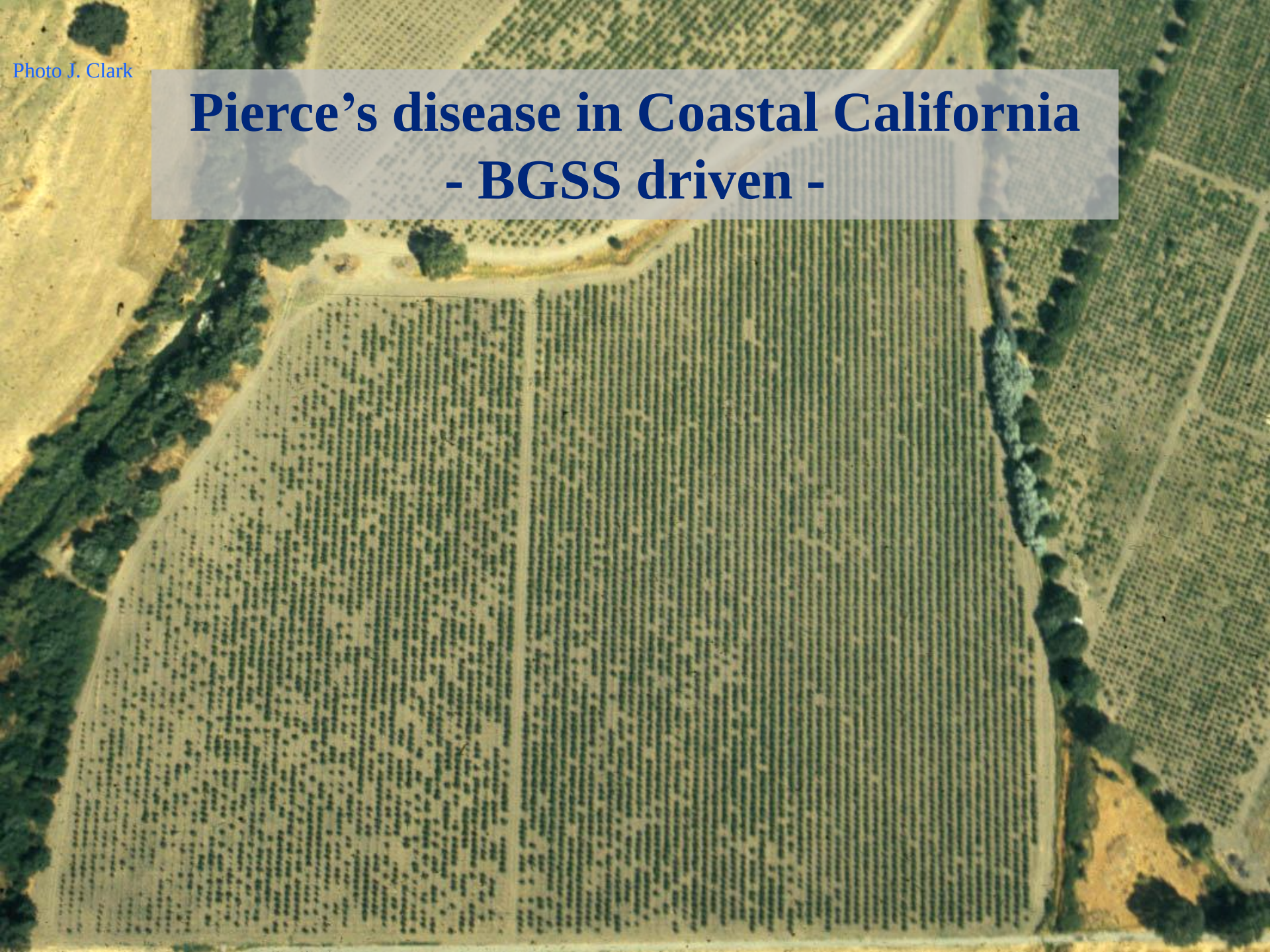
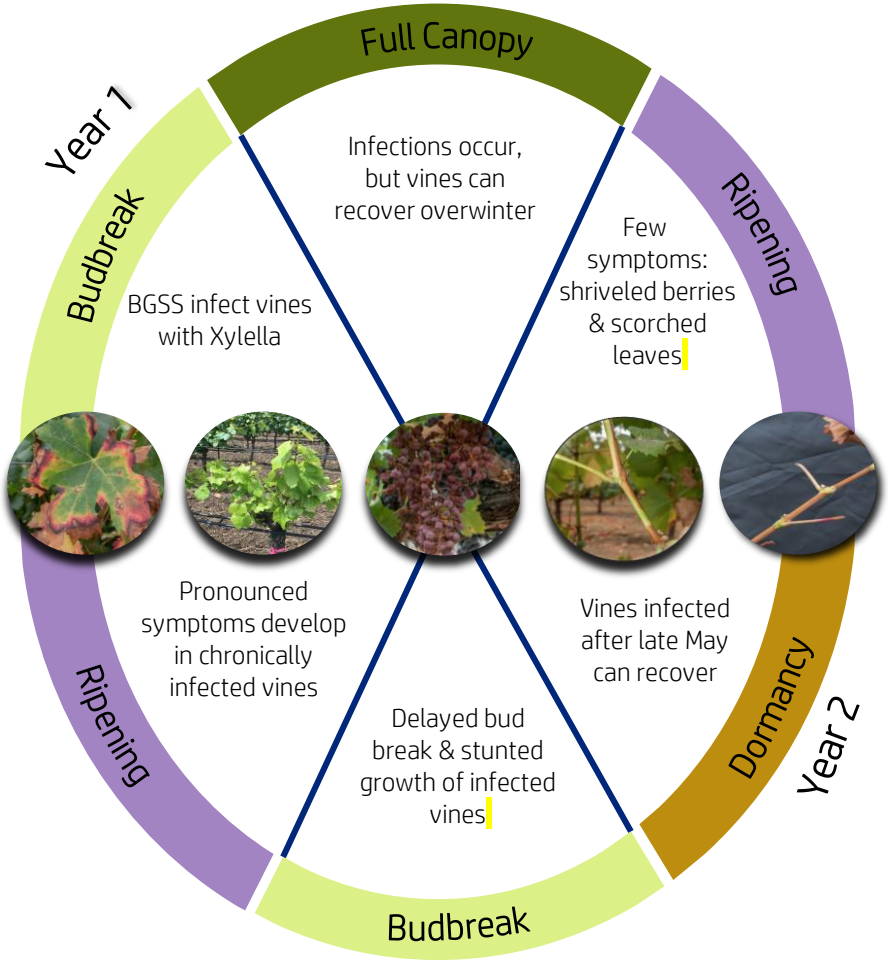


