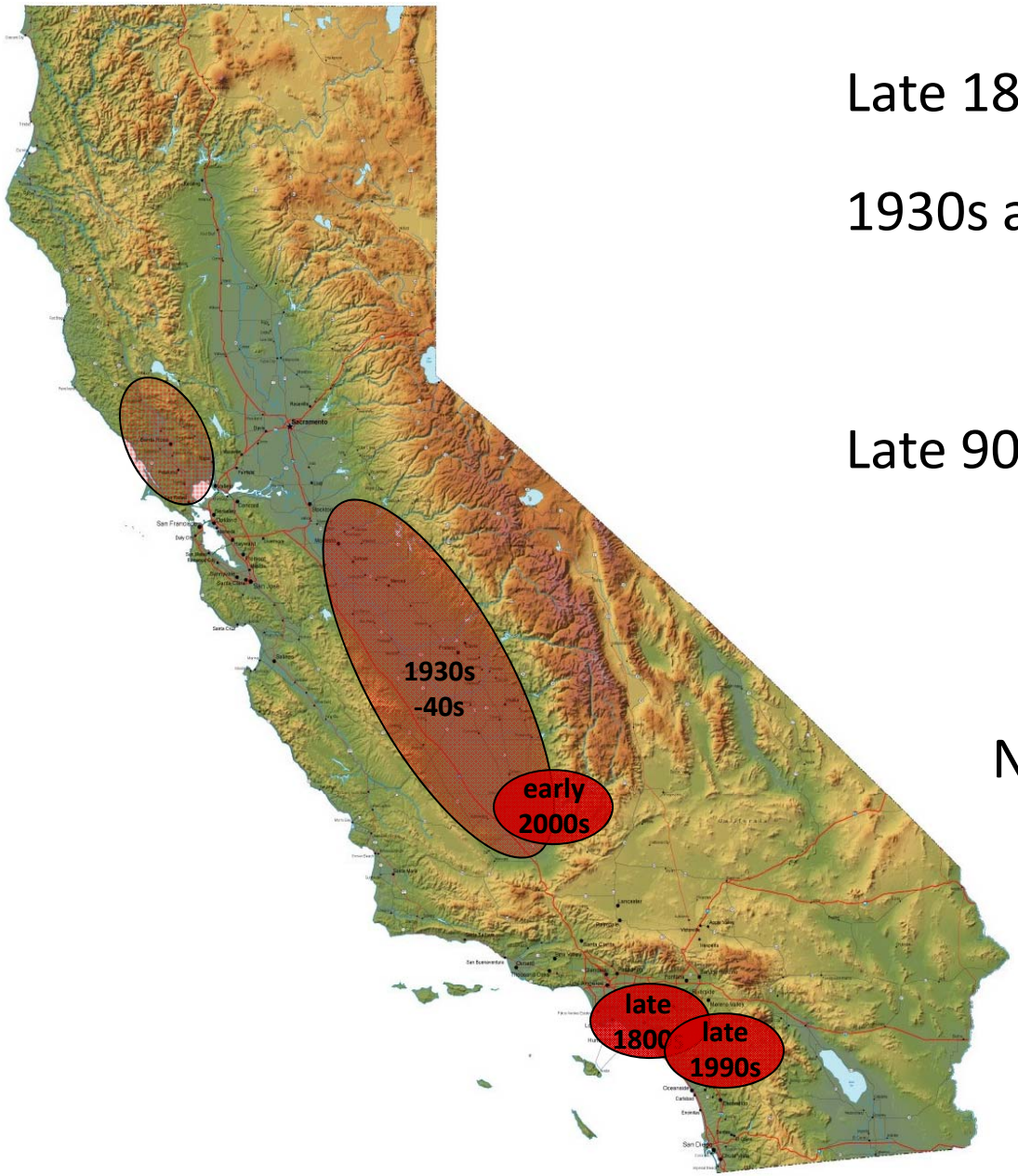
Pierce's disease epidemiology and management in the North Coast

Matt Daugherty, Department of Entomology,
UC Riverside (mattd@ucr.edu)

Severe PD outbreaks are unusual



Late 1800s: Anaheim vine disease

1930s and 40s: Central Valley

-alfalfa

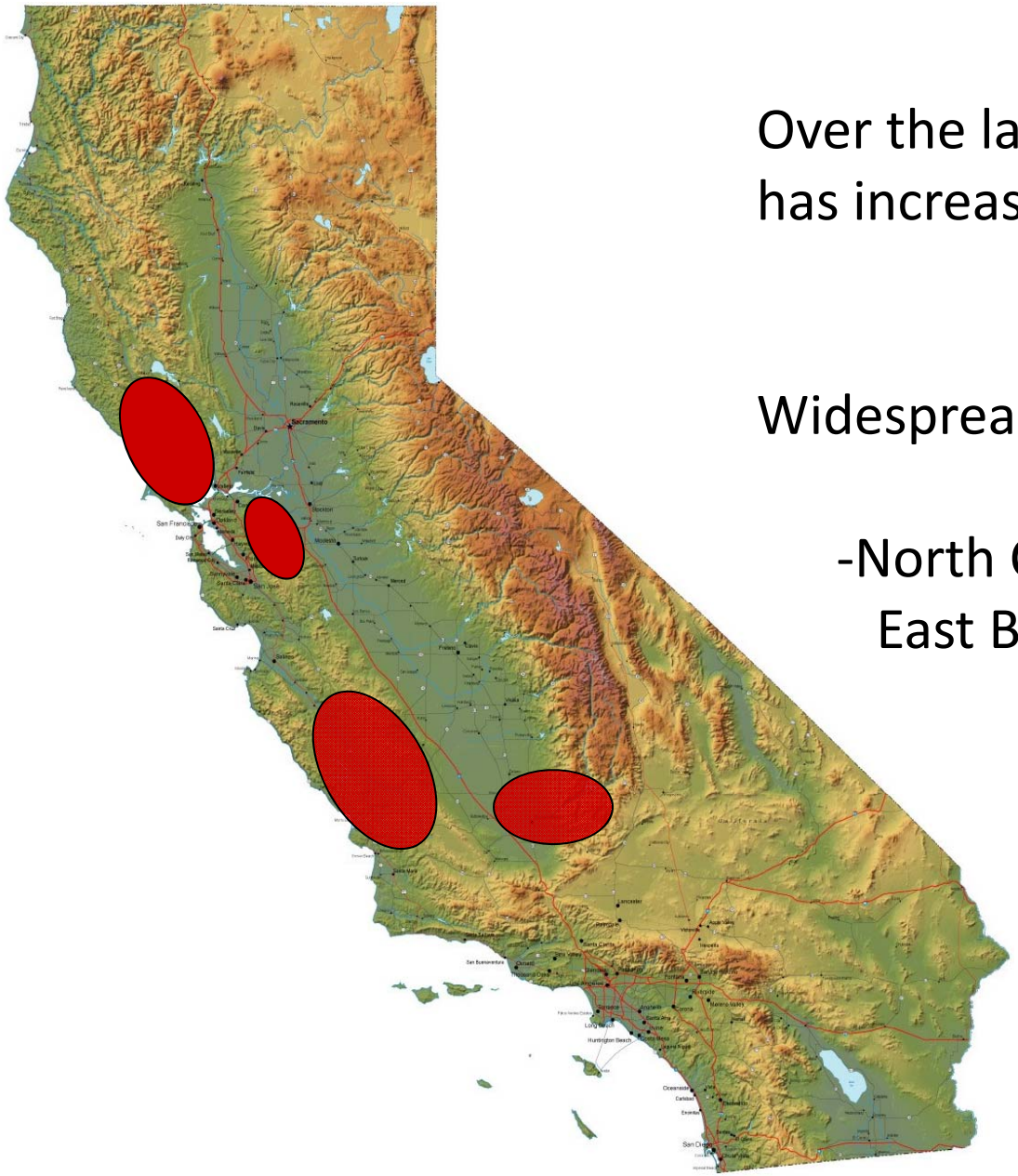
Late 90s - early 2000s: Temecula Valley and Kern County

-invasive GWSS

North coast: usually moderate, but episodic

-native BGSS

Severe PD outbreaks are unusual



Over the last few years PD prevalence has increased dramatically

Widespread phenomenon

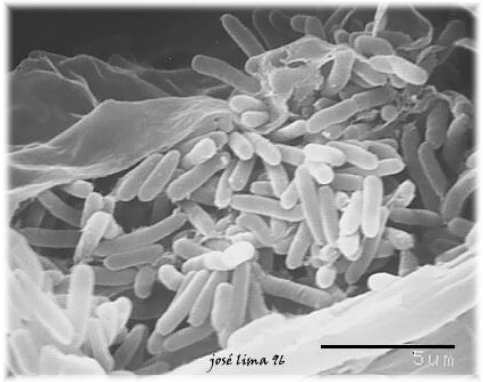
-North Coast, Central Coast, East Bay, Kern Co.

