Thousand Cankers Disease

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University of California
Agriculture and Natural Resources

UCDAVIS
UNIVERSITY OF CALIFORNIA

NPDN
National Plant Diagnostic Network

- **Thousand cankers disease (TCD) of *Juglans* species: A little history with a California focus**

- **Research highlights**

- **Diagnostic issues and future directions**

Geosmithia morbida

Pityophthorus juglandis
walnut twig beetle (WTB)

An epidemic in eastern black walnut, *Juglans nigra,* in western states

- Mortality of *J. nigra* was first observed in Utah & Oregon in the 1990's
- Mortality first observed in Colorado in 2001
- Disease widespread in Colorado Springs & Boulder by 2004
- By 2008 nearly all *J. nigra* trees in the Colorado Springs area were dead
- More than 2000 dead *J. nigra* in Boulder – Denver area
- Walnut twig beetle and new fungal pathogen associated with disease by Colorado State University scientists.

Photos by Ned Tisserat & Whitney Cranshaw, Colorado State University

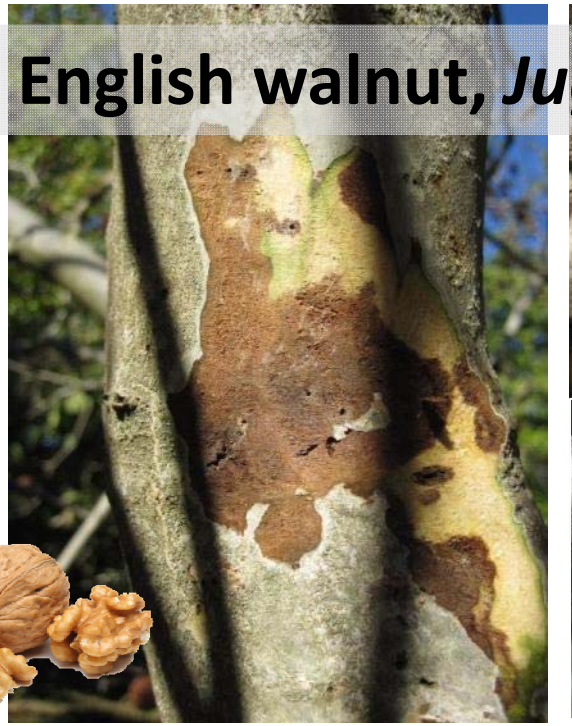
Dying *Juglans hindsii (northern CA black walnut)* trees outside Davis, CA in 2008

Photos by Steve Seybold and Andy Graves

R. Bostock

R. Bostock

TCD in English walnut, *Juglans regia*



Pityophthorus juglandis walnut twig beetle (WTB)

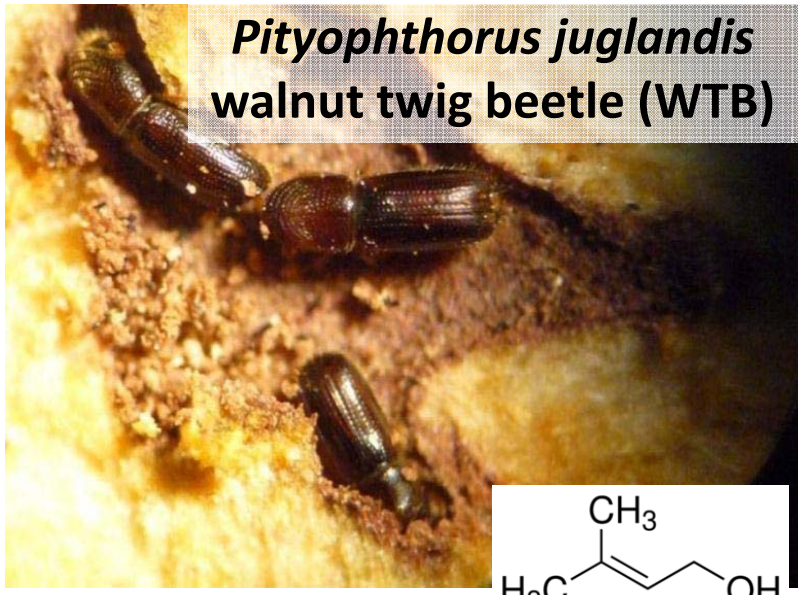
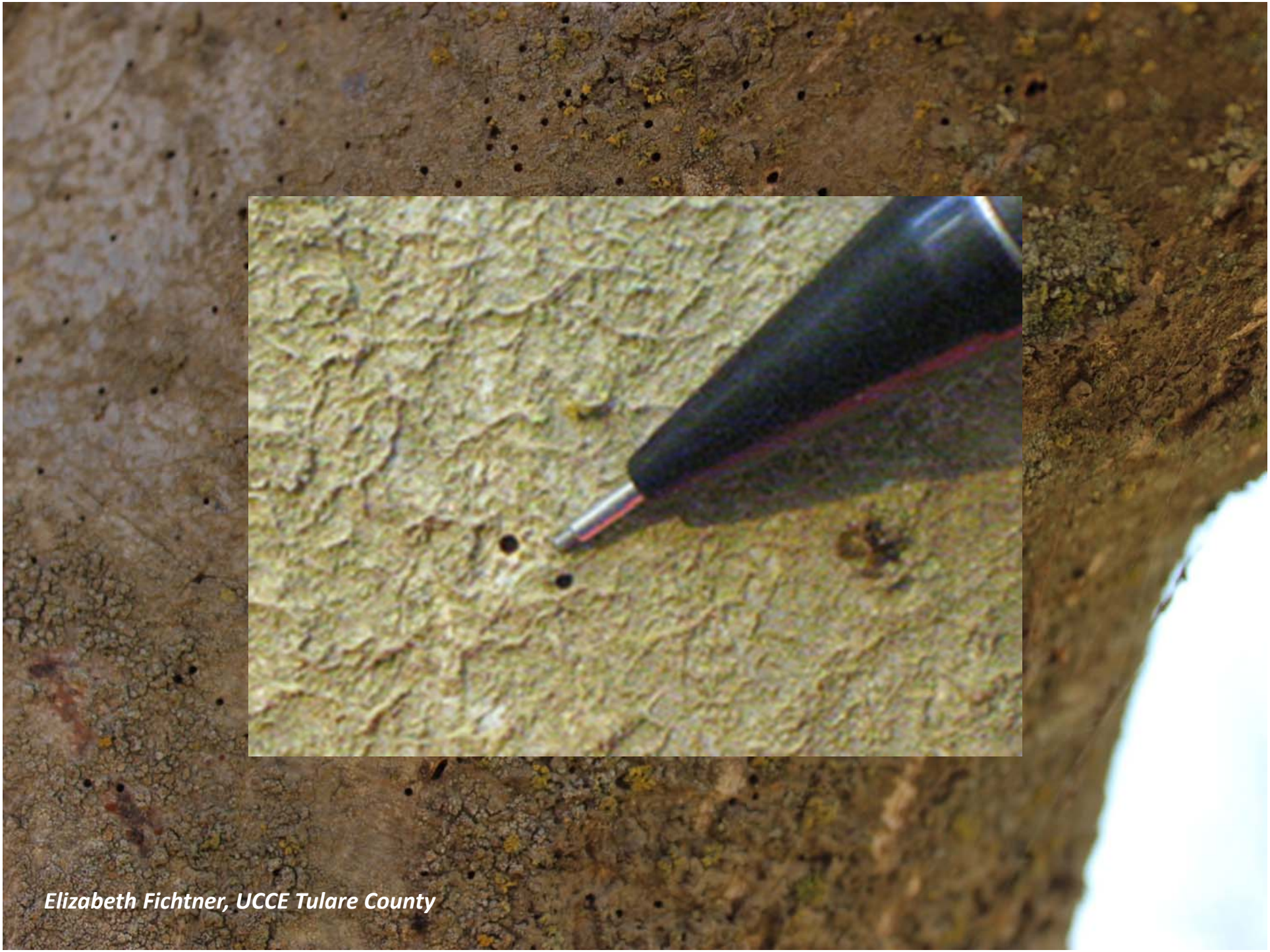


