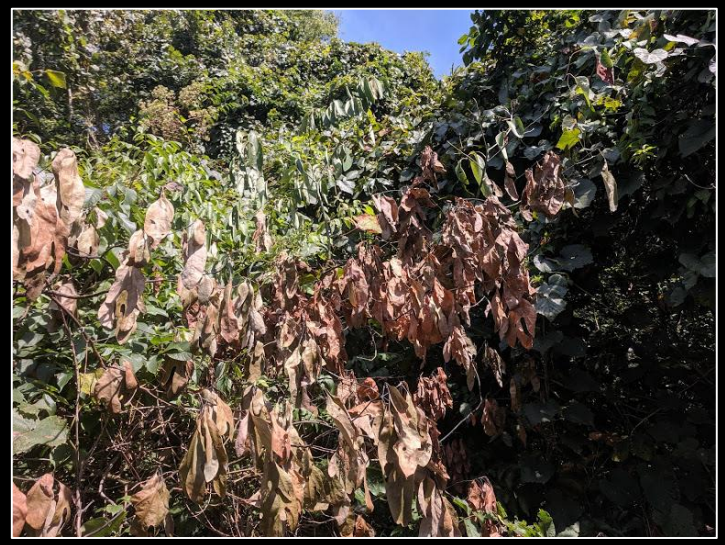
Laurel Wilt

A threat to Lauraceous plants in North America and beyond

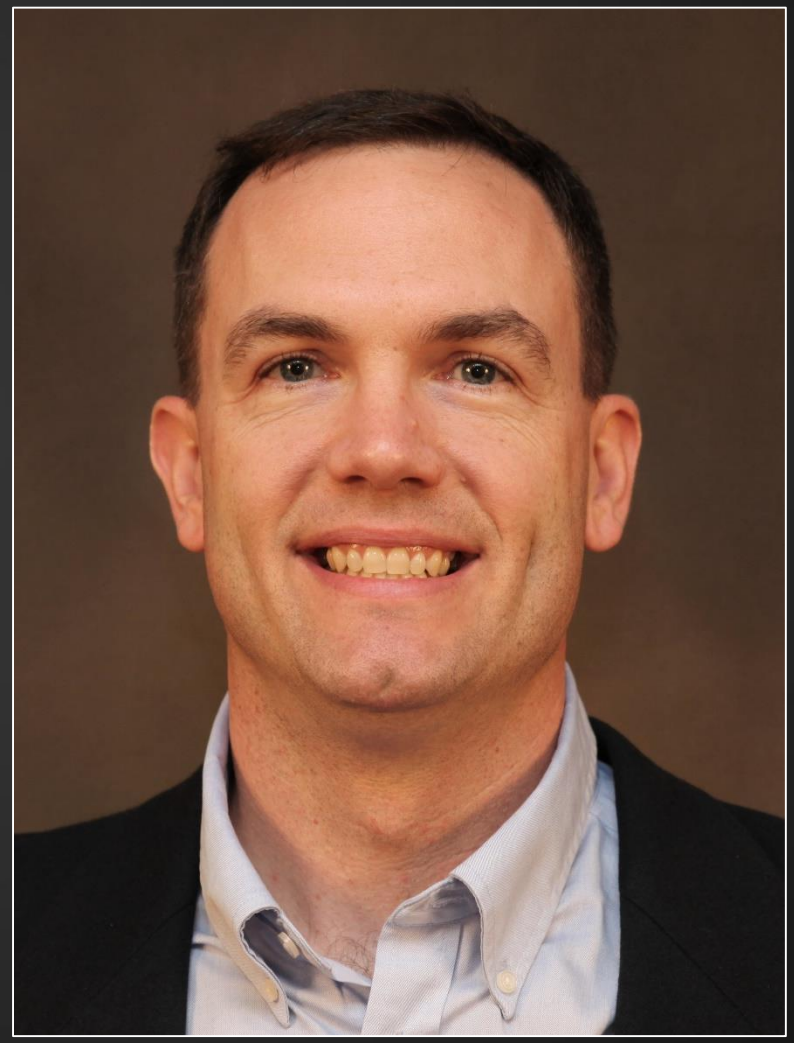


Albert “Bud” Mayfield
USDA Forest Service
Southern Research Station

Southern Regional Extension Forestry Webinar, 8 April 2020

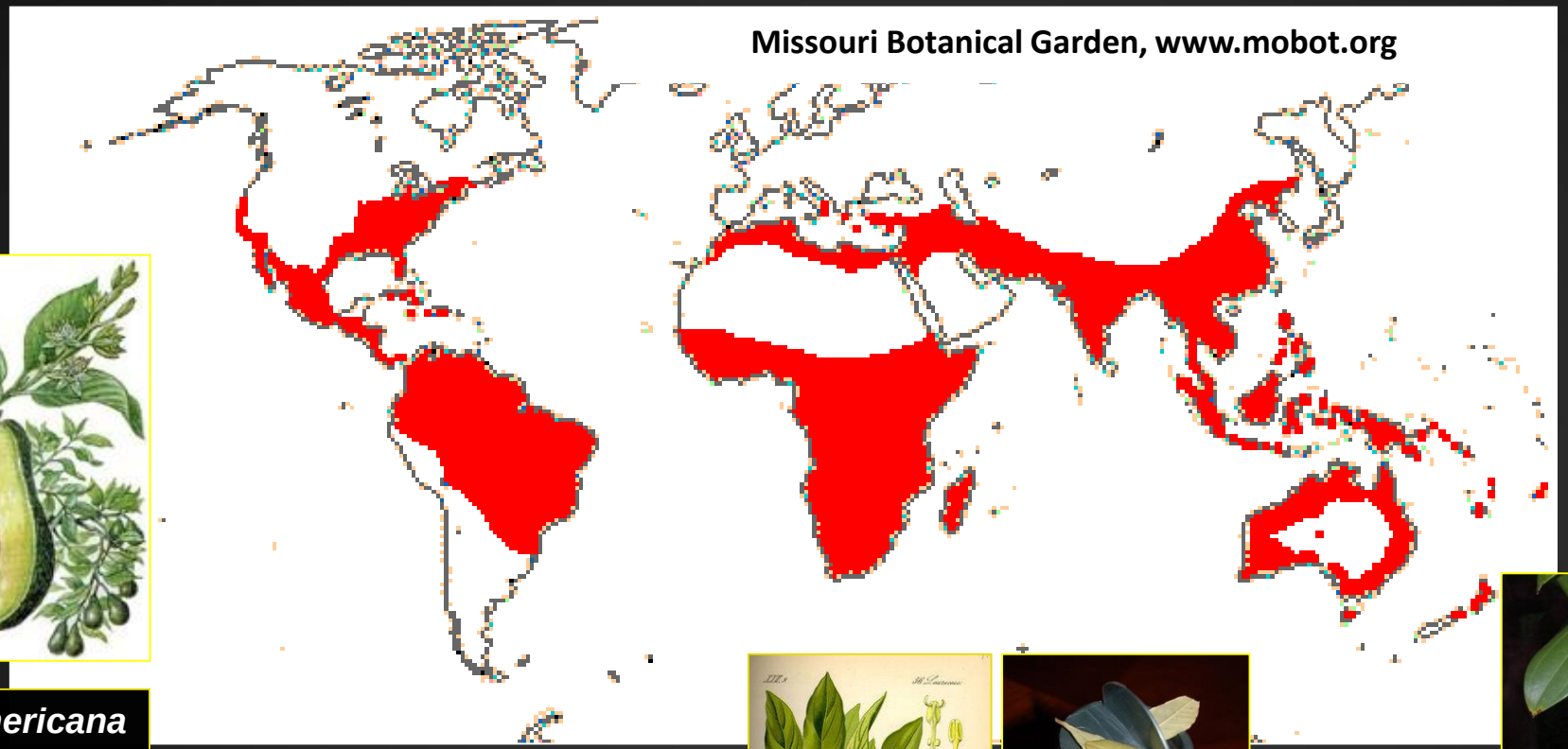
Alfred E. Neuman

Albert E. Mayfield



What is the Laurel Family (Lauraceae)?

