

Something old, something new: *Phytophthora* problems, and upcoming attractions from Southern California

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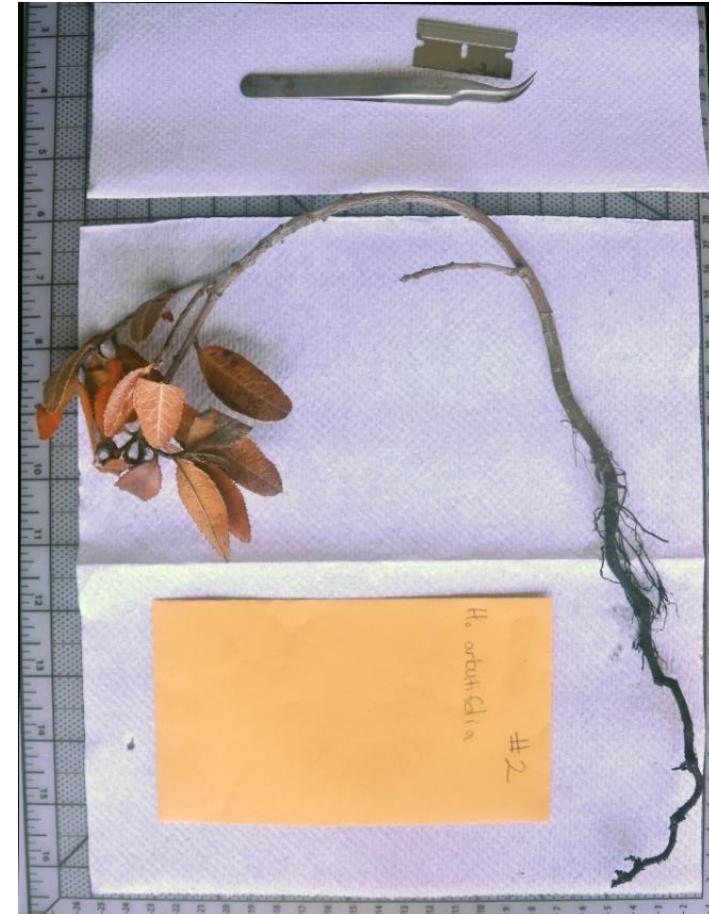
University of California
Agriculture and Natural Resources
Cooperative Extension

Slides “borrowed” from
Dr. Laura Sims
Dr. Doug Schmidt
Dr. Beth Grafton-Cardwell
Dr. Matt Daugherty
Dr. John Kabashima

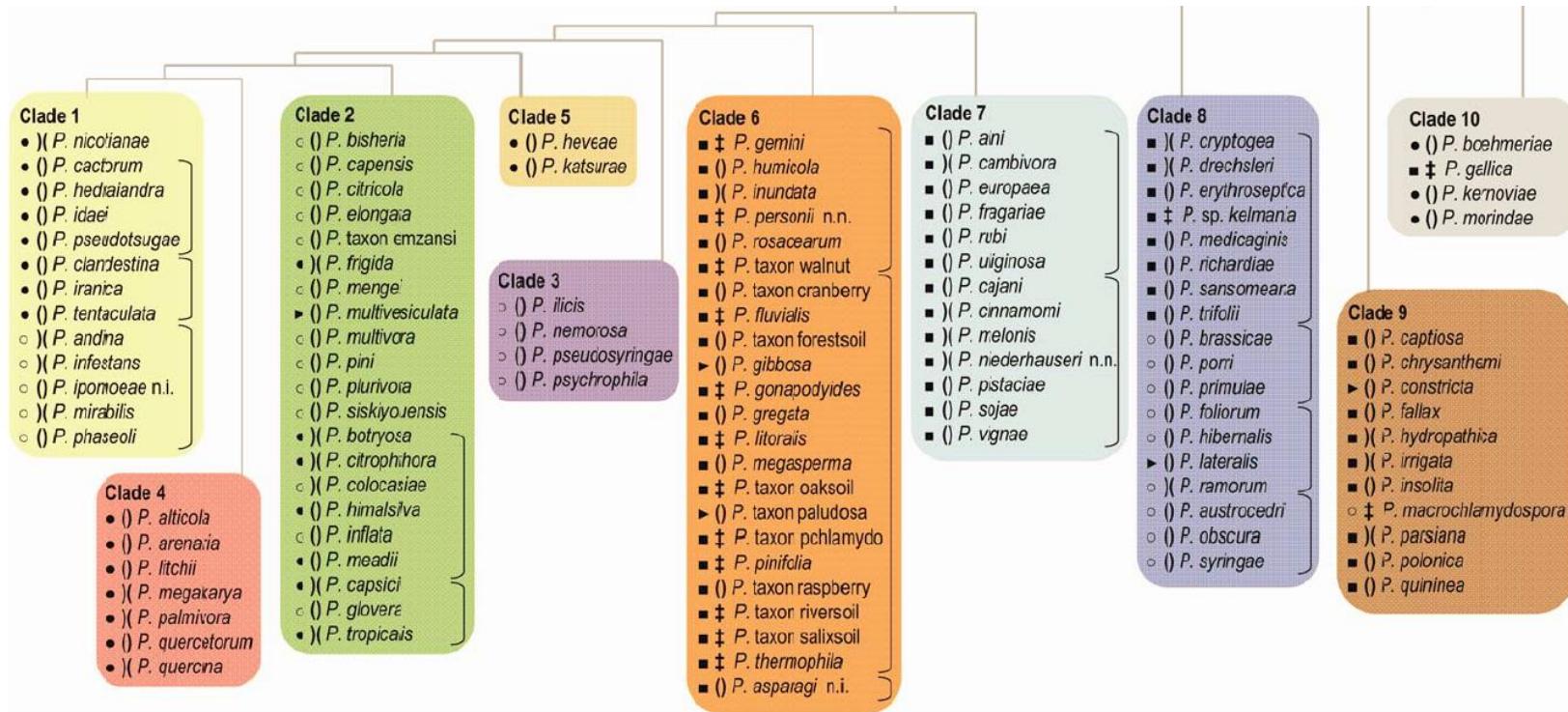


CISR, UC Riverside

The issue: Phytophthora diseases are one of the most important problems faced by landscape managers in both urban and wildland areas



Around the world ~ 120 *Phytophthora* species described



Potato Famine caused by *P. infestans*

Caused massive death and emigration due to food and economic loss.



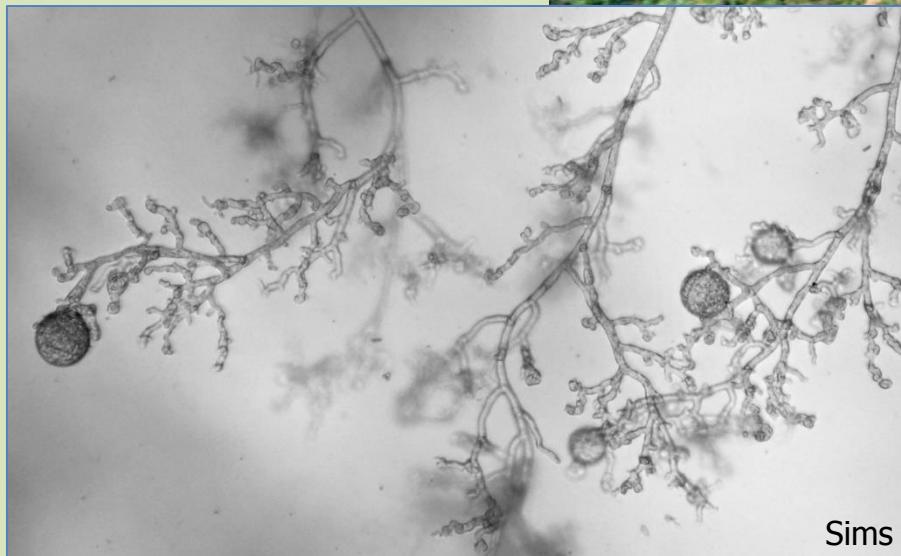
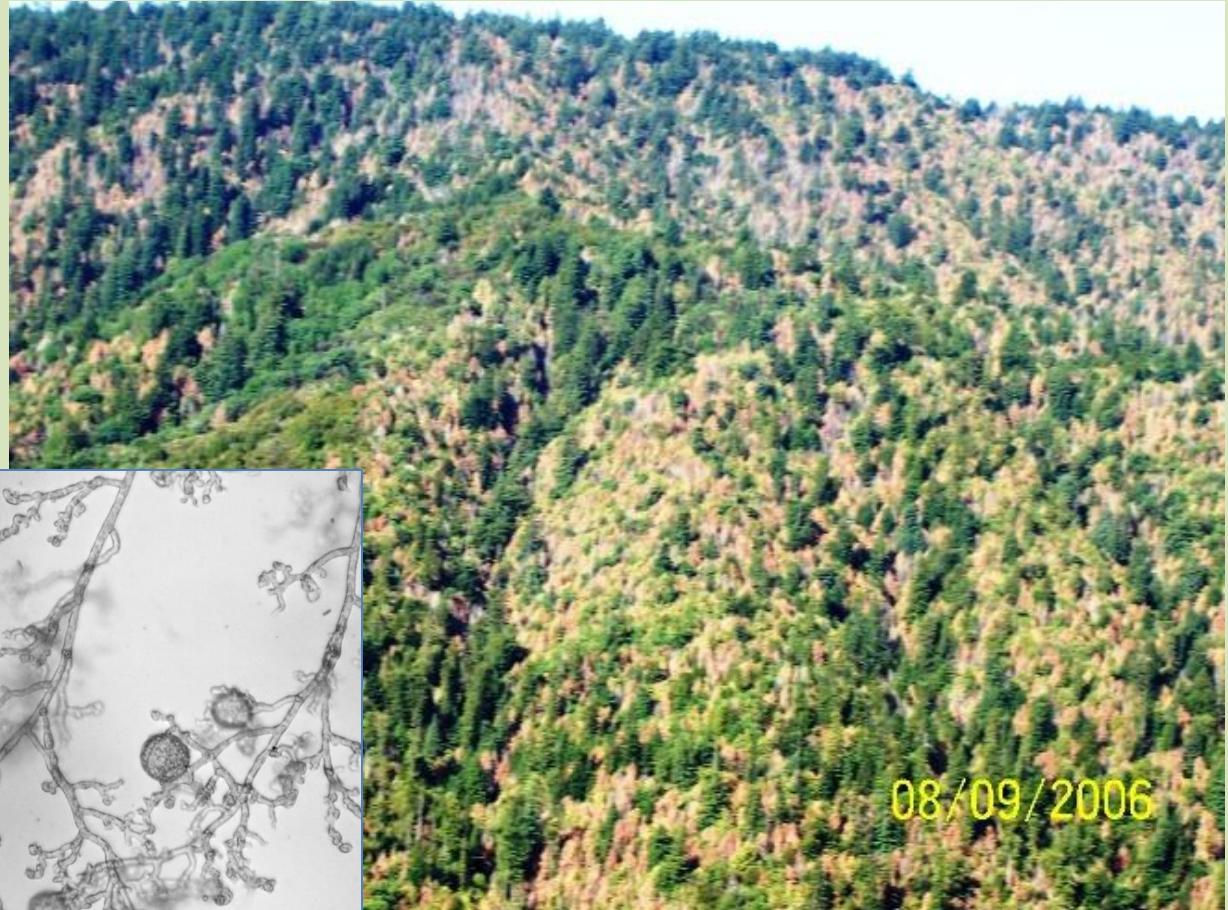
ATTACK ON A POTATO STORE.