Photo by S. Seybold

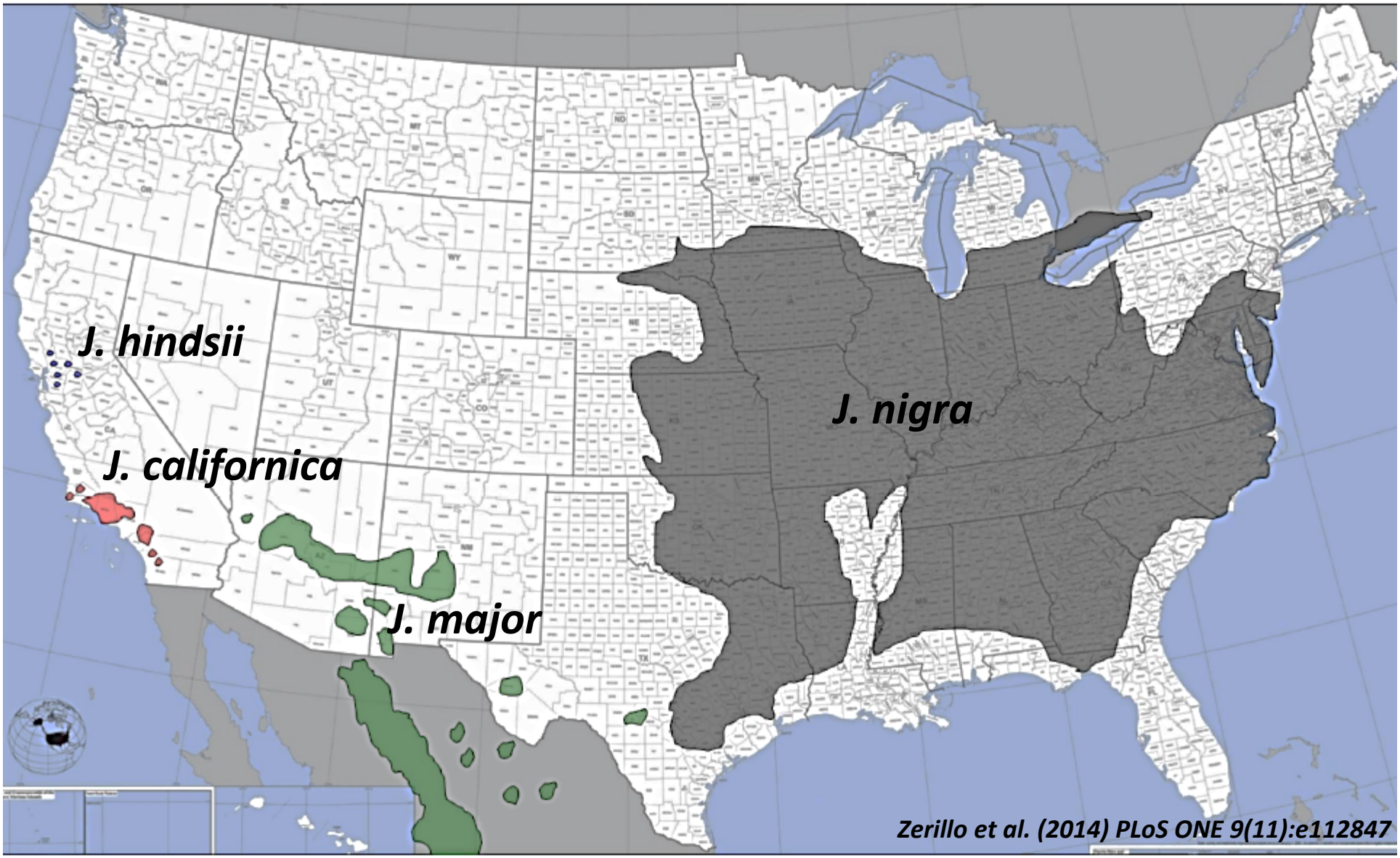


Elizabeth Fichtner, UCCE Tulare County

J. regia cv. Chandler
Tulare County

Elizabeth Fichtner, UCCE Tulare County

Natural distribution of some native *Juglans* species in the USA



Comparative TCD Symptoms

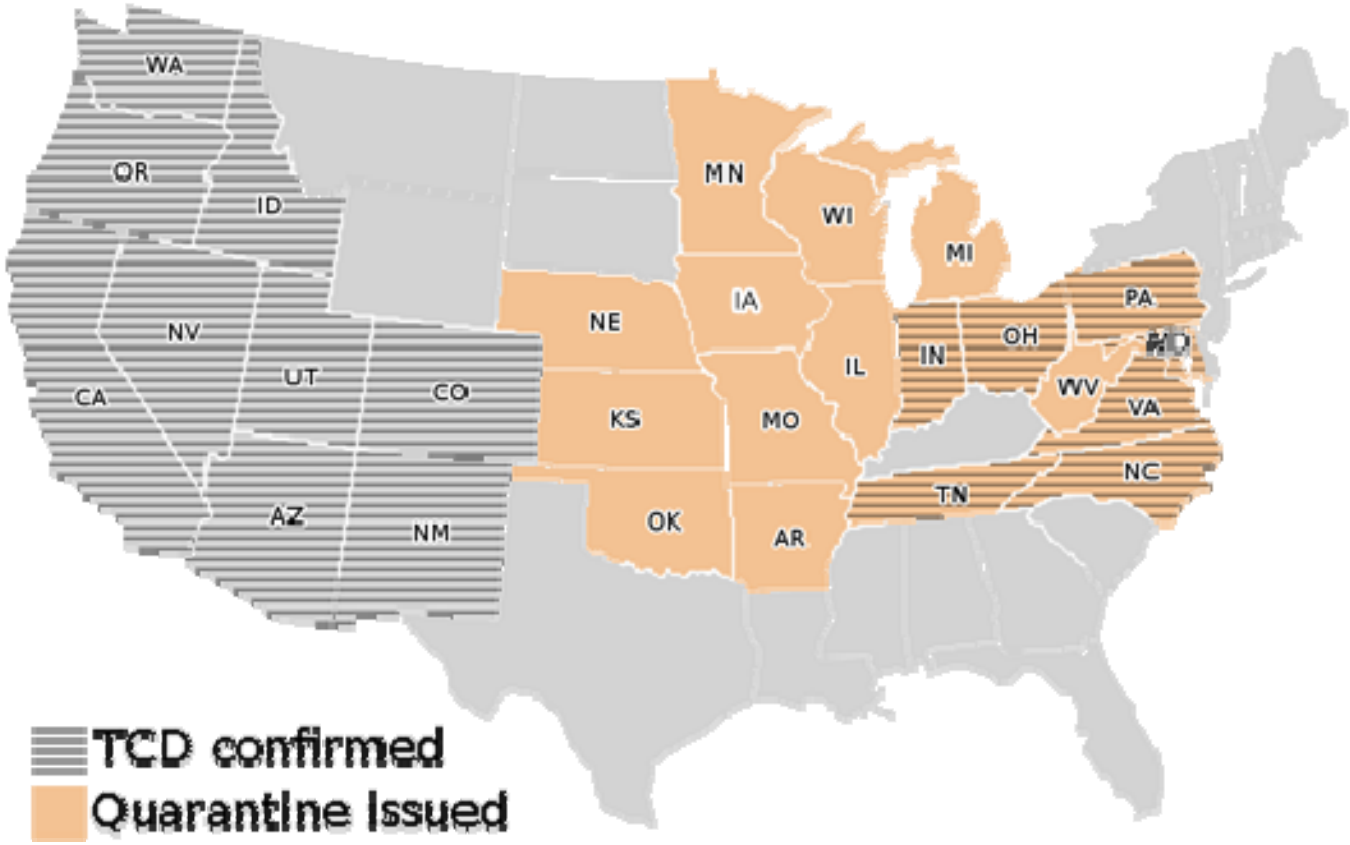
Juglans major
(southern NM)

Sporadic cankers, minimal staining on bark surface

Juglans californica
(in northern CA)

Numerous cankers, prolific staining on bark surface

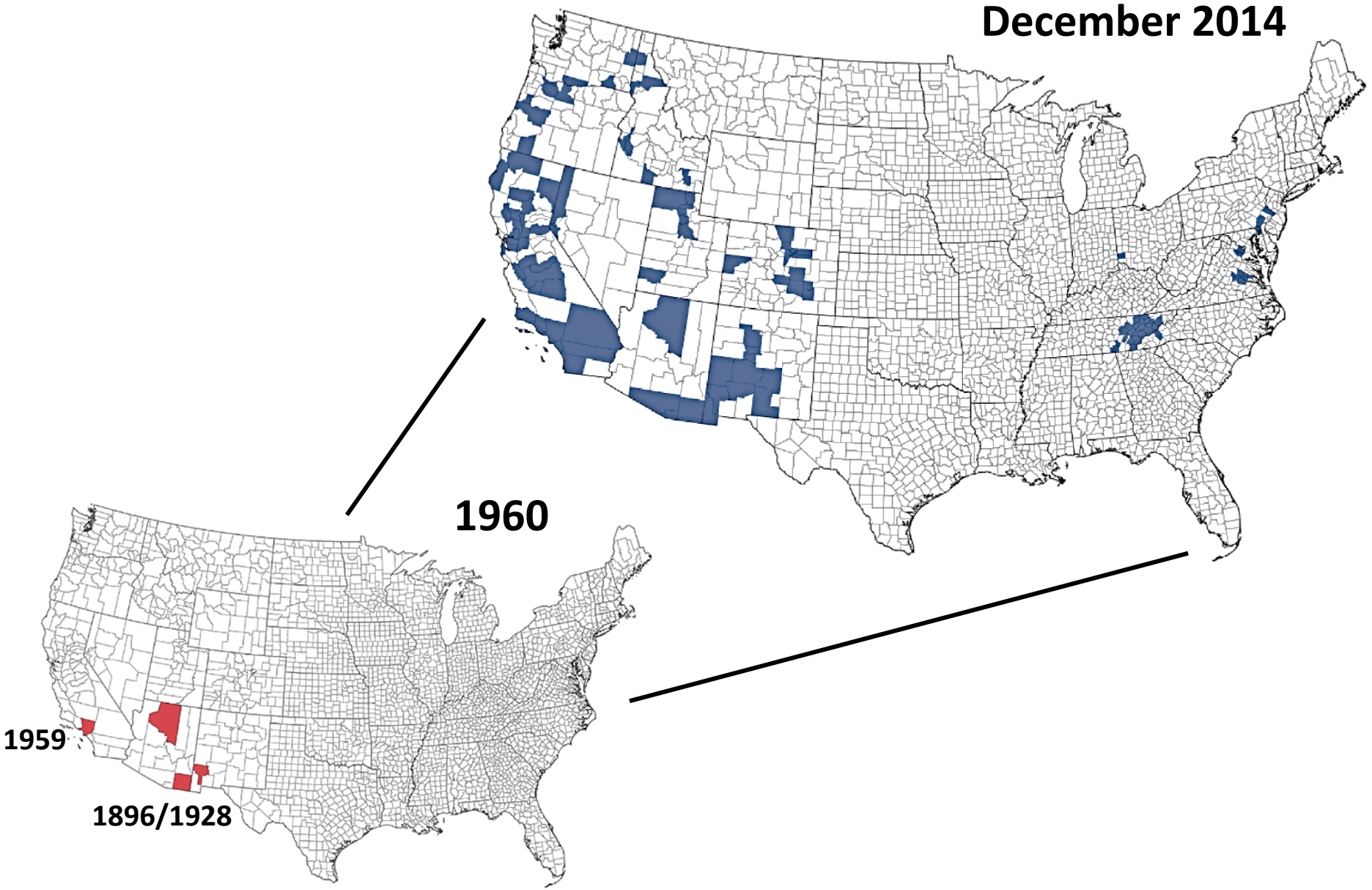
Distribution of TCD in the United States
October, 2015



Also present in English walnut in Italy; interceptions in China!