Laurel Family: Lauraceae



Persea americana

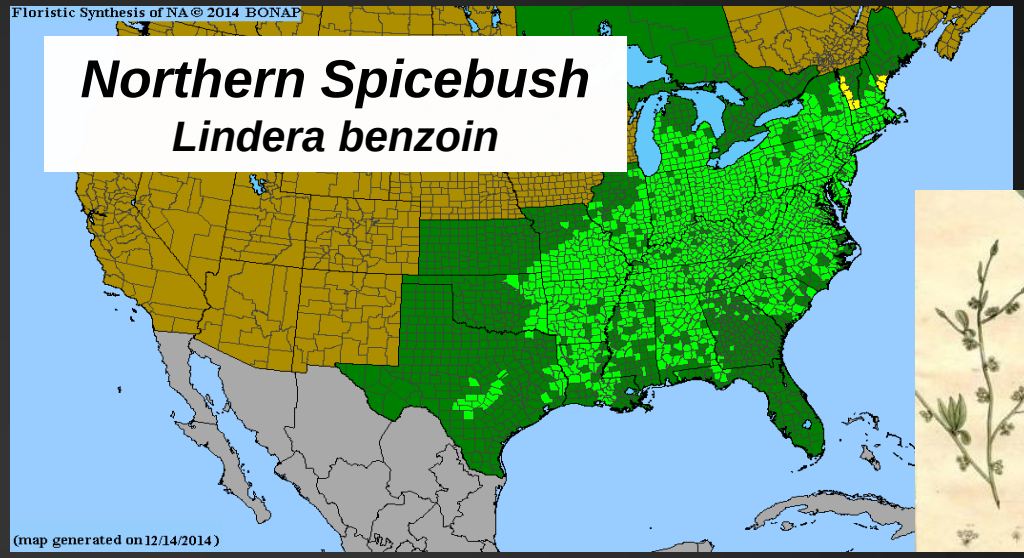
Laurel wreath

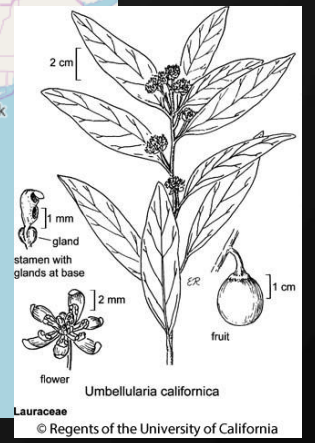
Laurus nobilis

Cinnamomum verum

- 55 genera, >2000 species worldwide
- Aromatic oils
-Economic, cultural, medicinal, and ecological importance

Major species of Lauraceae in North America





Laurel Family: Lauraceae

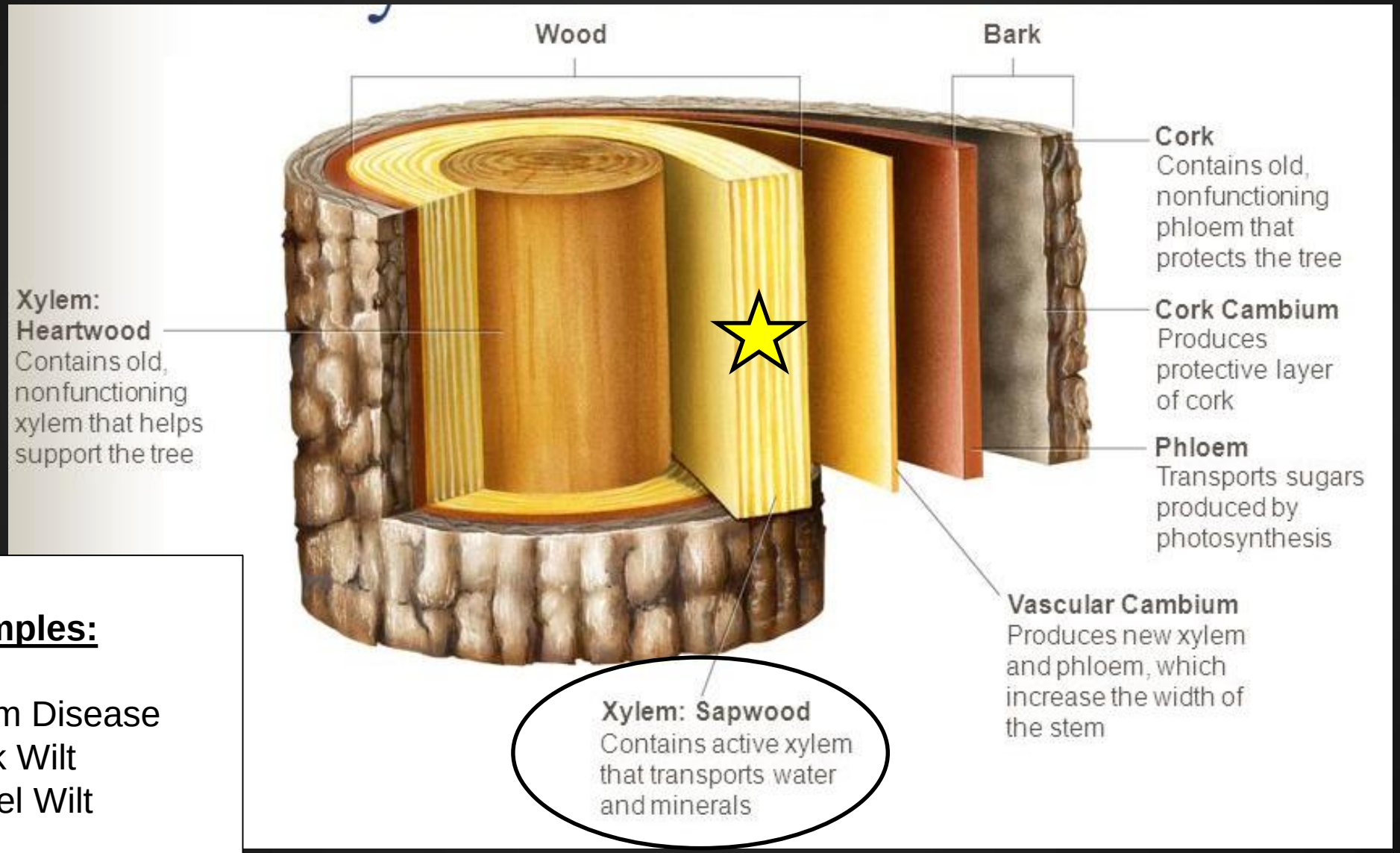
Laurisilva of Madeira

UNESCO World Natural Heritage Site

Island relict of a previously widespread laurel forest type, which covered much of Southern Europe 15-40 million ya

What is Laurel Wilt, and what causes it?

