Invasive Ambrosia Beetle Conference The Situation in California August 12 - 14, 2012

Meeting sponsored by:
The Hofshi Foundation
University of California, Riverside
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The Huntington Botanical Gardens
The Los Angeles Arboretum

Invasive Ambrosia Beetle Conference The Situation in California August 12 - 14, 2012

Session 4
Biology of the Fungal Symbiont



A complex of fungal species associated with polyphagous shot hole borer in California

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Symptoms on a backyard avocado tree in South Gate, Los Angeles

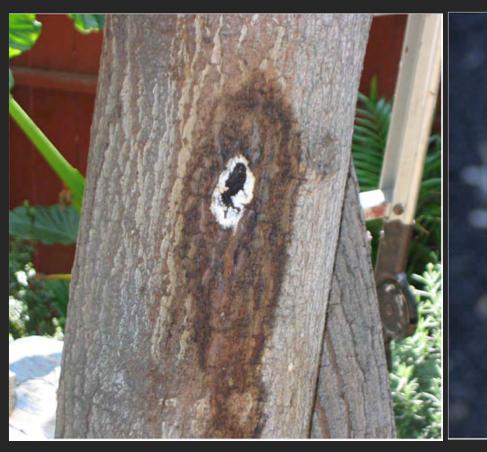


Symptoms on the bark and cortex tissue





Symptoms on the bark and cortex tissue





Symptoms on avocado branches (cv. Hass)





Symptoms on avocado branches (cv. Hass)





Fusarium sp. isolated from both symptomatic plant tissues, beetle and larvae







Fusarium sp.

Tea Shot hole borer (Euwallacea fornicatus)







Polyphagous Shot hole borer (Euwallacea sp.)







	Host Plant	Female Beetle	Male Beetle	Larvae	Gallery Wall
Fusarium sp.	Χ	X	Χ	X	Х
Fusarium solani 1	Χ	X			
Fusarium solani 2	Х	X			
Fusarium sp. 2	X	Х			
Graphium sp.	Х	Х	Х	Х	Х
Yeast		Х	Х		Х





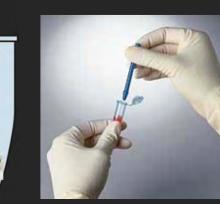




Female Beetle Hd

	Host Plant	Female Beetle	Male Beetle	Larvae	Gallery Wall
<i>Fusarium</i> sp.	Χ	X	Х	Χ	Х
Fusarium solani 1	Χ	X			
Fusarium solani 2	Χ	X			
<i>Fusarium</i> sp. 2	Х	Х			
<i>Graphium</i> sp.	Χ	Х	X	X	Х
Yeast		Х	X		Х



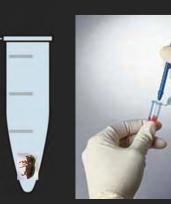




Female Beetle Bd

	Host Plant	Female Beetle	Male Beetle	Larvae	Gallery Wall
Fusarium sp.	Х	Χ	X	Х	Х
Fusarium solani 1	Χ	X			
Fusarium solani 2	Χ	X			
<i>Fusarium</i> sp. 2	X	Х			
<i>Graphium</i> sp.	Х	Х	Х	Х	Х
Yeast		Х	Х		Х



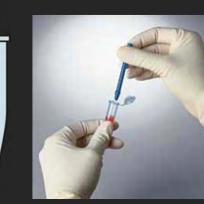




Male Beetle

	Host Plant	Female Beetle	Male Beetle	Larvae	Gallery Wall
Fusarium sp.	Χ	X	Χ	X	Х
Fusarium solani 1	Χ	X			
Fusarium solani 2	Х	X			
Fusarium sp. 2	X	Х			
Graphium sp.	Х	Х	Х	Х	Х
Yeast		Х	Х		Х



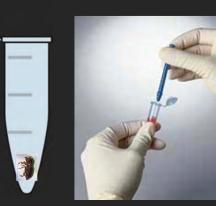




Larvae

	Host Plant	Female Beetle	Male Beetle	Larvae	Gallery Wall
Fusarium sp.	Х	Χ	X	Х	Х
Fusarium solani 1	Χ	X			
Fusarium solani 2	Χ	X			
<i>Fusarium</i> sp. 2	X	Х			
<i>Graphium</i> sp.	Х	Х	Х	Х	Х
Yeast		Х	Х		Х



