

Fusarium dieback, an emerging exotic disease/pest complex causing dieback throughout agricultural, urban, and wildland landscapes in Southern California

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USDA Forest Service

Tea spot holeborer (*Ebwalia arabica*)



2.5 mm (0.1 inch) long



1.5 mm (0.05 inch) long



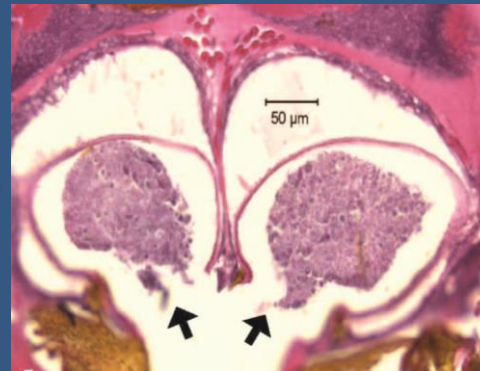
PSHB Life Cycle and Reproduction



- Sex ratio of offspring is female biased
- Brothers mate with sisters in galleries
- Mated females leave the galleries to create their own galleries
- Female can fly, male usually stay in the gallery



Symbiotic fungi associated with PSHB

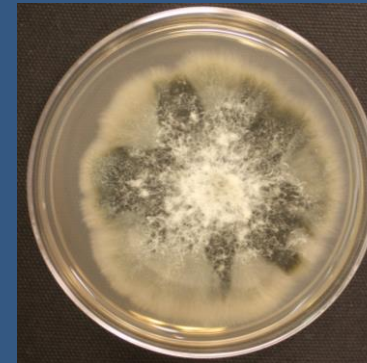


Mycangia

Figure: Matthew Kasson



Fusarium euwallaceae
(Freeman et al 2013)



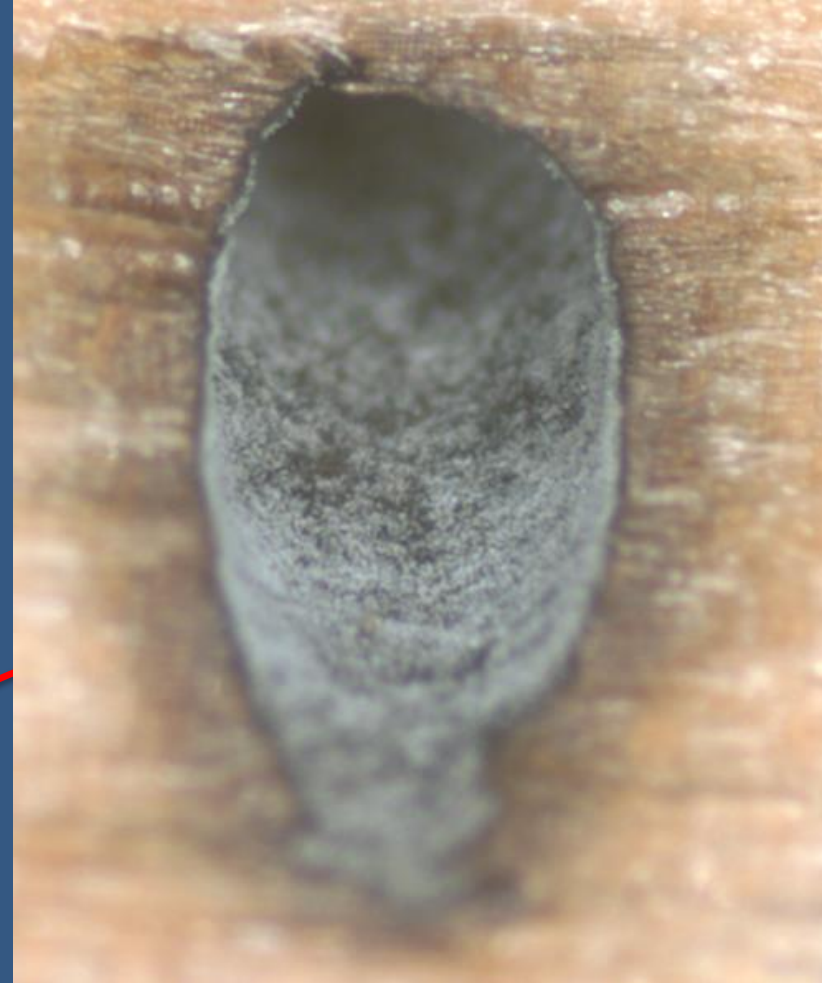
Graphium sp.