Vascular Wilt Diseases

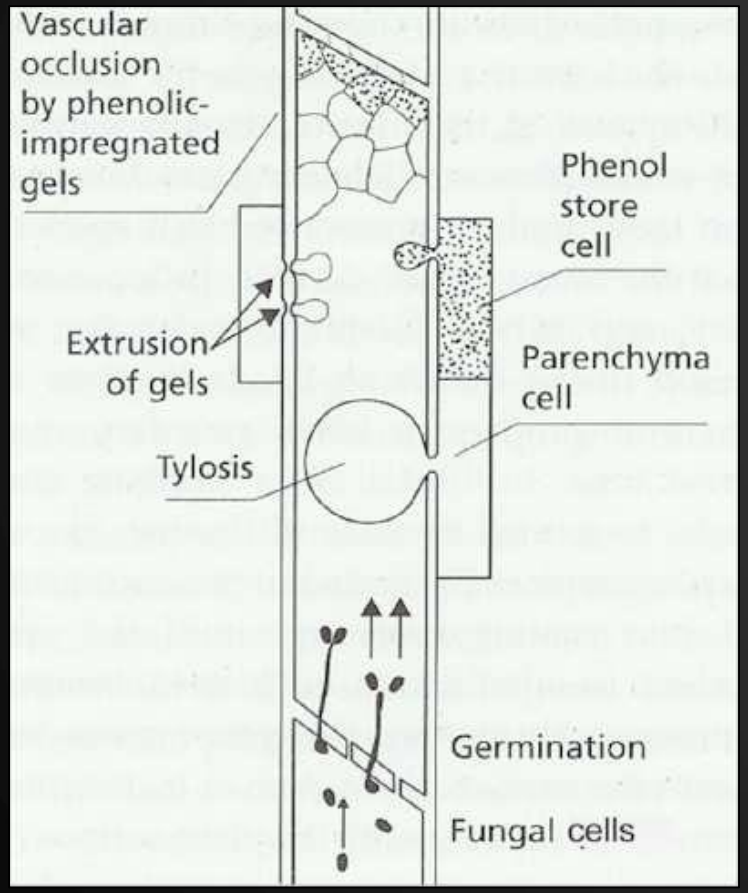


Examples:

Dutch Elm Disease
Oak Wilt
Laurel Wilt

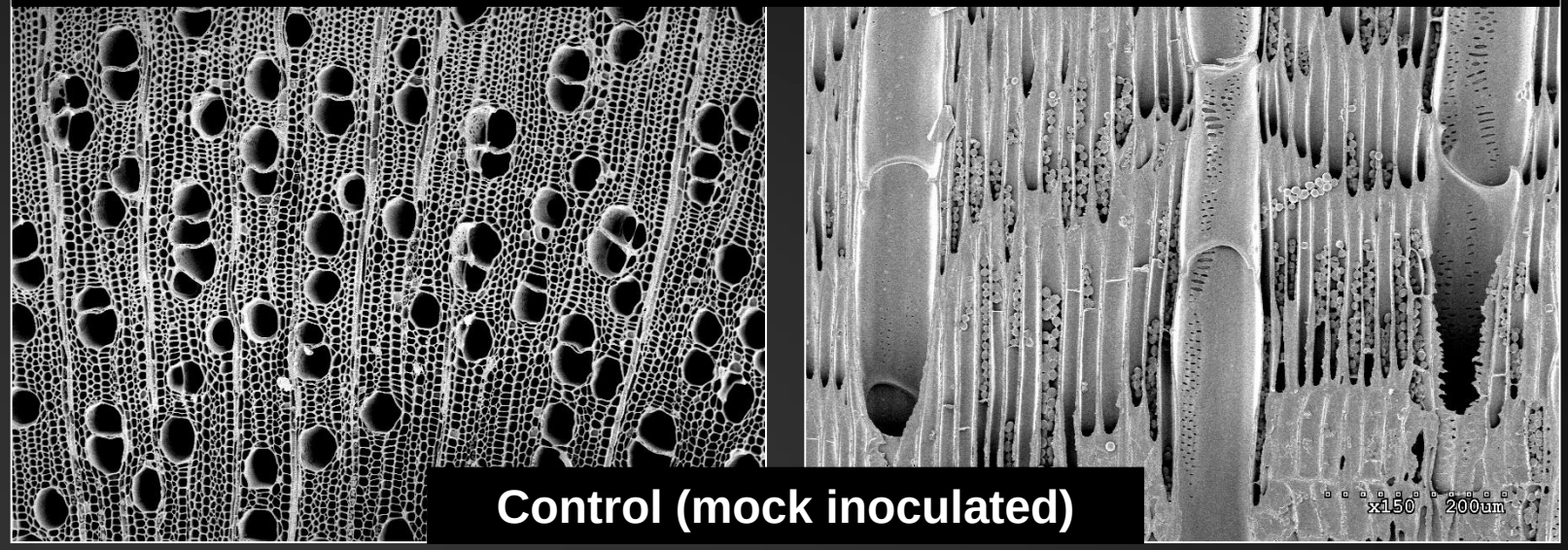
Vascular Wilt Disease

Xylem vessel:

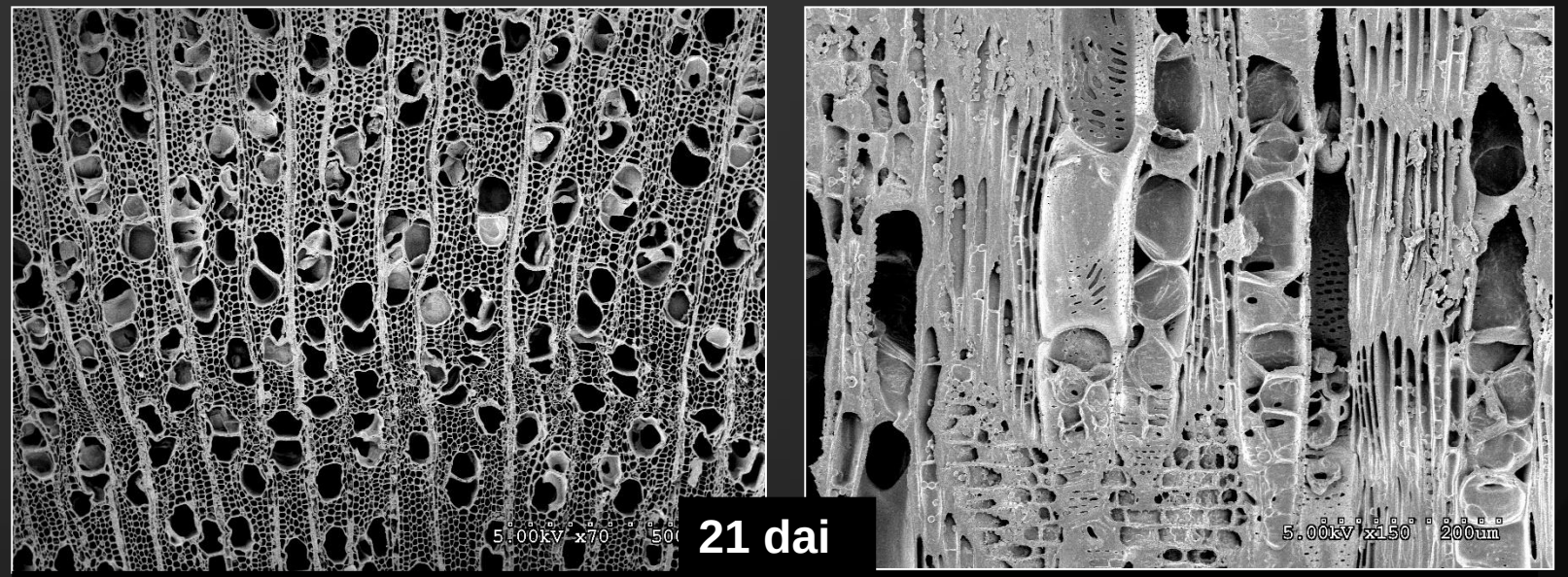


Beckman and Talboys 1981

Tylose formation plays a role in xylem dysfunction



Control (mock inoculated)



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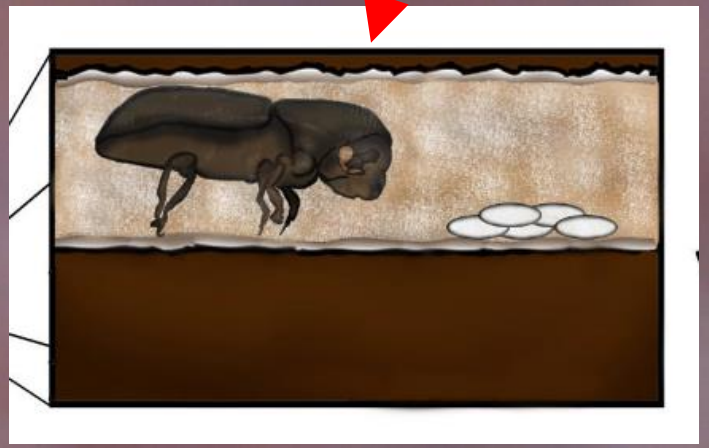
Photos by Randy Ploetz, Univ Fla.