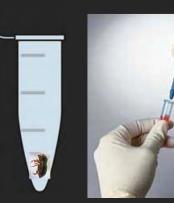




Gallery Wall

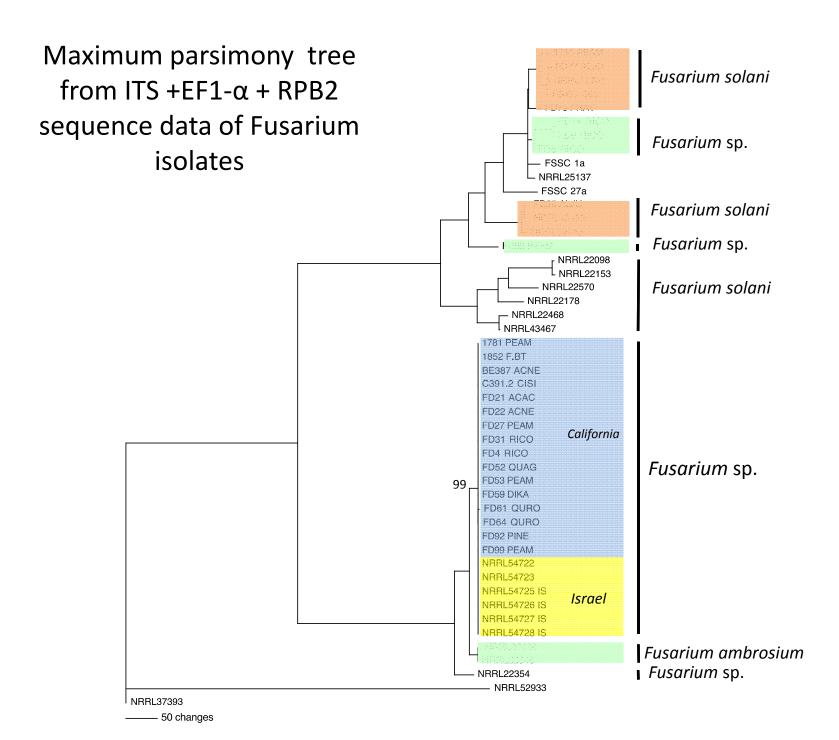
	Host Plant	Female Beetle	Male Beetle	Larvae	Gallery Wall
Fusarium sp.	Χ	X	Χ	X	Х
Fusarium solani 1	Χ	X			
Fusarium solani 2	Х	X			
Fusarium sp. 2	X	Х			
Graphium sp.	Х	Х	Х	Х	Х
Yeast		Х	Х		Х



