Holy Guacamole! Insights into the laurel wilt pandemic

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Ambrosia beetles are typically *harmless*

But, some are causing mass tree mortality

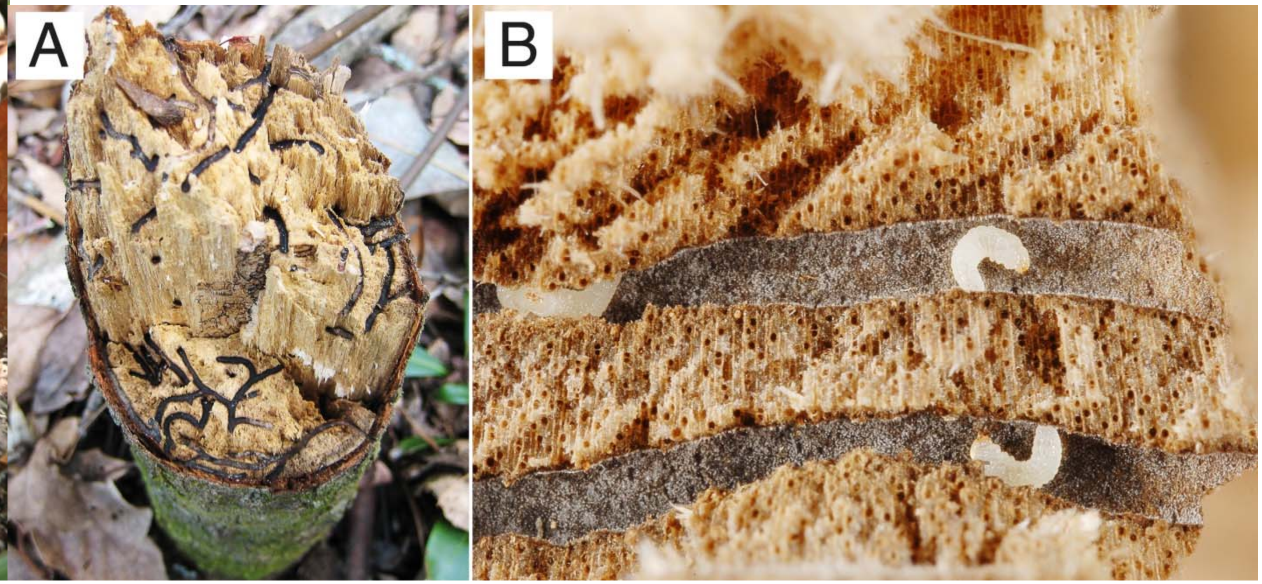
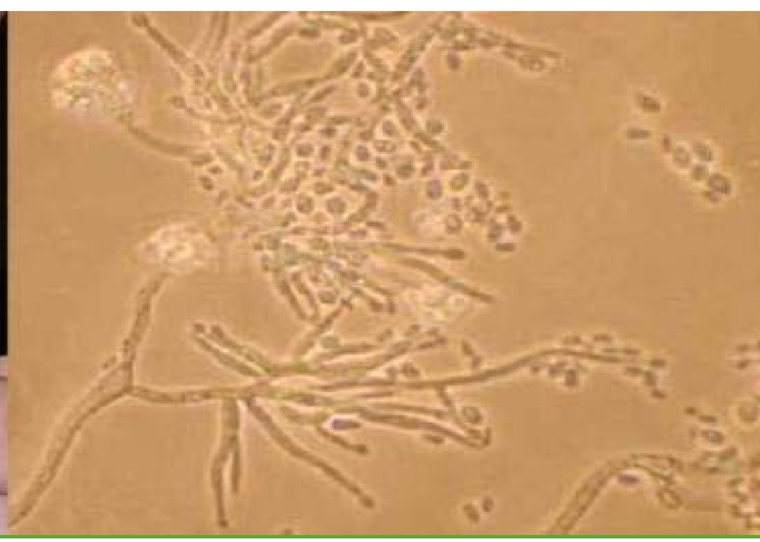



Photo: Chip Bates

Xyleborus glabratus – redbay ambrosia beetle

Clonal symbiosis!

Raffaelea lauricola - Ophiostomatales



e-**X**tra*

Development of Multilocus PCR Assays for *Raffaelea lauricola*, Causal Agent of Laurel Wilt Disease

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NPDN
National Plant Diagnostic Network

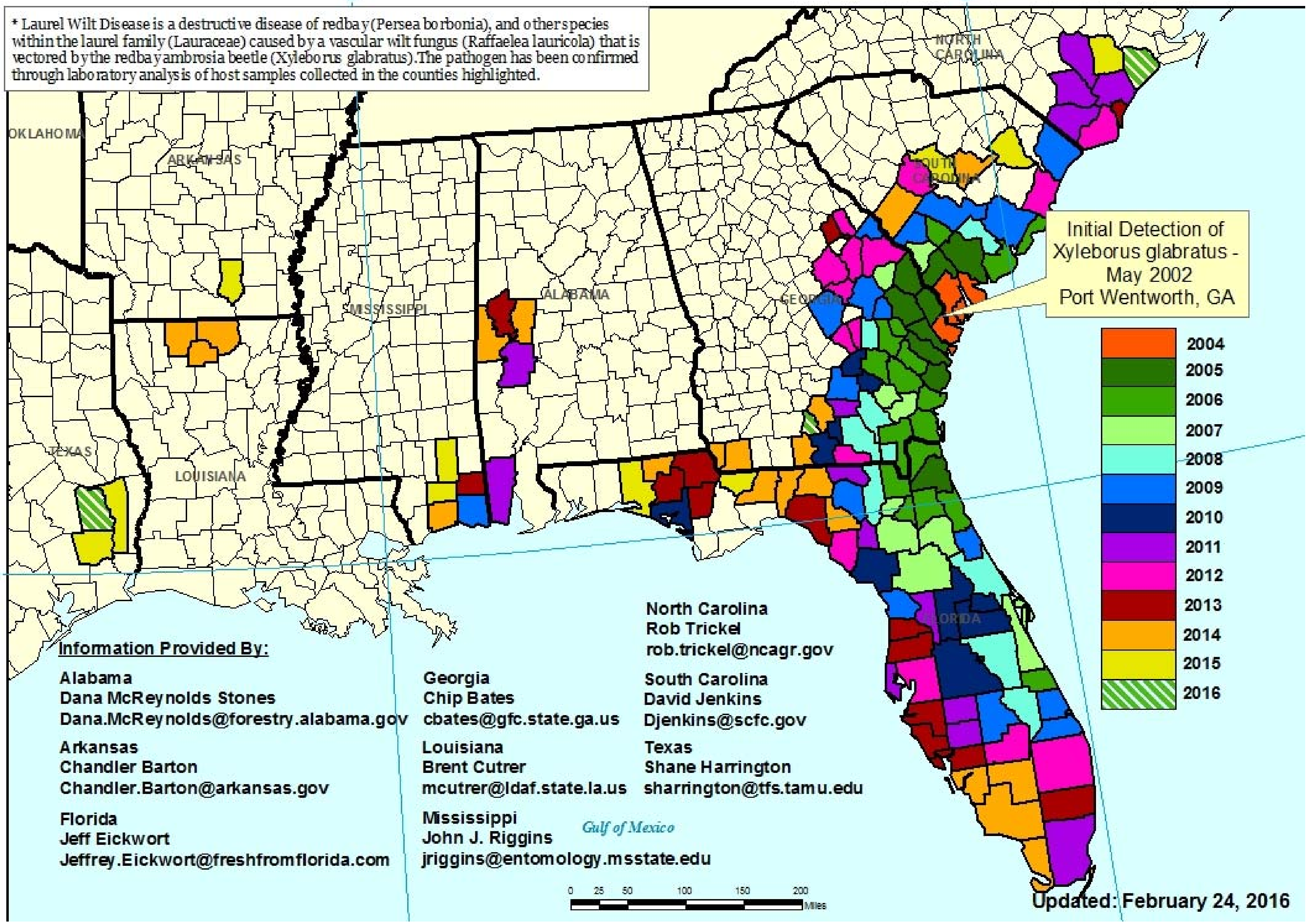
National Plant Diagnostic Network

Standard Operating Procedure for Plant Diagnostic Laboratories

Laurel Wilt and the Redbay Ambrosia Beetle
Raffaelea lauricola
and its vector, *Xyleborus glabratus*