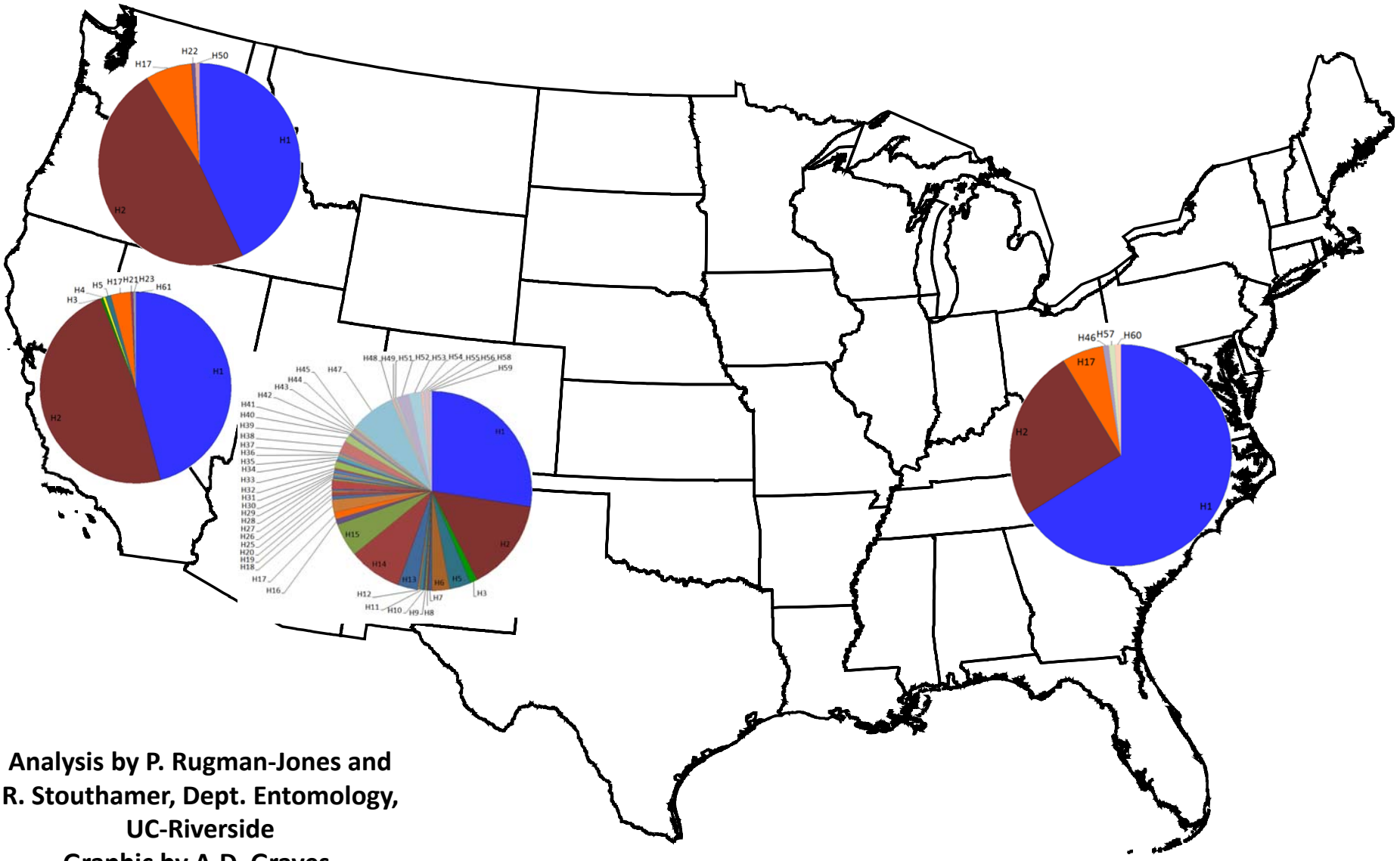
http://www.thousandcankers.com/quarantines.php

WTB distribution in the USA



from Rugman-Jones et al. (2015) PLoS ONE 10(2):e0118264

Genetic analyses of WTB mitochondrial haplotypes suggest migrations from southwest U.S. to other regions



Analysis by P. Rugman-Jones and R. Stouthamer, Dept. Entomology, UC-Riverside
Graphic by A.D. Graves, USDA FS FHP, Albuquerque

Phylogram

Rugman-Jones et al. (2015) PLoS ONE 10(2):e0118264

WTB range expansion and spread of TCD?

Zerillo et al. (2014) PLoS ONE 9(11):e112847
Rugman-Jones et al. (2015) PLoS ONE 10(2):e0118264