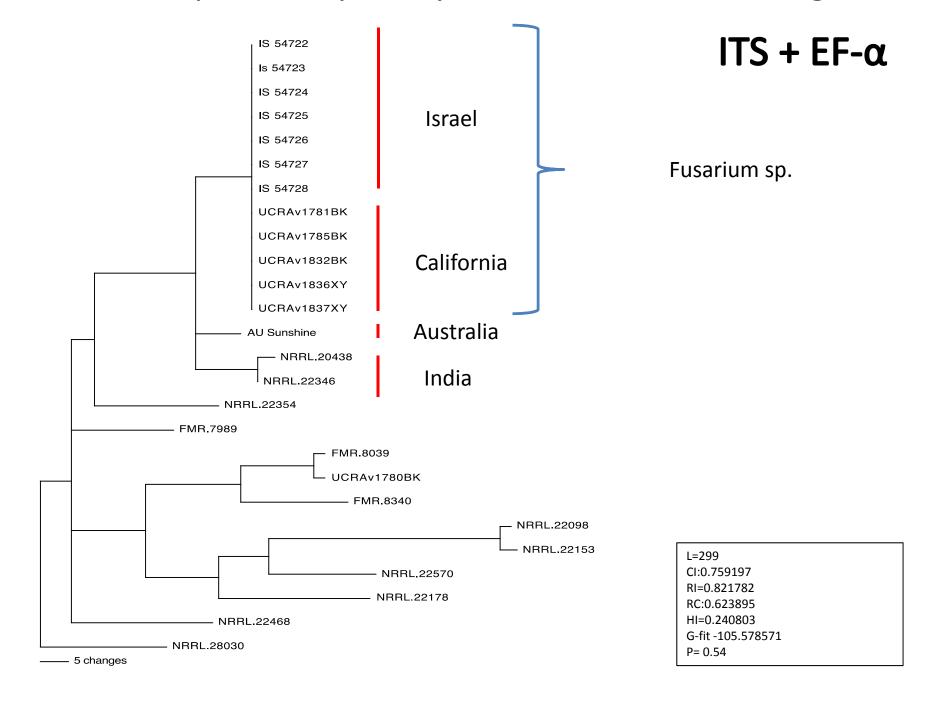


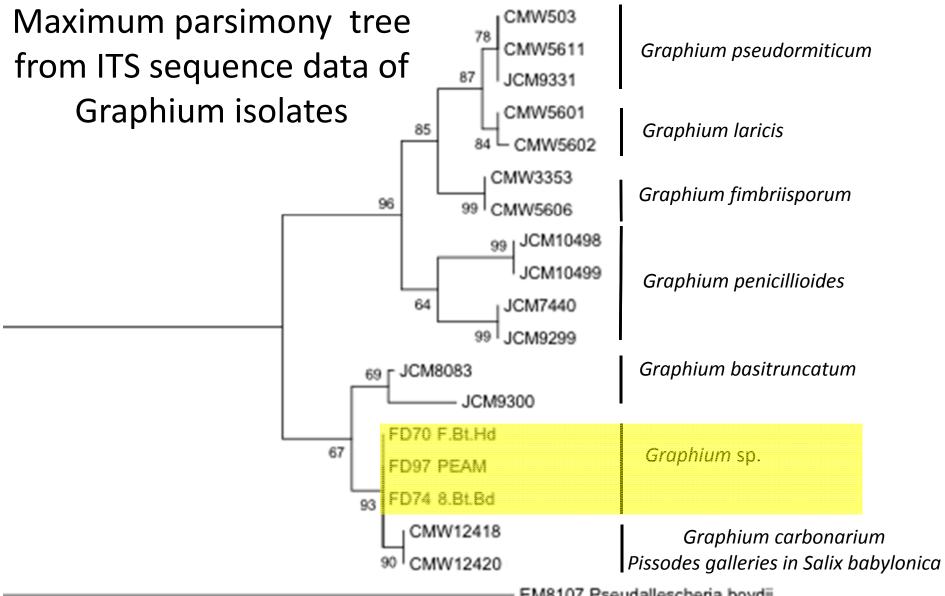


Gallery Wall



Maximum parsimony analysis of the ITS and EF1- α genes





Characterisation of synnematous bark beetle-associated fungi from China, including *Graphium carbonarium* sp. nov.

D. Paciura \cdot X. D. Zhou \cdot Z. W. De Beer \cdot K. Jacobs \cdot H. Ye \cdot M. J. Wingfield

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Abstract Ophiostomatoid fungi on trees are typically bark beetle associates that cause sapstain in timber and some are pathogens. Very little is known regarding the ophiostomatoid fungi associated with bark beetles in China and the aim of this study was to identify a collection of these fungi with synnematous anamorphs. Micromorphology and DNA sequences of the internal transcribed spacer regions (ITS) of the ribosomal DNA and the partial β-tubulin gene were used for identifications. The isolates could be divided in six morphological groups. DNA sequence comparisons with published data confirmed that these groups represented six species, four in the Ophiostomatales (Sordariomycetidae) and two in the Microascales (Hypocreomycetidae). The majority of these were isolated from conifer hosts. Ophiostoma quercus, O. setosum, Pesotum fragrans (Ophiostomatales) and Graphium pseudormiticum (Microascales) were found on Tsuga dumosa infested by a Pissodes sp. In addition, O. quercus and P. fragrans were found associated with Tomicus yunnanensis on Pinus yunnanensis, P. fragrans with a Pissodes sp. on P. armandi, and O. piceae with Ips subelongatus on Larix olgensis. Only two species, O. quercus and a new species in the Graphium penicilliodes complex, described here as Graphium carbonarium sp. nov., were isolated from Pissodes galleries on Salix babylonica. These results include several new fungus-host and fungus-insect associations, and G. pseudormiticum is reported here for the first time from China.