CSREES
EDUCATION · RESEARCH · EXTENSION
USDA

Distribution of Counties with Laurel Wilt Disease* by year of Initial Detection



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Updated: February 24, 2016

Known hosts in the USA

Persea borbonia - Redbay

Persea palustris – Swamp bay

Persea humilis - Silkbay

Persea americana - Avocado

*Persea indica**

Cinnamomum camphora - Camphortree

Sassafras albidum - Sassafras

Umbellularia californica – California bay laurel*

Laurus nobilis – European bay laurel

Lindera benzoin - Northern spicebush*

Lindera melissifolia - Pondberry

Litsea aestivalis - Pondspice

*Licaria triandra** - Gulf licaria

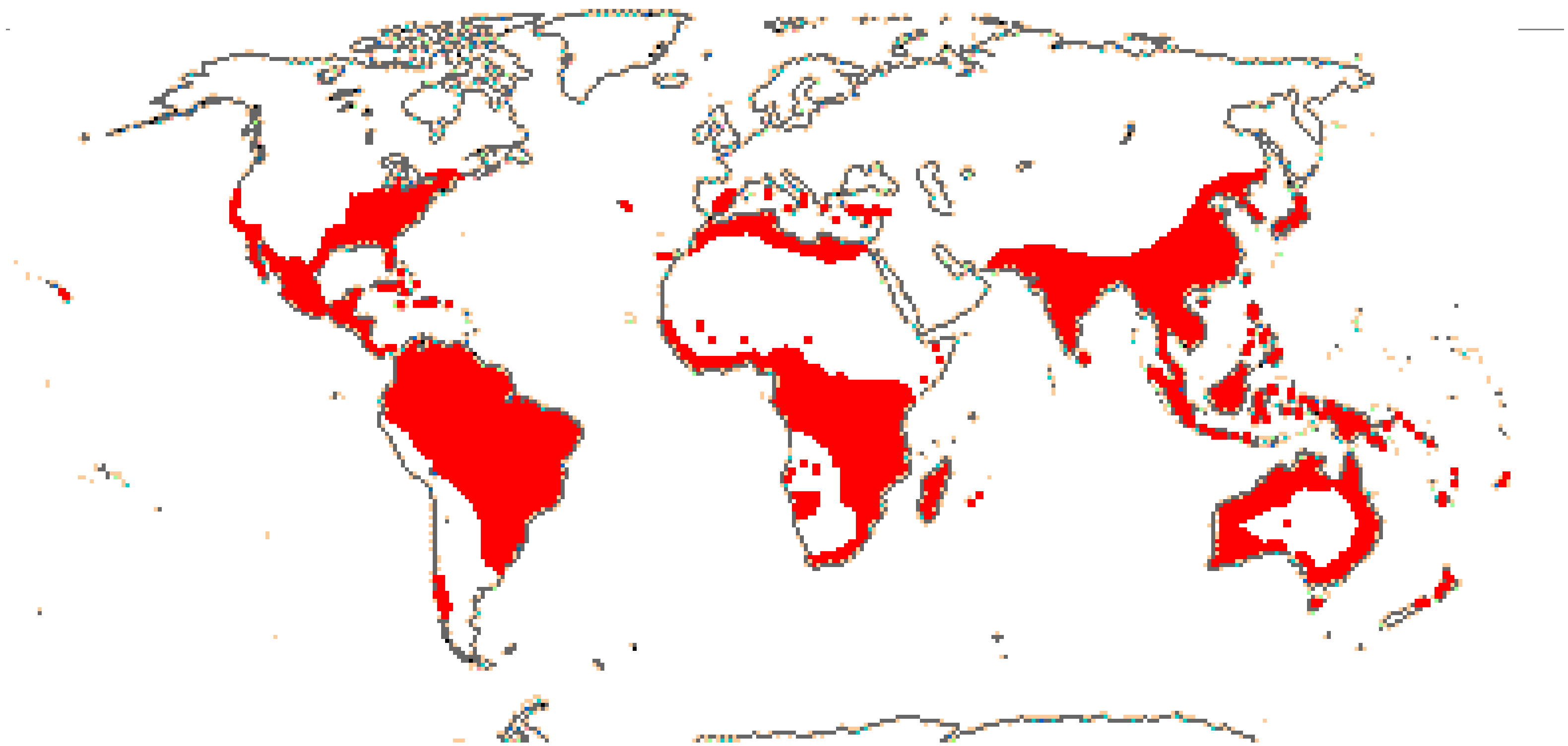
*Ocotea coriacea** - Lancewood

***Persea mexicana* – Mexican redbay**

* = Artificial inoculation

Many more hosts may remain!