Juglans National Clonal Germplasm Collection

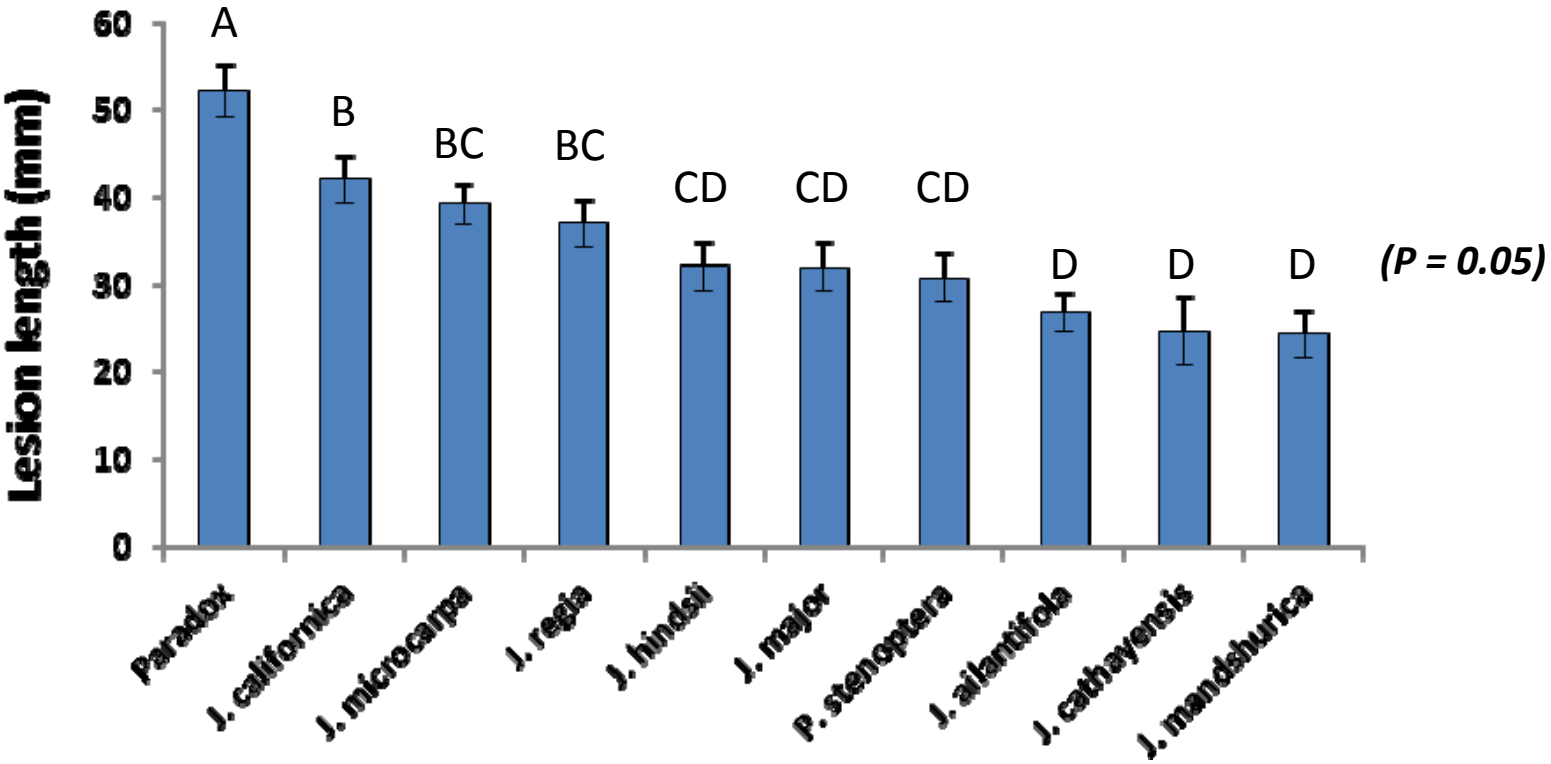
USDA/ARS NCGR – Winters, CA

J. ailantifolia
J. australis
J. californica
J. cathayensis
J. hindsii
J. major
J. mandshurica

J. microcarpa
J. mollis
J. neotropica
J. nigra
J. olanchana
J. regia
J. sinensis
J. hindsii x J. regia (Paradox)

Most are developmental hosts for the WTB and can contract TCD

Juglans species show differences in susceptibility to *Geosmithia morbida*



TCD in Paradox rootstock, Tulare Count
slide courtesy Elizabeth Fichtner

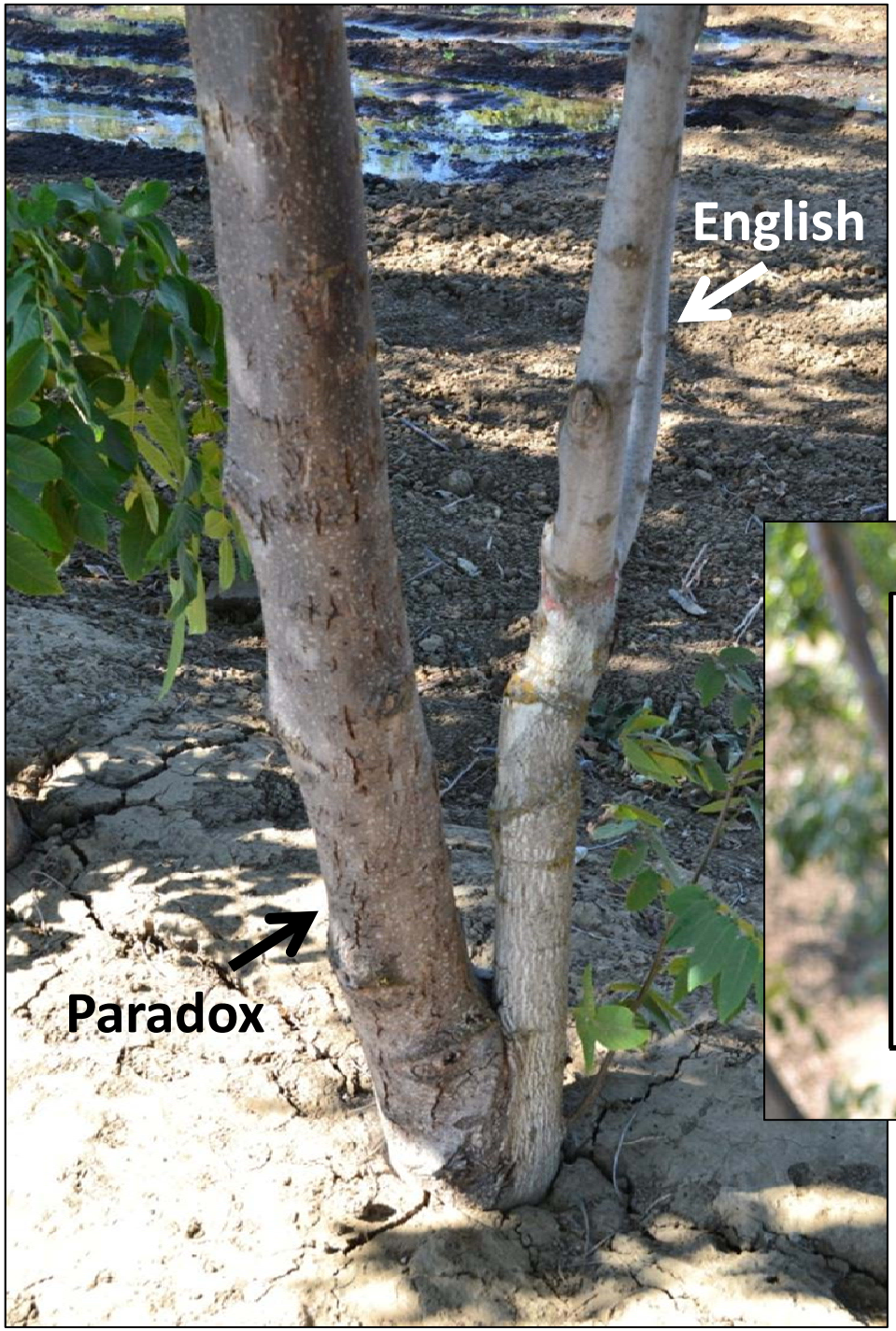
English scion

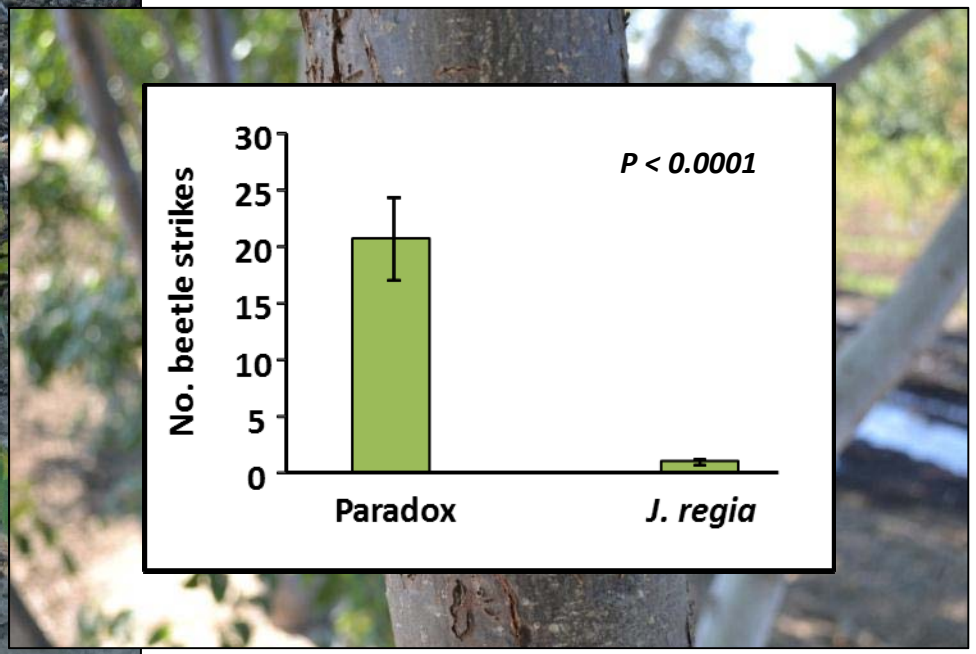
WTB appears to select Paradox over English

Paradox rootstock

Tulare County, CA 2013

WTB appears to select Paradox over English



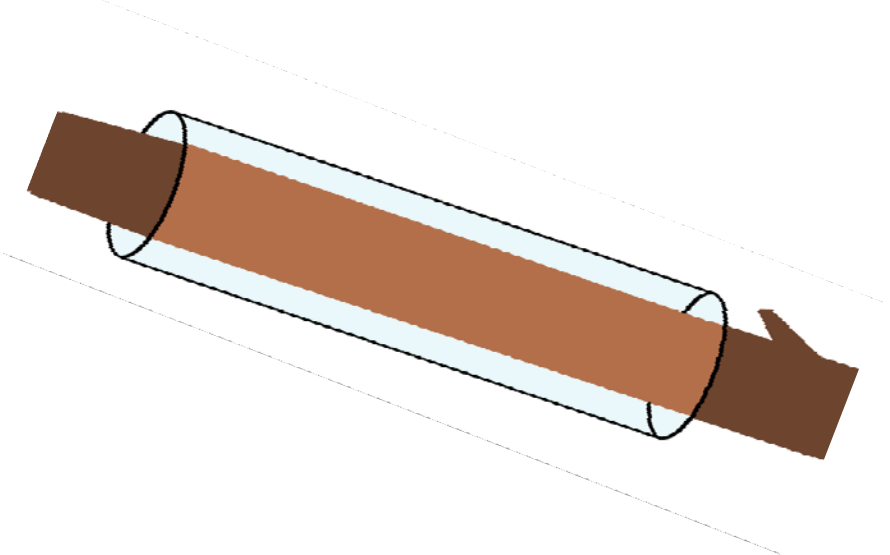


Armstrong Plant Pathology Research Station
UC Davis

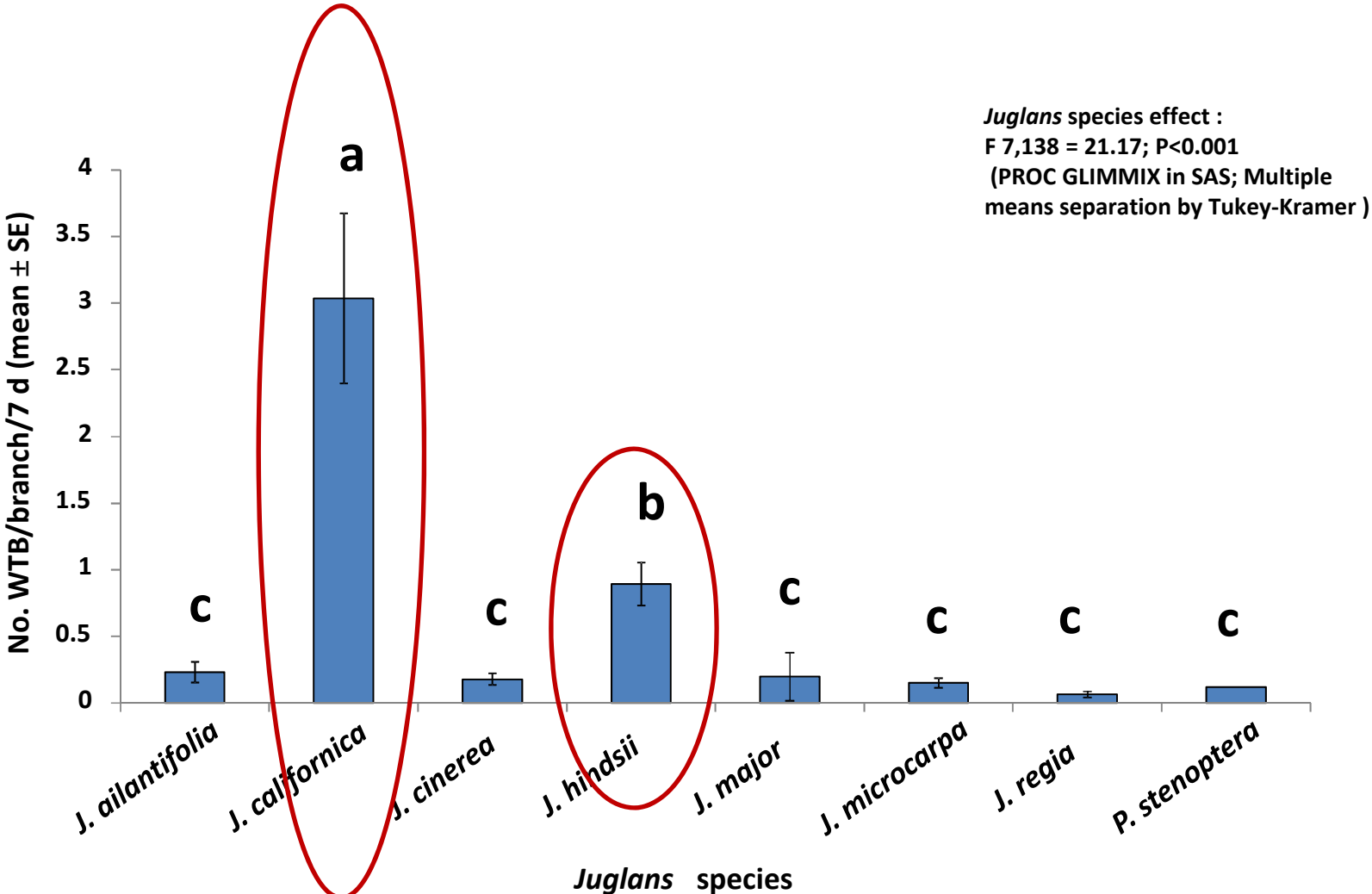
Unbaited live branch studies
NCGR – Winters, CA
2012-2013