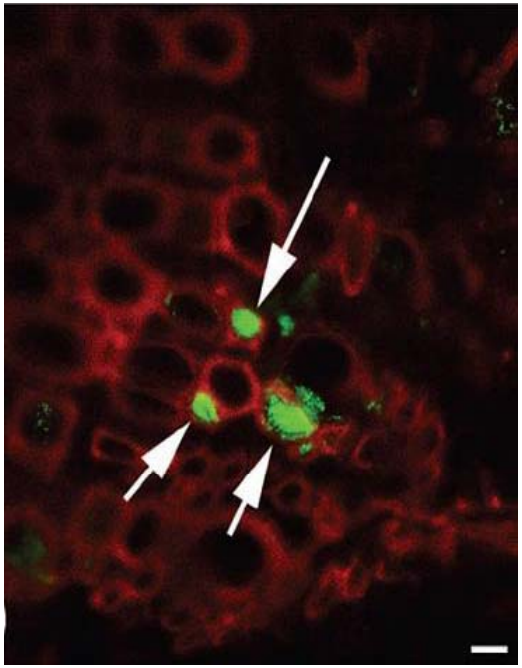
Xylella fastidiosa

Xylem-limited bacterium

Infects native, ornamental, & weedy plants

Threat to several crops
(e.g., grapes, almond, citrus, alfalfa)





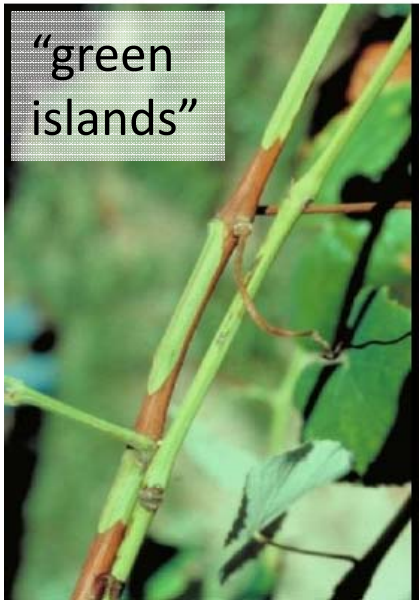
Xylella diseases

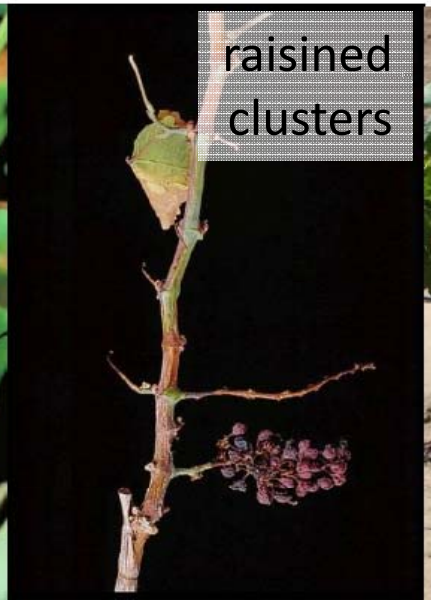
Plugs xylem vessels, restricts water flow

Leaf scorch or stunting symptoms vary among hosts (Pierce's disease in grapes, Alfalfa dwarf)

No cure

Pierce's disease





Pierce's disease strain/subspecies of *X. fastidiosa* is one of several types

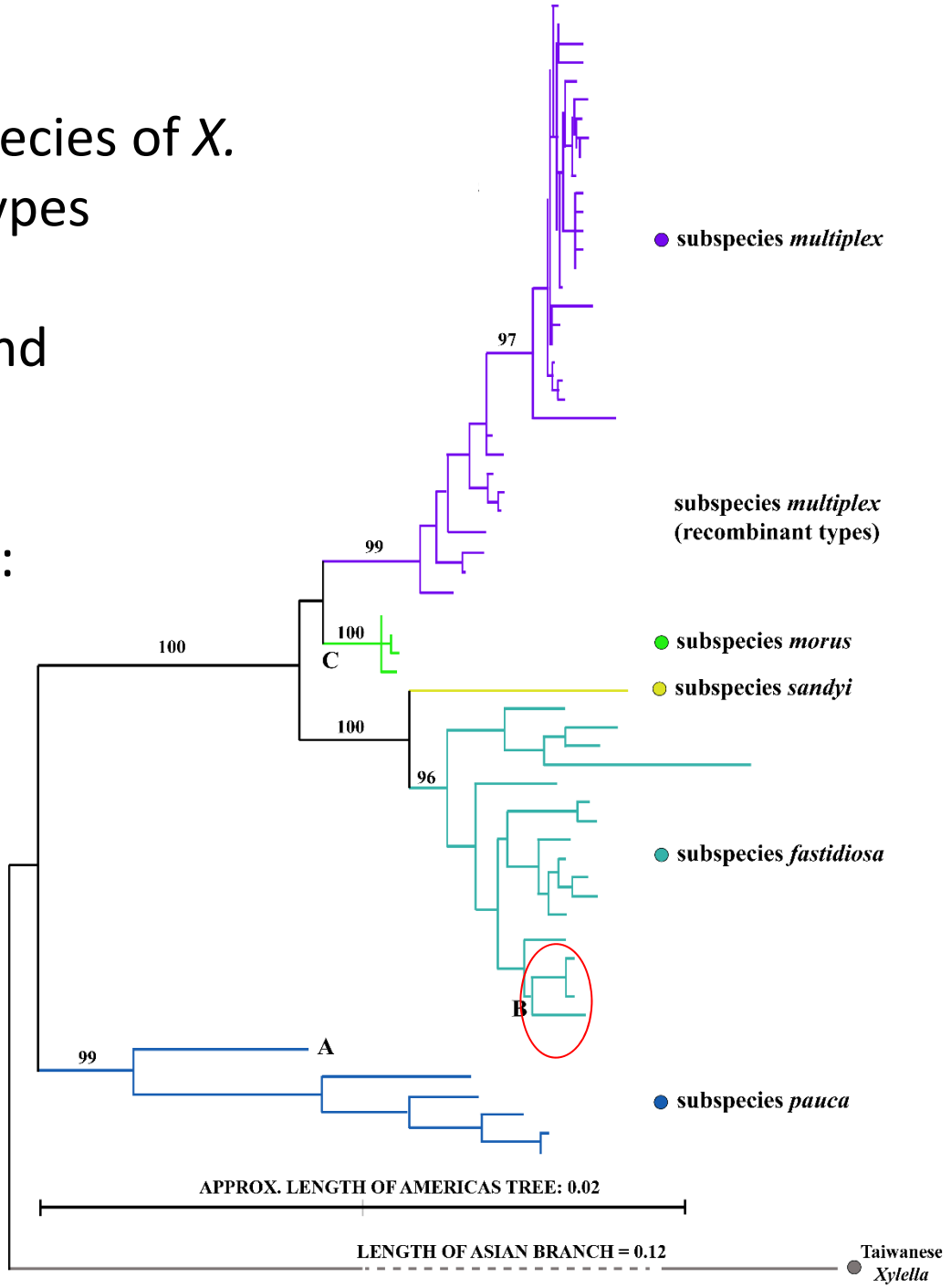
Strains differ in host range and virulence

Other strains responsible for:

-Almond leaf scorch

-Oleander leaf scorch

-Olive leaf scorch



Xylella fastidiosa transmission

Transmitted by xylem sap-feeding insects

No transovarial transmission

No latent period

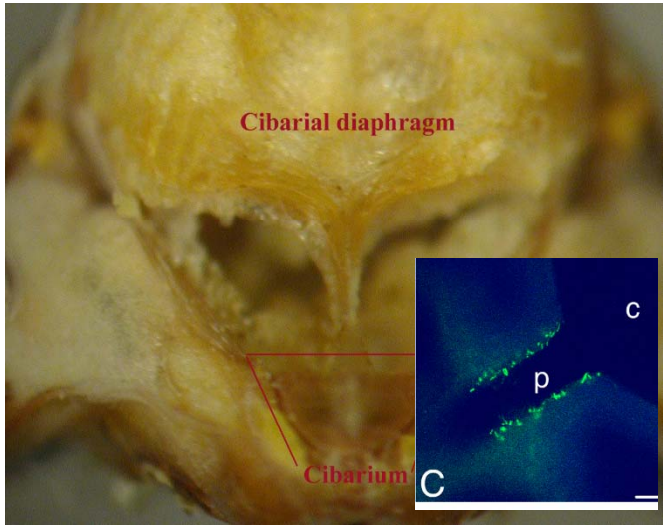
Nymphs & adults can transmit

-no transmission after molting

-persistent in adults

Vector species differ in efficiency

-BGSS >> GWSS



Which vectors are most important in the North Coast?