Global Lauraceae Forests

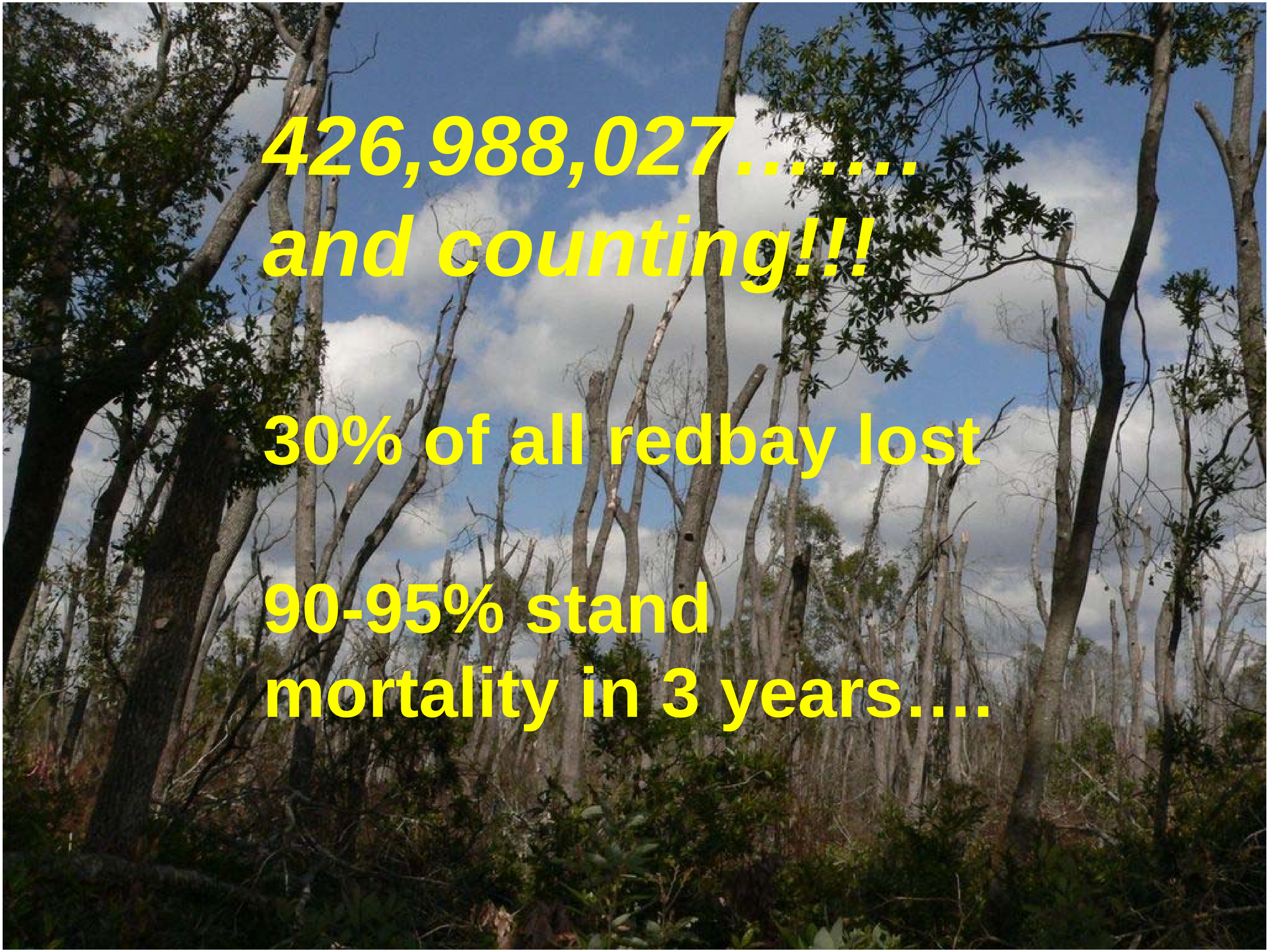


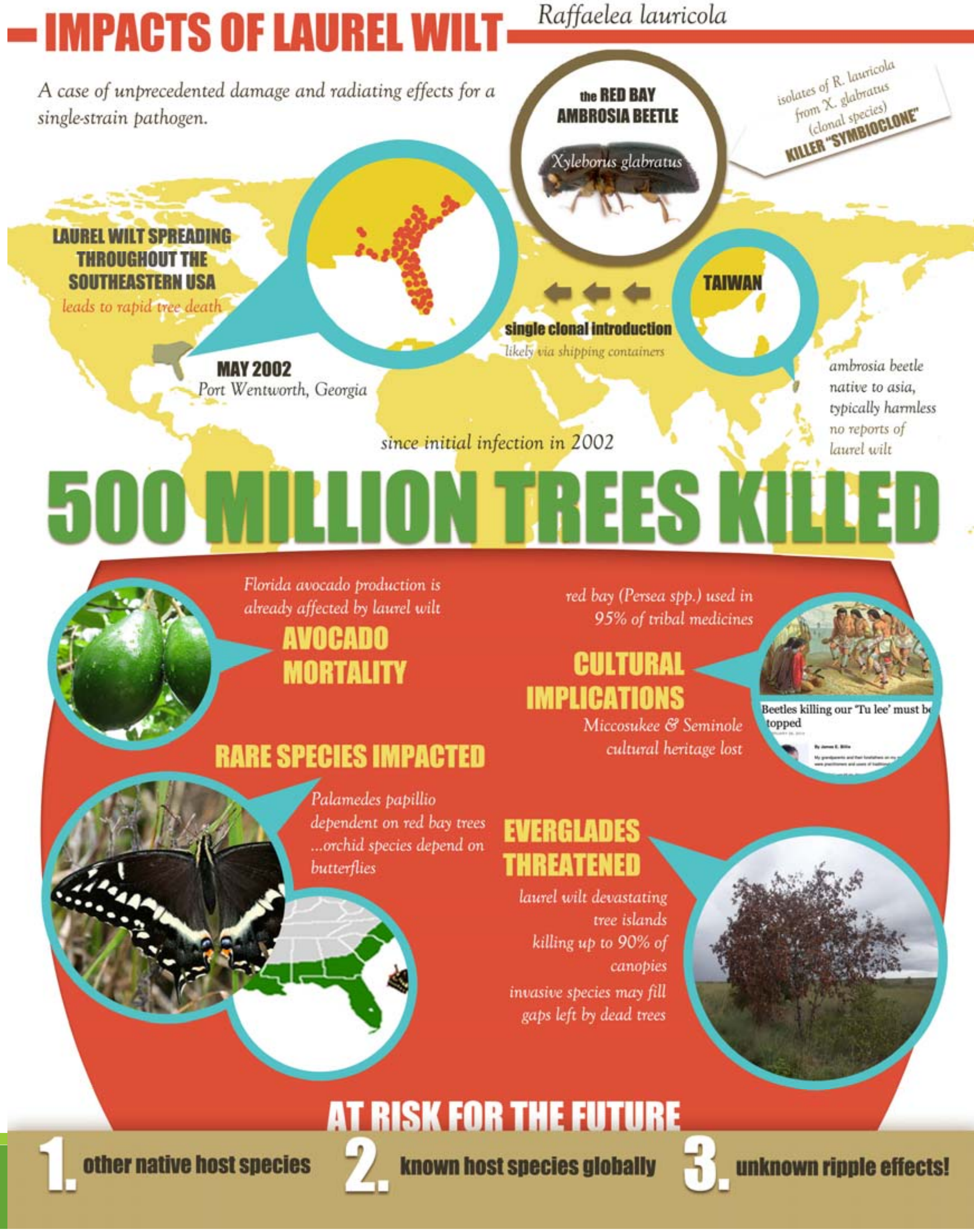
www.mobot.org

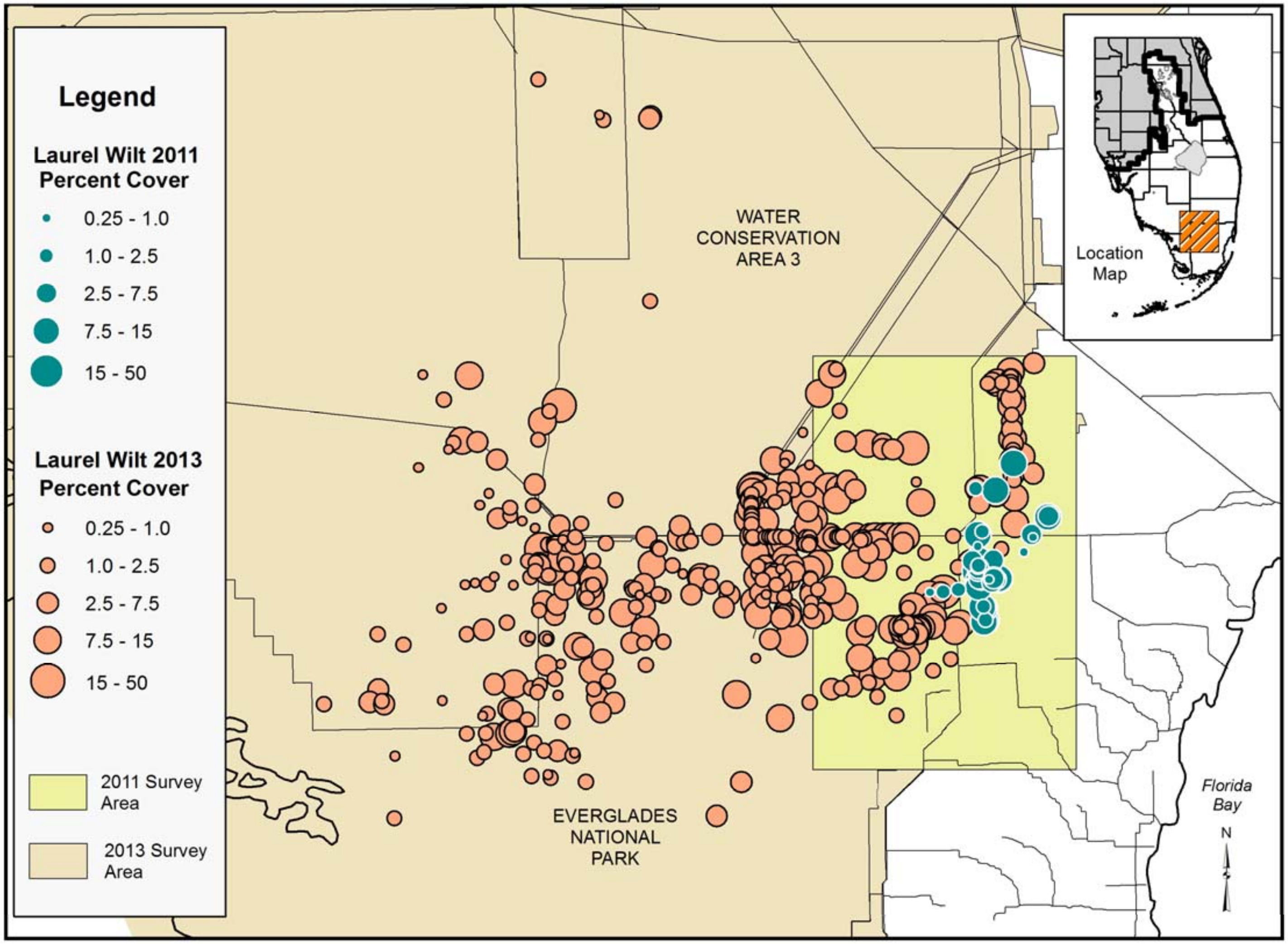
Lateral transfer to additional vectors

Transfer to at least 8 additional species complicates management and regulatory control.

Carrillo et al., 2014


426,988,027…….
and counting!!!
30% of all redbay lost
90-95% stand
mortality in 3 years….


IMPACTS OF LAUREL WILT
Raffaelea lauricola
A case of unprecedented damage and radiating effects for a single-strain pathogen.
the RED BAY AMBROSIA BEETLE
Xyleborus glabratus
isolates of R. lauricola from X. glabratus (clonal species)
KILLER "SYMBIOCLONE"
LAUREL WILT SPREADING THROUGHOUT THE SOUTHEASTERN USA
leads to rapid tree death
TAIWAN
single clonal introduction
likely via shipping containers
MAY 2002
Port Wentworth, Georgia
ambrosia beetle native to asia, typically harmless
no reports of laurel wilt
since initial infection in 2002
500 MILLION TREES KILLED
Florida avocado production is already affected by laurel wilt
AVOCADO MORTALITY
red bay (Persea spp.) used in 95% of tribal medicines
CULTURAL IMPLICATIONS
Miccosukee & Seminole cultural heritage lost
Beetles killing our 'Tu lee' must be stopped
RARE SPECIES IMPACTED
Palamedes papillio dependent on red bay trees ...orchid species depend on butterflies
EVERGLADES THREATENED
laurel wilt devastating tree islands
killing up to 90% of canopies
invasive species may fill gaps left by dead trees
AT RISK FOR THE FUTURE
1. other native host species
2. known host species globally
3. unknown ripple effects!



4,925 to 133,740 ha in 26 months

Rodgers et al., 2014


Photo: LeRoy Rodgers

Arboriculture & Urban Forestry 2008. 34(5):317–324.

ARBORICULTURE & URBAN FORESTRY
Scientific Journal of the International Society of Arboriculture

Effect of Propiconazole on Laurel Wilt Disease Development in Redbay Trees and on the Pathogen In Vitro

Albert E. Mayfield III, Edward L. Barnard, Jason A. Smith, Shawn C. Bernick, Jeffrey M. Eickwort, and Tyler J. Dreaden

J Econ Entomol. 2013 Oct;106(5):2093-100.

Effect of chipping on emergence of the redbay ambrosia beetle (Coleoptera: Curculionidae: Scolytinae) and recovery o