Acremonium sp.



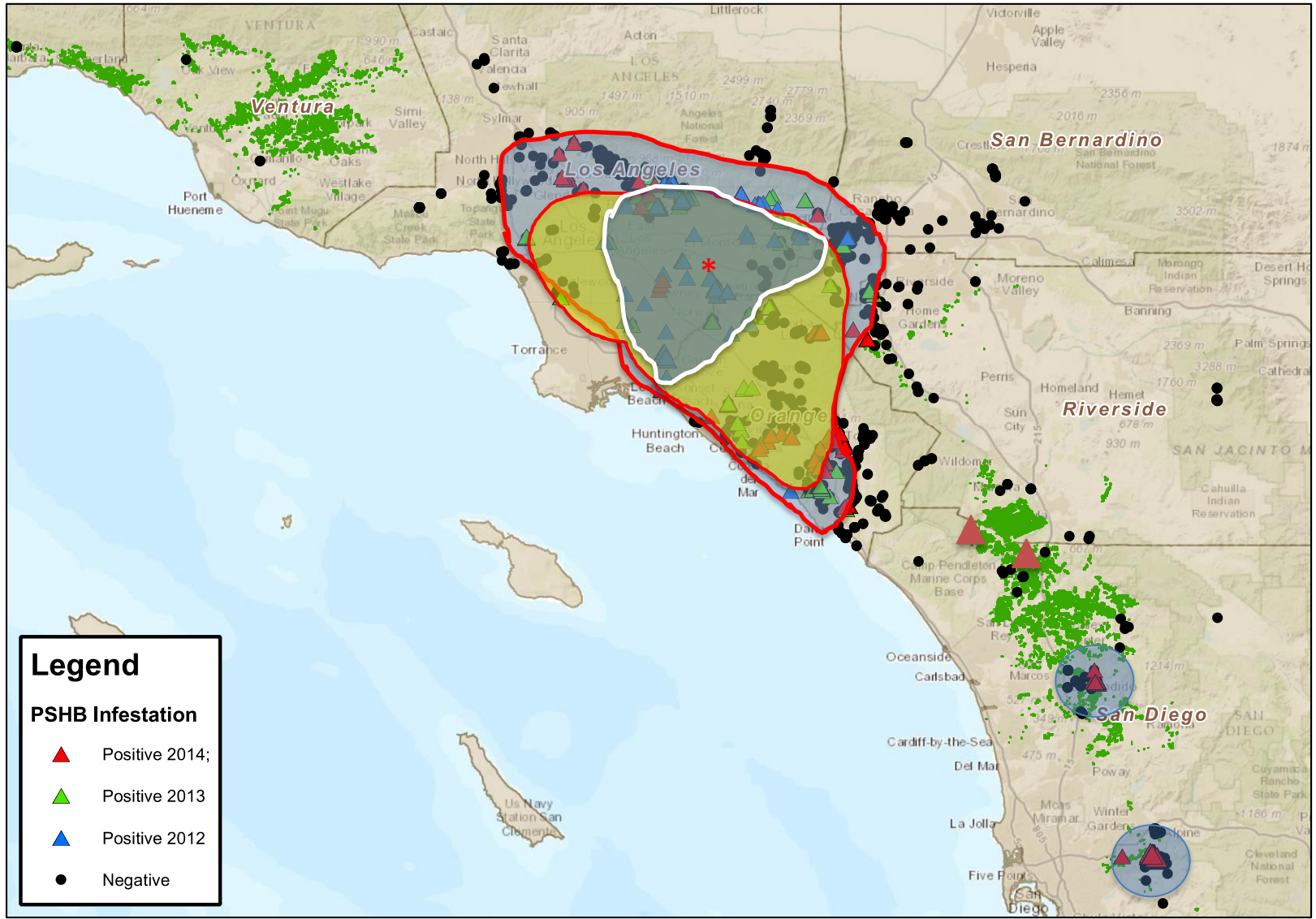
Fusarium dieback caused by fungal pathogens