- Glassy-winged sharpshooter – not present
- Blue-green sharpshooter – present; very important vector in the past and today
- Other sharpshooters – if present, they are of lesser importance in the North Coast

  -green, red-headed, smoke tree
- Meadow spittlebug – present; likely important in certain settings

Blue-green sharpshooter (*Graphocephala atropunctata*)

Dominant vector of *Xylella* in the North Coast

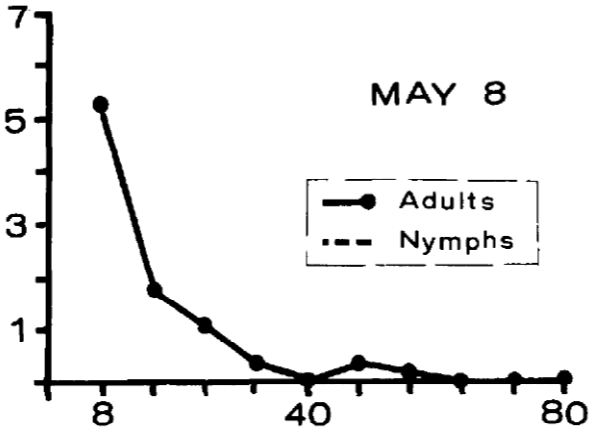
Strong association with riparian habitats

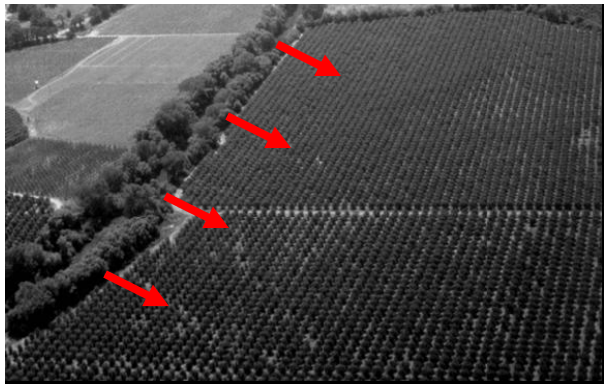
-wild grape, blackberry, mugwort….

Becomes active in vineyards in the Spring, when days become warmer

>65 F

Typically does not travel too far into vineyards





Typical Pierce's disease pattern

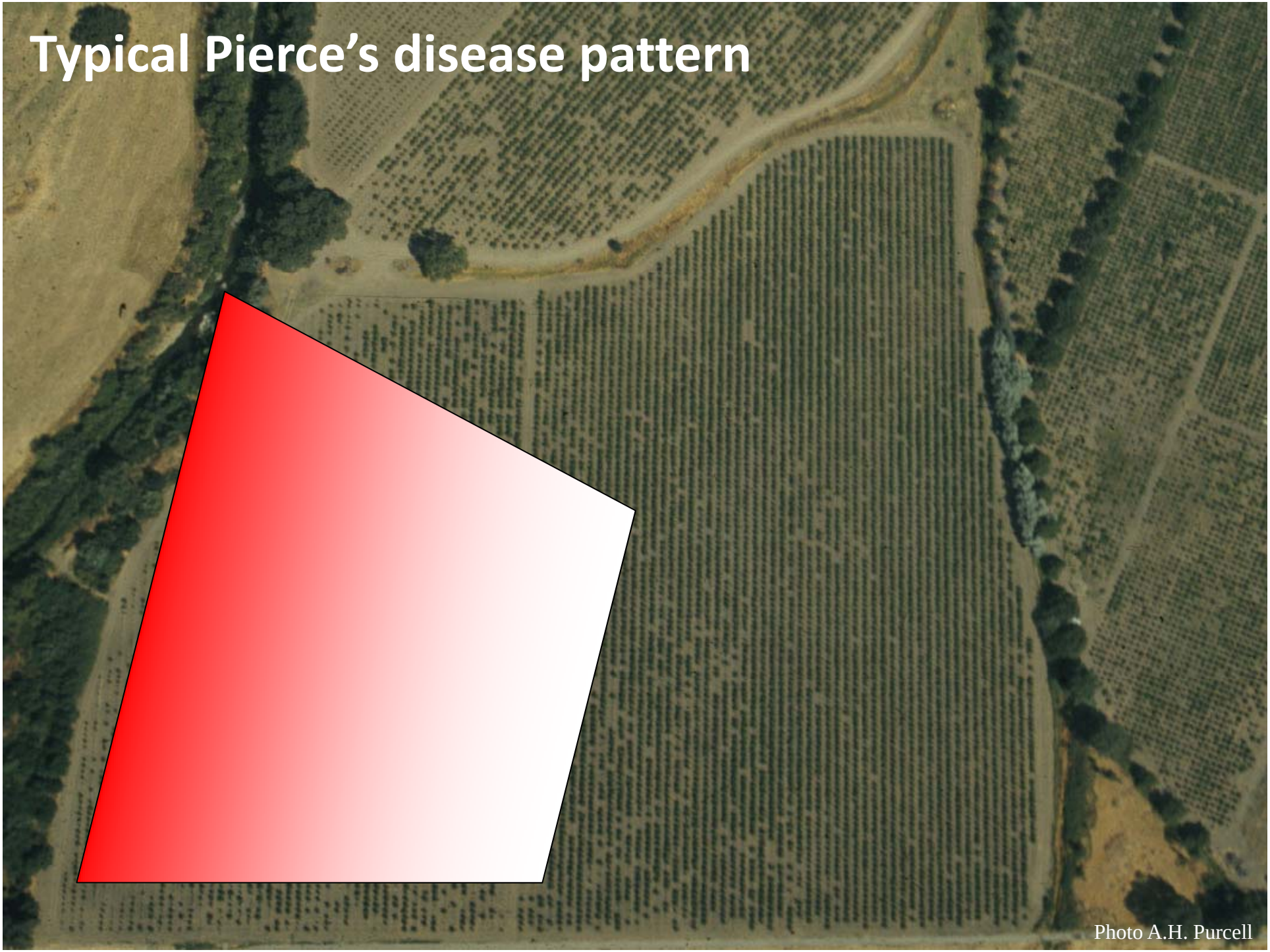
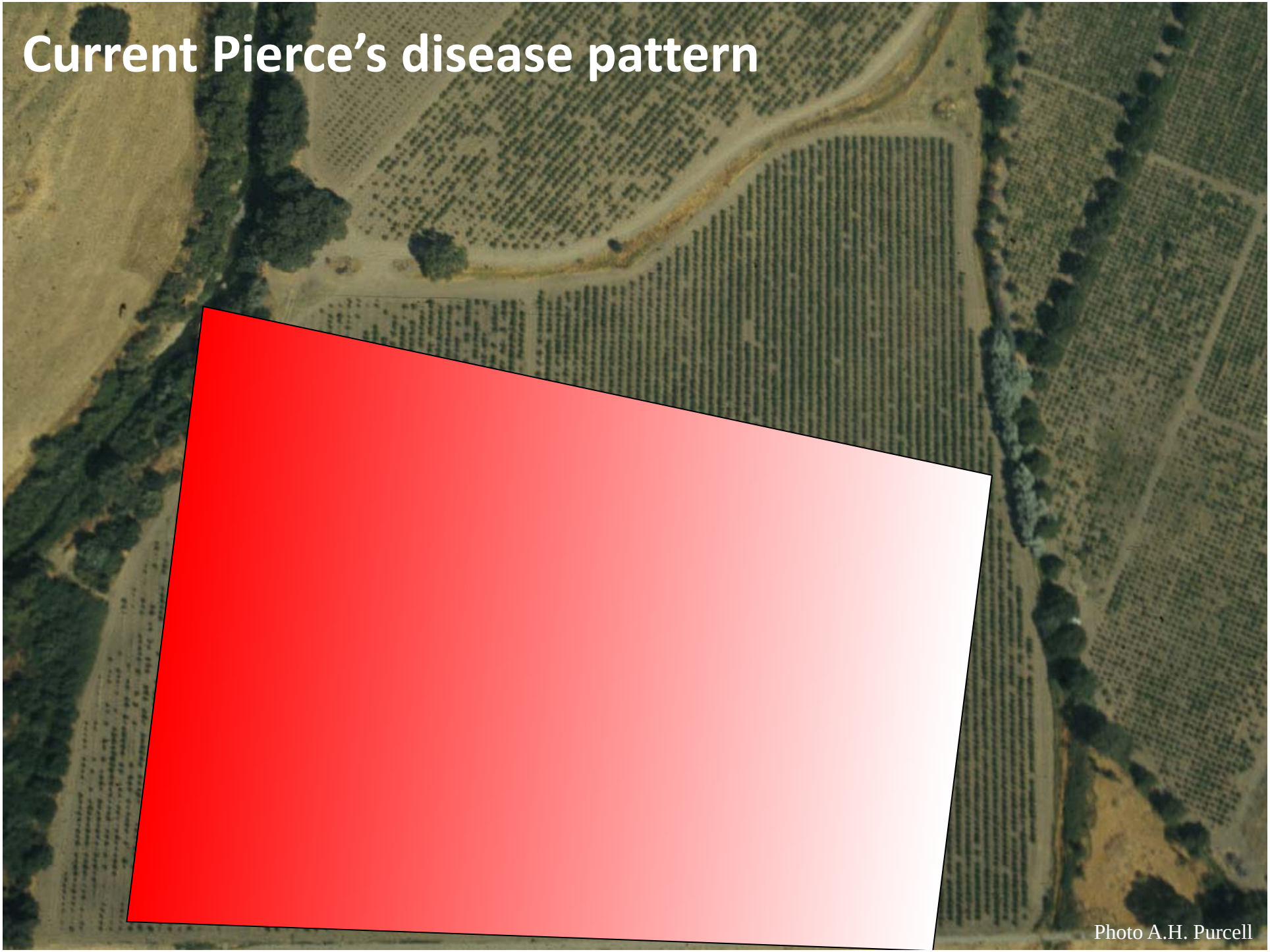