Encyclopedia Britannica

Oomycete Downy mildews- *Plasmopara viticola*



Sudden Oak Death

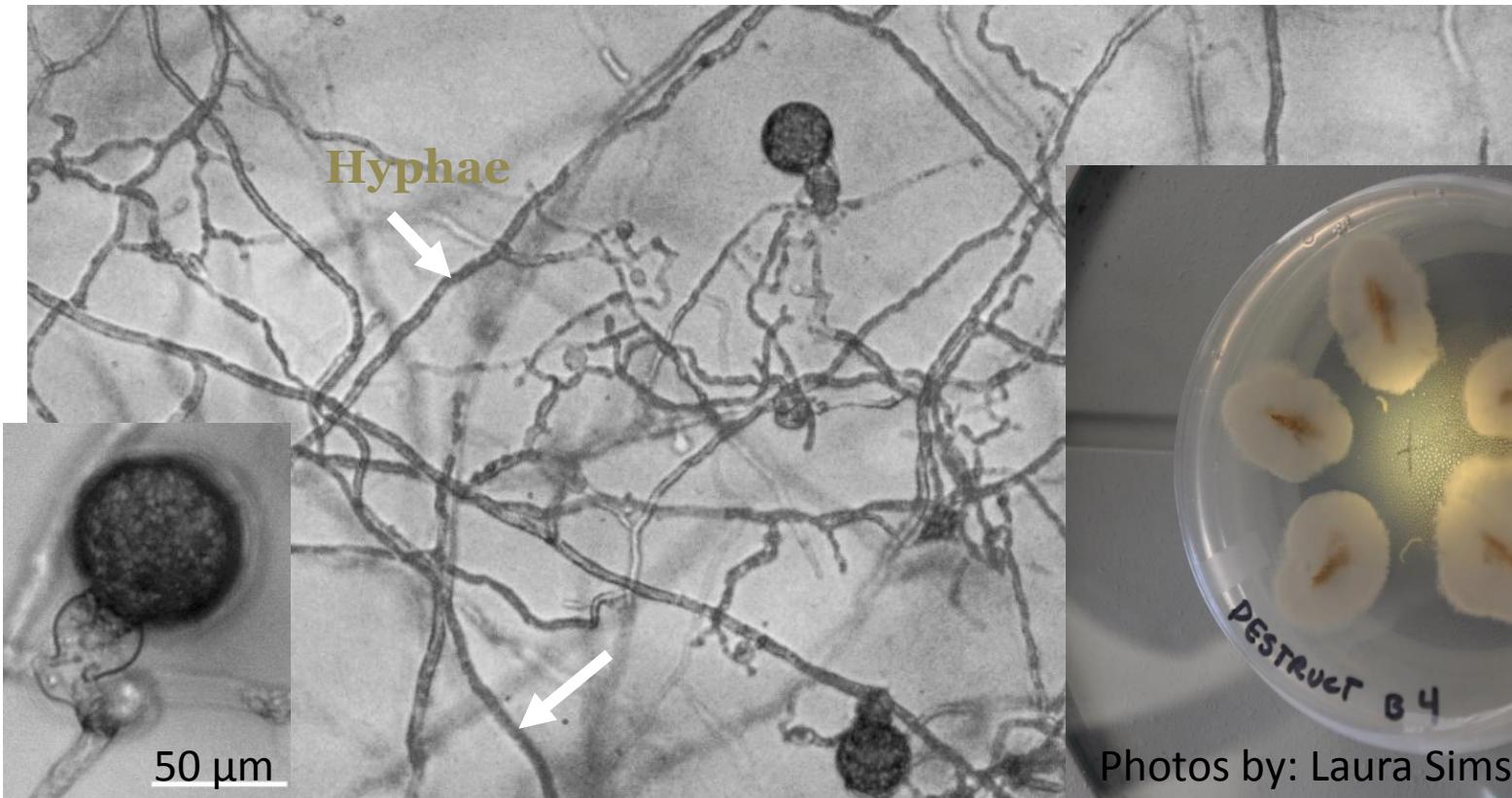


Sims

Janet Klien

What does *Phytophthora* look like?

Microscopic fungal-like organism that produces spores and hyphae (unrelated to true Fungi)



Photos by: Laura Sims

Water mold -*Phytophthora* needs water to complete its lifecycle



Photo Credit: Ellen Conner

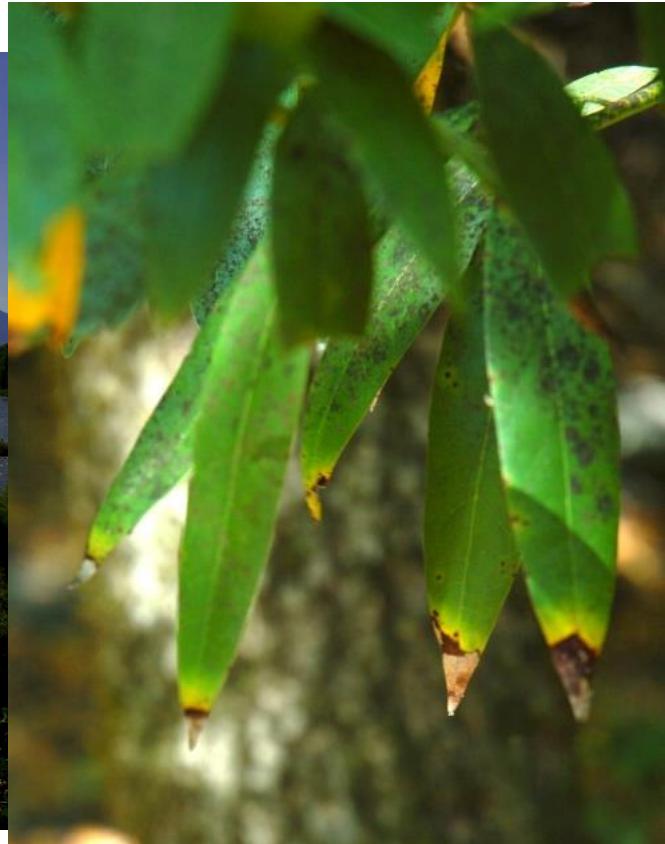
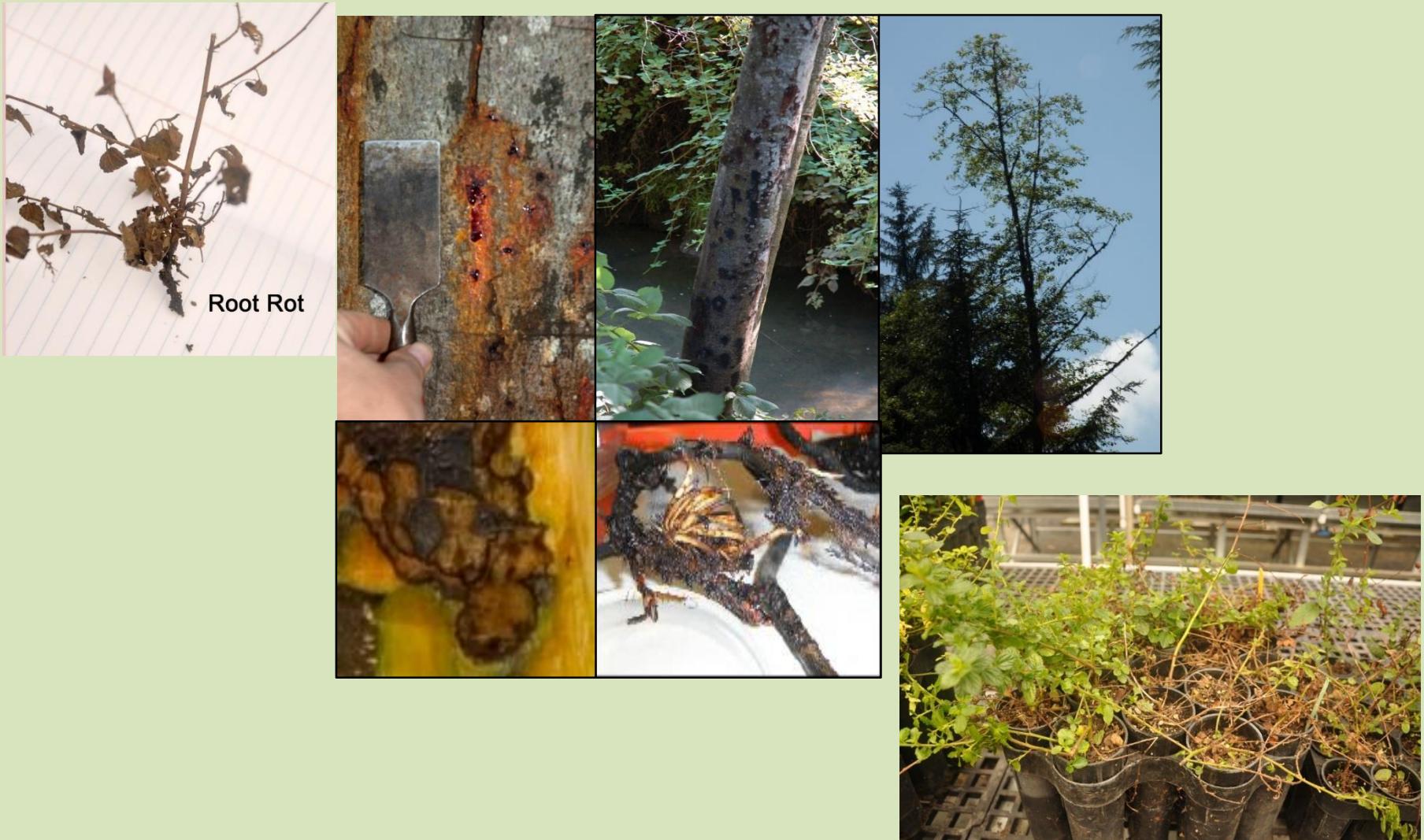