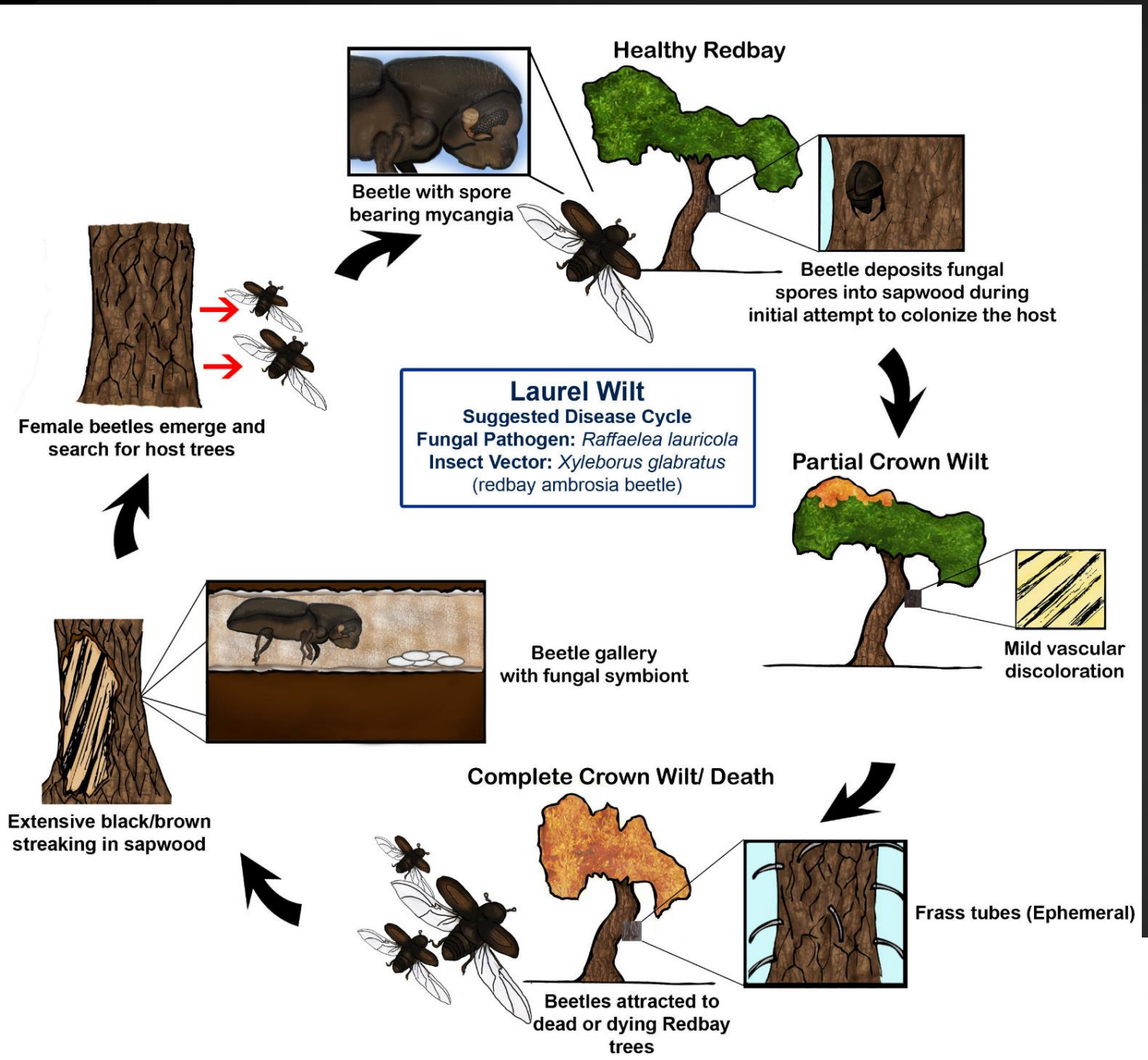
(see Inch and Ploetz (2012) *For. Pathol.* 42: 239)

Laurel Wilt

- A vascular wilt disease
- Caused by a fungus (*Raffaelea lauricola*)
- Carried into trees by a non-native ambrosia beetle vector

Redbay ambrosia beetle
Xyleborus glabratus
A “fungus farmer”





Proposed Laurel Wilt Disease Cycle Model

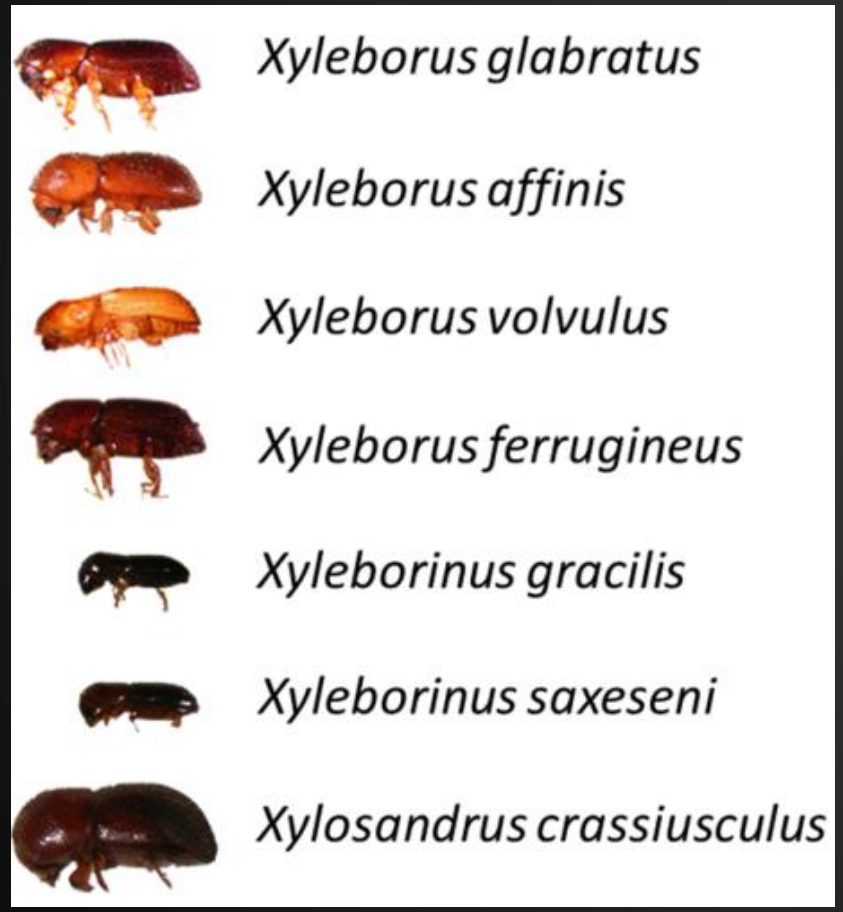
in redbay

M. A. Hughes[1], A. E. Mayfield[2], J. Thomas and K. Olson
plantdochughes@gmail.com amayfield02@fs.fed.us jeffreythomasart.com kelseyo.com
[1]University of Florida, School of Forest Resources and Conservation, Gainesville FL
[2]USDA Forest Service

Underground transmission

Sassafras grows clonally and the pathogen is suspected to travel from stem-to-stem through the roots