Photo A.H. Purcell

Current Pierce's disease pattern



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Current Pierce's disease pattern

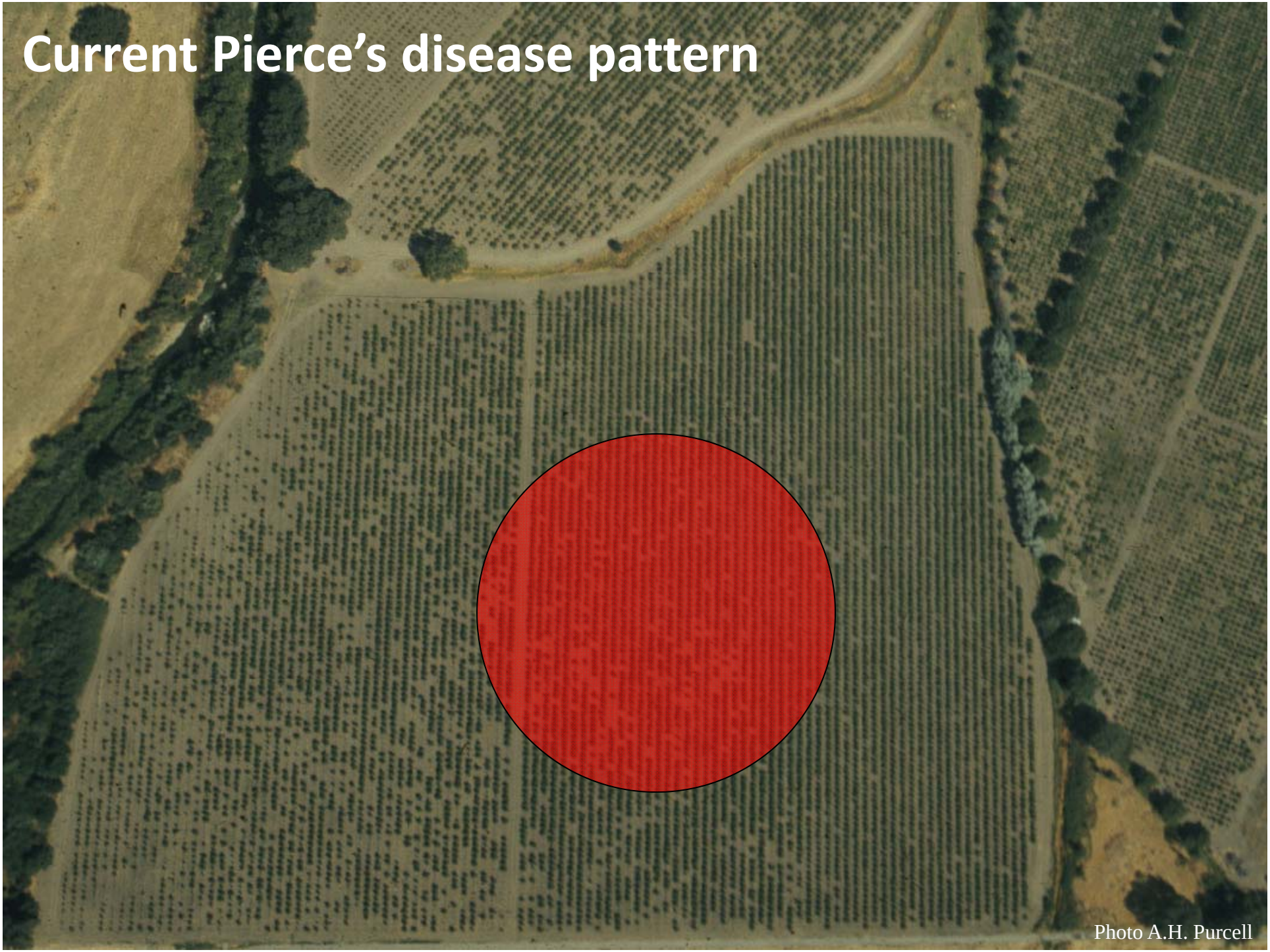
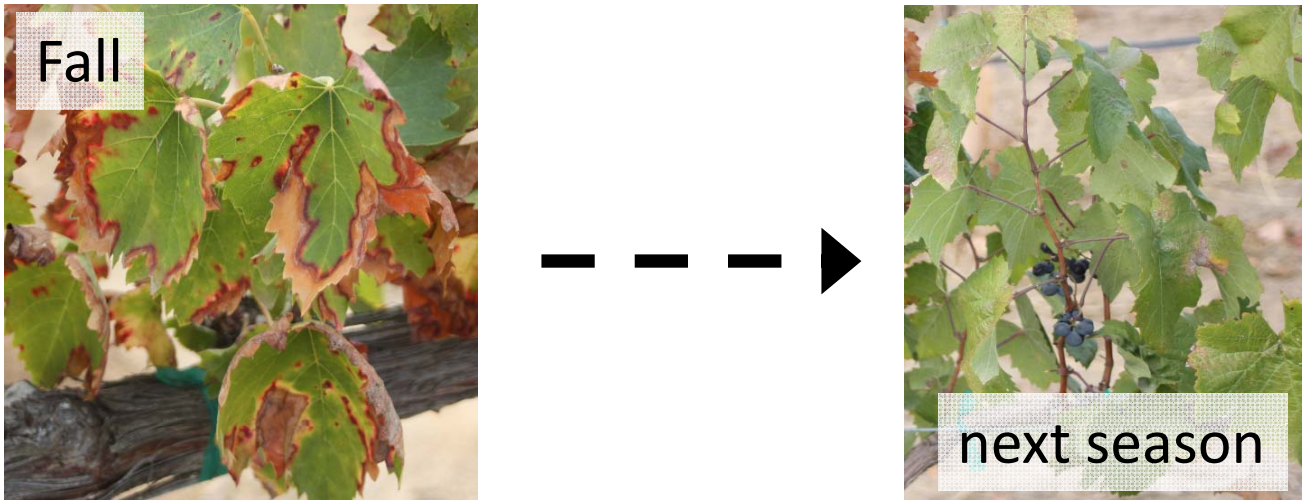


Photo A.H. Purcell

Why more PD – less over winter recovery?