uglans ailantifolia, *J. californica*, *J. cinerea*, *J. hindsii*, *J. major*, *J. microcarpa*, *J. regia, and Pterocarya stenoptera*

rees of each species, 1 uninfested branch/tree

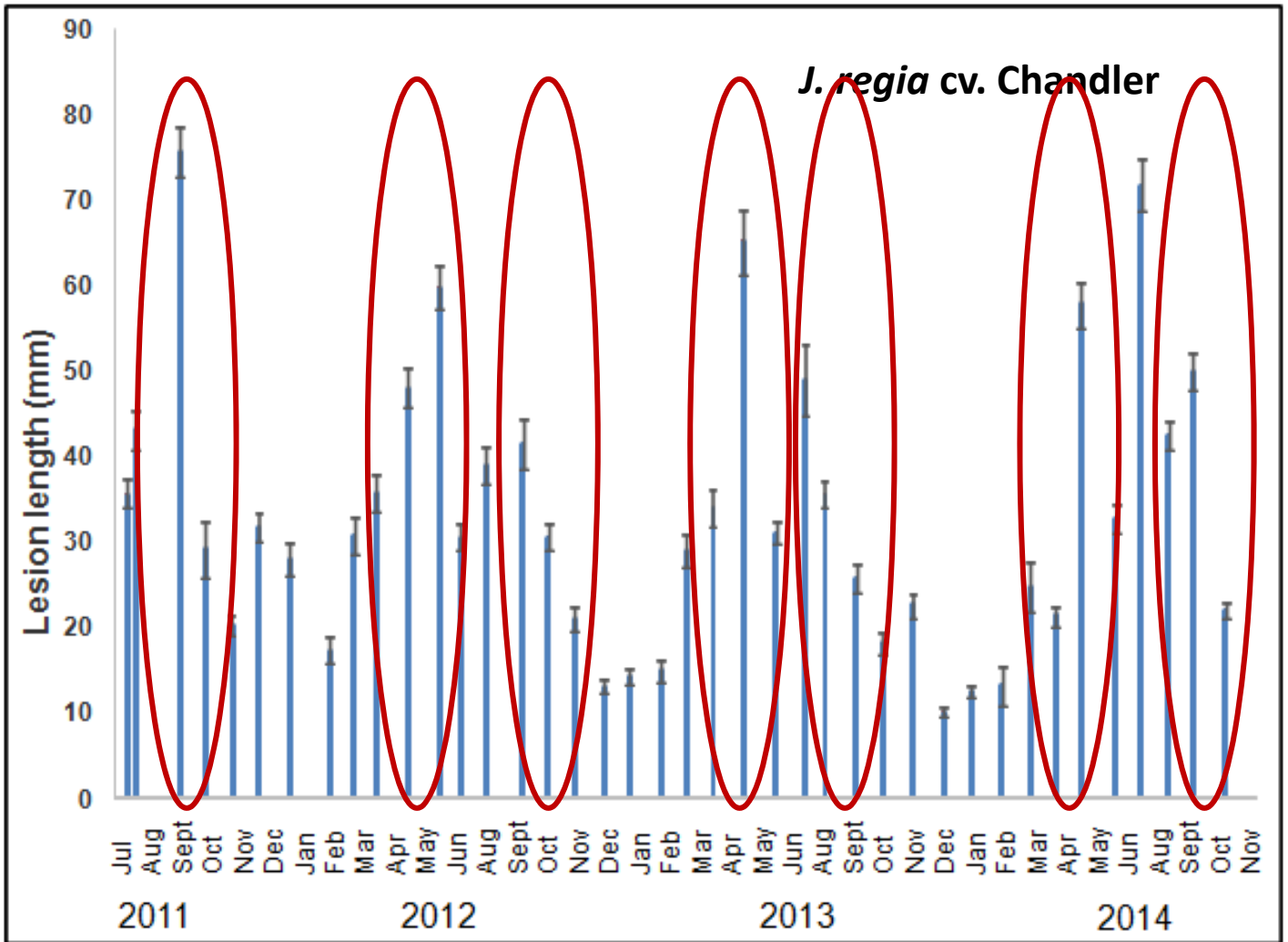


Landing rate of WTB on branches of six species of *Juglans* and one *Pterocarya* species (2013)

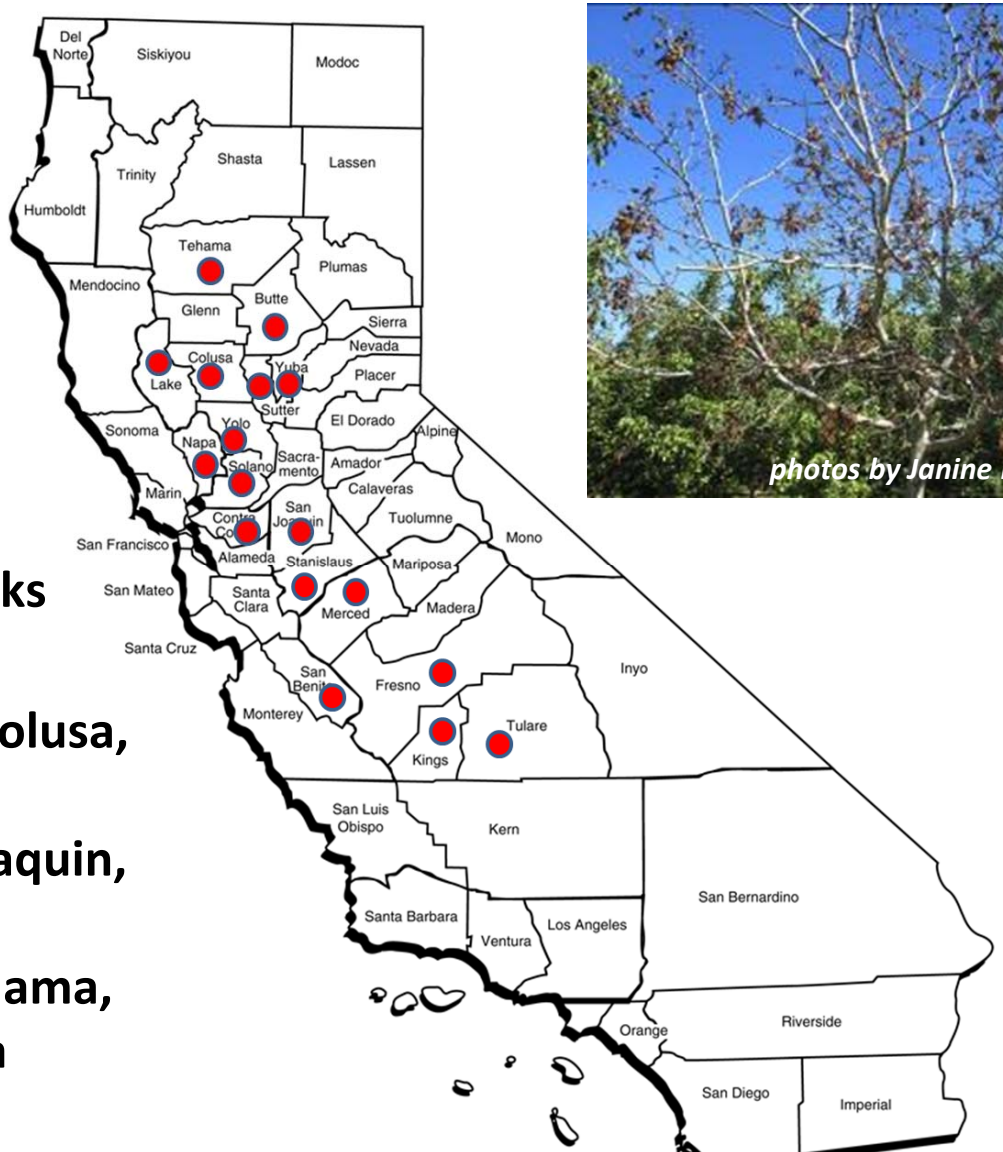


asonal variation in English walnut susceptibility to *G. morbida*

k periods of beetle flights (May-July & Sept-Oct) and host susceptibility may overlap in spring and summer