Spence DJ[1], S

Plant Pathology (2012) **61**, 801–808 Doi: 10.1111/j.1365-3059.2011.02564.x

Responses of avocado to laurel wilt, caused by *Raffaelea lauricola*

R. C. Ploetz[a*], J. M. Pérez-Martínez[a], J. A. Smith[b], M. Hughes[c], T. J. Dreaden[b], S. A. Inch[a] and Y. Fu[a]

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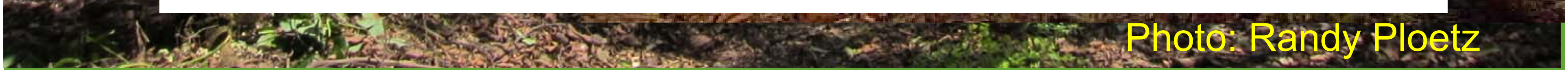
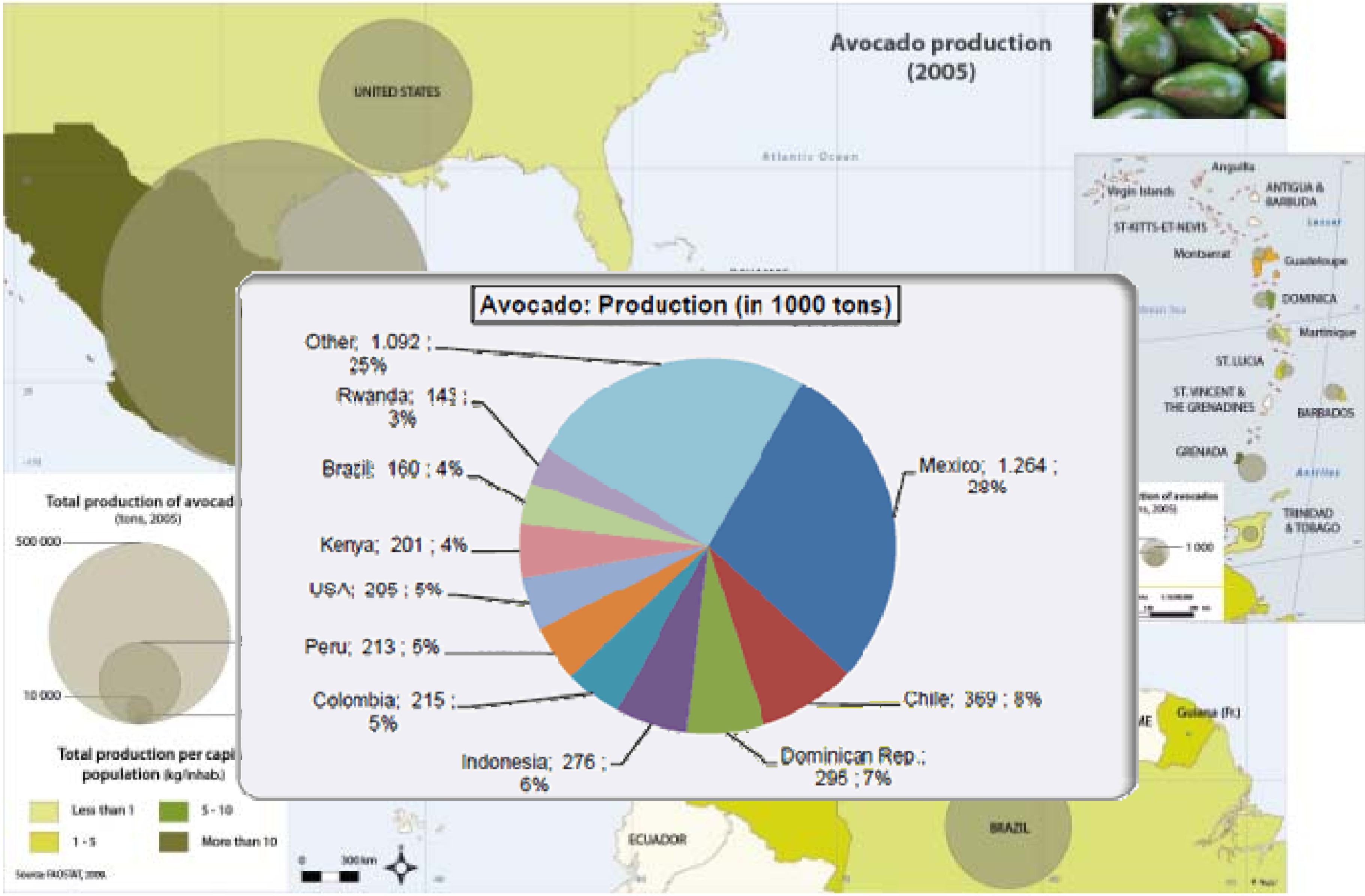




www.caribbeanatlas.org

‘Simmonds’, 5 cm + inoc pt

A. Mock inoculated. External symptoms (es) = 1, internal symptoms (is) = 1

B. 3 days after inoculation (dai), es = 1, is=1

C. 7 dai, es=1, is=2

D. 14 dai, es = 2, is=3

E. 21 dai, es = 3, is = 5

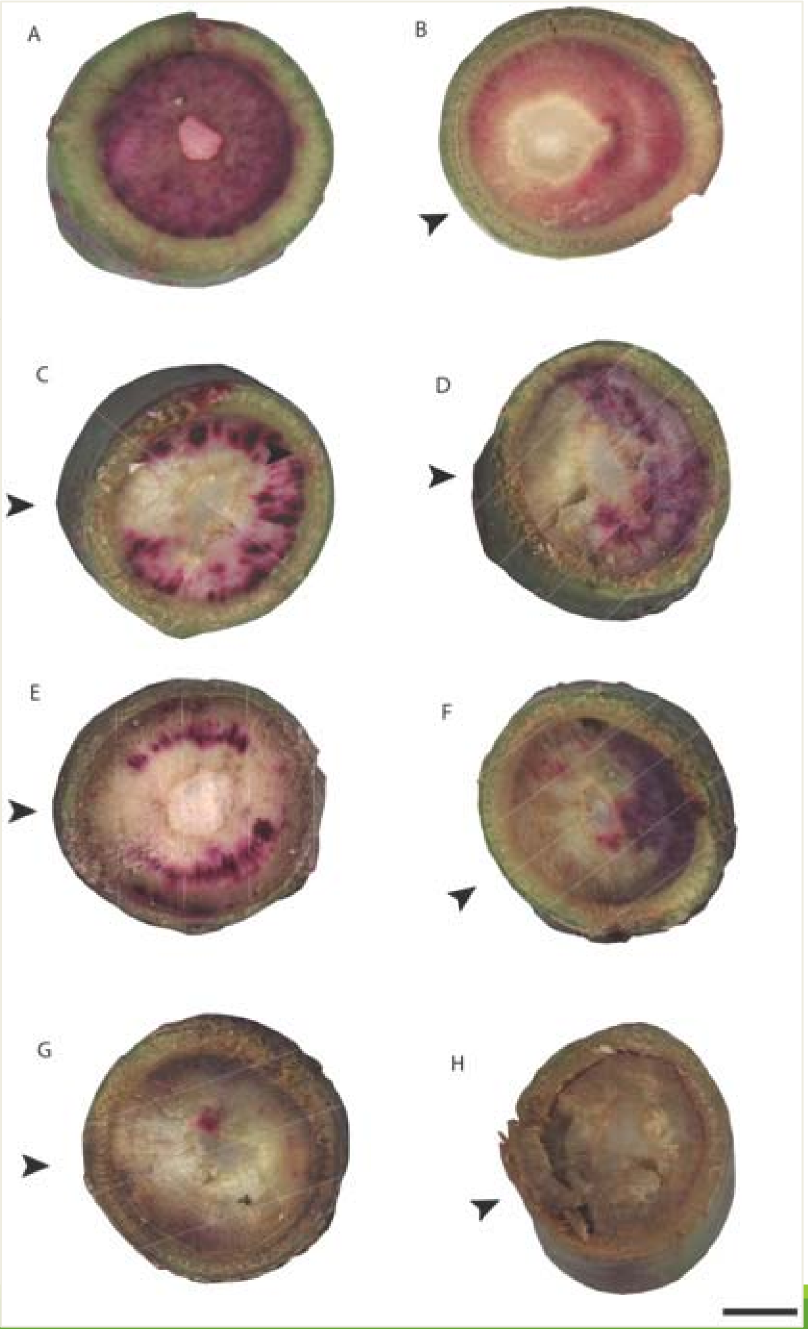
F. 21 dai, es = 5, is = 6

G. 42 dai es = 8, is = 9

H. 42 dai, es = 9, is = 9

Scale bar = 0.5 cm. Arrows denote side of stem that was inoculated.

Inch et al., 2012



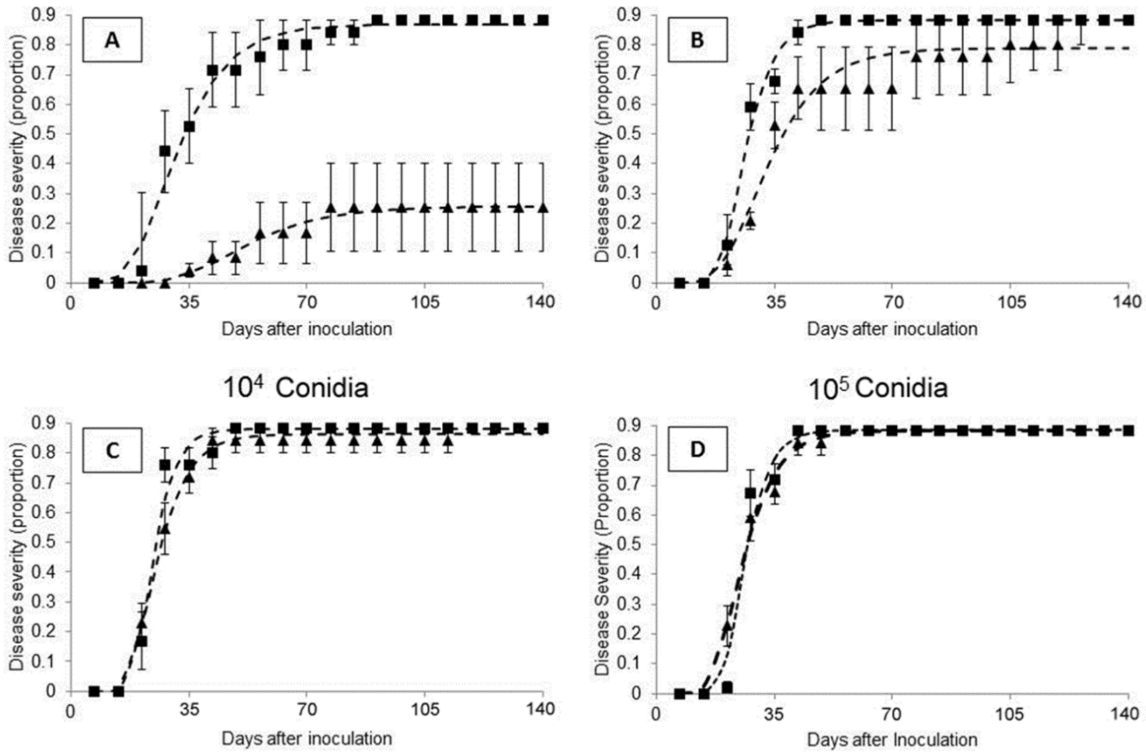
Forest Pathology WILEY-BLACKWELL

For. Path.