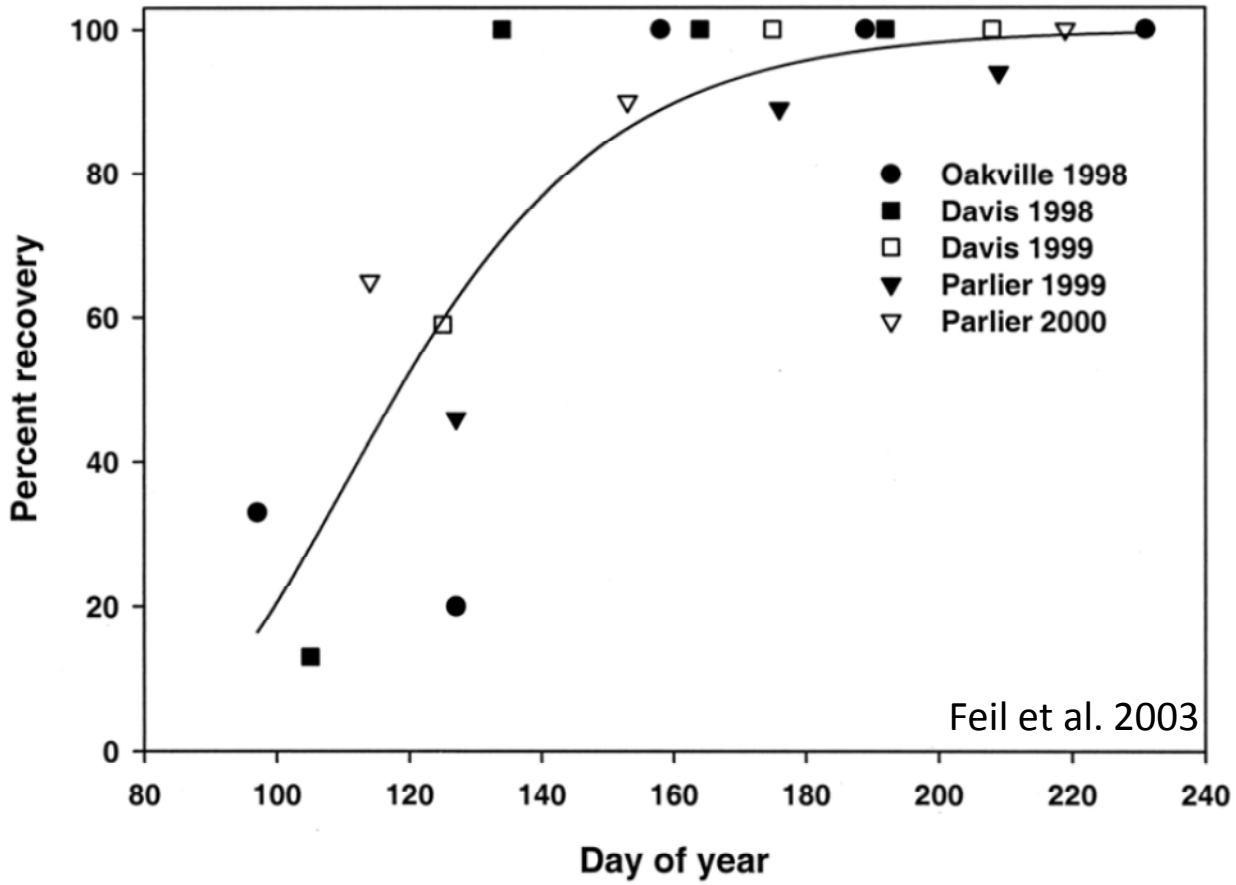
Some diseased vines lose their infection over the winter



Mechanism of recovery is not completely understood

Recovery rate depends on: temperature, timing of infection, varietal

The time of year a vine becomes infected affects recovery

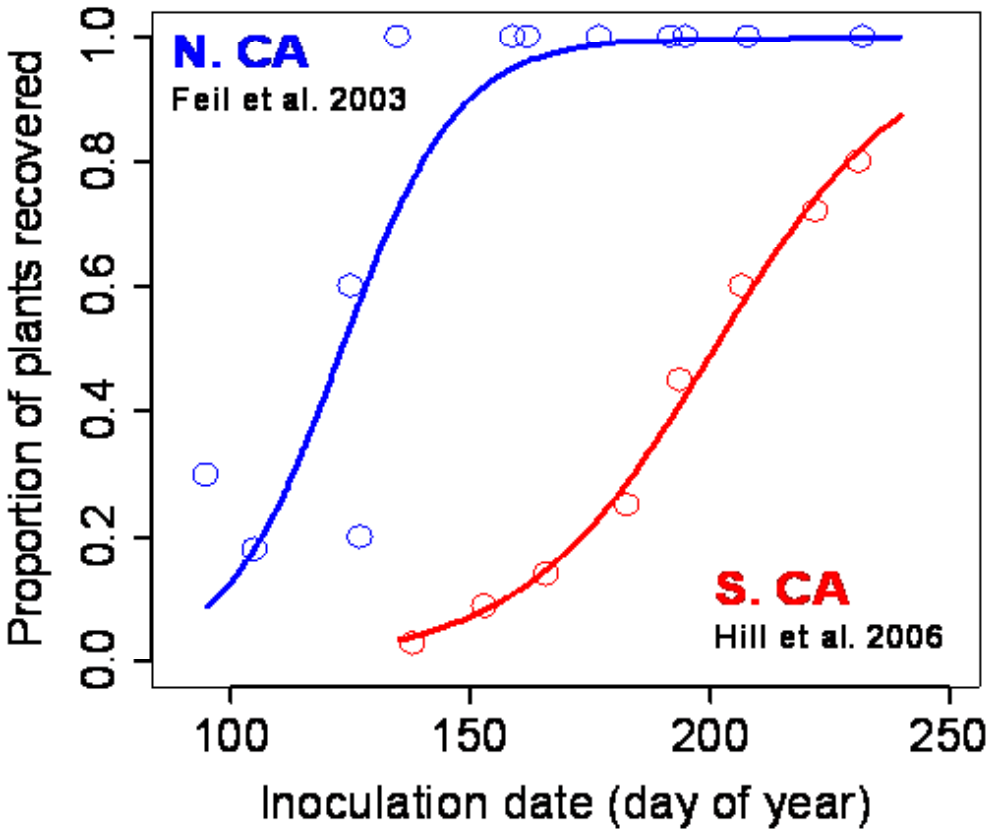


Late-season infections are “dead ends”