Photo:Chastagner & Benson, The Christmas Tree: Traditions,
Production, and Diseases

Root infecting *Phytophthora* can move with
irrigation runoff

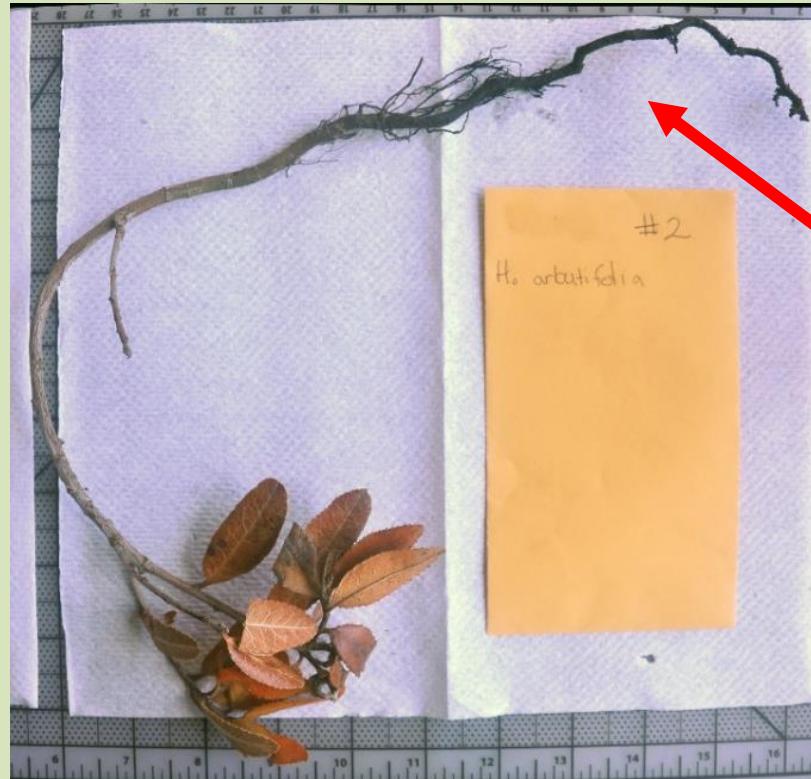
Symptoms of Phytophthora canker and root disease



*Phytophthora*s interruption to plant root function

-When roots are damaged from disease causing agent one or more of these functions is interrupted:

- Anchorage
- Absorption
- Storage
- Conduction



Non-functional root system resulting in disease and ultimately death

Photo by: Laura Sims

Drought tolerant native plant may work off of reserves long after roots used for absorption are gone

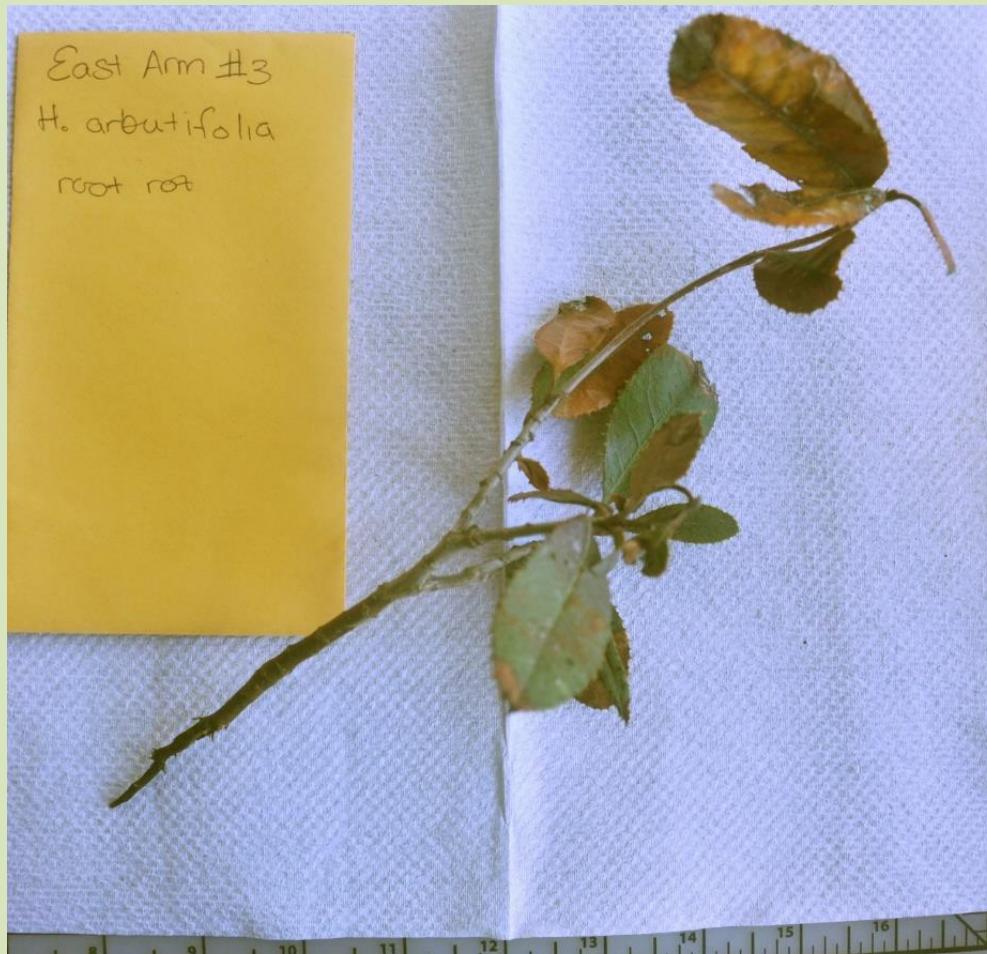
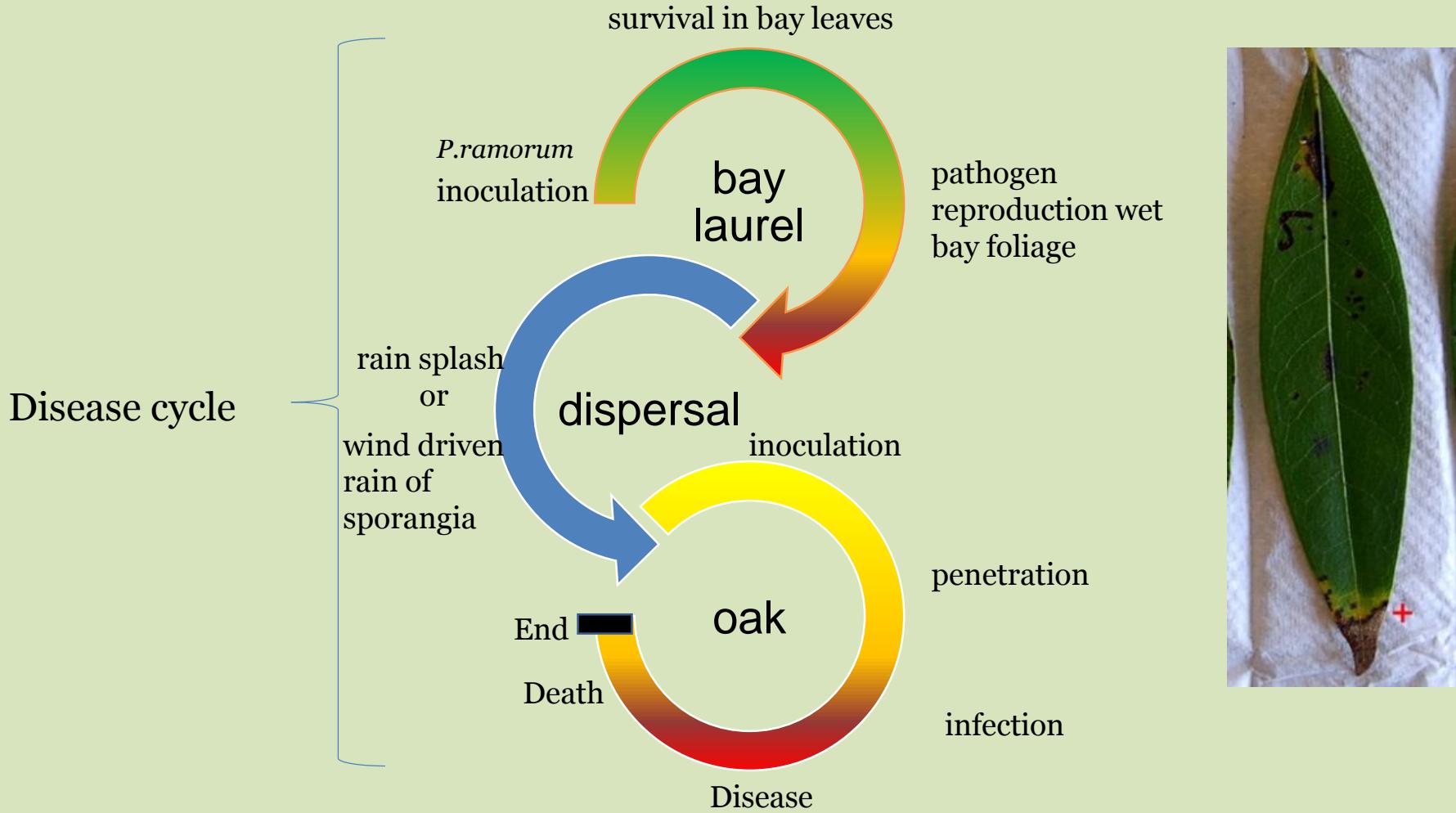