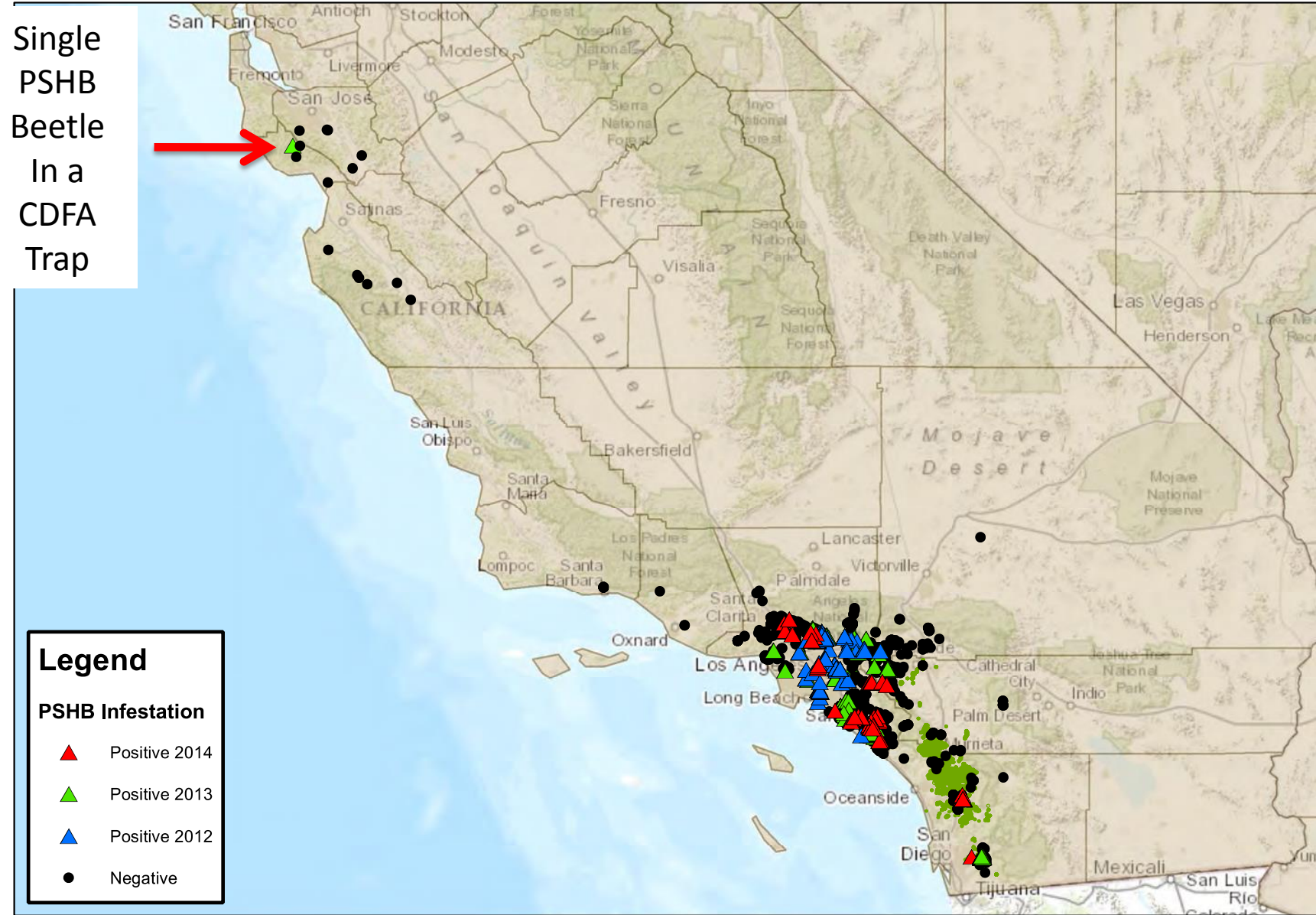
Branch Dieback and Tree Wilt



Coast Live Oak



0 5 10 20 30 40 Miles



Host Range FD/PSHB

	2012	2014
Tree Species Attacked by Beetle	286	303
Tree Species Infected by Fungus	117	138
Agricultural Crops	13	13
California Native Tree Species	11	18
Number of Tree Families	58	62
Number of Reproductive Hosts	19	34