-e.g., > 95% of June 1st infections recover

Recovery rate also depends on local climate

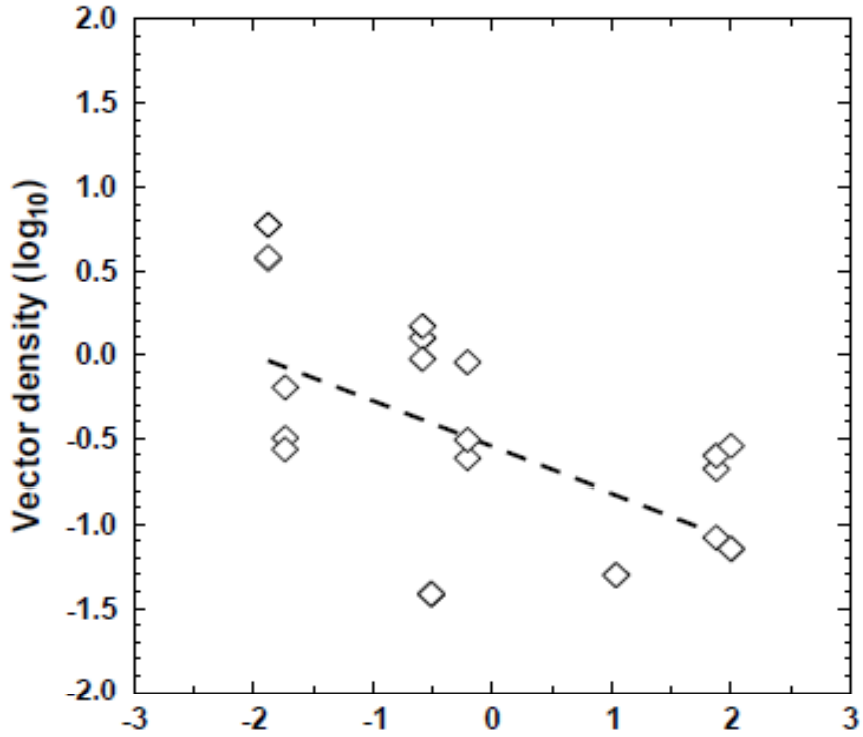
-”cold curing” over the winter



Recent warm winters may have led to more chronic disease

Why more PD – vector dynamics?

Warm, wet winters favor higher BGSS population densities



warm, wet winter

cold, dry winter

Warmer conditions may encourage early season BGSS activity, or movement further into vineyards (border sprays insufficient)

Why more PD – a new(ly appreciated) vector?

Spittlebugs (*Philaenus spumarius)* are known vectors of *Xylella*

-less efficient that BGSS, less mobile

Can be locally abundant in some vineyards using a wide range of forbs/weeds

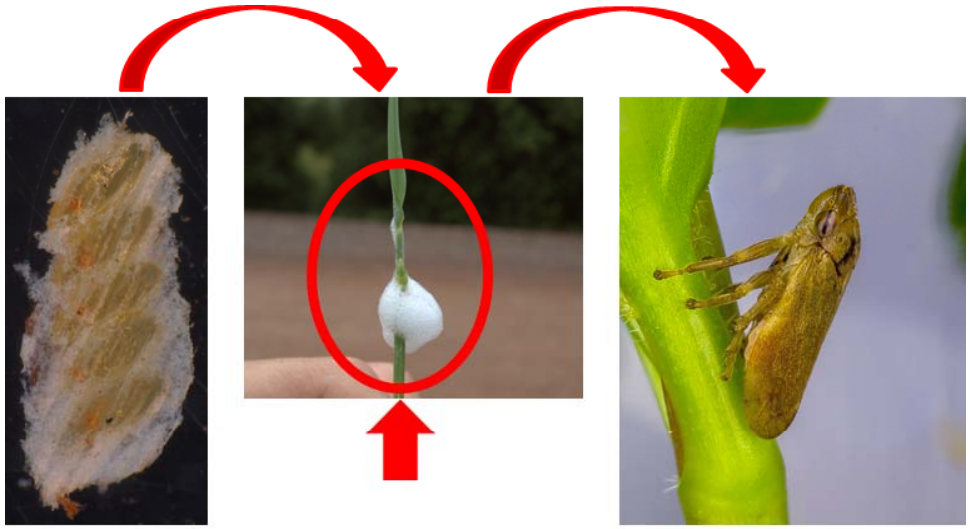


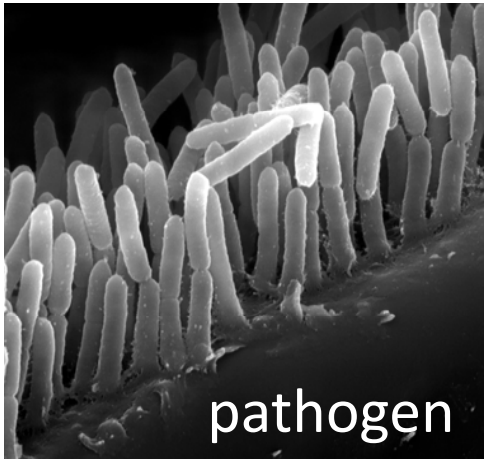
Photo credit: Daniele Cornara

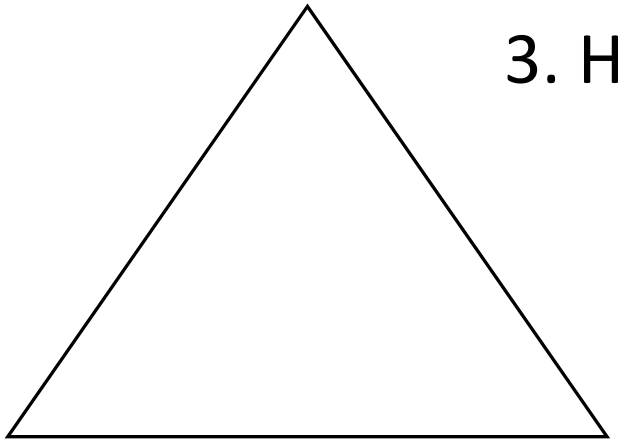
Are spittlebugs now an important vector?

-if so, weed control may be important for PD management

Management of vector-borne disease

1. Vector control
2. Eliminate inoculum supply
3. Host resistance





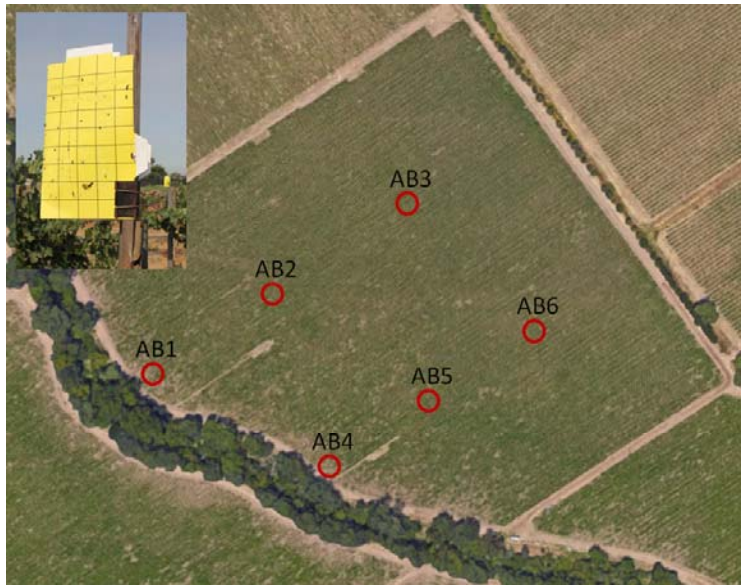
Pierce's disease management

1. Vector control
    - -chemical control
    - -biological control
    - -barriers to vector movement
2. Eliminate inoculum supply
    - -disrupt transmission
    - -eliminate infected vines (e.g., roguing, pruning)
    - -eliminate reservoir hosts (e.g., riparian)
3. Host resistance
    - -resistant hybrids, transgenics
    - -anti-microbial treatments

Monitoring for sharpshooters

Lots of interannual, seasonal, and spatial variability in BGSS activity

Monitoring is important for identifying areas most at risk and optimizing foliar insecticides



1. Deploy sticky traps throughout blocks in a grid pattern or in a set of transects away from suspected BGSS sources (riparian, ornamentals, roadsides)