Lateral pathogen transfer to additional ambrosia beetles

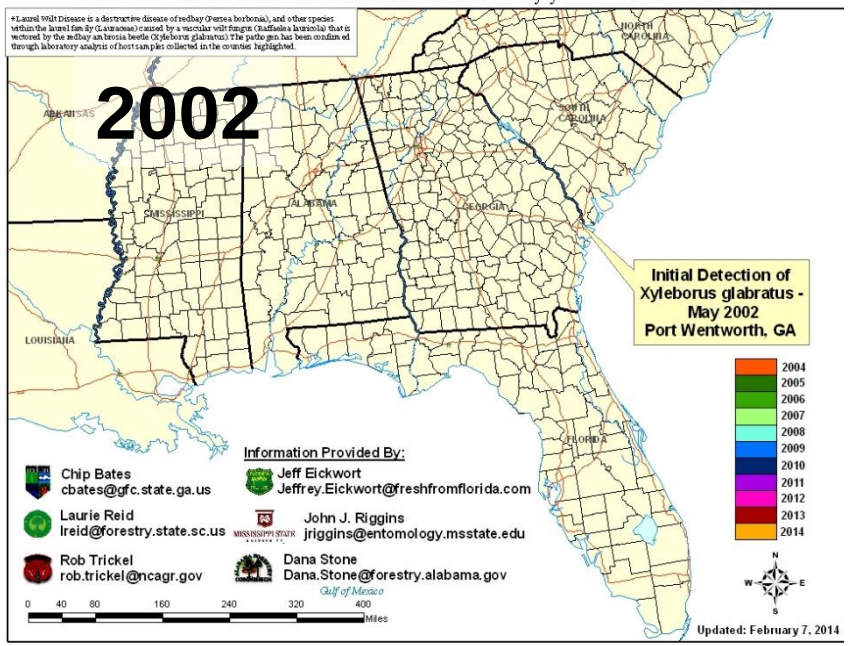


Lateral transfer of a phytopathogenic symbiont among native and exotic ambrosia beetle
Carrillo et al. (2014) Plant Pathology 63: 54-62

Six additional ambrosia beetle species that co-occur with *Xyleborus glabratus* in redaby, avocado may carry the LW pathogen. Role in disease spread uncertain.

Laurel Wilt Distribution and Spread

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



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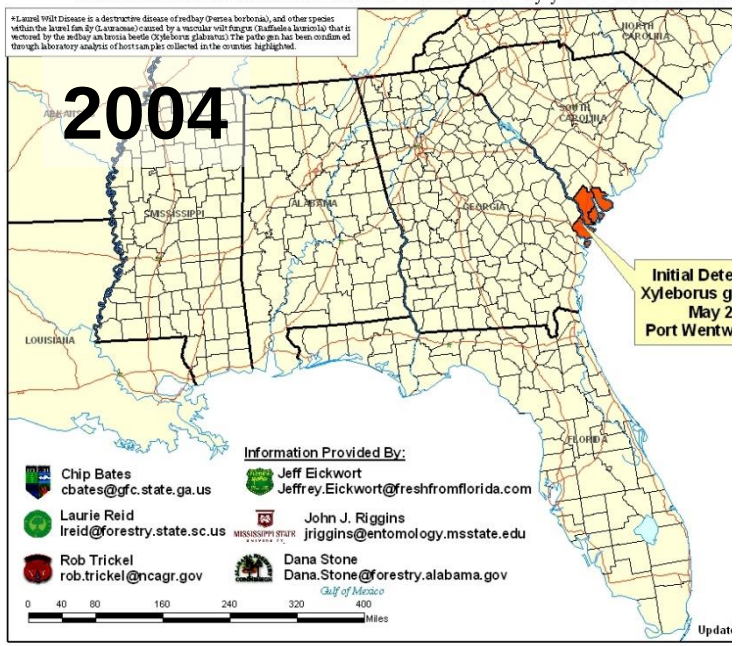

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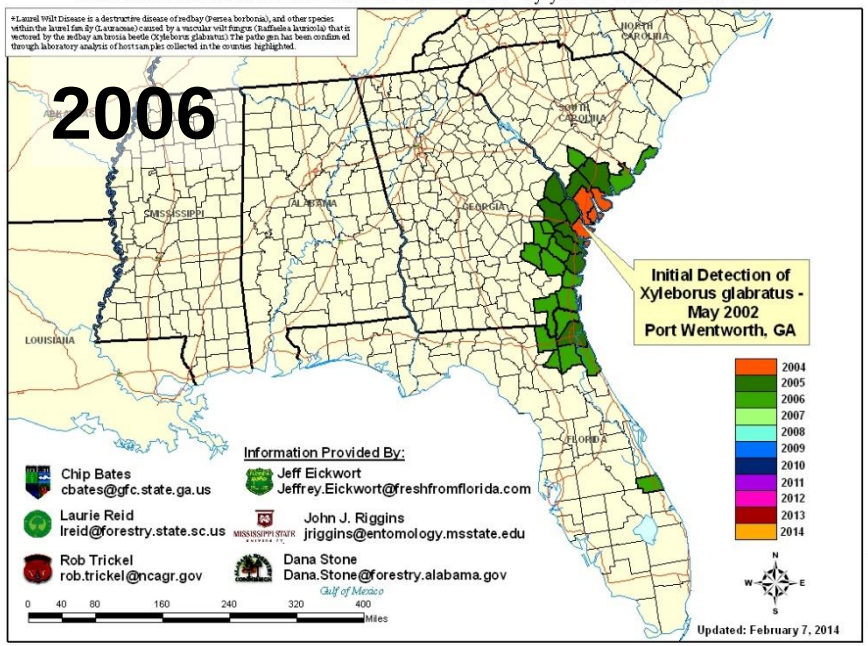

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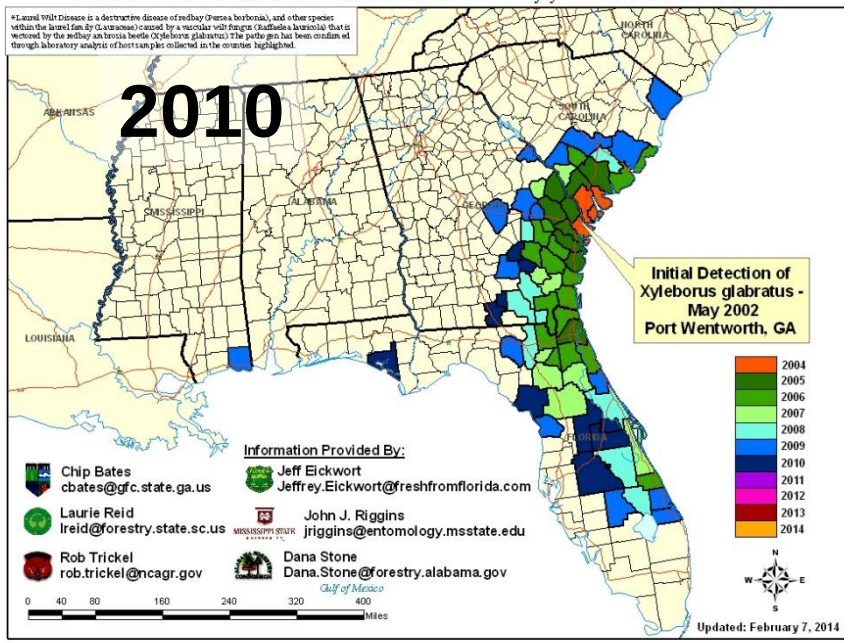