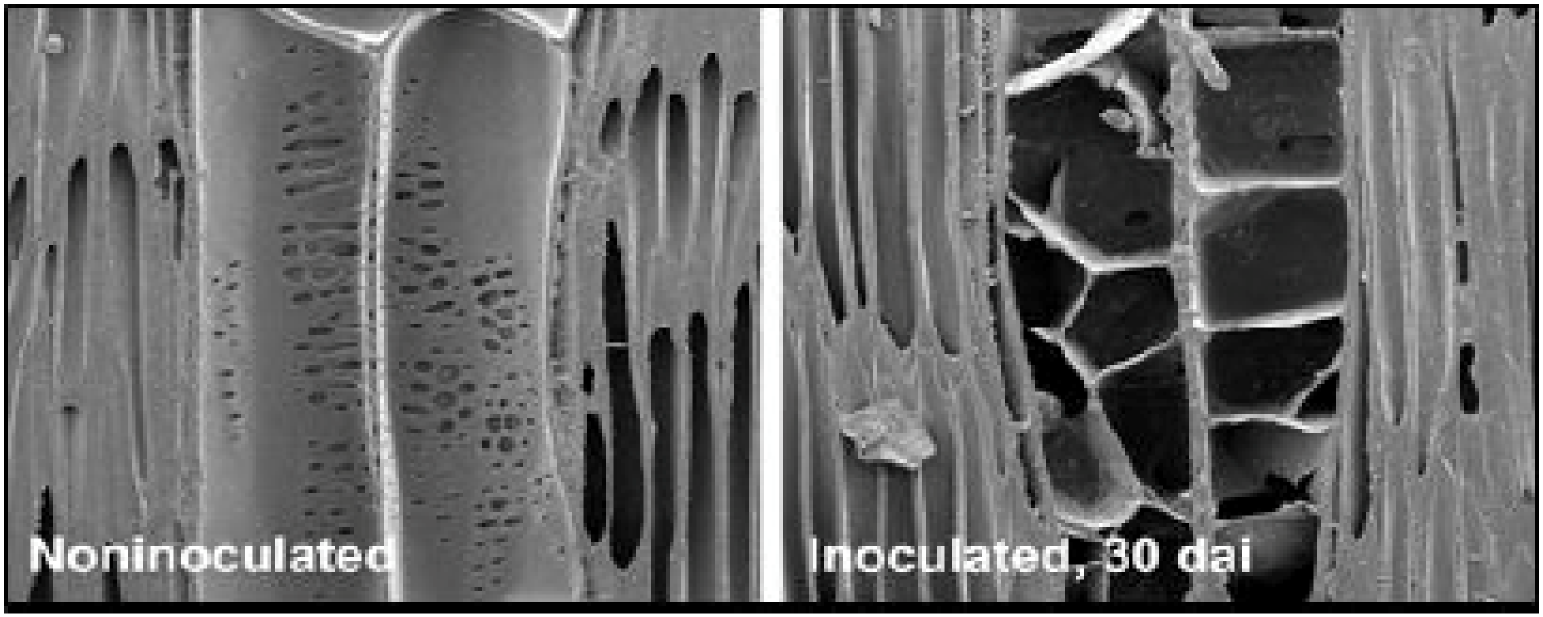
doi: 10.1111/efp.12134

Responses of swamp bay, *Persea palustris*, and avocado, *Persea americana*, to various concentrations of the laurel wilt pathogen, *Raffaelea lauricola*

By M. A. Hughes[1,5], S. A. Inch[2], R. C. Ploetz[3], H. L. Er[4], A. H. C. van Bruggen[4] and J. A. Smith[1]



Disease symptoms co-occur with tylosis



Genome comparisons

R. lauricola, *R.* sp. 272 and several close relatives sequenced with both Ion Torrent and Illumina

Transcriptomes

- RNAseq underway

Cerato-platanin homolog exists in RL, but not non-pathogenic species (potential effector?)

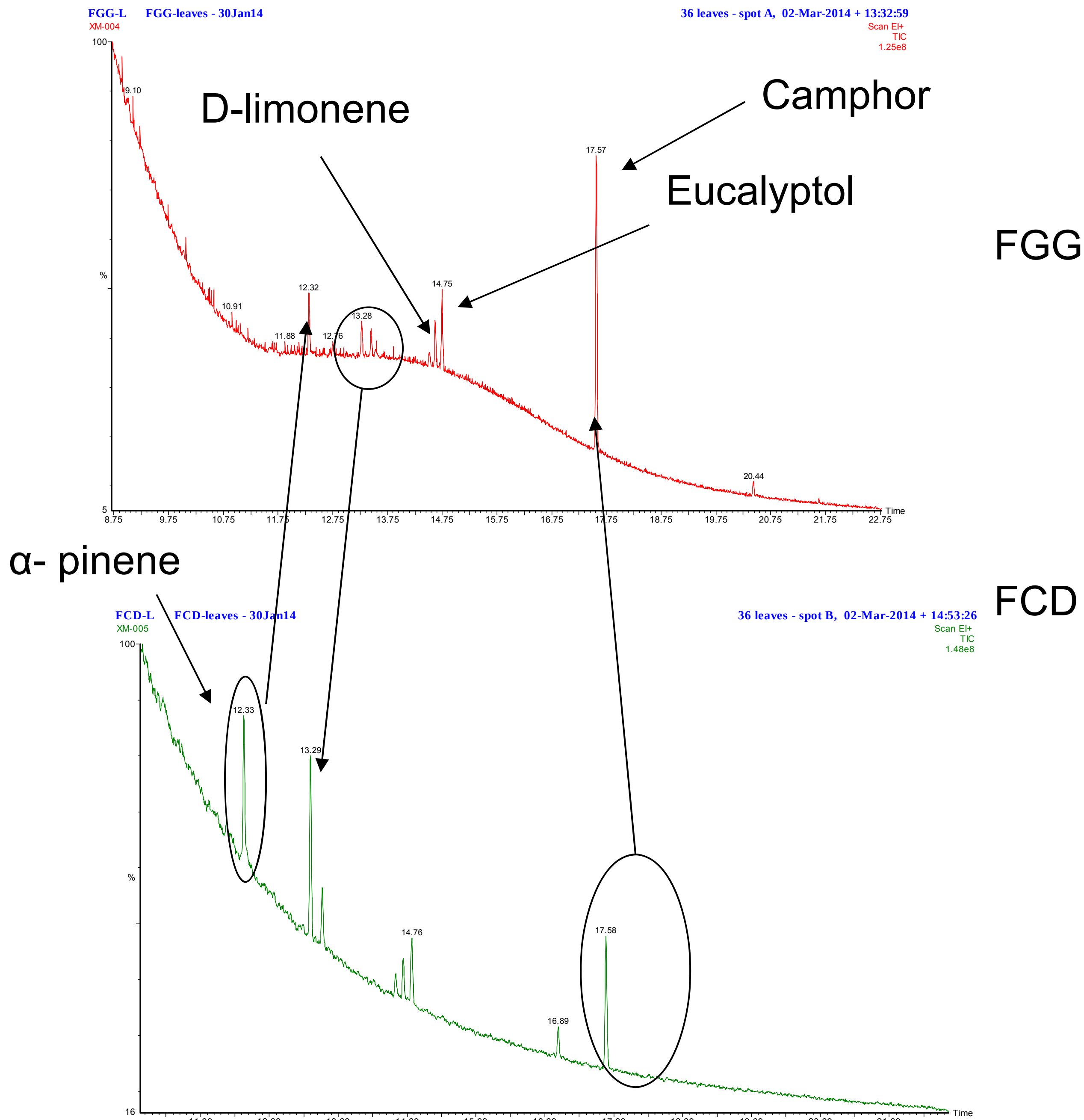
Transformed isolates have been made and will be tested for function

REFEREED RESEARCH

Vegetative propagation of putatively laurel wilt-resistant redbay (*Persea borbonia*)