2. Check traps at least twice a month during the growing season

-more frequently during early season

Limited role for biological control of BGSS

Parasitoids play an important role in management of some sharpshooters

-GWSS egg parasitoids

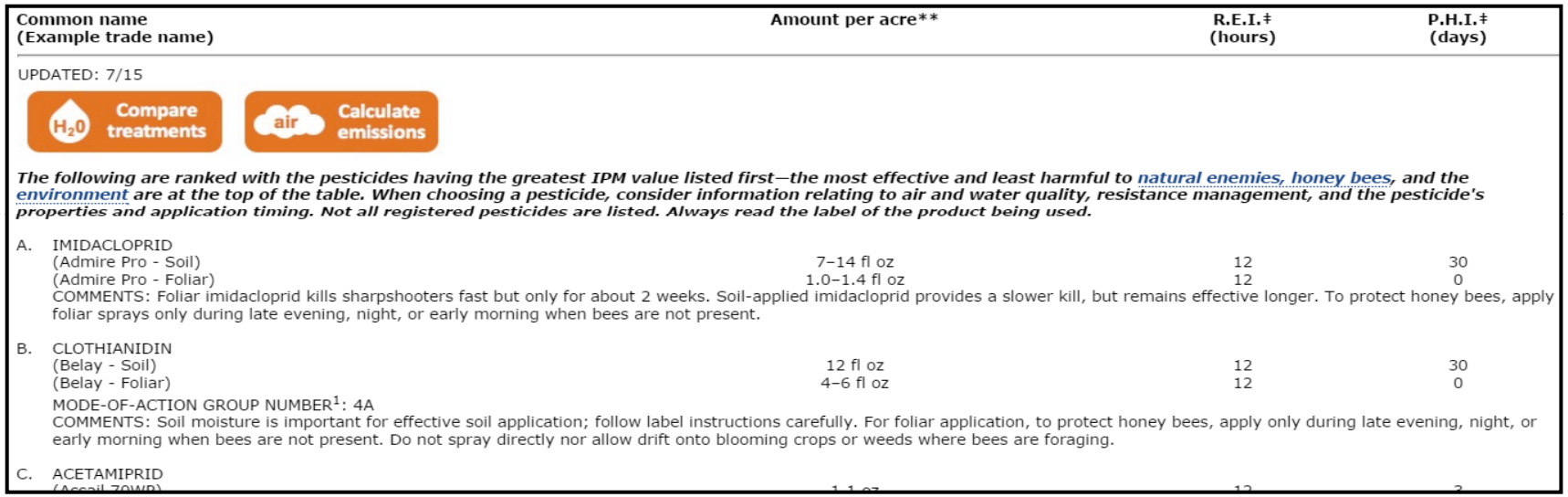
Several common generalist predatory arthropods attack sharpshooters

Insectivorous birds have been encouraged for BGSS control

May help, but effect isn't likely to be enough to reduce PD

Chemical control of sharpshooters

Insecticides for sharpshooter control include conventional systemics and foliars, and organics http://www.ipm.ucdavis.edu/PMG/r302301711.html



Common name (Example trade name)	Amount per acre**	R.E.I.‡ (hours)	P.H.I.‡ (days)
UPDATED: 7/15			
Compare treatments / Calculate emissions			
The following are ranked with the pesticides having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment are at the top of the table. When choosing a pesticide, consider information relating to air and water quality, resistance management, and the pesticide's properties and application timing. Not all registered pesticides are listed. Always read the label of the product being used.			
A. IMIDACLOPRID			
(Admire Pro - Soil)	7–14 fl oz	12	30
(Admire Pro - Foliar)	1.0–1.4 fl oz	12	0
COMMENTS: Foliar imidacloprid kills sharpshooters fast but only for about 2 weeks. Soil-applied imidacloprid provides a slower kill, but remains effective longer. To protect honey bees, apply foliar sprays only during late evening, night, or early morning when bees are not present.			
B. CLOTHIANIDIN			
(Belay - Soil)	12 fl oz	12	30
(Belay - Foliar)	4–6 fl oz	12	0
MODE-OF-ACTION GROUP NUMBER[1]: 4A			
COMMENTS: Soil moisture is important for effective soil application; follow label instructions carefully. For foliar application, to protect honey bees, apply only during late evening, night, or early morning when bees are not present. Do not spray directly nor allow drift onto blooming crops or weeds where bees are foraging.			
C. ACETAMIPRID			
(Assail 70WP)	1.1 oz	12	3

Imidacloprid, dinotefuran, thiamethoxam, fenpropathrin….

-systemics can have long residual efficacy (i.e. months)

Pyrethrin, kaolin

-short residual efficacy (week-10 d retreatment)

Most of what we know about chemical control relates to glassy-winged sharpshooter

Systemic insecticides (i.e. imidacloprid) were important in containing GWSS outbreaks in Southern California

-sharpshooters process 100s to 1000s times their body weight in xylem sap

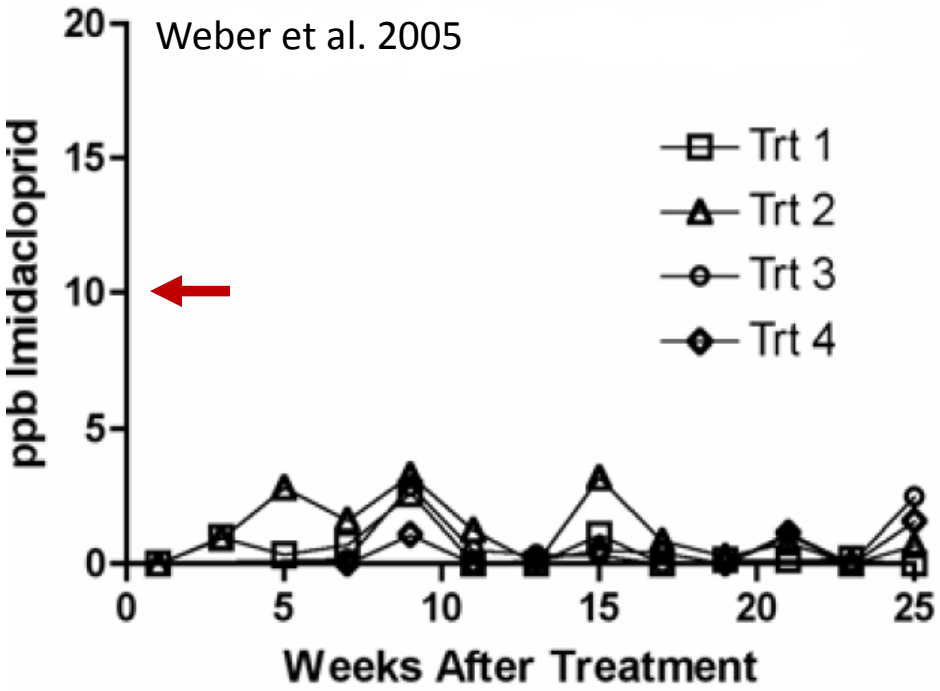
~10 ppb for high GWSS mortality

-anti-feedant effects

Strategies for GWSS chemical control don't translate well to the North Coast

More clay-rich soils and limited watering minimize systemic insecticide uptake in the North Coast

-imidacloprid rarely gets to the root zone



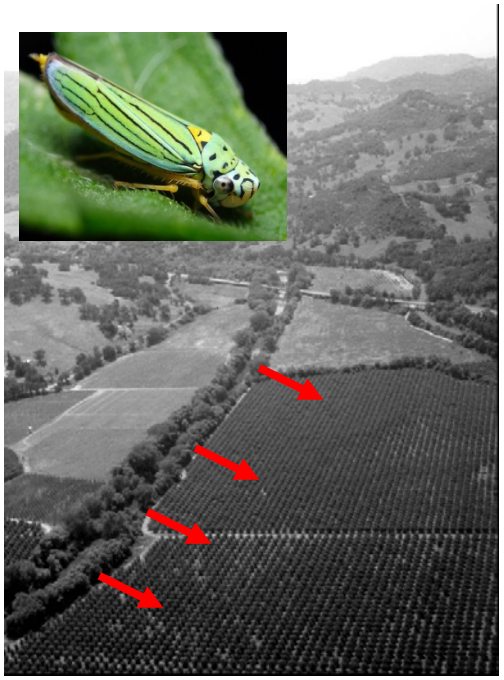
Soil-applied systemics aren't as reliable in Napa and Sonoma

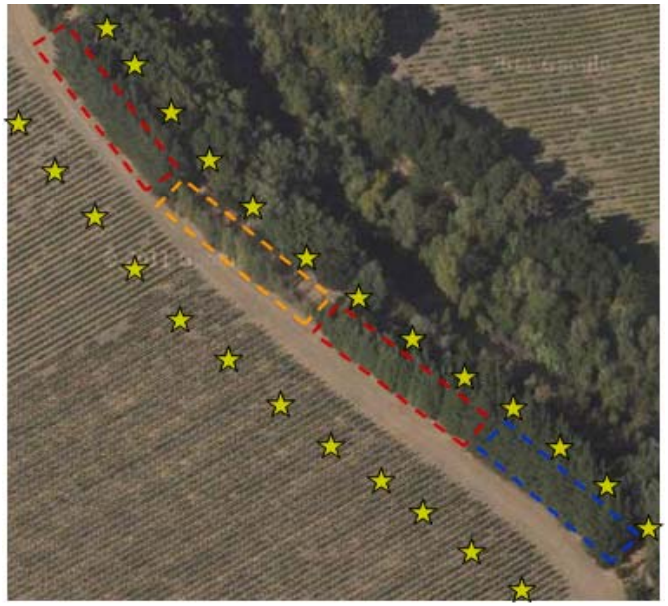
Disrupting BGSS movement into vineyards

Sharpshooters are not great fliers

Most BGSS fly close to the ground
(90% <5m)

Can a barrier between riparian and vineyard reduce incursion into vineyards?