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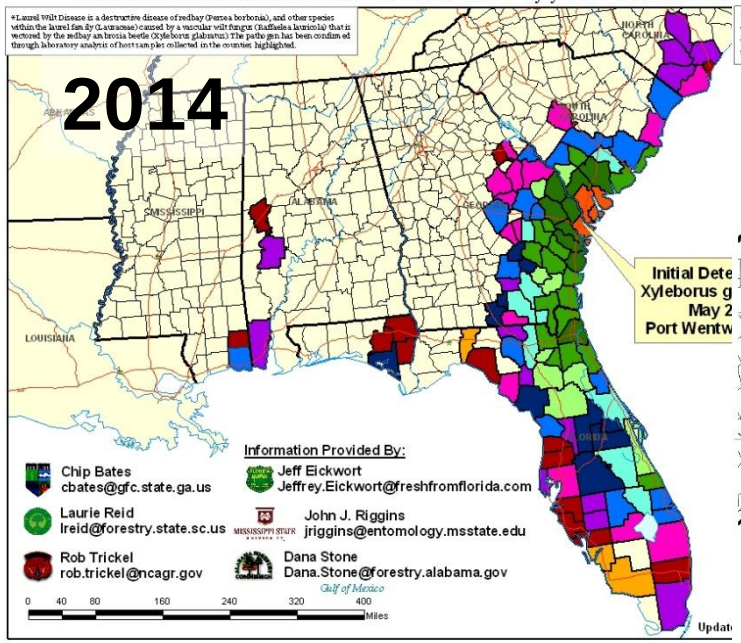
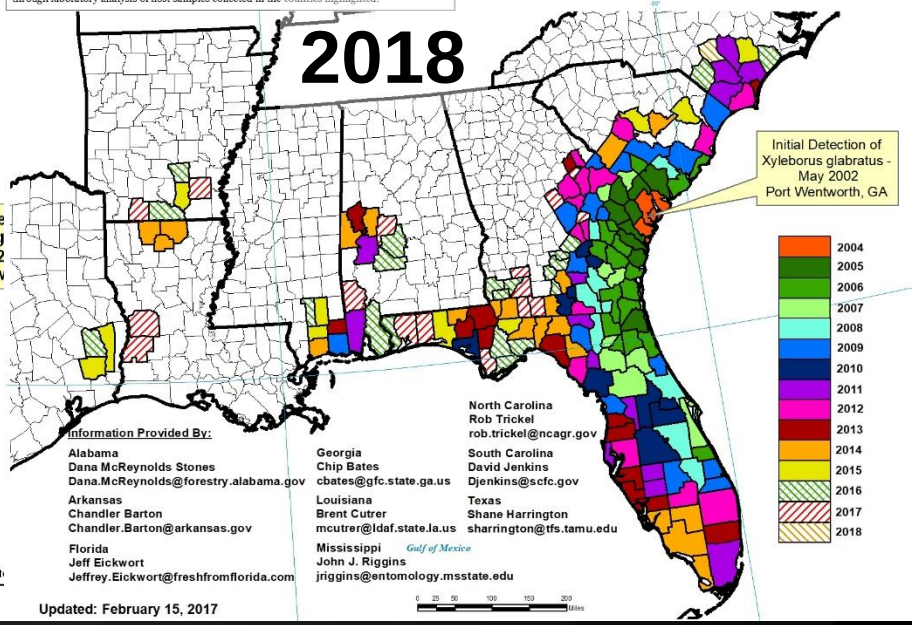


Distribution of Counties with Laurel Wilt Disease* by year of Initial Detection

* Laurel Wilt Disease is a destructive disease of redbay (Persea borbonia), and other species within the laurel family (Lauraceae) caused by a vascular wilt fungus (Raffaelea lauricola) that is vectored by the redbay ambrosia beetle (Xyleborus glabratus).The pathogen has been confirmed through laboratory analysis of host samples collected in the counties highlighted.



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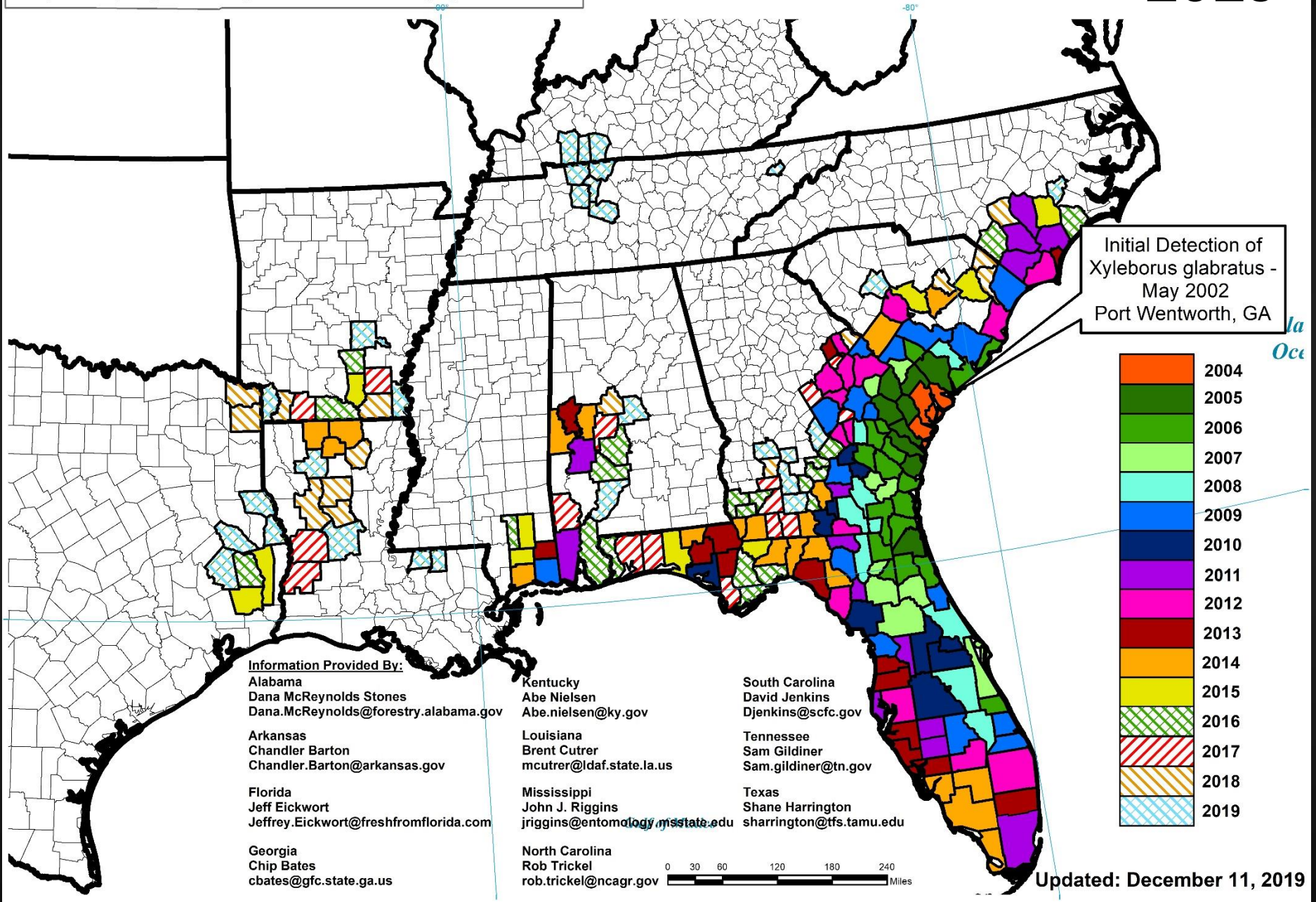

What host plants are affected by Laurel Wilt?

TABLE 1
Forest tree species with laurel wilt due to natural infections, with Koch's postulates completed.

Host[a]	Reference
Persea borbonia (L.) Spreng. (Redbay)	Fraedrich et al. 2008
Persea palustris (Raf.) Sarg (Swamp bay)	Fraedrich et al. 2008
Sassafras albidum (Nutt.) Nees (Sassafras)	Fraedrich et al. 2008
Persea americana Mill. (Avocado)[b]	Mayfield et al. 2008a
Litsea aestivalis (L.) Fernald (Pondspice)[c]	Hughes et al. 2011
Lindera melissifolia (Walter) Blume (Pondberry)[c]	Fraedrich et al. 2011
Persea humilis Nash (Silk bay)	Hughes et al. 2012
Laurus nobilis (L.) (Bay laurel)[b]	Hughes et al. 2014
Cinnamomum camphora (L.) J. Presl (Camphortree)[b]	Fraedrich et al. 2015

[a] Plant names derived from The PLANTS Database (http://plants.usda.gov) and The Plant List (2013), Version 1.1. (http://www.theplantlist.org).

[b] Non-native, landscape or agricultural species.

[c] Indicates threatened or endangered status (state or federally).