Most Affected Families: Aceraceae, Fabaceae, Fagaceae

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](#). In 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*)
1. California box elder (*Acer negundo*)
7. California sycamore (*Platanus racemosa*) *
2. Coast live oak (*Quercus agrifolia*)
8. Red willow (*Salix laevigata*) *
3. California Sycamore (*Platanus racemosa*)
9. Avocado (*Persea americana*)
4. Avocado (*Persea americana*)*
10. Mimosa (*Albizia julibrissin*)
5. Peruvian pepper tree (*Simarouba*)
11. English oak (*Quercus robur*)
3. Olive (*Olea europaea*)
12. Coast live oak (*Quercus agrifolia*)*
7. Macadamia (*Macadamia integrifolia*)
13. Eucalyptus (*Eucalyptus*)
8. Eastern mulberry (*Broussonetia papyrifera*)
14. Eucalyptus (*Eucalyptus*)
9. White Alder (*Alnus rhomboides*)
10. Red oak (*Quercus rubra*)
16. Red oak (*Quercus chrysolepis*)
8. Eucalyptus (*Eucalyptus*)
11. California bay laurel (*Umbellularia californica*)
12. Desert Palo Verde (*Washingtonia filifera*)
10. Valley oak (*Quercus lobata*) *
19. California buckeye (*Aesculus californica*)
20. Coral tree (*Erythrina corallodendron*)
14. Coffee berry (*Rhamnus californica*)
21. Blue palo verde (*Cercidium aculeata*) *
15. Velvet ash (*Fraxinus velutina*)
22. Palo verde (*Parkinsonia aculeata*)
16. Japanese Cottonwood (*Populus trichocarpa*)
23. Moreton Bay Chestnut (*Castanospermum australe*)
17. California ash (*Fraxinus dipetala*)
24. Brea (*Cercidium sonora*)
18. Gooding's black willow (*Salix gooddingii*)
25. Mesquite (*Prosopis articulata*) *
26. Weeping willow (*Salix babylonica*)
27. Chinese holly (*Ilex cornuta*)
28. Camelia (*Camellia semiserrata*)
29. Acacia (*Acacia* spp.)
30. Liquidambar (*Liquidambar styraciflua*)
31. Red Flowering Gum (*Eucalyptus ficifolia*)
32. Japanese wisteria (*Wisteria floribunda*)
33. Black Cottonwood (*Populus trichocarpa*)*
34. Gooding's black willow (*Salix gooddingii*)*

Sign and Symptoms

Symptoms of PSHB/FD on different hosts



Coast live oak



Liquidambar



California Sycamore



Excelsa



Coast live oak



Avocado



English Oak



Castor bean

Size of the plant attacked by the beetle

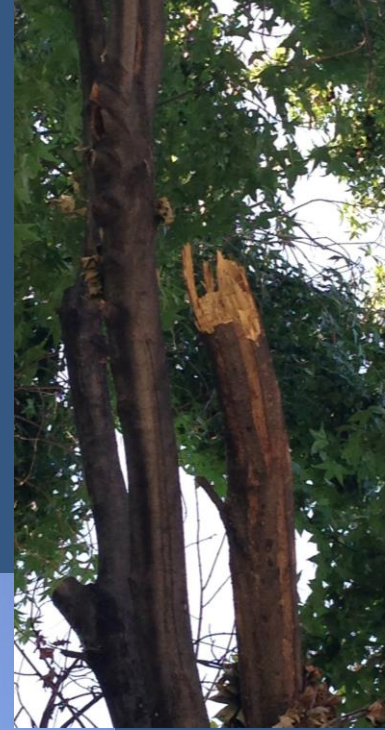


Avocado



Coast live oak

Box elder



Coast Live Oak





California sycamore

Red willow (*Salix laevigata*)



Pasadena Glen Canyon in Angels National Forest

Palo Verde (*Parkinsonia aculeata*) Near Los Angeles



Spring 2014

Late summer 2014



Fremont Cottonwood

Photo Credit: Tom Coleman

Castor Bean (*Ricinus communis*)