Marc A Hughes and Jason A Smith

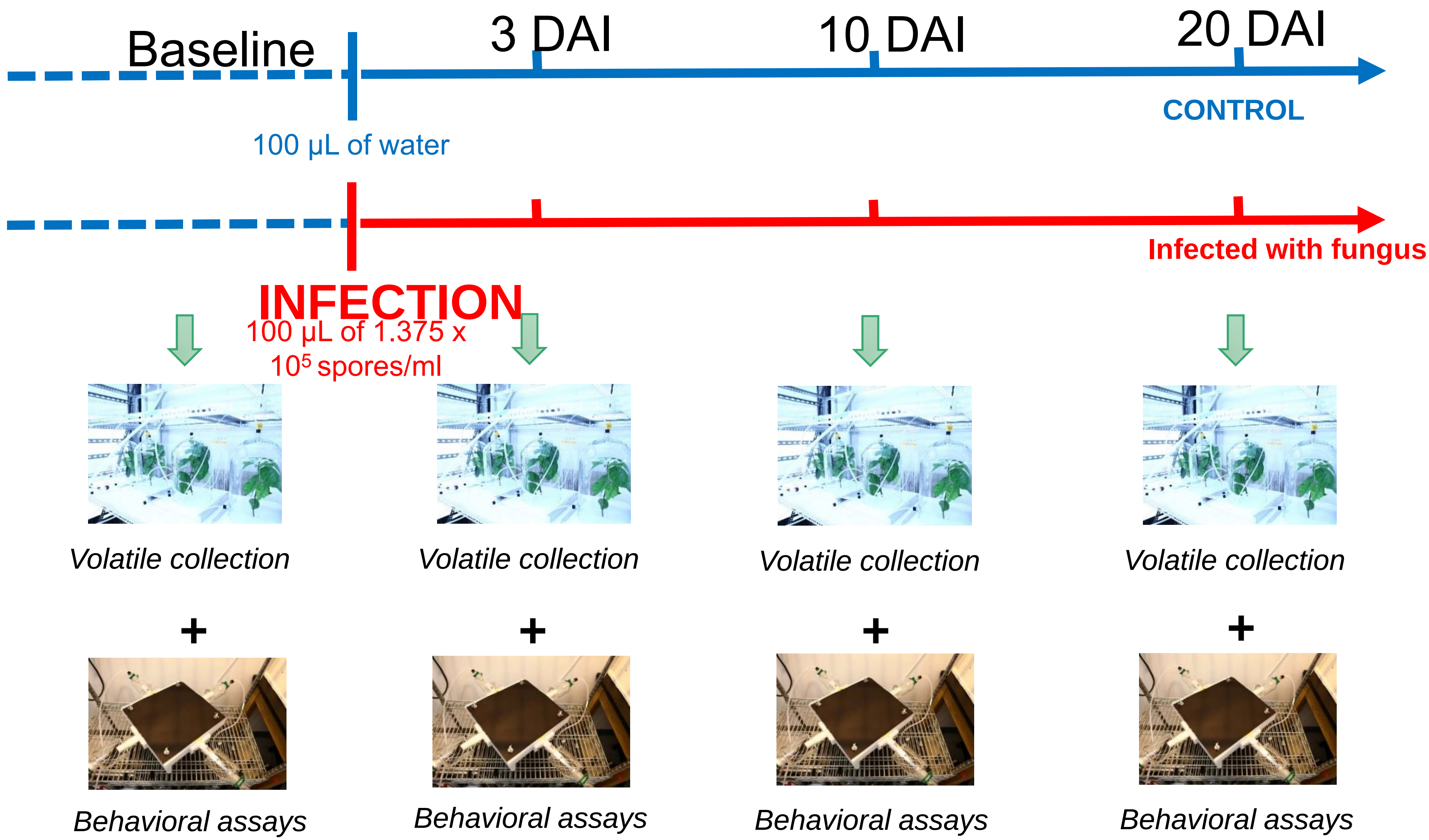
Native Plants Journal, 2014



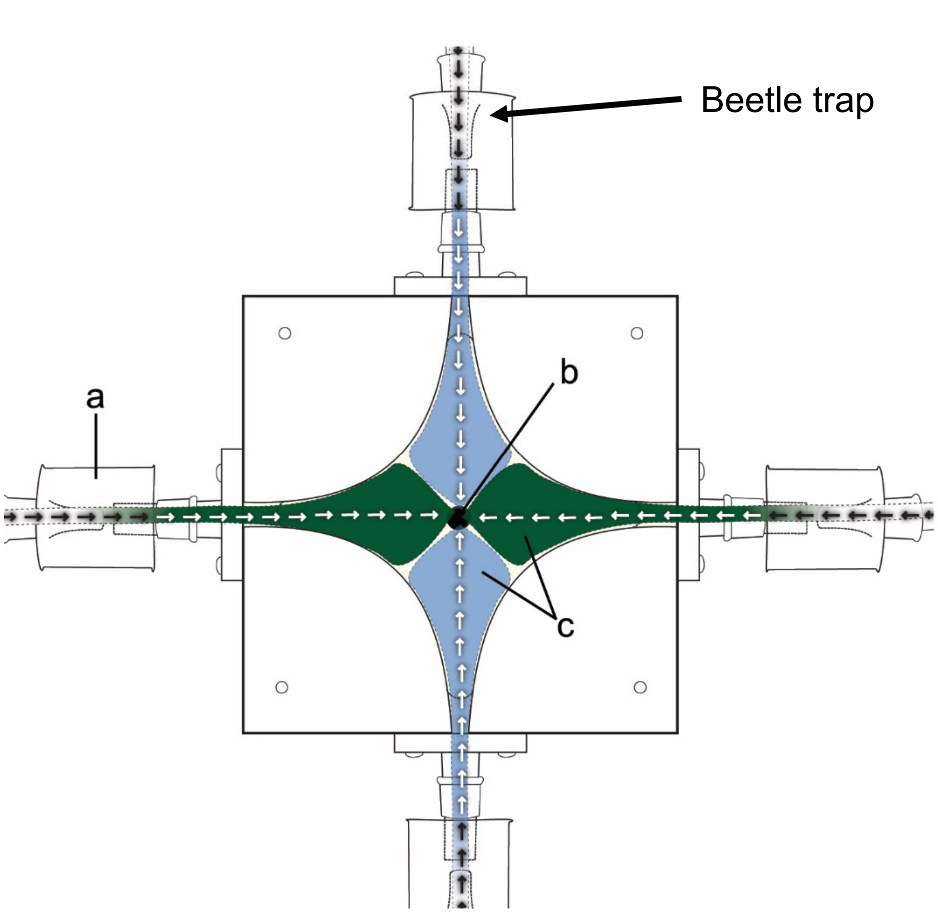
FGG-L FGG-leaves - 30Jan14
XM-004
36 leaves - spot A, 02-Mar-2014 + 13:32:59
Scan EI+
TIC
1.25e8
D-limonene
Camphor
Eucalyptol
FGG
9.10
10.91
11.88
12.32
12.76
13.28
14.75
17.57
20.44
100
%
5
Time
8.75
9.75
10.75
11.75
12.75
13.75
14.75
15.75
16.75
17.75
18.75
19.75
20.75
21.75
22.75
α- pinene
FCD
FCD-L FCD-leaves - 30Jan14
XM-005
36 leaves - spot B, 02-Mar-2014 + 14:53:26
Scan EI+
TIC
1.48e8
12.33
13.29
14.76
16.89
17.58
100
%
16
Time
11.69
12.69
13.69
14.69
15.69
16.69
17.69
18.69
19.69
20.69
21.69

Experimental protocol

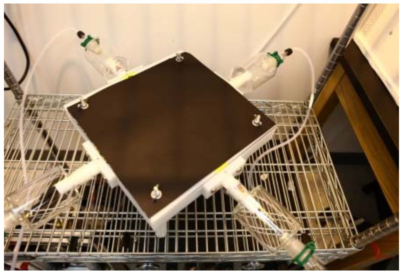
Fungus manipulation of plant odor (Martini and Hughes)



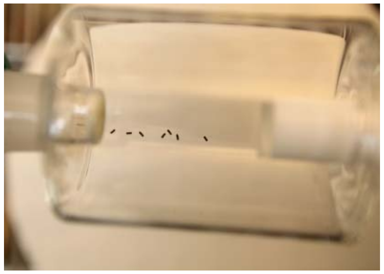
Behavioral assays



4-way olfactometer



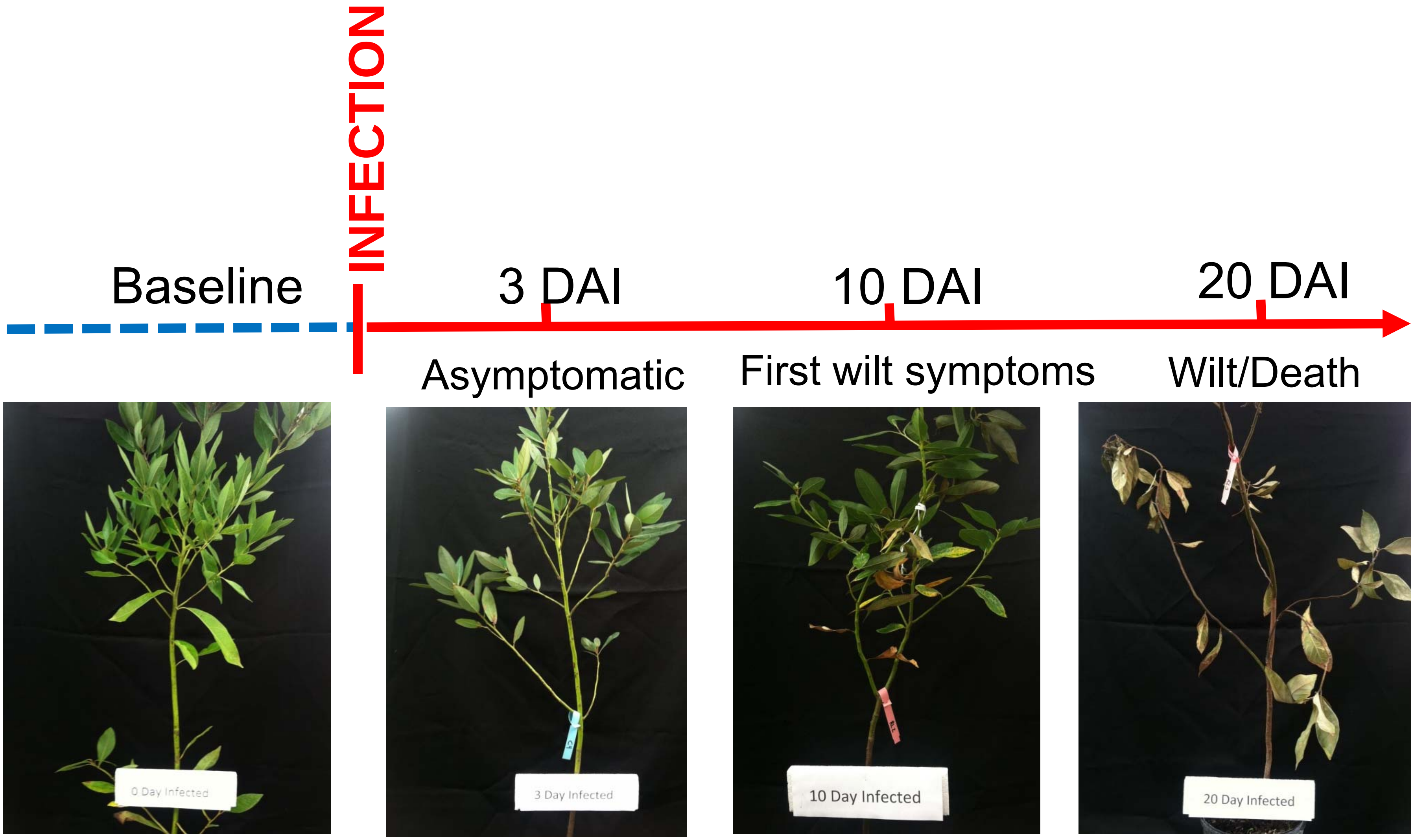
The olfactometer was covered with a black cover