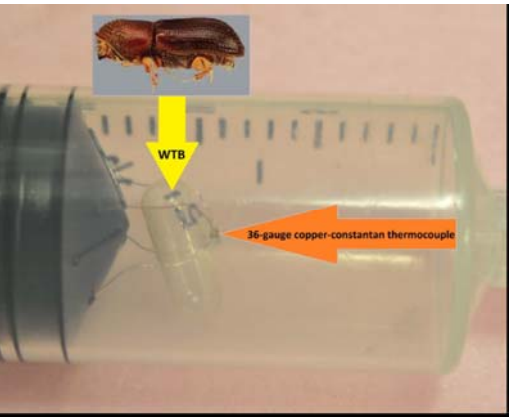
TCD Status in California English Walnuts



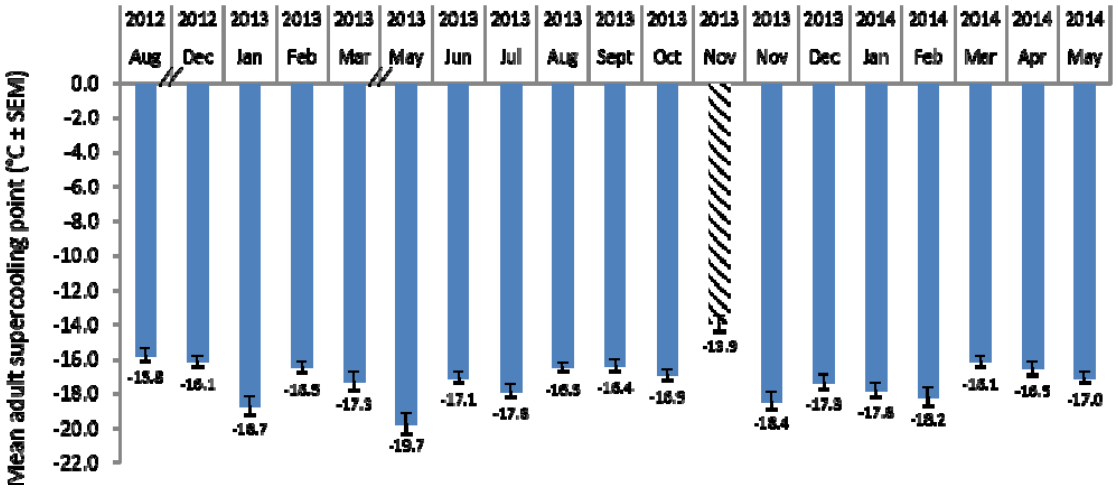
irmed TCD in rootstocks English scions in:

Butte, Contra Costa, Colusa, Fresno, Kings, Lake, Merced, Napa, San Joaquin, San Benito, Solano, Stanislaus, Sutter, Tehama, Tulare, Yolo, and Yuba counties

WTB Cold Tolerance



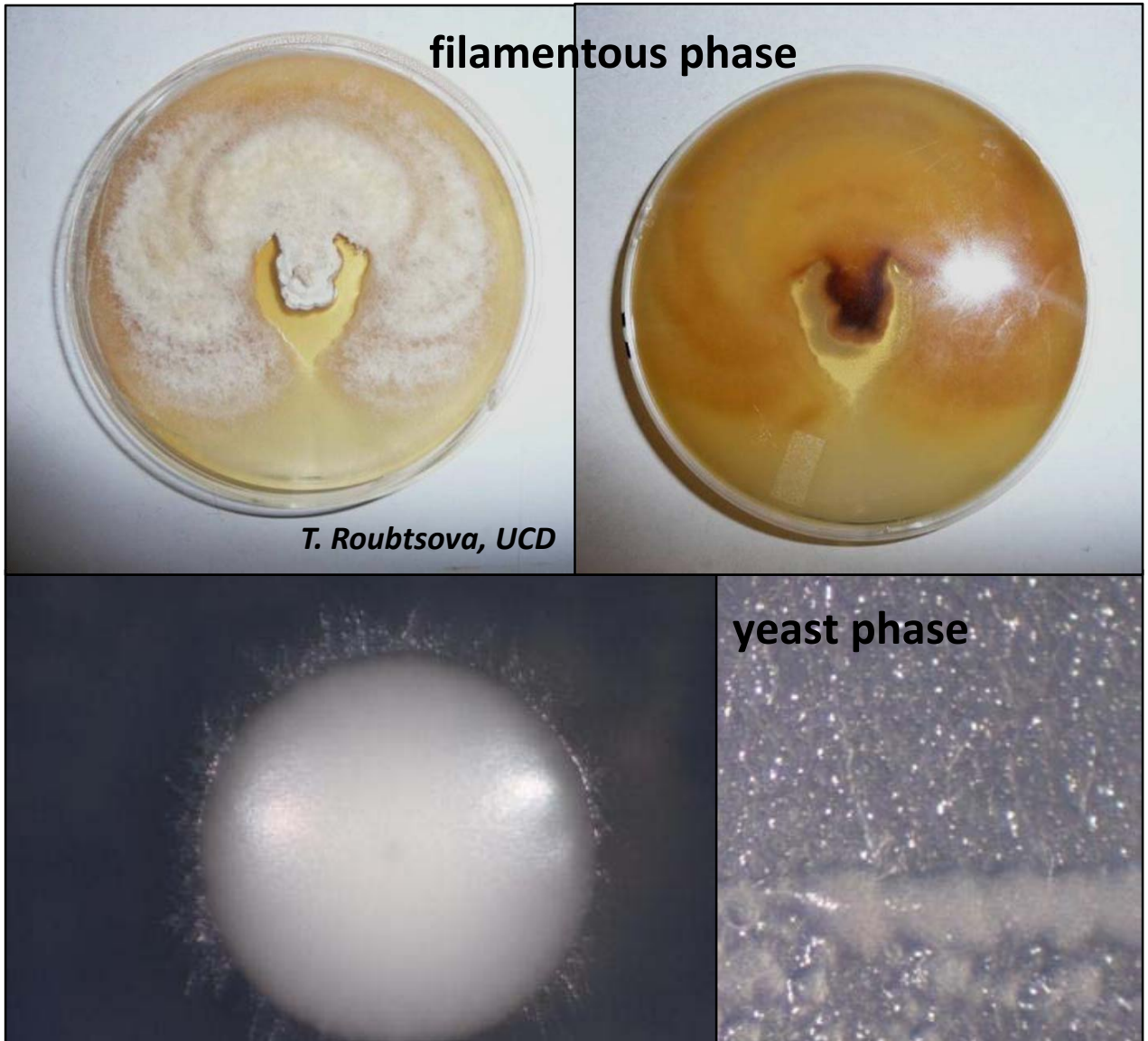
Contact thermocouple-thermometry



Changes in the mean supercooling point of WTB adults from Sutter Co., CA by month. Bars with crosshatching designate individuals from Orofino, ID (Andrea Hefty et al., unpublished data, Univ. of Minnesota, Ph.D. Thesis Data)

Geosmithia morbida – a new species 2011

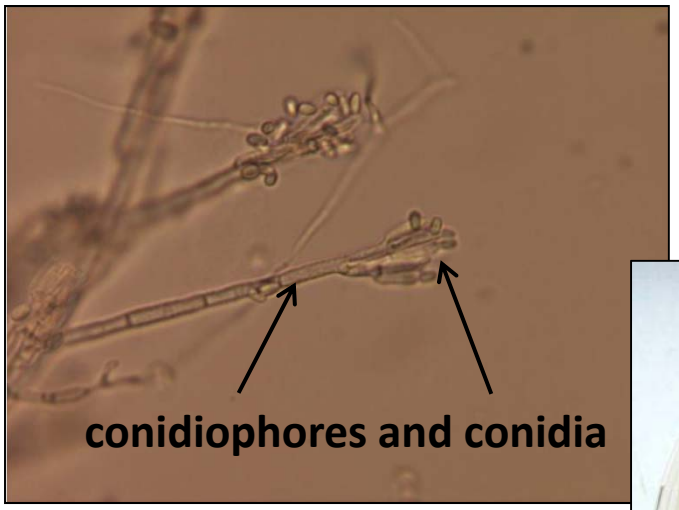
Kolarik M. et al. (2011) Mycologia 103:325



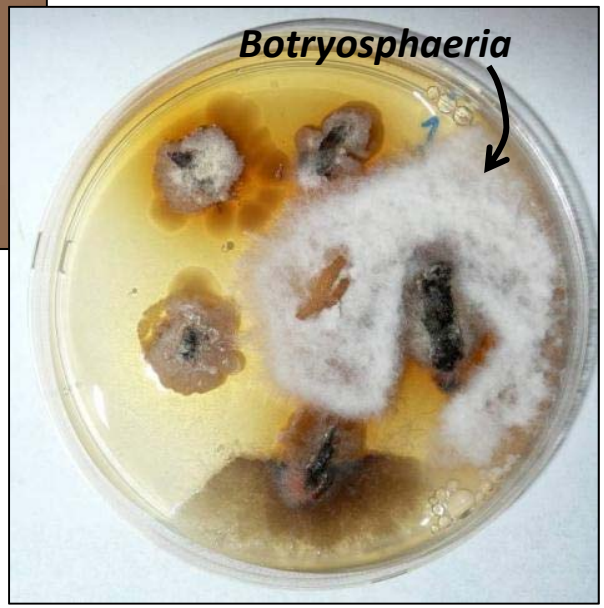
Removal of outer
bark tissue reveals
galleries and canker