Hughes et al. 2015. Plant Health Progress 16: 173-210

TABLE 2
Tree species displaying laurel wilt symptoms after artificial inoculation with *R. lauricola*, yet lacking documented cases of laurel wilt in the wild.

Host[a]	Reference
Umbellularia californica (Hook. & Arn.) Nutt. (California laurel)	Fraedrich 2008
Lindera benzoin (L.) Blume (Northern spicebush)	Fraedrich et al. 2008, **2016** ★
Licaria triandra (Sw.) Kosterm. (Pepperleaf sweetwood)[c]	Ploetz and Konkol 2013
Persea indica (L.) Spreng. (Viñátigo [Spanish])[b]	Hughes et al. 2013
Nectandra coriacea (Sw.) Griseb. (Lancewood)	Hughes & Ploetz, *unpublished*

[a] Plant names derived from The PLANTS Database (http://plants.usda.gov) and The Plant List (2013), Version 1.1. (http://www.theplantlist.org).

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Hughes et al. 2015. Plant Health Progress 16: 173-210

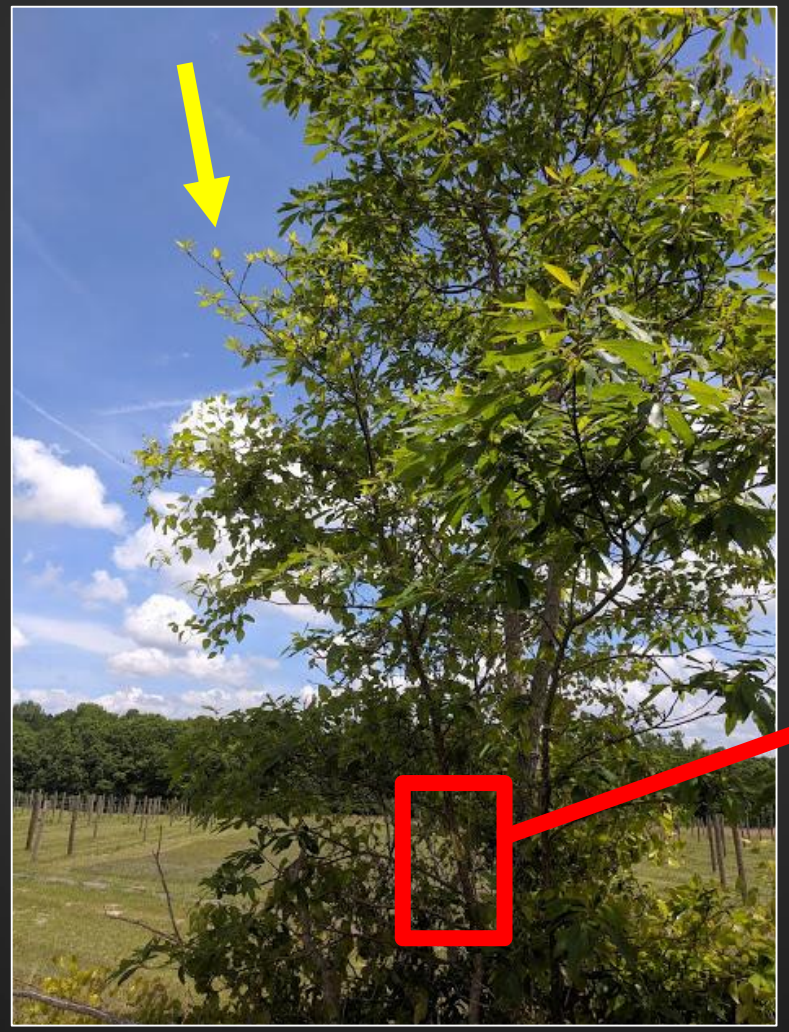
What are the Symptoms of Laurel Wilt?

Wilted Foliage: Sassafras

Leaf drop fairly quick in sassafras

Wilted foliage retained longer in redbay

Stunted foliage in sassafras



Dark discoloration in the outer sapwood

Signs of Ambrosia Beetles

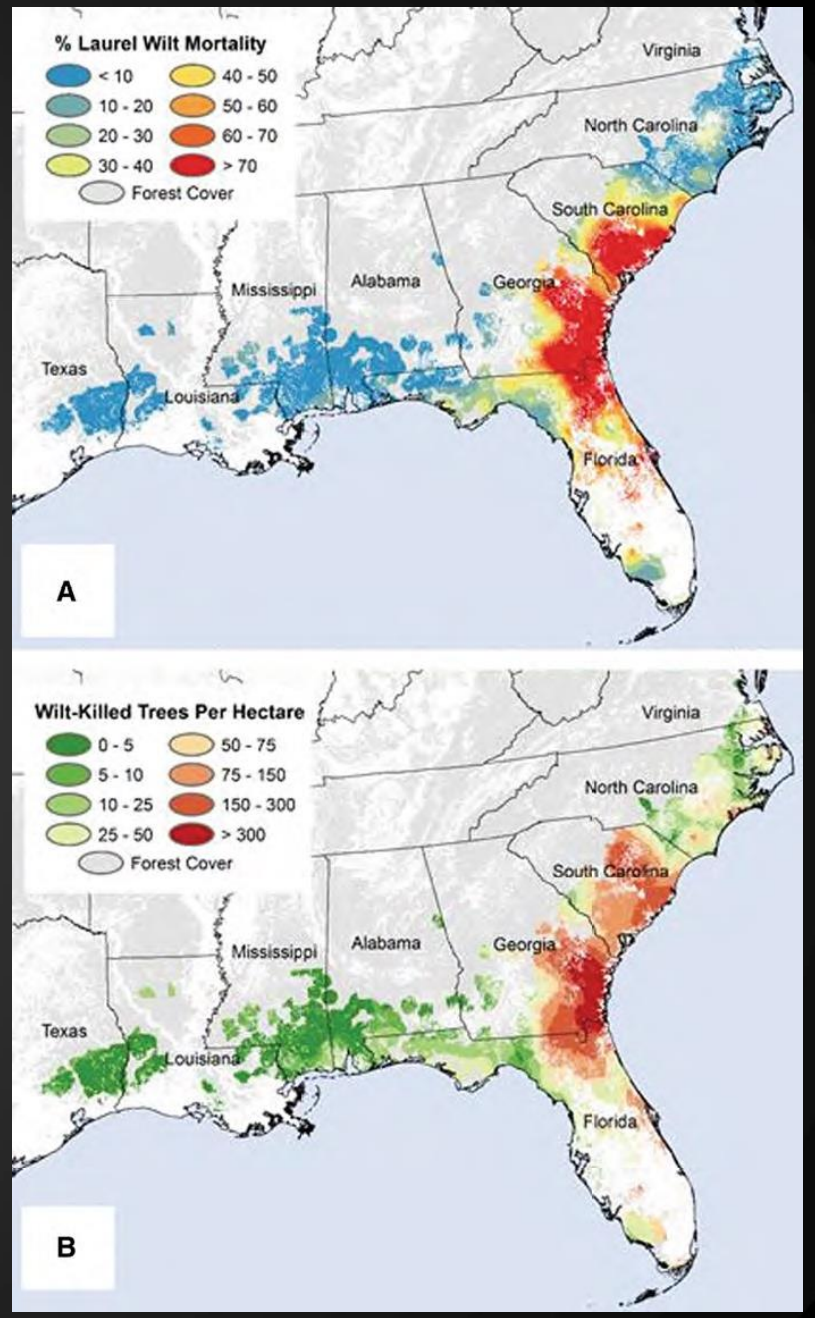
- Not diagnostic for laurel wilt.
- Created by RAB and other species
- Dust is ephemeral

Impacts of Laurel Wilt

Redbay Mortality in the Coastal Plain

Over 300 million trees killed (Hughes et al. 2017)

- Altered stand structure
- Coarse woody debris
- Hazard trees
- Threatens cultural uses



Hughes et al. 2017 Biol Invasions 19: 2143

Laurel wilt in the Everglades

Persea palustris (swampbay)