Beetles caught in traps

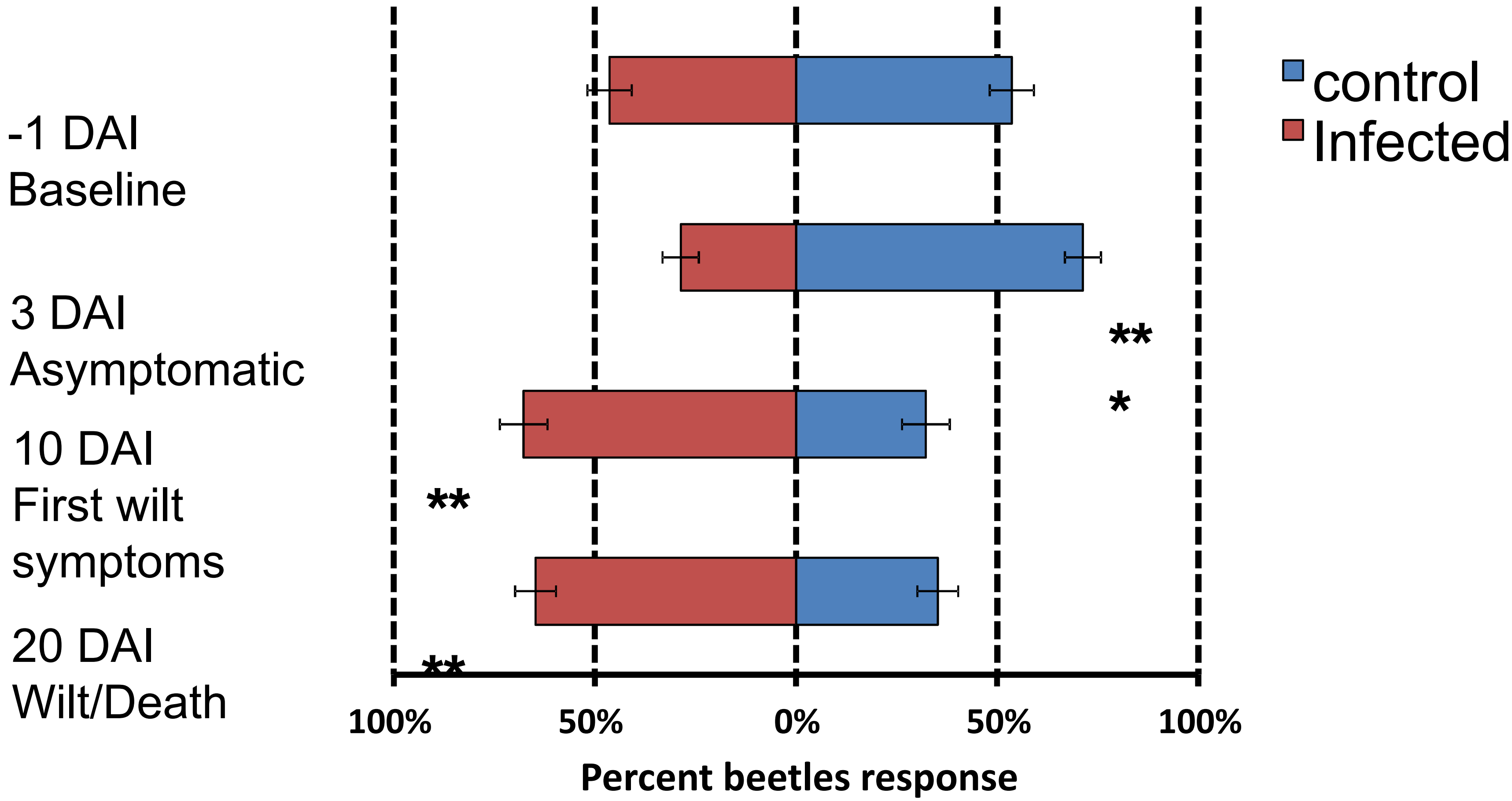
Leaf volatiles collected from a redbay

Disease progression



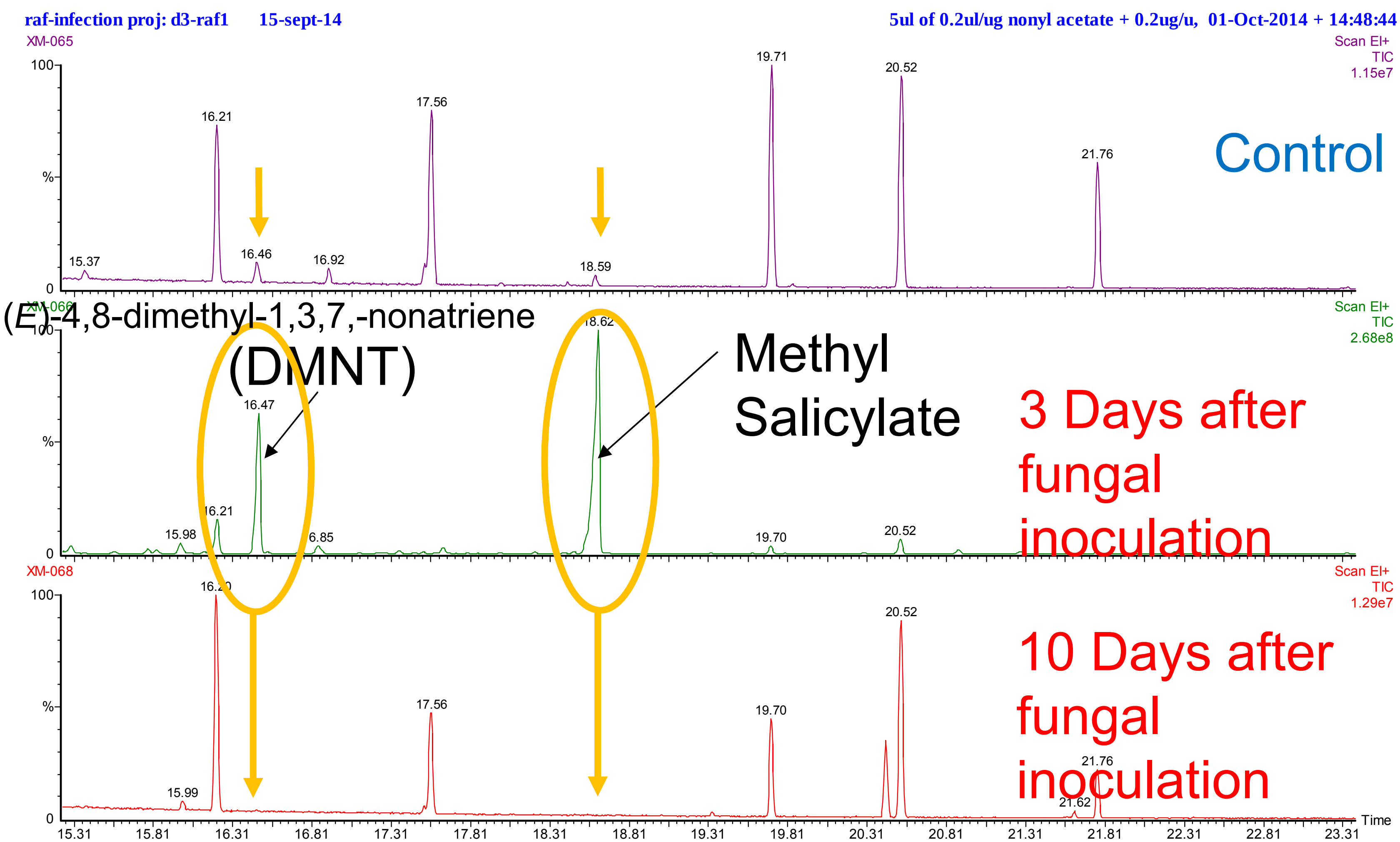
Results

Behavioral assays

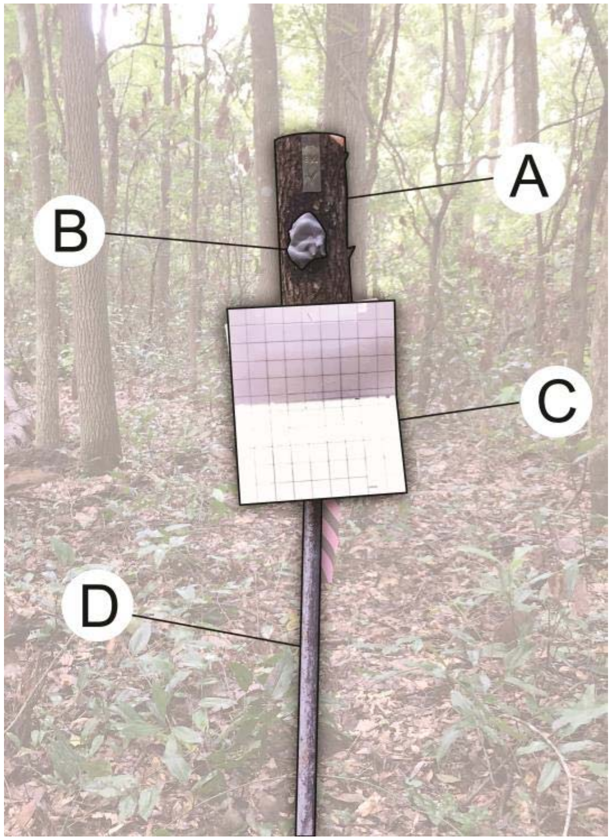


Results

Volatile collection: potential repellents



Trap Logs

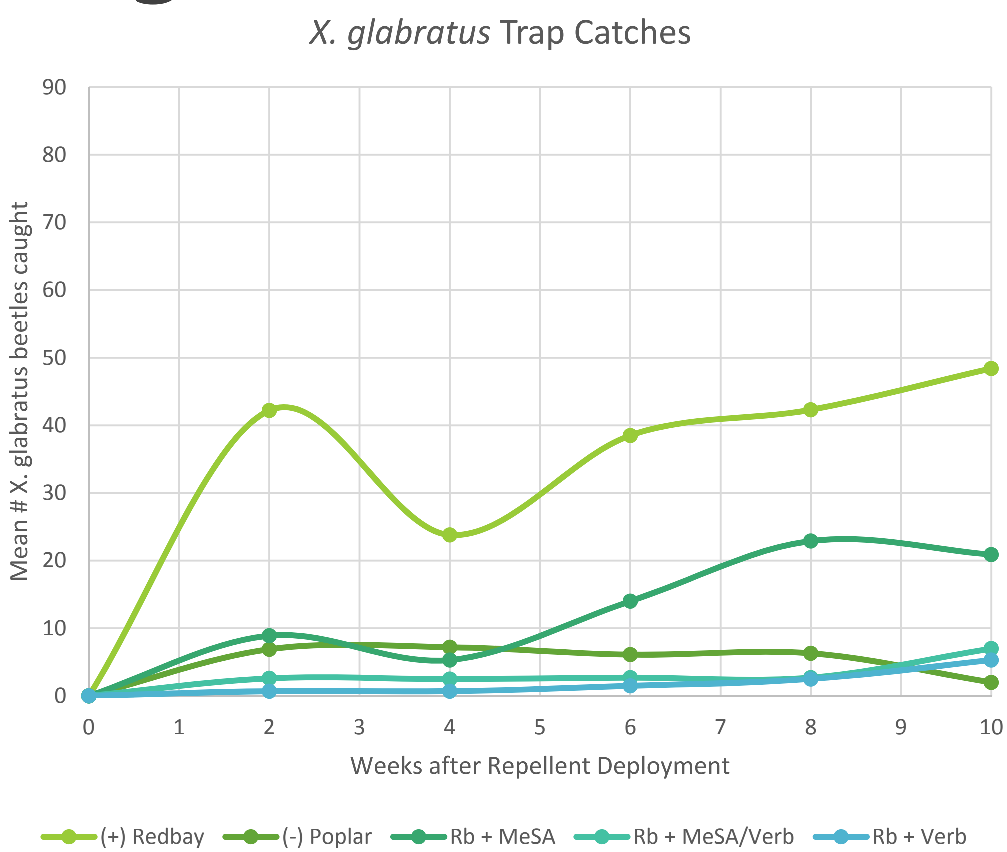


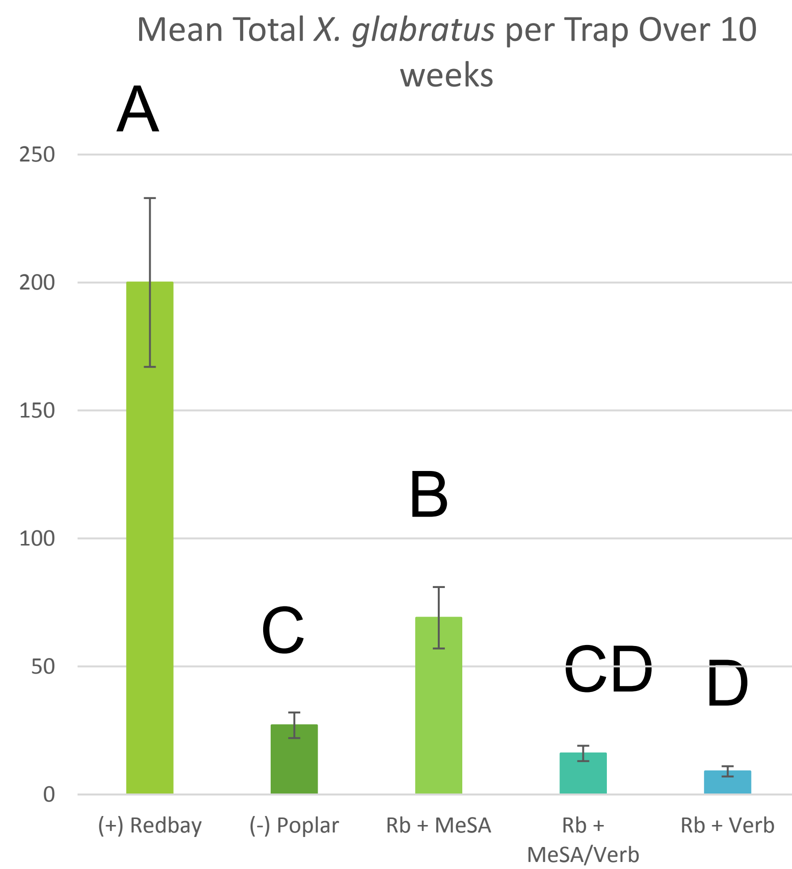
A. Fresh redbay bolt
B. SPLAT repellent
C. Sticky Card (x 2)
D. Metal Pole (1” dia.)

Trap Approx. 4-5 ft. tall

To refresh odors, a cork-borer was used to remove 2 circular bark sections every 2 weeks

Potential Repellents of *Xyleborus glabratus*

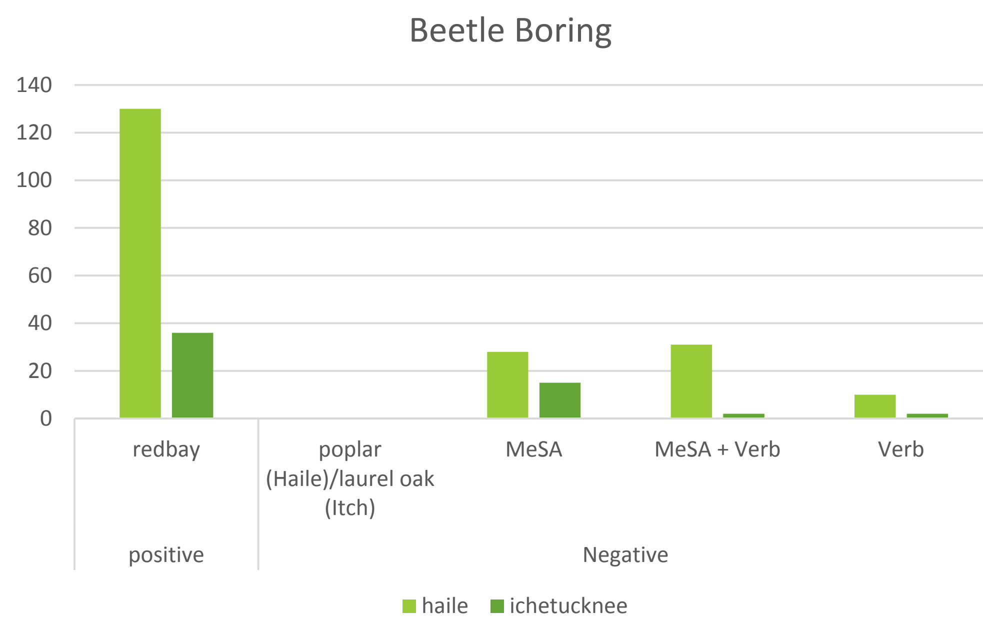




Did the Repellents Stop Boring Activity ?

- Refrigerate logs
- De-bark
- Count entrance holes
  - No. 1 paperclip
  - Exposed bark
  - Under bark

Positive control redbay log



Research questions to be addressed in near future

What are the mechanisms of resistance?

- Genetic mechanism?

How do implement long-term management and carry out restoration?

What is the potential host range expansion and is there tolerance in other hosts?

How does pathogen kill hosts?

Are other *Raffaelea* killers out there?

Research Team – Thank You

- Tyler Dreaden, Marc Hughes, Fred Beckman, Don Spence, Keumchul Shin; Randy Ploetz, Lukasz Stelinski, Jiri Hulcr, Sharon Inch, Bud Mayfield, Jeff Eickwort, Alina Campbell, John Riggins, Steve Fraedrich, Grechen Pruett, Ben Held, Robert Blanchette, Tom Harrington, Adam Black

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Recovery Plan for Laurel Wilt on Redbay and Other Forest Species Caused by *Raffaelea lauricola* and Disseminated by *Xyleborus glabratus*

Updated May 2015

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