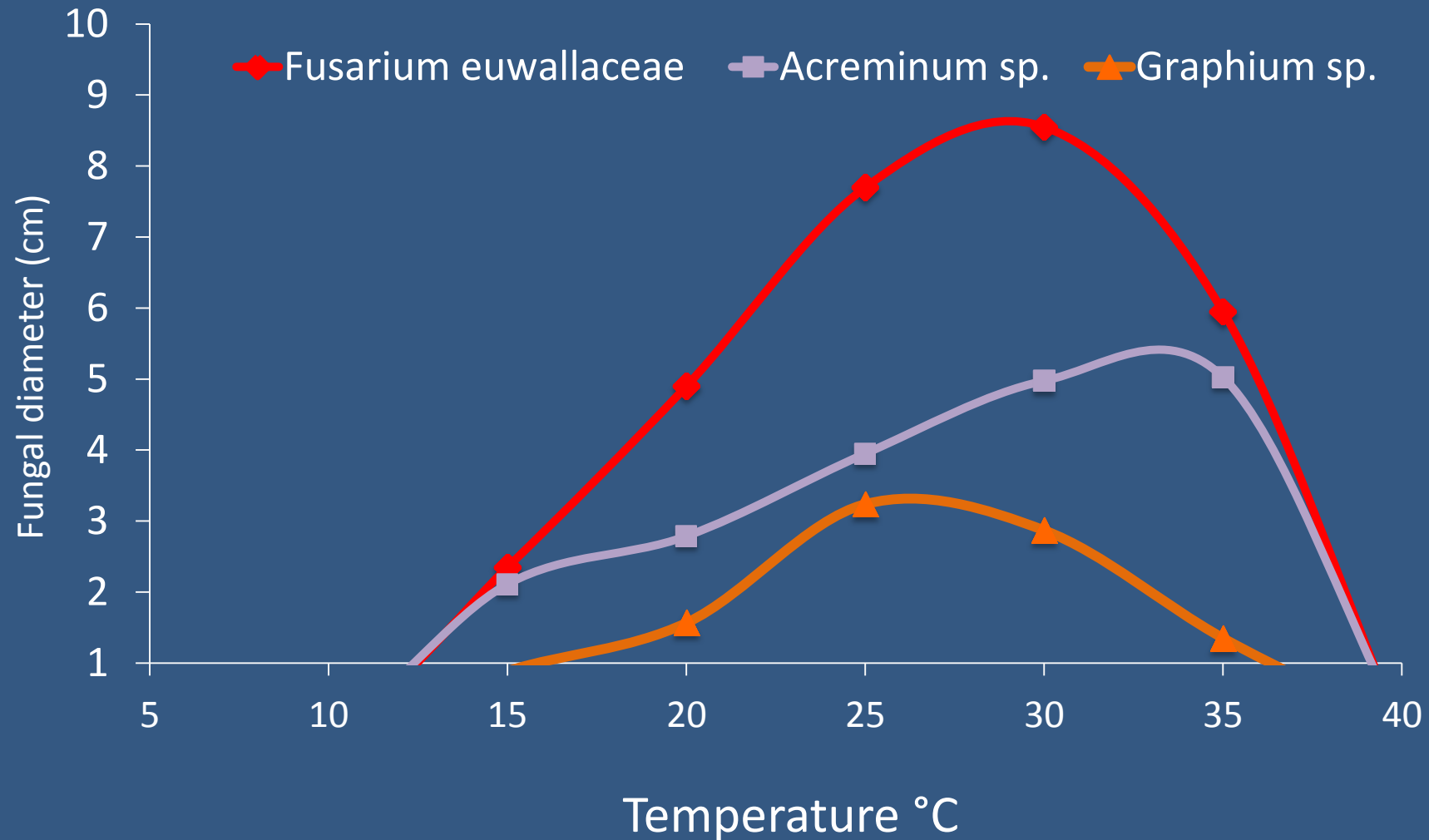


PSHB Temperature Trials

	25 °C	30 °C
Developmental Time (Days)	42	23
Average Offspring	17.85	13.17
Highest Recorded # Offspring	42	44