Photo by: Laura Sims

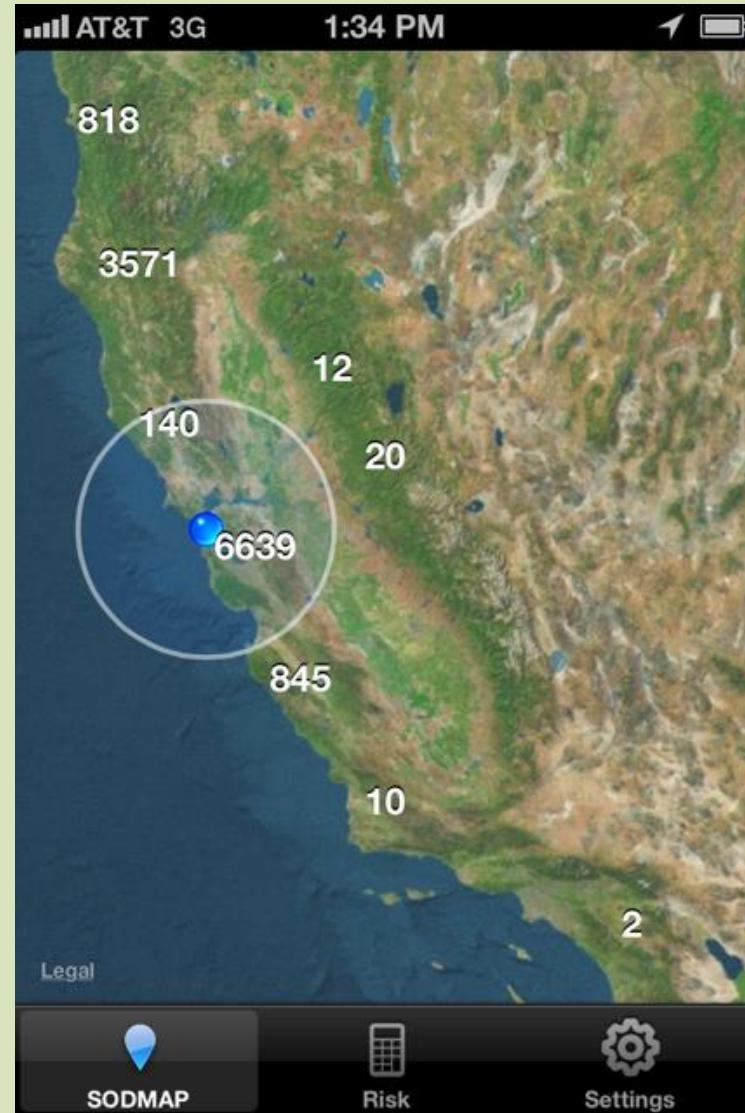
Sudden Oak Death Disease cycle in the oak-bay system



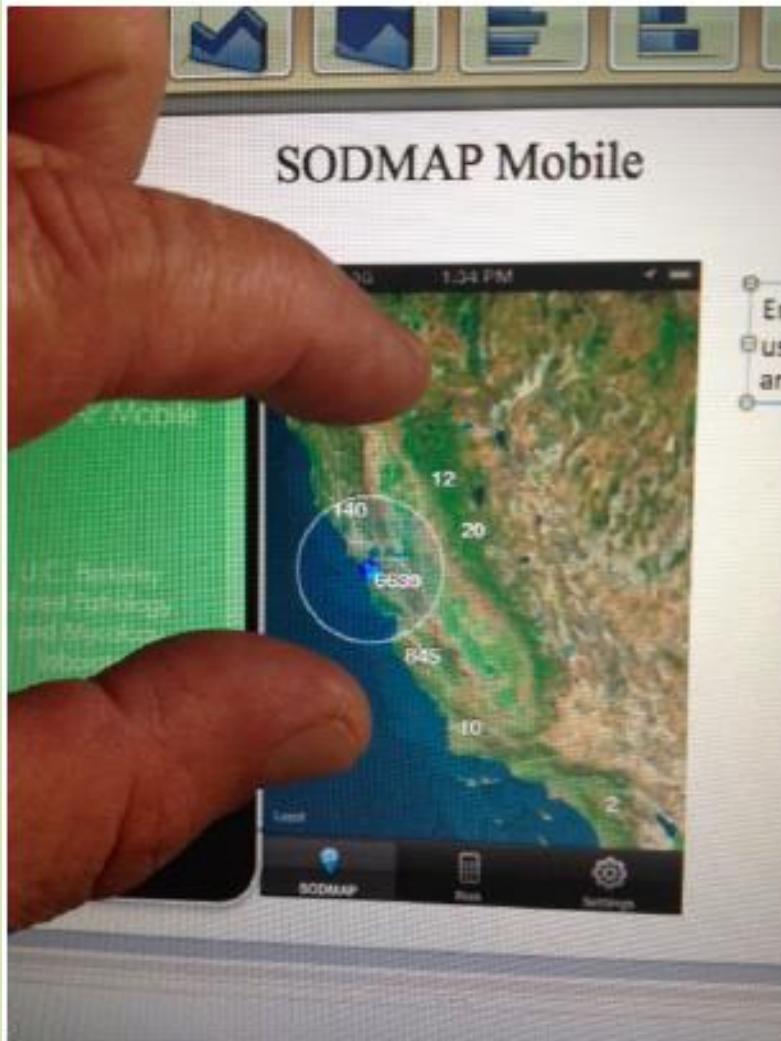
SODmap Mobile:

SODMAP Mobile

U.C. Berkeley
Forest Pathology
and Mycology
Laboratory



Enlarge screen view using your
Index and thumb fingers



Red pins = SOD positive, tap to
find out date and number





SODMAP

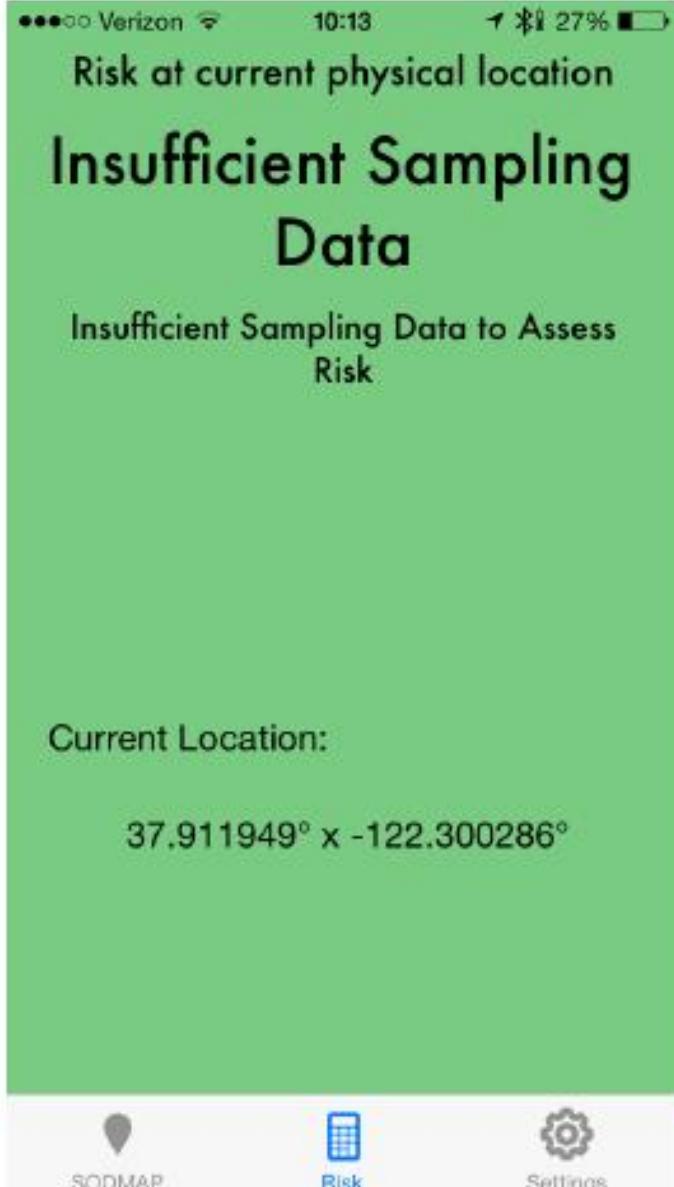


Risk



Settings

Tap on risk icon



Risk where you are physically standing

Risk at current physical location

Low or No Risk Level

37 Trees within 1km, no positives

14 Trees sampled post 2009

Current Location:

37.865746° x -122.272460°

When assessing risk at a second location, remember to tap SODMAP button and then Risk button, in order to reset, otherwise you may get same warning as in the previous location

A two-digit number in this line gives you more confidence

Number > 4 in this line gives you more confidence

Precise location and coordinates of user:
You can record if needed



SODMAP



Risk



Settings

Stay alert but no need to do anything

••••• Verizon LTE

17:53

1 * 61%

Risk at current physical location

Moderate Risk Level

1 Positive trees between 200m - 1km

39 Negative trees within 1km, 37
Trees sampled post 2009

Current Location:

37.868105° x -122.270557°



SODMAP



Risk



Settings

May want to do something

••••• Verizon LTE

10:40

1 * 24%

Risk at current physical location

High Risk Level

1 Positive trees within 200m

2 Positive trees within 1km, 168 trees
sampled post 2009

Current Location:

37.872738° x -122.262817°



SODMAP



Risk



Settings

Urgent to do something if you have
Oaks and bays growing together

What to do and when to act

- Insufficient data or low risk
 - Keep monitoring your bay trees for infection, by participating in one of the many SOD blitzes in the Spring of each year. For info and details go to www.sodblitz.org
- Moderate or high risk
 - Do most of the significant yard work (e.g. pruning, grading, cutting dead trees) in the late summer or fall
 - Selectively remove “key” bay laurel trees in Summer and Fall
 - Apply a preventive phosphonate treatment to oaks at risk in the late Fall (after Halloween and before Xmas)

Phytophthora tentaculata in California since at least 2012



Photo by: S. Rooney-Latham



Photo: Phytosphere research

Pay attention to the material you are working with. Be alert for disease symptoms on buy-ins. Make sure materials brought in are high quality. Test for pathogens, hold for several weeks prior to introduction into the landscape.

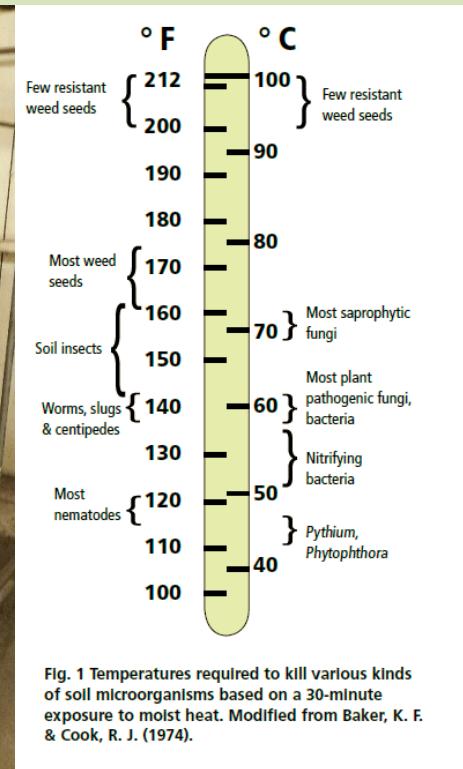


Photos by: Christa Conforti

Don't use dirty containers or reuse soil/ potting materials without treatment

Do-

- Soil Pasteurization
- Clean and sanitize containers



Photos by: Lew Stringer

Don't keep or use sick plants
Do be on the look out for plant disease symptoms



Photos by: Laura Sims

After planting, be alert for disease symptom



Photos by: Laura Sims

Asian Citrus Psyllid and the Citrus Disease Huanglongbing

Psyllid



Huanglongbing



Beth Grafton-Cardwell

Department of Entomology

UC Riverside

Photography: M. Rogers, S. Halbert and E. Grafton-Cardwell

Asian Citrus Psyllid and Huanglongbing



- 1) HLB kills citrus trees, we have no cure, and it's starting to spread in S. CA (21 trees in San Gabriel)
- 2) HLB is spread by grafting infected plant material and by the Asian citrus psyllid (ACP)
- 3) The goal of local eradication or suppression of ACP is to buy time for the scientists to find a cure for HLB
- 4) If ACP is found, it is important for the city to support eradication as 60% of Californians have citrus in their yards and HLB is going to destroy those trees
- 5) People play a part in moving psyllids (green waste, plant movement, bulk citrus movement) and so education of the general public is essential

**The psyllid (pronounced síl - lid) is a small insect,
about the size of an aphid**



**Adult psyllids can feed on either young or mature leaves.
This allows adults to survive year-round.**



When feeding, the adult leans forward on its elbows and tips its rear end up in a very characteristic 45° angle.

The nymphs produce waxy tubules that direct the honeydew away from their bodies. These tubules are unique and easy to recognize.



Thus, nymphs are found only when the plant is producing new leaves.

Nymphs can only survive by living on young, tender leaves and stems.



Why are we so worried about this psyllid?

The Asian citrus psyllid can vector Huanglongbing (HLB) disease

Huanglongbing means “yellow shoot disease” in Chinese.

It causes the leaves on some of the branches of citrus to turn yellow.



*Candidatus
Liberibacter
asiaticus*



HLB leaf symptoms can range from slight to nearly completely yellow



In addition to yellow mottling, the veins of the leaf may be thickened



HLB disease prevents the fruit from developing the proper color

The lower half of the fruit may remain green, which is why this disease is also sometimes called citrus greening.



In as little as 5 years after HLB infection, the tree stops bearing fruit and eventually dies

There is no cure for the disease!

This citrus tree in a backyard in Florida is obviously very sick, with few leaves and no fruit.



The HLB leaf and fruit symptoms can look very similar to another disease called citrus stubborn



Clementine topworked on
Stubborn Marsh Grapefruit

Don't panic if you see yellowed leaves or off-colored fruit –
but do get them checked out!

How does the bacterium spread? – Two ways

The bacteria can be spread by grafting infected plant material

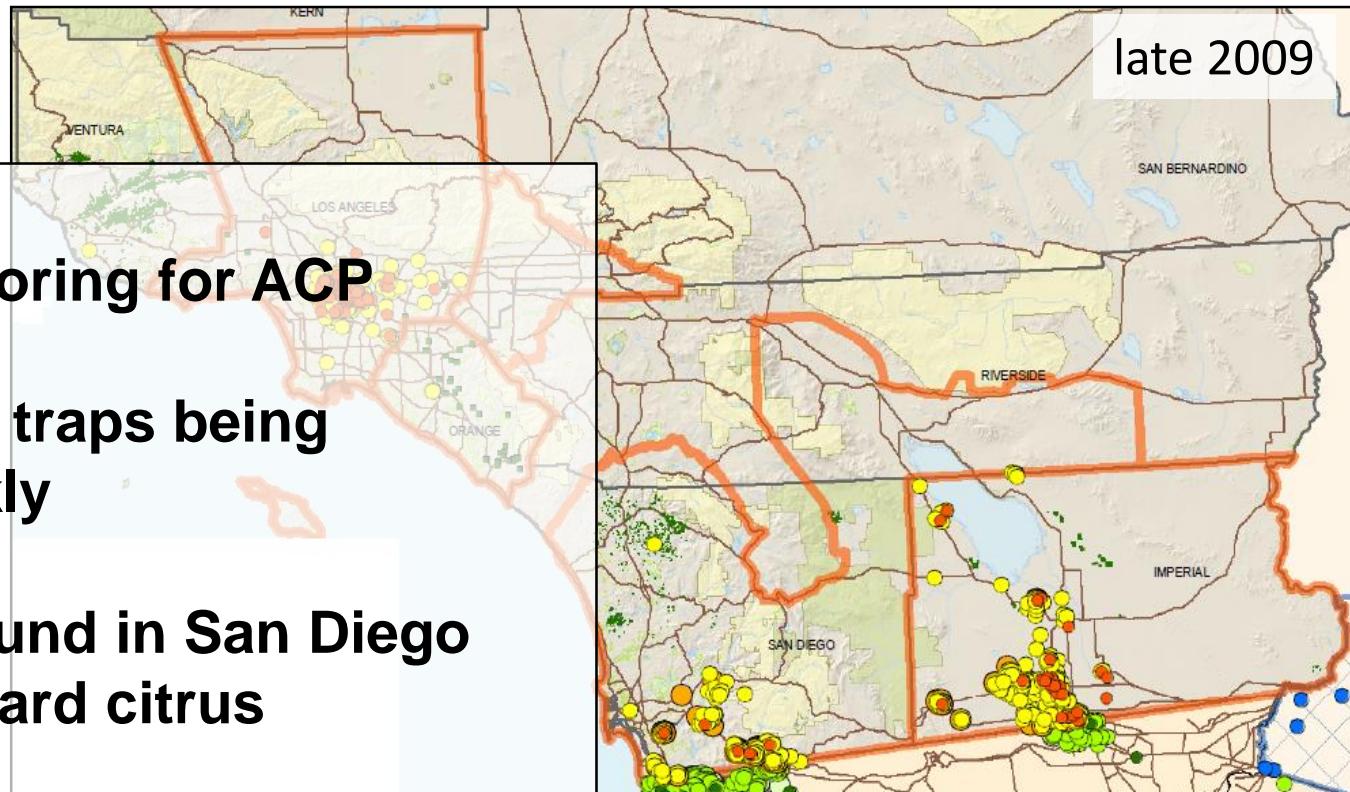


When the insect feeds it takes up the bacteria and passes it on when it feeds on the next citrus tree or ‘citrus-like’ plant



The psyllid can pick up the bacteria as a nymph or adult and then it carries the bacteria in its body for the rest of its life (weeks to months).