Keywords Conifers · *Graphium* · Hardwoods · *Ophiostoma* · *Pesotum* · Phylogeny · Taxonomy

Introduction

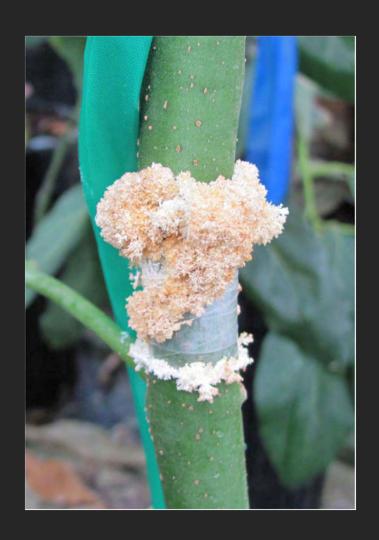
Koch's Postulates on Hass



1 mm diameter drill bit



Pathogenicity test on Avocado (cv.Hass)





Fusarium sp.

Control

Internal symptoms on green shoot of avocado (cv. Hass)



Fusarium sp.

Control

Species infested with PSHB

Species infected with Fusarium sp.

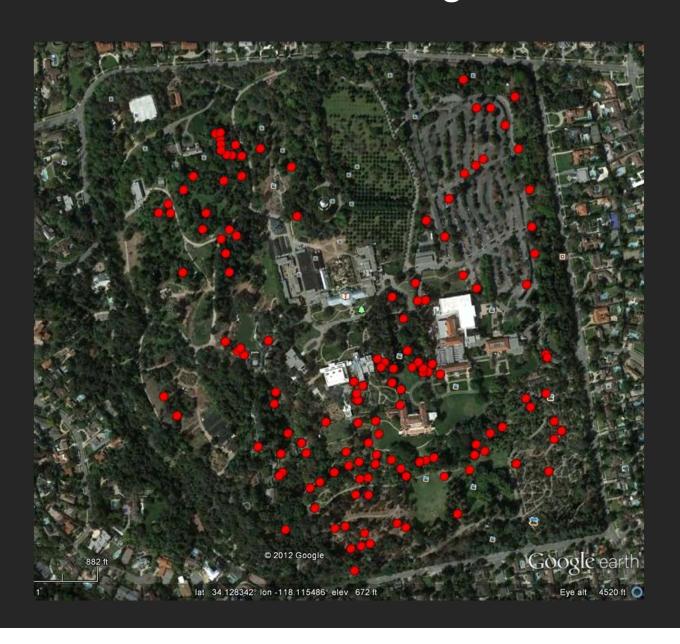
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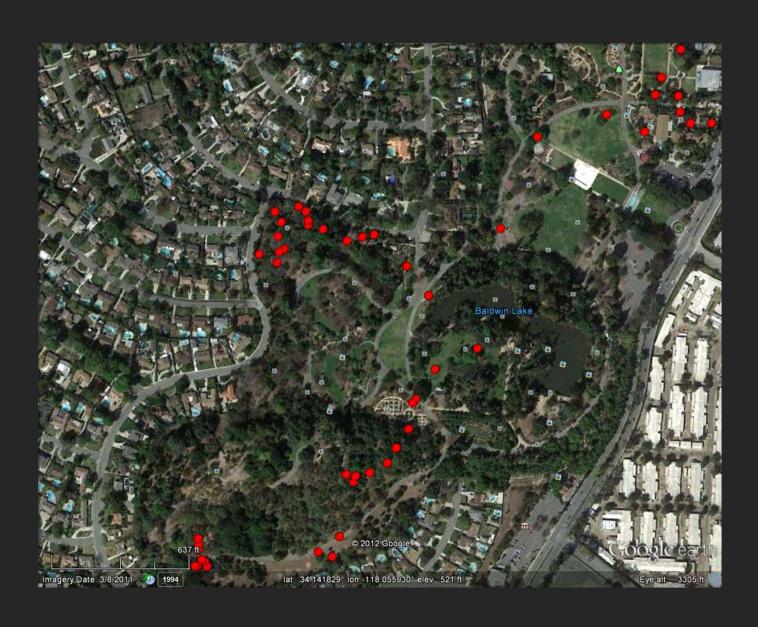
Legend