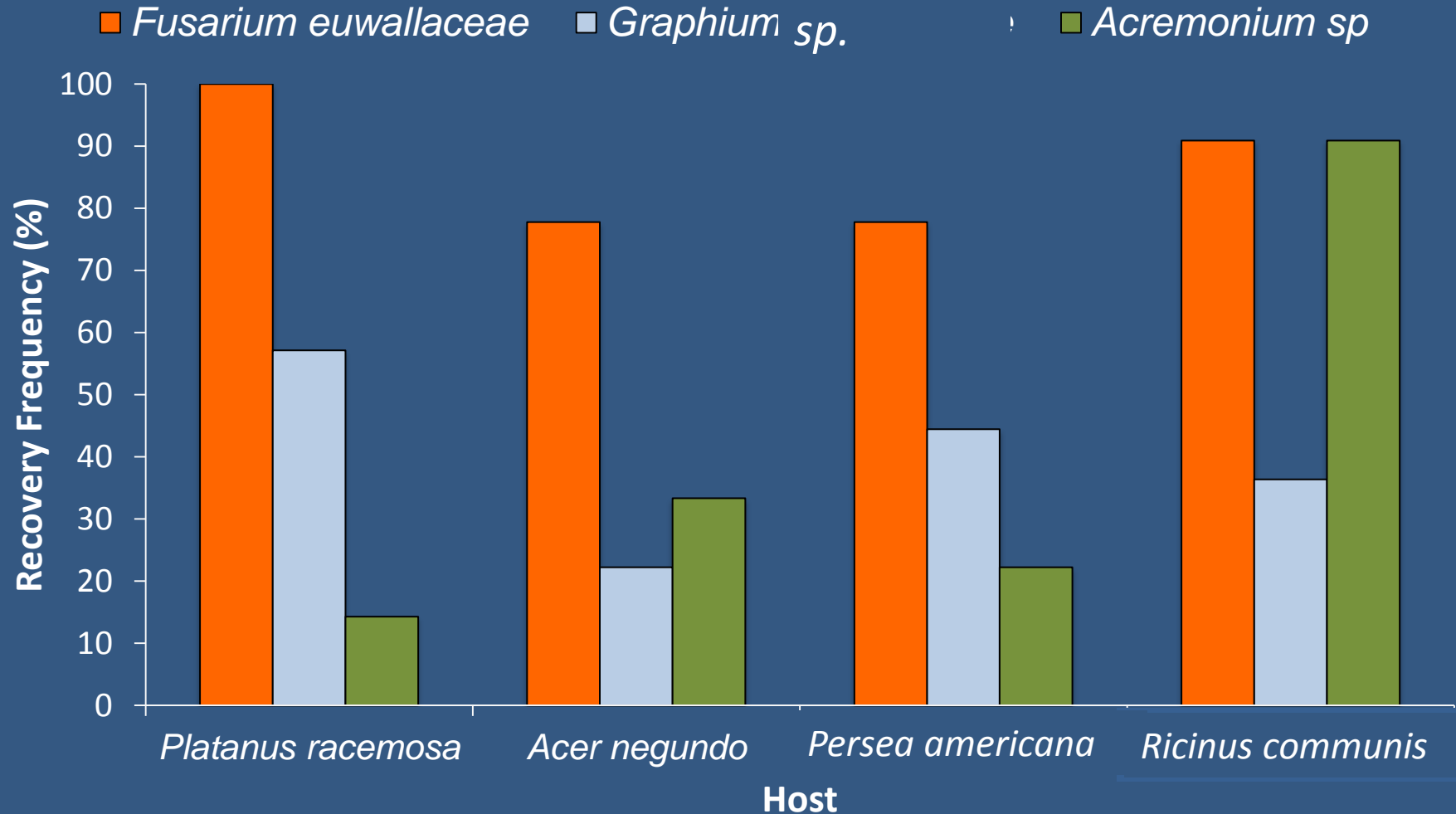
Tim Paine Lab, UC Riverside Dept. Entomology