The situation in California



Extensive monitoring for ACP

-thousands of traps being checked weekly

ACP was first found in San Diego County in backyard citrus

It then spread to Imperial and Los Angeles Counties

**In March 2012, HLB was found in a residential tree
in Southern California. How did it get there?**

**Illegally imported citrus trees or
budwood**



**It is very important to obtain disease-free trees and
budwood from reputable nurseries, rather than
trading plant material of unknown origin**

ACP and HLB in California

2008



2009



2010



2011



2012



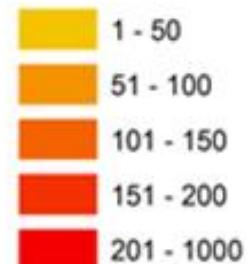
2013



2014



ACP Distribution



Southern California: reduce ACP densities enough to slow HLB spread

Most other areas: contain or locally eradicate ACP

2. ACP quarantines



Steps being taken to limit the impact of ACP and HLB in California

1. Statewide monitoring for ACP and HLB
 - residential and commercial trapping
 - inspections of nurseries

2. Treatments of residential citrus

3. Quarantine zones established around infested areas
 - restrictions on movement of plant material

4. Areawide treatments of commercial citrus

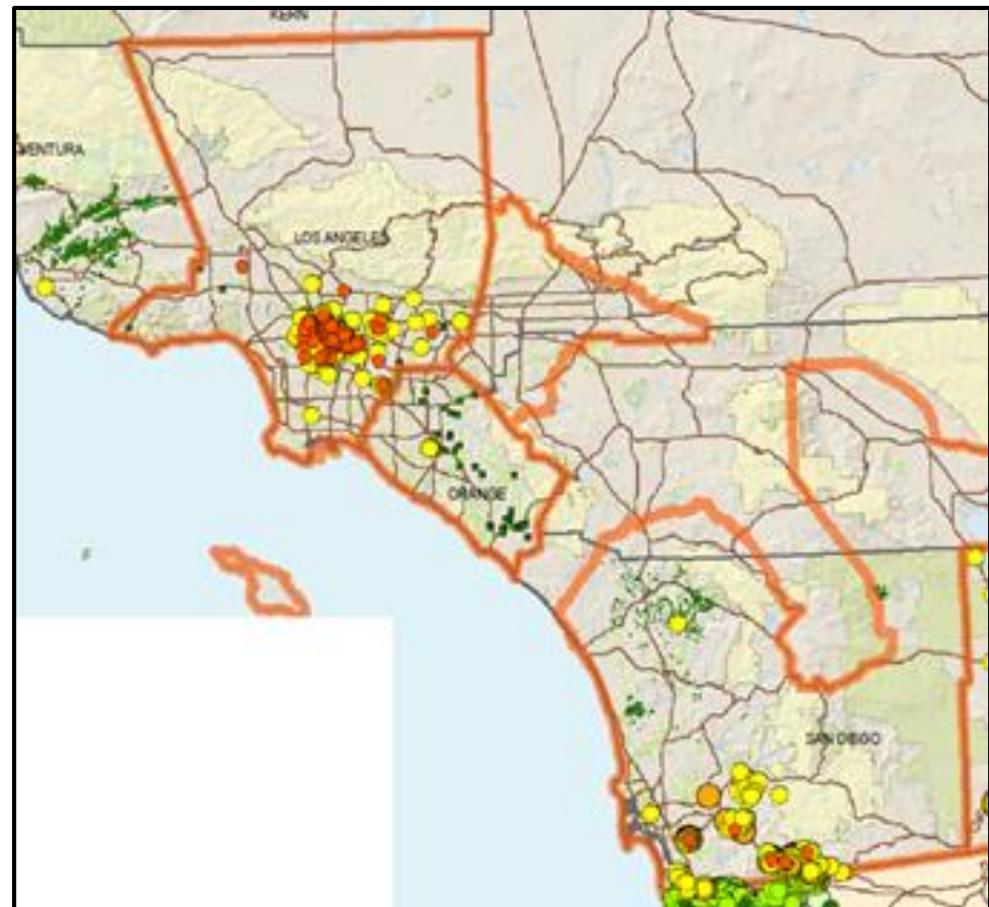
5. Biological control

Statewide monitoring is used to delimit ACP quarantine zones

<https://www.cdfa.ca.gov/plant/acp/regulation.html>

Quarantines regulate:

- movement of nursery plants
- shipping and packing of fruit
- movement of green waste



Implications of quarantines

ACP quarantines

- ACP host plants can't be moved to the outside of quarantine
- fruit must be free of leaves/stems or otherwise be treated
- nursery production only in approved screenhouses
- nursery plants restricted from movement out, and must receive specified insecticide treatments
- green waste movement requires compliance agreement

HLB quarantine

- host plants can't be moved in or out of quarantine
- trees found to be infected will be removed



Regulations to limit risk posed by retail nursery citrus

1. Insecticide treatment of plants prior to shipping to retail stores

- foliar (pyrethroids, OPs) and systemic (neonicotinoids)

- can't ship before 30 d post treatment

- certified for 90 d

2. Tagging of all ACP/HLB host plants

- tag number tracks treatment information

3. Restricted movement of host plants





What landscapers and homeowners can do
(and not do) to help

Inspect your trees

Check citrus and other ACP host plants whenever they're producing new leaves

Look for:

-eggs

-nymphs & waxy tubules

-adults (45° angle)

Varieties that flush more often should be checked more often



If You Find it: Act Fast, Time is Critical

Call
800/491-1899

Think you found the [Asian citrus psyllid](#) or [HLB symptoms](#) on your tree.

- Time is critical.
- Secure psyllids and leaf samples in a clear, locked sandwich bag, jar or plastic container.
- Contact your local Agricultural Commissioner's office or call the California Department of Food and Agriculture hotline immediately.

How do I look for the disease?

Look for blotchy yellowed leaves and small oddly shaped fruit.



Help maintain the quarantines

Make sure restricted plant material
is not moved across quarantine

-ACP quarantines

-HLB quarantine



Citrus trees in nurseries in the quarantine areas will have a tag on them

The tag explains that the tree should not be moved out of the quarantine area.



Plant only citrus trees acquired from a reputable nursery

1. If you don't know where plants came from, then don't buy them

- they are not likely to have received appropriate treatments

- they are at risk of ACP infestation and infection by the HLB pathogen

2. Don't trade/grant plant material unless you're sure about its quality



If I am in the quarantine area, is it ok to pick the fruit and give it to my friends?

The psyllids can't live on citrus fruit. So as long as you brush or wash the fruit and make sure it is free of leaves and twigs before transporting it, it is ok to move it.



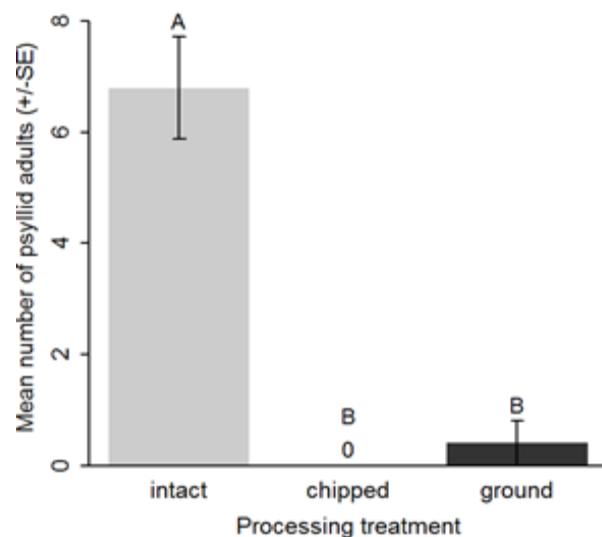
What to do with green waste?



ACP does not survive well off of young live plant tissue, the bacterium does not survive outside of plant phloem

Chipping or grinding citrus waste greatly reduces ACP survival

Options for dealing with green waste from ACP host plants:



1. Chip or grind on site
2. Prune and let dry on site for 1-2 wk
3. Double bag and dispose

Where can I get more University of California information?

- **ACP HLB Website:**
www.ucanr.edu/sites/ACP
- **UC IPM Pest note for homeowners**
<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74155.html>
- **UCIPM Quick tip for homeowners**
<http://www.ipm.ucdavis.edu/QT/asiancitruscard.html>

University of California, Division of Agriculture and Natural Resources

[EMAIL](#) [PRINT](#) [SITE MAP](#) [Enter Search Terms](#)

Asian Citrus Psyllid Distribution and Management



Home Growers Homeowners Map of Psyllids, HLB and Parasites

Home

Grower Options

Homeowner Options

Homeowners Management

- What Am I Looking For?
- How do I look for it?
- What should I do if I find it?
- Biological Control
- Insecticidal Control

Homeowner Facts

Residential ACP Management Strategy

The Asian citrus psyllid (ACP) is widely established in urban and suburban areas throughout Southern California. Large-scale eradication of ACP in these environments is not feasible. Rather, the goal is to reduce psyllid populations enough to slow the establishment and spread of Huanglongbing (HLB) disease. While HLB has only been found in one tree to date, it's likely to begin spreading soon and it will kill citrus trees. Homeowners can help by looking for the psyllid and helping to control it and by reporting trees they suspect have the disease.



Asian citrus psyllid nymph and adult (inset) on citrus shoot. Photo: M. Lorio, UC Riverside

See the tabs at the left to answer questions about what steps you should take to help in the effort to control the psyllid and disease in order to protect California citrus.