Photo J. Clark

Pierce's disease in Coastal California
- BGSS driven -

Pierce's disease cycle
North Coast, California



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Pierce's disease in Southern California
- GWSS driven -

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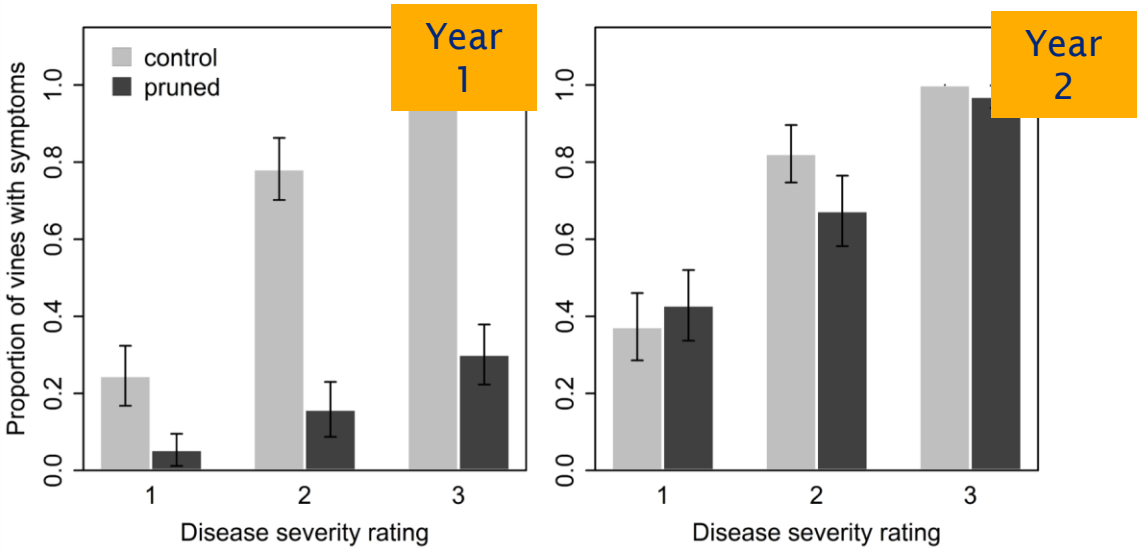
Control strategies

- Biological control
  - *Paraburkholderia phytofirmans*
  - Phage therapy
- Vector control
  - Chemical – problem with resistance
  - Vegetation management – may work well for spittlebugs
  - Biological – parasitoid wasps
  - Genetic –CRISPR modifications
- Roguing is key – removal of inoculum
- 'Cure' compounds – peptides, nanoparticles, zinc
- Plant immune responses/strategies

Severe pruning & retraining does not remove *Xf*



Rating scale & description

1	marginal leaf scorch on up to 4 scattered leaves total
2	foliar symptoms on 1 shoot, or on fewer than ½ leaves on 2 shoots on one cordon; <25% clusters shriveled
3	foliar symptoms on 2 or more shoots on both cordons; dead spur positions + cluster shrivel

Daugherty et al. 2018. *AJEV* 69: 289-294

Breeding PD Resistant Winegrapes

Andy Walker

VITICULTURE & ENOLOGY
UNIVERSITY OF CALIFORNIA DAVIS

We discovered a single dominant gene for resistance in *V. arizonica* (b43-17), which we genetically and physically mapped.