- ▲ Positive finding Fusarium sp./Polyphagous Shot Hole Borer
- O Negative-Fusarium sp./Polyphagous Shot Hole Borer

Distribution of infestation in Huntington Botanical Garden



Distribution of infestation in LA Arboretum



Symptoms on Castor Bean (Ricinus communis)



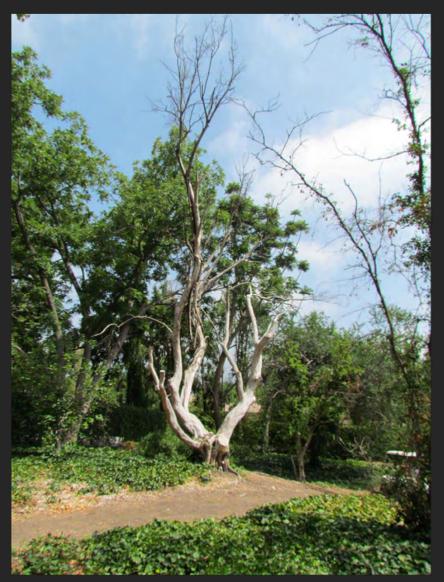




Symptoms on Castor Bean (Ricinus communis)







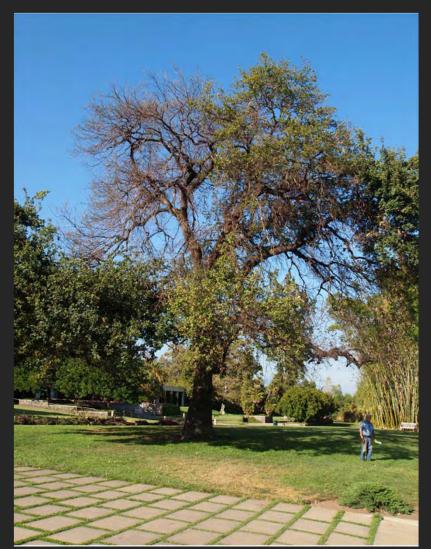


Box Alder (Acer negundo)





Box Alder (Acer negundo)





English Oak (Quercus robus)

Symptoms on avocado (cv. Hass)



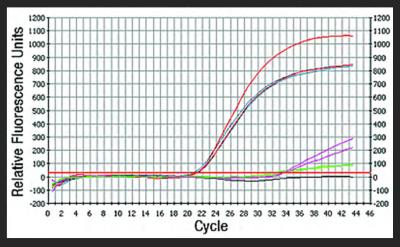






Coast live oak (Quercus agrifolia)

Detection of *Fusarium sp.* directly from plant material using Quantitative Real Time PCR





EF-1α

Forward: ACGTGATTGACCACAAAC

Reverse: CAGCGACATACCAATGAC



Ladder
Water Control
Fusarium sp.
Fusarium sp.

188 bp

Conclusion

- •Fusarium dieback (FD) is a new disease of avocado and landscape trees caused by new *Fusarium* sp. vectored by an ambrosia beetle.
- •Multiple species, including *Fusarim solani* and a new *Graphium* sp. are associated with PSHB in California
- •Los Angeles and Orange counties thus far are infested with FD/PSHB in California
- •Symptoms of FD on Box elder, castor bean, avocado and English oak are more severe than observed on other hosts.
- •Biology, epidemiology and management strategies are now being investigated.

Collaborators

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California Avocado Commission