SITE

M?

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l pests

vironment pests

vasive pests

ENEMIES

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models & degree-days

information

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training

Asian Citrus Psyllid and Huanglongbing Disease

Revised 8/13

In this Guideline:

- [Background](#)
- [Identification and life stages of the psyllid](#)
- [Identification of the HLB disease](#)
- [Damage](#)
- [Management](#)
- [About Pest Notes](#)
- [Publication](#)
- [Glossary](#)

[Download PDF](#)

[Quick Tip](#)

[Nota Breve](#)

The Asian citrus psyllid (ACP), *Diaphorina citri*, is a tiny mottled brown insect, about the size of an aphid, that poses a serious threat to California's citrus trees—including those grown in home gardens and on farms. The psyllid feeds on all varieties of citrus (e.g., oranges, grapefruit, lemons, and mandarins) and a few very closely related ornamental plants in the family Rutaceae (e.g., calamondin, box orange, Indian curry leaf, and orange Jessamine or orange jasmine).

This psyllid damages citrus directly by feeding on new leaf growth (flush); this feeding twists and curls young leaves and kills or burns back new shoots. More seriously, the insect is a vector of the bacterium *Candidatus Liberibacter asiaticus*, associated with the fatal citrus disease huanglongbing (HLB), also called citrus greening disease. The psyllid takes the bacteria into its body when it feeds on bacteria-infected plants. The disease spreads when a bacteria-carrying psyllid flies to a healthy plant and injects bacteria into it as it feeds.

HLB can kill a citrus tree in as little as five years, and there is no known cure. The only way to protect trees is to prevent spread of the HLB pathogen in the first place, by controlling psyllid populations and removing and destroying any infected trees.

The Asian citrus psyllid is widely distributed throughout Southern California, and it is likely to continue to spread into the Central Coast and the Central Valley. HLB was found in March 2012 in a tree in a yard in Los Angeles County, which means it is now even more important to keep the psyllid populations low so they don't find infected trees like this one and spread the disease. HLB is also spreading towards the California border from Mexico.

For up-to-date maps of ACP quarantines, HLB finds, and other important information, see the Asian Citrus Psyllid Distribution and Management web site.

BACKGROUND

The Asian citrus psyllid and huanglongbing disease originated in Asia or India and then spread to



Brownish adult, yellow white wax of Asian citrus psyllid



Yellowish psyllid nymph eyes and white waxy tube

How can I manage the psyllid and disease?

- Plant trees from reputable nurseries to avoid bringing either the insect or HLB into your yard.
- Learn where you are relative to quarantines. If you move citrus plants or clippings out of infected areas because doing so can spread the insect and disease.
- Parasitic wasps that attack Asian citrus psyllids have been released in the area. These wasps have helped reduce psyllid numbers but aren't likely to stop the spread of HLB disease.
- You can reduce psyllid numbers by treating infected trees with insecticides including oils, and carbaryl. These treatments are short-lived and control doesn't last long, so they need to be reapplied every few weeks. Carbaryl and imidacloprid are longer lasting, but because both are systemic, dead leaves fall off the tree when citrus trees are in bloom. Make sure fall-applied insecticides reach the new growth where young psyllids hide.
- Apply pesticides if psyllids have been found on your tree.
- When HLB is detected, diseased trees must be removed to protect the trees around them from becoming infected.

See Pest Notes: [Asian Citrus Psyllid and Huanglongbing Disease](#) at www.ipm.ucanr.edu for more details.



Brownish adult, yellow white wax of Asian citrus psyllid. Specimen of HLB an inset and that right.

Minimize the use of pesticides that pollute our waterways. Instead, consider using less toxic pesticide products whenever possible. Read product labels carefully and follow instructions on proper use, storage, and disposal.

For more information about managing pests, contact your University of California Cooperative Extension office listed under the county government pages of your phone book or visit the UC IPM Web site at www.ipm.ucanr.edu.

What you use in your landscape affects our rivers and oceans!

University of California Agriculture and Natural Resources Statewide IPM Program

UC IPM University of California Pest Management Center

For an in-depth study of the psyllid and ACP in English, take the ANR Online Class on ACP for Master Gardeners <http://class.ucanr.edu>

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- Course Description
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- ▶ Chapter 2: Huanglongbing Disease
- ▶ Chapter 3: Huanglongbing Spread
- ▶ Chapter 4: The California Situation
- ▶ Chapter 5: Detection and Action
- ▶ Chapter 6: California Response Plan
- ▶ Quiz

Asian Psyllid and Huanglongbing for Homeowners

Introduction

Asian Citrus Psyllid & the Dreaded Huanglongbing Citrus Disease
A study of the biology and management from a California homeowner perspective



Instructor
Beth Grafton-Cardwell
Dept. of Entomology,
University of California
Riverside



Duration: 60 minutes

University of California
Agriculture and Natural Resources

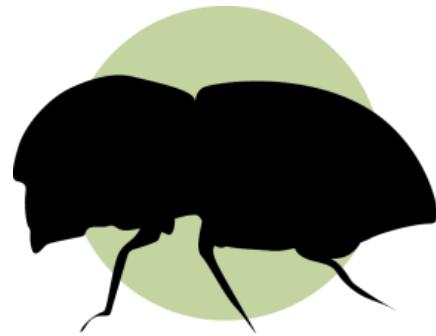
◀ PREV NEXT ▶

Summary from Dr. Beth...

- 1) HLB kills citrus trees, we have no cure, and it's starting to spread in S. CA
- 2) HLB is spread by grafting infected plant material and by the Asian citrus psyllid (ACP)
- 3) The goal of local eradication or suppression of ACP is to buy time for the scientists to find a cure for HLB
- 4) If ACP is found, it is important for the city to support eradication as HLB is going to destroy citrus trees
- 5) People play a part in moving psyllids (green waste, plant movement, bulk citrus movement) and so education of the general public is essential

Thank you...!

Igor: ilacan@ucanr.edu



Emerging Tree Pests: Shothole Borers

John Kabashima, UCCE



Situation in California

- First detected in CA in 2003 in Whittier Narrows
- Caused death of large number of Box Elder street trees in Long Beach in 2010
- Problem was not recognized until 2012 when we found it on a backyard avocado tree

IN GOD WE TRUST

LIBERTY

2012

D

Fusarium dieback caused by fungal pathogens



Branch Dieback and Tree Wilt



Feb 2014



May 2015

Branch Dieback and Tree Wilt



Box Elder



Sycamore

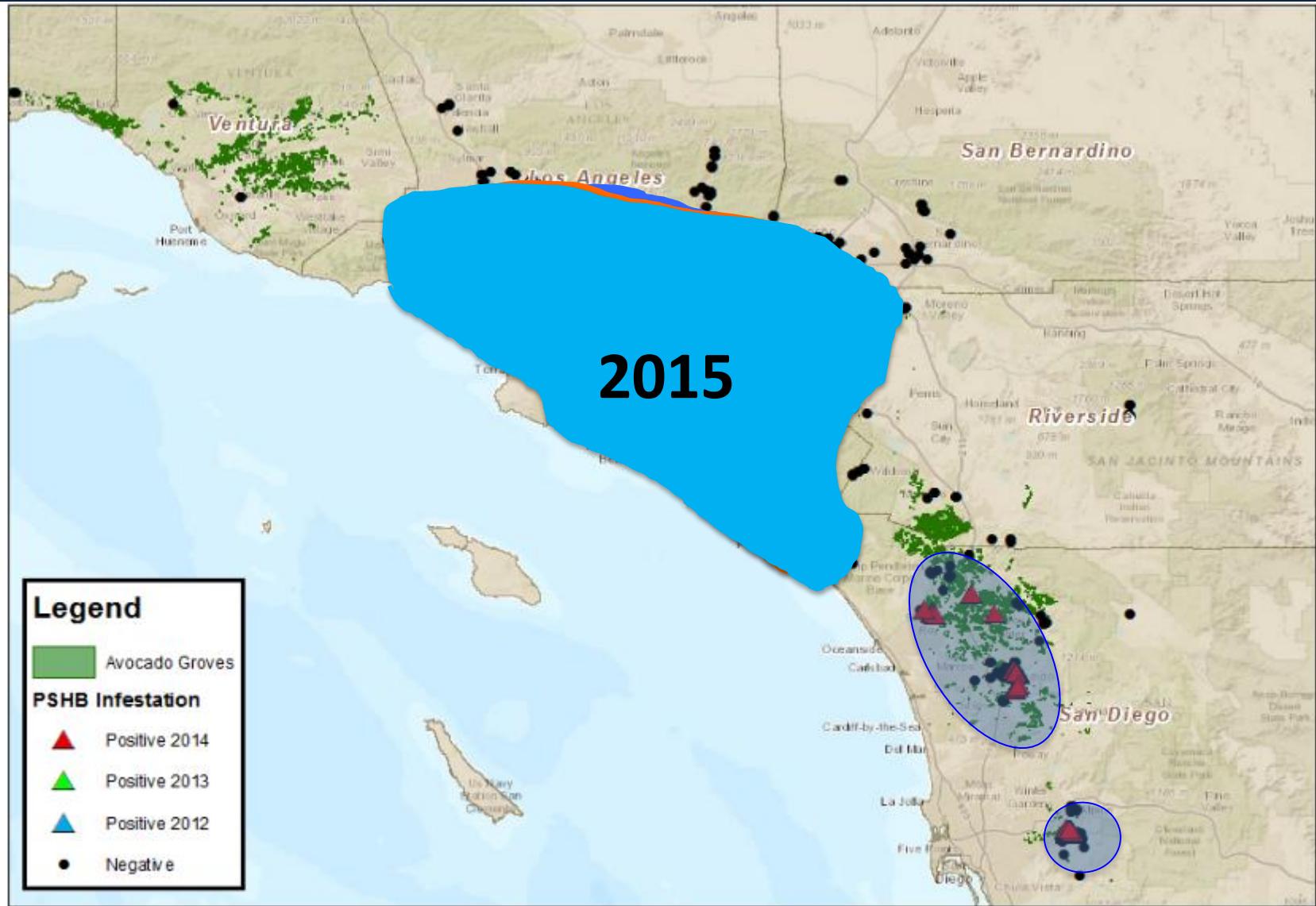
Host Range FD/PSHB

	2012
Tree Species Attacked by Beetle	286
Tree Species Infected by Fungus	117
Agricultural Crops	13
California Native Tree Species	11
Number of Tree Families	62
Number of Reproductive Hosts	19

Eskalen, A., Stouthamer, R., Lynch, S.C., Rugman-Jones, P., Twizeyimana, M., Gonzalez, A., Thibault, T. 2013. Host Range of Fusarium Dieback and its Ambrosia Beetle (Coleoptera: Scolytinae) Vector in Southern California. *Plant Disease*. 97:7, 938-951.