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Marker-Assisted Selection for *PdR1*

- DNA extracted from seedlings
- Aggressive growing techniques to get flowers and fruit in year 2
- Two-year cycle with marker-assisted selection (MAS)
- Select for lack of symptoms and low bacterial levels
- F1 = 50% vinifera; BC1 = 75%; BC2 = 88%; BC3 = 94%; BC4 = 97%
- Optimizes classical breeding – not GMOs

Caminante Blanc

62.5% Cab Sauv, 12.5 Carig, 12.5 Chard

Late bloom, mid-season ripening

Small berries, small clusters

Medium productivity

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163333-022

PdR1b x *PdR2* resistant selections – 14309-111 x Cab Sauvignon
(96% *vinifera*)

1.3 g berries, 286 g clusters, moderate fruitfulness

Red to orange light juice, fruity, Pinot noir–like

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CALIFORNIA PD/GWSS BOARD

Partnership for Winegrape Pest Solutions

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Winegrape Assessment

- Set at $1.25 for the 2022 harvest
- Averaged $1.35 per $1,000 of value since 2001
- $78.6 million over 21 years
- Funds research & other activities

Research Highlights

PD/GWSS Basic Research

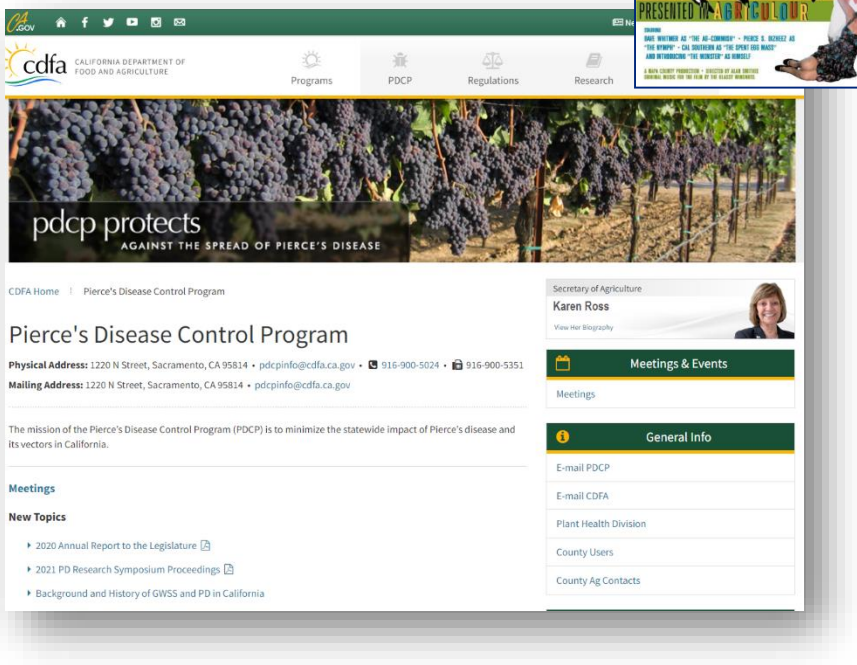
- General knowledge and epidemiology – *Almeida, UC Berkeley*
- Conventional PD resistance breeding and molecular studies – *Walker (ret), Cantu, UC Davis*
- Transgenic modification of GWSS – *Atkinson, UC Riverside*
- Biocontrol of *Xylella* with endophytes – *Lindow, UC Davis*
- Zinc nanoparticle PD treatment – *De La Fuente, Auburn*
- Bluegreen sharpshooter communication – *Krugner, USDA*
- *Trichoderma* for biocontrol – *Wallis, USDA*

PD/GWSS Applied Research: Biopesticide evaluation – *Eskalen, UC Davis*

PD/GWSS Field Trials: Transgenic rootstocks – *Gilchrist, Dandekar, UC Davis*

Outreach

- Awareness & compliance increased rapidly
- Public help discover new infestations
- Meetings, brochures, website, mailings, news stories, posters, etc.
- Outreach also done via PD/GWSS Board



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