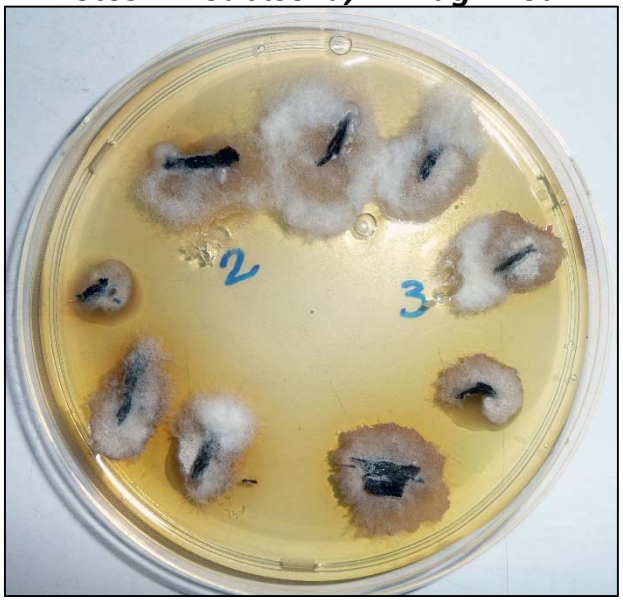
Geosmithia morbida – isolation on A-PDA

Photos T. Roubtsova, M. Yaghmour



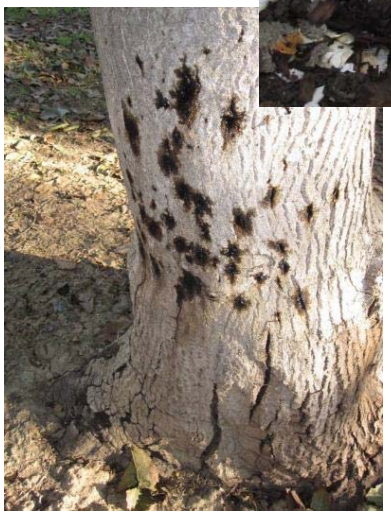
Sometimes find other canker fungi in disease samples also – can be tricky.





Several canker diseases impact CA walnuts
Challenge for field surveys and diagnostics

deep bark canker
(*Brennaria rubifaciens*)



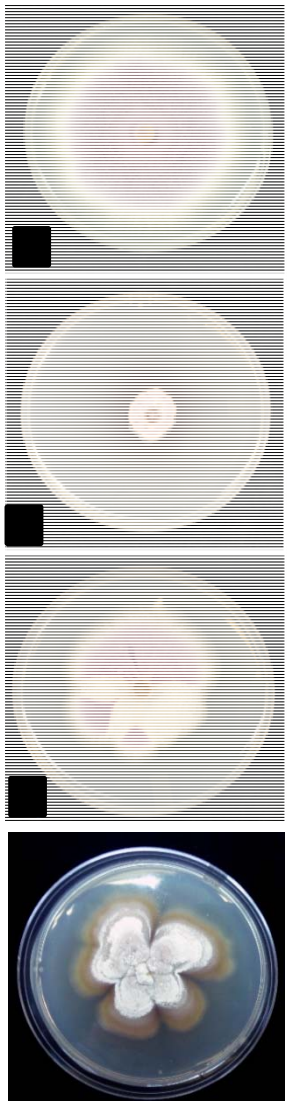
?

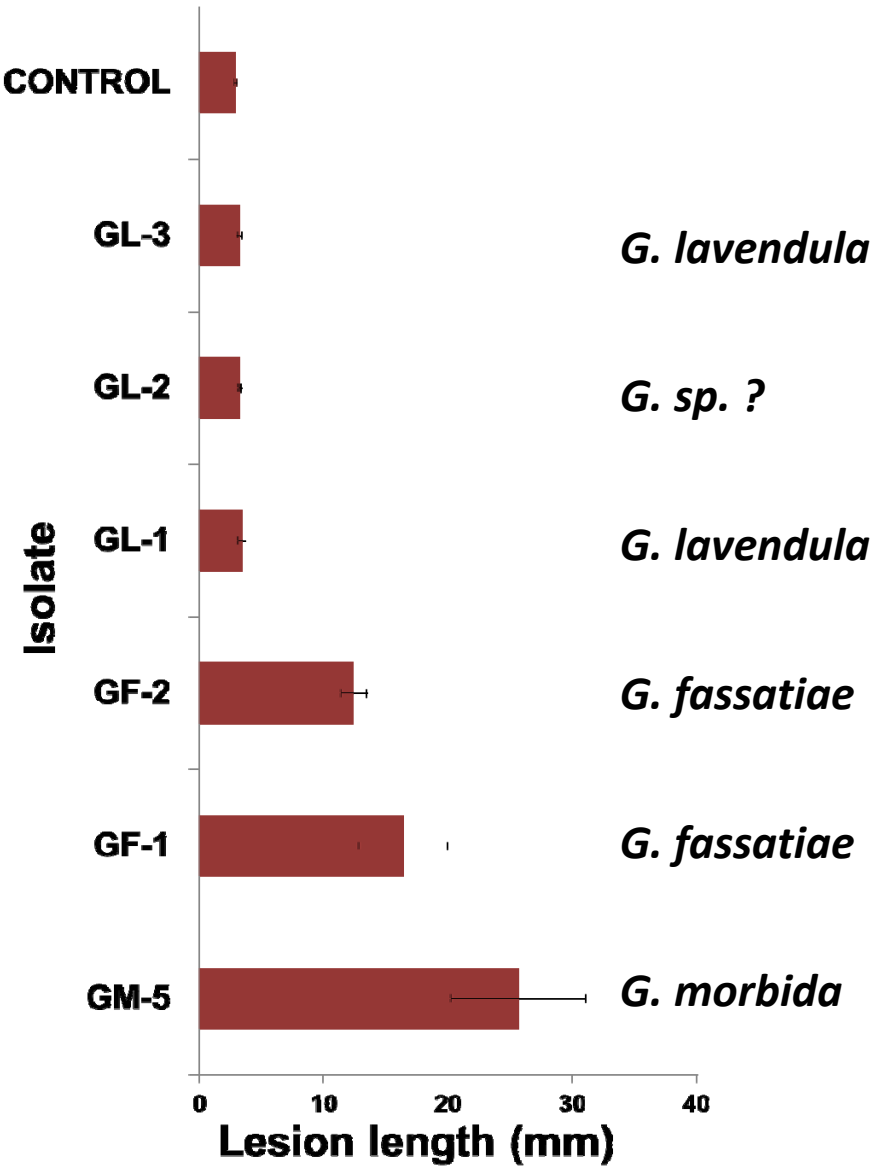
lethal paradox disease

shallow bark canker
(*Brennaria nigrifluens*)

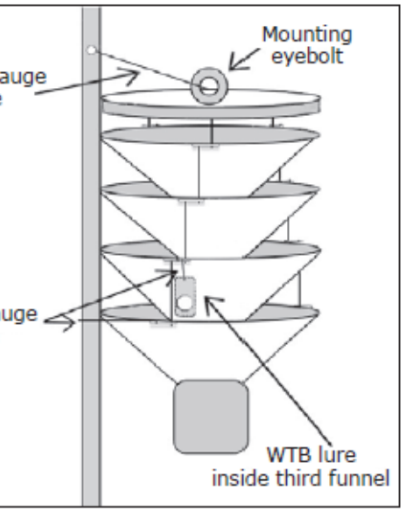
shallow bark canker and TCD
→ dying trees

Several *Geosmithia* species are associated with the WTB



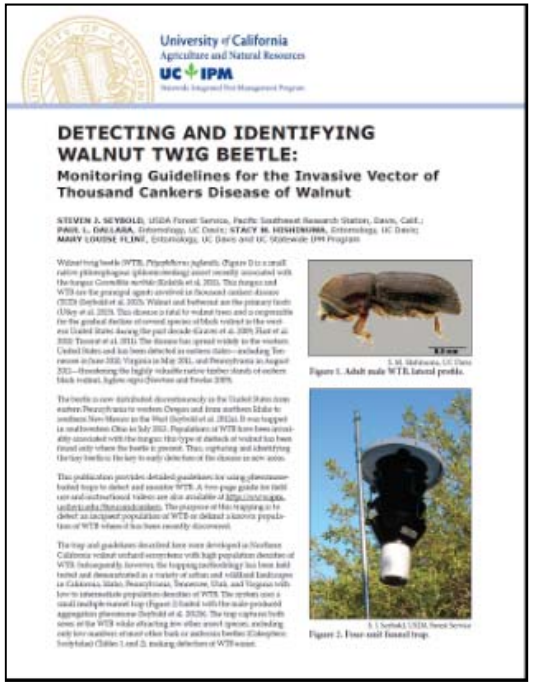


Funnel Traps for Capturing Walnut Twig Beetle



J. A. King, UC Davis

**. Schematic of a four-unit funnel
owing the attachment between the
and pole with heavy-gauge wire,
ent and placement of the lure,
chment of the lowest funnel strut
ole with light-gauge wire.**



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Agriculture and Natural Resources
UC IPM

DETECTING AND IDENTIFYING WALNUT TWIG BEETLE:

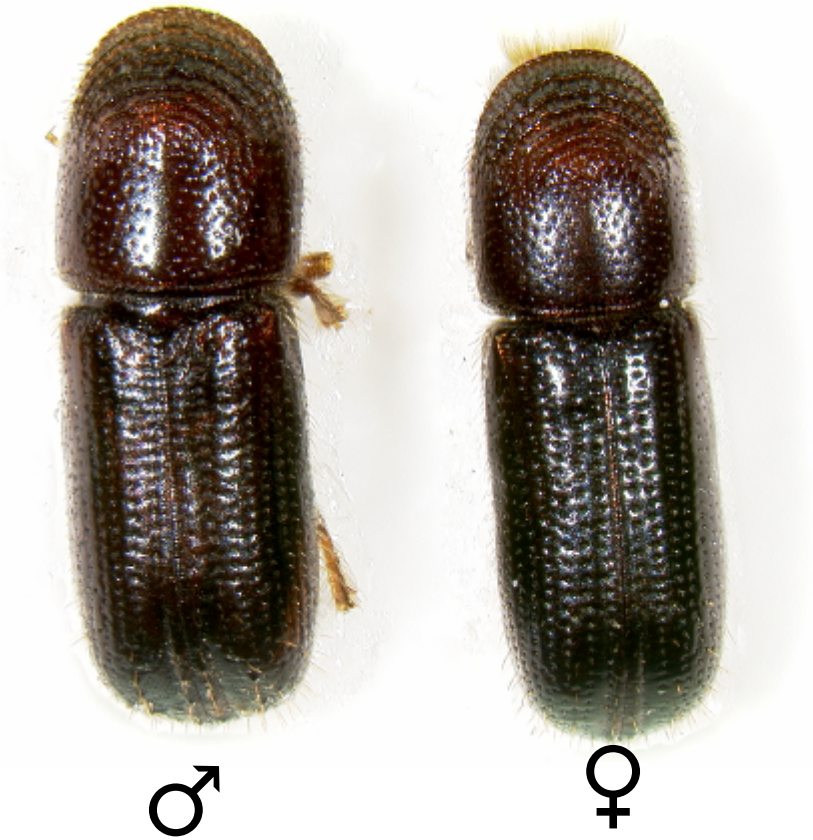
Monitoring Guidelines for the Invasive Vector of Thousand Cankers Disease of Walnut

old *et al.* (2013) WTB Trapping and I.d. Guidelines, UC-IPM
//www.ipm.ucdavis.edu/PMG/menu.thousandcankers.html

Walnut Twig Beetle
Pityophthorus juglandis

WTB

0.5 mm

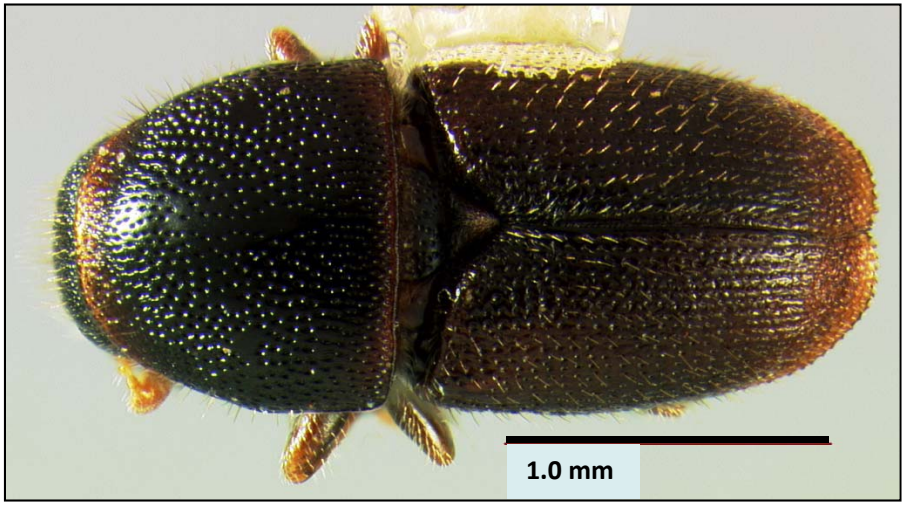


♂ ♀

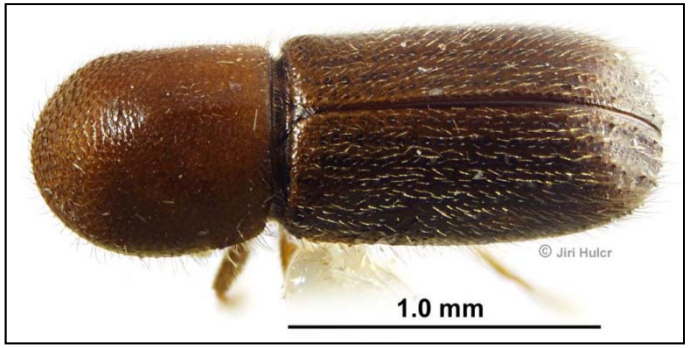
An ambrosia beetle,
Xyleborinus saxeseni

Other taxa in walnut orchards

ypothenemus eruditus
bark beetle



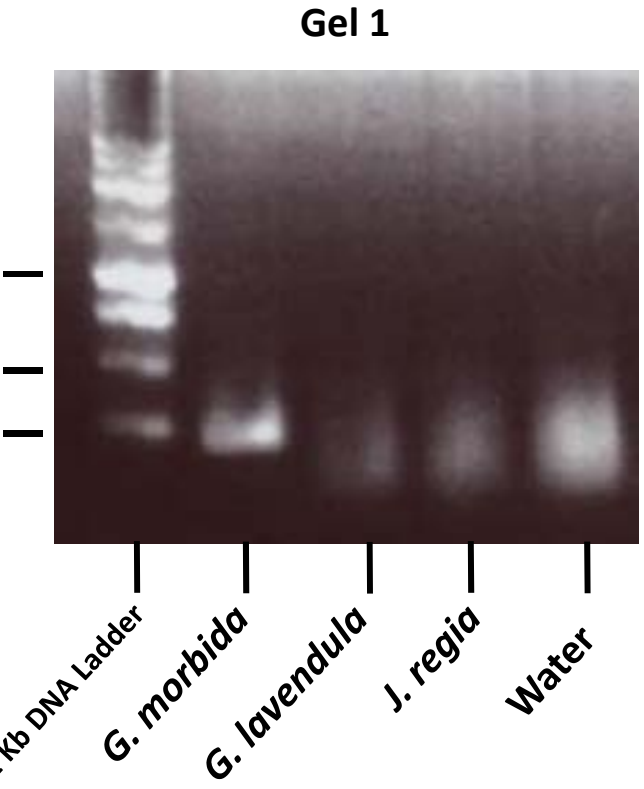
Scolytus rugulosus
shot-hole borer

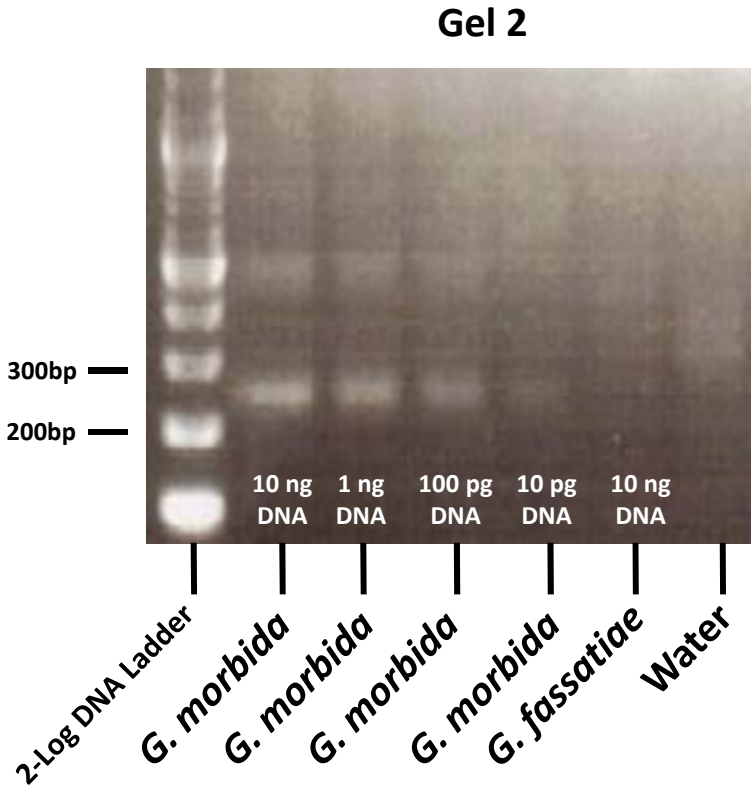


Cyclorhipidion bodoanum

Recombinase Polymerase Amplification (RPA) Assay

Specific detection of *G. morbida* with 10 picogram DNA sensitivity!





se gel electrophoresis of amplicon using *Geosmithia morbida*-specific *EF-1α* primers

EF-1α primer specificity for *Geosmithia morbida* over *G. lavendula*, *G. fassatiae*, and *J. regia*

Mil Ulceras Enfermedad de Nogales

Una Enfermedad nueva en California

Por Ricardo Hoenisch, Departamento de Fitopatología, UC Davis

cdfa NPDN UCDAVIS

Mil Ulceras de Nogales
el género botánico *Juglans*

TCD management and future directions

Fungicides? Insecticides? Unlikely

Sanitation to mitigate spread – removal of dead and severely declining trees; grind or burn immediately.
http://www.ipm.ucdavis.edu/EXOTIC/thousandcankers.html

Do not transport/ship infested walnut material, especially where this is prohibited by state quarantines.

Need to keep beetles from landing on trees:

- ✓ host selection behavior and chemistry of attraction/repulsion
- ✓ host and pathogen VOC's as coattractants with pheromone

Improved diagnostic tools

Acknowledgements

o-PI: Dr. Steven Seybold, USDA Forest Service and Dept. of Entomology and Nematology, UC Davis

C Davis and UCCE

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