Green barrier of planted conifers

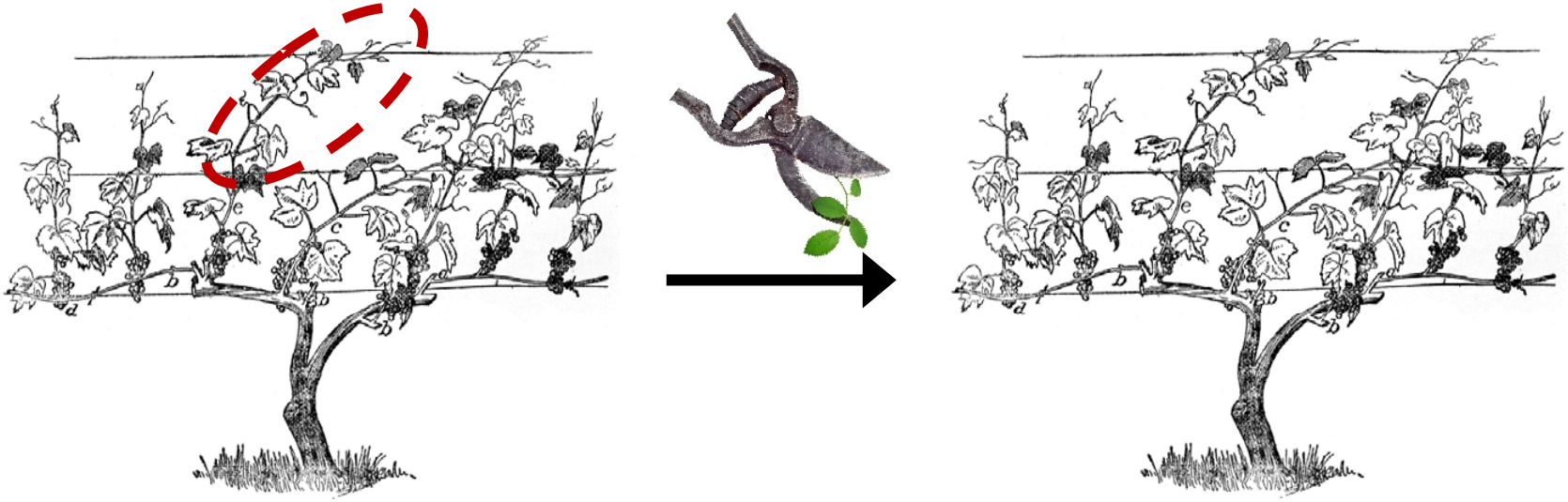
Best case 50% reduction in BGSS, most years there was no effect

Is effect enough to reduce PD?

“pruning out” *Xylella* infection is impractical

Xylella infections can be “patchy” within vines, especially early on

Can aggressive pruning clear vines of infection?



Can clear incipient infections, but most would recover anyway during winter

Does not clear vines with systemic infections; temporary benefit

Riparian vegetation management

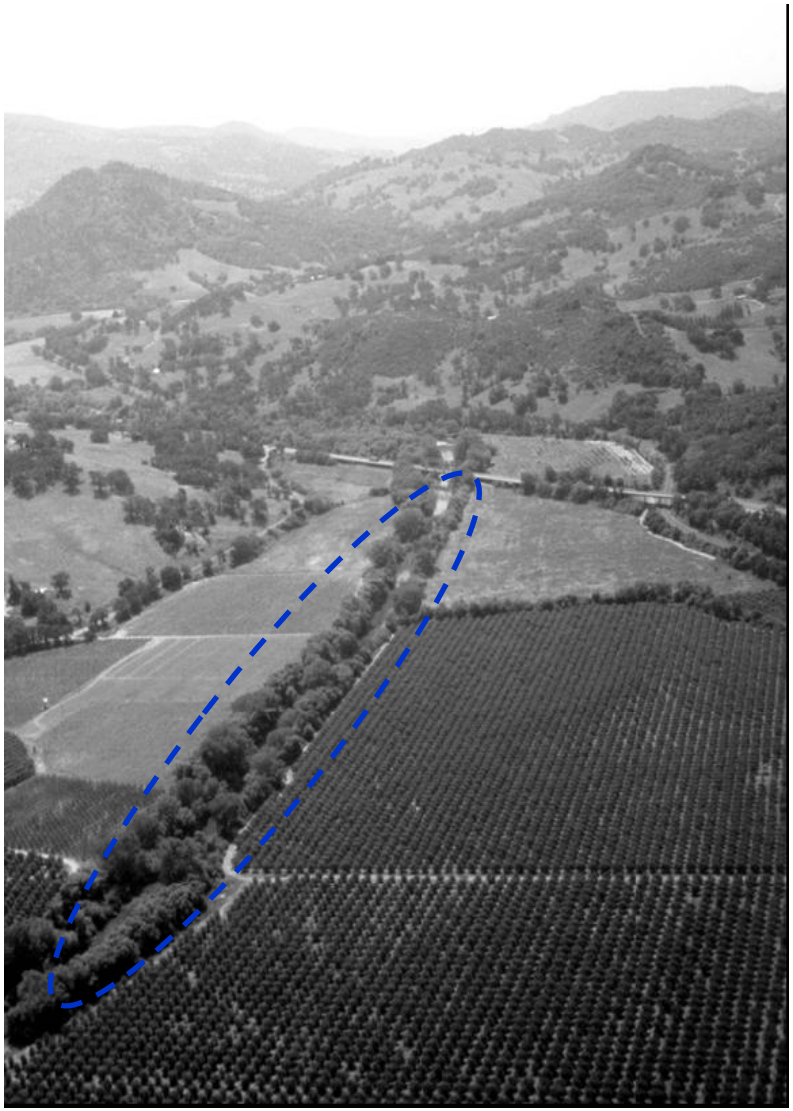
At many sites, riparian corridors are the source of BGSS

Management involves targeted removal of key hosts plants

Removal of reproductive hosts can dramatically reduce BGSS density

-by upwards of 90%

Also may reduce somewhat pathogen supply



Key host plants:

Non-native host plants

Common name	Latin name
Himalayan blackberry	*Rubus discolor*
periwinkle	*Vinca major*
wild grape (escaped cultivar or *Vitis californica* hydrid)	*Vitis sp.*

Native host plants

Common name	Latin name
California blackberry	*Rubus ursinus*
California grape	*Vitis californica*
mugwort	*Artemisia douglasiana*
stinging nettle	*Urtica dioica*
mulefat	*Baccharis salicifolia*
blue elderberry	*Sambucus mexicana*

Riparian vegetation management manual:

https://nature.berkeley.edu/xylella/control/PDNorthCoast/

Long-term management strategy

-permitting by CDFW

Requires vigilance to continue to see benefits

So how do I manage Pierce's disease?

Monitor regularly for sharpshooters

Conventional or organic foliar insecticides

-timing based on monitoring and weather (>65^{o}F)

Within-vineyard weed control?

Remove diseased vines to ensure they're not sources of infection?

Management of riparian plants

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Entomology

http://www.cnr.berkeley.edu/xylella/

http://www.ipm.ucdavis.edu/PMG/r302301711.html

http://www.piercesdisease.org/

http://www.cdfa.ca.gov/pdcp/