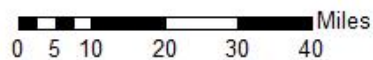
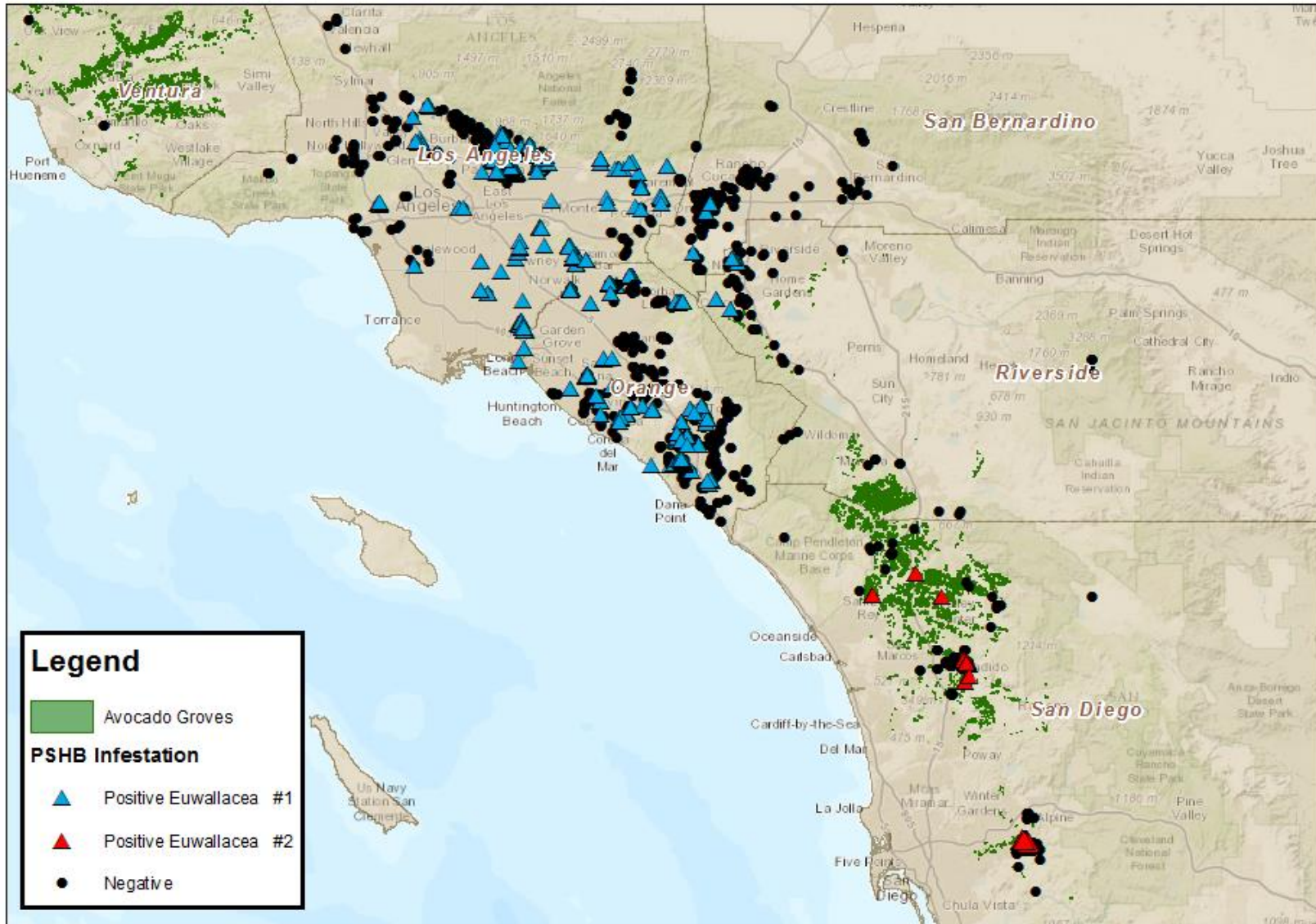
Radial growth assay of symbiotic fungi at different temperatures



**Frequency of symbiotic fungi
recovered from female heads of PSHB**

Frequency of fungal species recovered from the heads of PSHB collected from different hosts





Trap and bait development

- Recently Stouthamer lab experimented with a lure that attracts the beetles (Work done with USDA)
- Quercivorol (1-methyl-2-cyclohexen-1-ol)
- Lure is developed from aggregation pheromone (males) of *Platypus quercivorus* vector of Japanese oak wilt



Effective lure tested in LaHabra infected avocado orchard for three weeks



	Average of 15 traps with lure	Average of 15 traps w/o lure
Week 1	61	1
Week 2	42	0.5
Week 3	78	1.2

Lures probably last about 6 weeks

What to do with the heavily infested trees?

- Chip infested wood at least 1" size on-site.
- If the wood is too large to chip, should be solarized using clear plastic tarp on-site for several months.
- Solarize chipping material using clear plastic tarp for several months
- Don't move infested plant material without chipping and solarizing



Conclusion

- Two separate infestations of beetle in California, indicating multiple introductions of the beetle into the state
- *Fusarium euwallaceae* and new species of *Fusarium* *Graphium* and *Acremonium* are associated with PSHB in California
- Pathogenicity test confirmed that associated fungi are pathogenic to healthy box elder and avocado seedlings
- Lure traps may be effective at attracting the beetle
- Branch collar and pruning wounds seem to be more susceptible to beetle attack on oak and avocado trees

Acknowledgement

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