1. Box elder (*Acer negundo*) *
2. Big leaf maple (*Acer macrophyllum*)*
3. Evergreen Maple (*Acer paxii*)
4. Trident maple (*Acer buergerianum*)
5. Japanese maple (*Acer palmatum*)
6. Castor bean (*Ricinus communis*)
7. California sycamore (*Platanus racemosa*) *
8. Red willow (*Salix laevigata*) *
9. Arroyo willow (*Salix arborescens*) *
10. Mimosa (*Mimosa juliflora*)
11. English Oak (*Quercus robur*) spp.
12. California Sycamore (*Platanus racemosa*)
13. Garry Oak (*Quercus garryana*)
14. Bigleaf maple (*Acer macrophyllum*)
15. Cottonwood (*Populus fremontii*)*
16. White Alder (*Alnus rhombifolia*)
17. Valley oak (*Quercus lobata*)
18. Nuttall's Oak (*Quercus nuttalliana*)
19. Blue Palo verde (*Cercidium floridum*)
20. Logania (*Entada scandens*)
21. Cork Oak (*Quercus suber*)
22. Peach (*Prunus persica*)*
23. Orange Ash (*Fraxinus latifolia*)
24. Canyon Live oak (*Quercus chryssolepis*)
25. Black Walnut (*Juglans nigra*)
26. California bay laurel (*Laurus nobilis*)
27. Cassava (*Manihot esculenta*)
28. Moreton Bay Chestnut (*Castanopsis fissa*)
29. Brea (*Cercidium sonorae*)
30. Mesquite (*Prosopis glandulosa*)
31. Coffeeberry (*Rhamnus californica*)
32. Weeping Willow (*Salix babylonica*)
33. Velvet Ash (*Fraxinus velutina*)
34. Fremont cottonwood (*Populus fremontii*)
35. California ash (*Fraxinus dipetala*)
36. Liquidambar (*Liquidambar styraciflua*)
37. Goodding's black willow (*Salix gooddingii*)
38. Goodding's black willow (*Salix gooddingii*)*
39. Japanese wisteria (*Wisteria floribunda*)
40. Black Cottonwood (*Populus trichocarpa*)*
41. Goodding's black willow (*Salix gooddingii*)*
42. Tree of heaven (*Alianthus altissima*)
43. Kurrajong (*Brachychiton populneus*)
44. Black mission fig (*Ficus carica*)

Current distribution of infestation of PSHB/FD



0 5 10 20 30 40 Miles

Data source: Eskalen lab, Dept. of Plant Pathology and Microbiology, University of California, Riverside. www.eskalenlab.ucr.edu

Sign and Symptoms

Symptoms on English Oak (*Quercus robur*)



Coast Live Oak (*Quercus agrifolia*)



Top 3 Infested Species at OC Parks

California sycamore

53.52% of OCP infestation



London plane

12.73% of OCP infestation



White alder

9.66% of OCP infestation



Weak Branch Connection - Fusarium Dieback



Photos | John Kabashima, UC Cooperative Extension

OC Parks Follow-Up Survey Results 2015

1,988 PSHB-positive trees at 19 facilities throughout the county

94.5% reproductive hosts (1,878 trees)

5.5% non-reproductive hosts (110 trees)

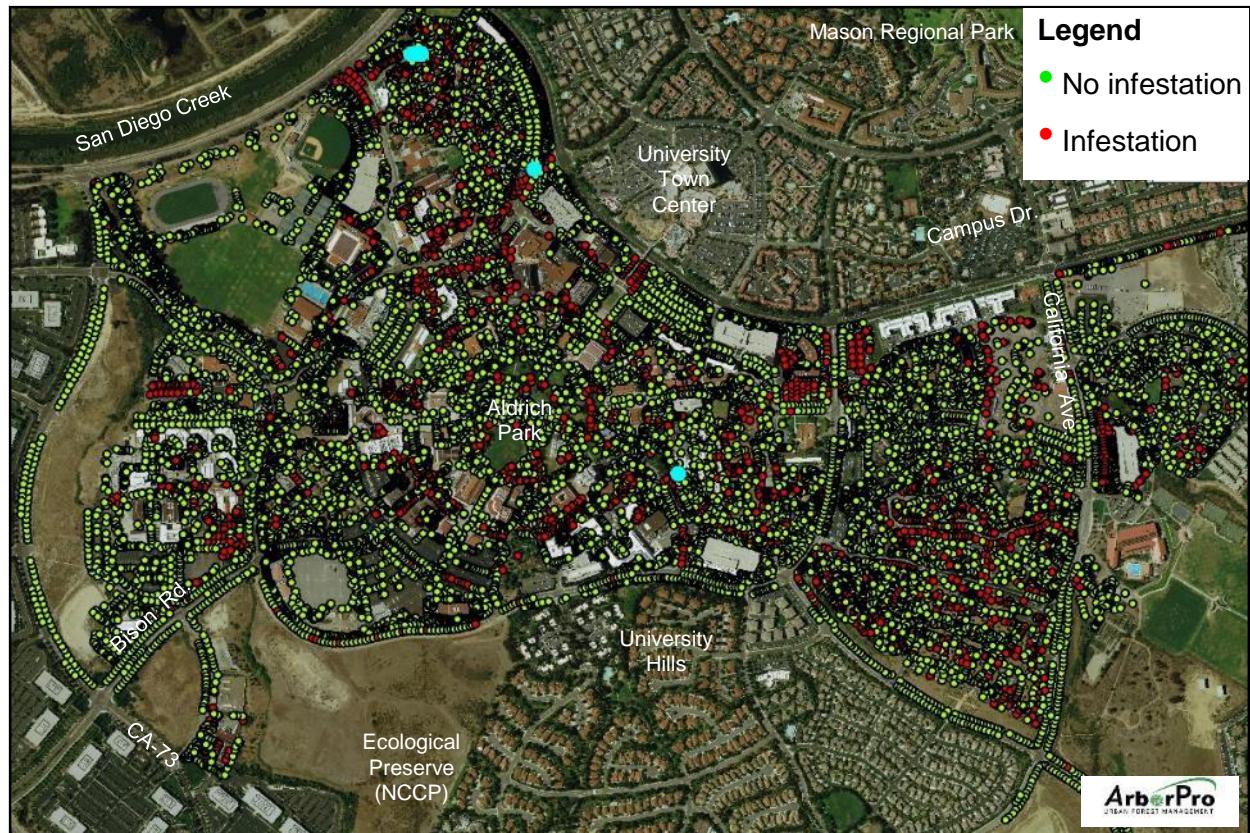
Value of 1,988 trees estimated at over 5.9 million USD*

400 trees removed due to heavy PSHB/FD infestation (as of February 2016)

*based on West Coast Arborist Inventory data

Status of UCI Infestation

- 2,500+ trees attacked
- 75 species attacked
 - Reproductive host species
 - Non-host species
- 523 trees removed (as of March 2016)



2015 Tijuana River Wetland San Diego County

A Watershed Invasion

- 140,000 Willows attacked
- Symptoms expressed quickly
- Endangered species habitat
- Increased risk of
 - Flooding
 - Fire



Photo | Kabashima, UC Cooperative Extension



Ambrosia Beetles are difficult to control

- Sibling mating before females disperse
- Generally only short time outside the tree
- Attract Sex pheromones- No
- Aggregation pheromone – No
- Host attractants – Yes
 - Querciverol



Control Options

Cultural / Sanitation

- Tree and stump removal
- Pruning infested branches
- Pruning wound protection (bifenthrin +)
- Chipping, Composting, Solarization
- Restrict firewood movement

Chemical

- Beetle and/or Fungal Symbionts
- Trunk sprays – bifenthrin + cease
- Systemic-Soil injection/drench, trunk injection
 - imidacloprid

Biocontrol? (Long Term Strategy)

- Natural Enemies
- Use of Entomopathogenic Fungi
- Use of Endophytic bacteria and/or fungi

Monitor Attract & Kill Traps

- Use of flight data in management decisions
- Lure and Pesticides

Identify Risk of Movement

- Natural spread through landscape
- Pathways or corridors
- Risk to native and agricultural resources
- Facilitated movement



Facilitated Movements

- Firewood Movement



UGA5039049

Joseph O'Brien, USDA Forest Service, Bugwood.org

PSHB Impacts

- Cost of:
 - Treatment
 - Pruning
 - Removal \$(650 to \$1000 per tree)
 - Chipping
 - Stump grinding
 - Handling and disposal
 - Transport
 - Compost
 - Alternative Daily Cover
 - Biomass Electrical Generation



WILL HOMEOWNERS DO OR BE ABLE TO AFFORD THIS?

- Injury Hazards from falling and weakened limbs