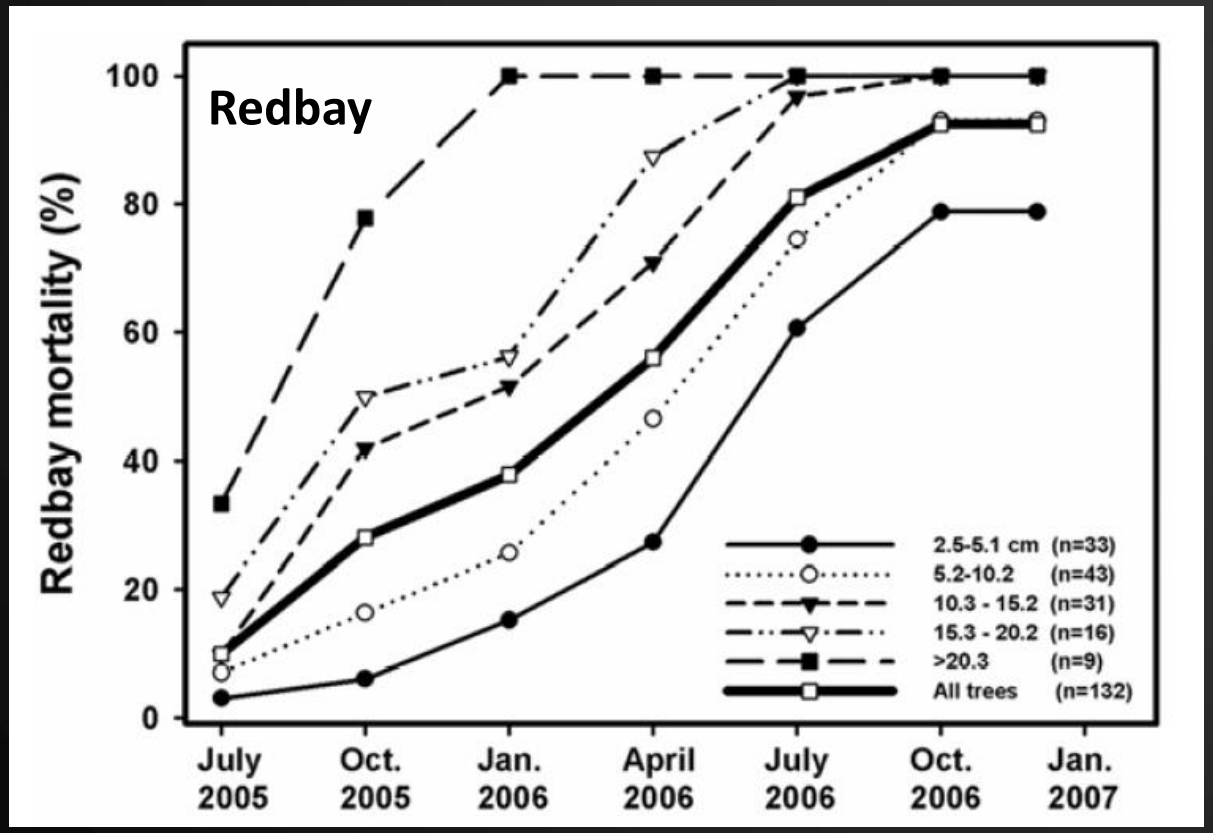
- Everglades are globally unique ecosystem
- Tree islands are critical to ecosystem function
- Laurel wilt killed up to 90% of tree canopies
- Invasion of disturbed areas likely

Photo: LeRoy Rodgers, see Rodgers et al. 2014

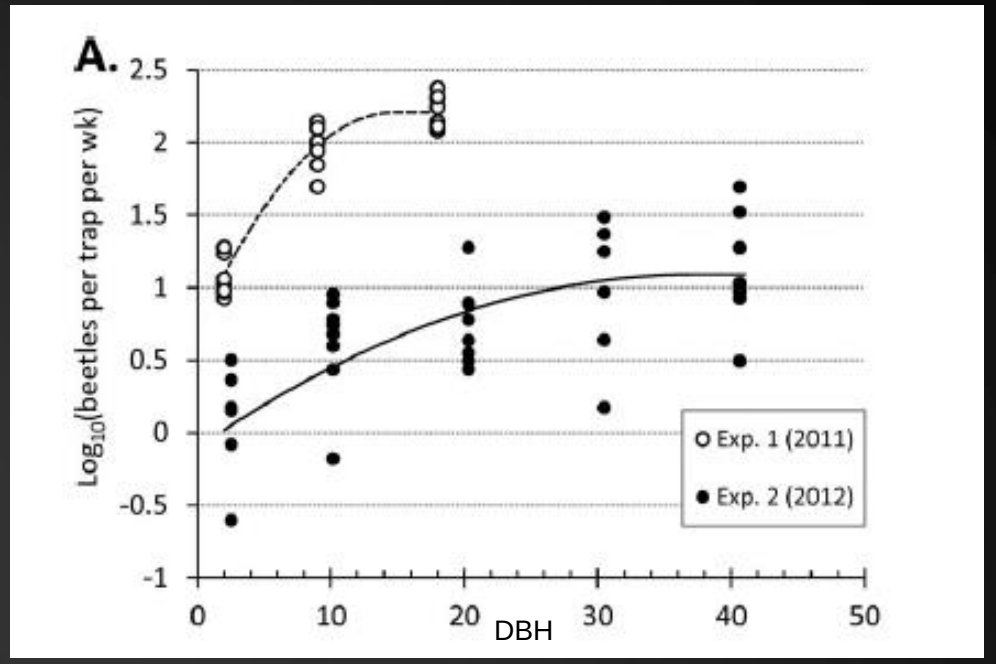
Laurel wilt mortality progression

Larger diameter trees:

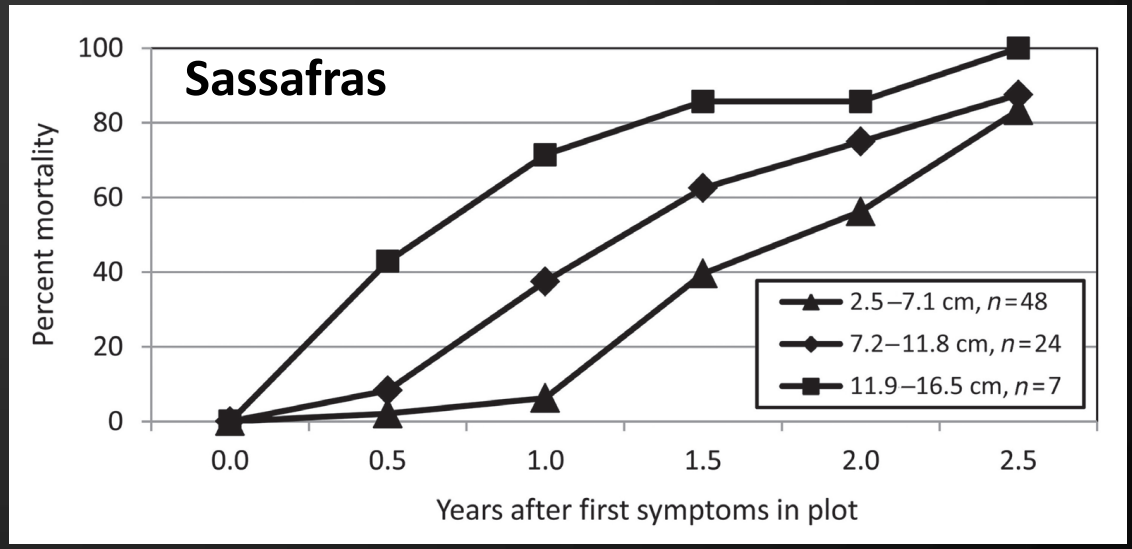
- more visually attractive to the beetle
- Die first and at higher rates



Fraedrich et al. 2008 Plant Disease 92:215



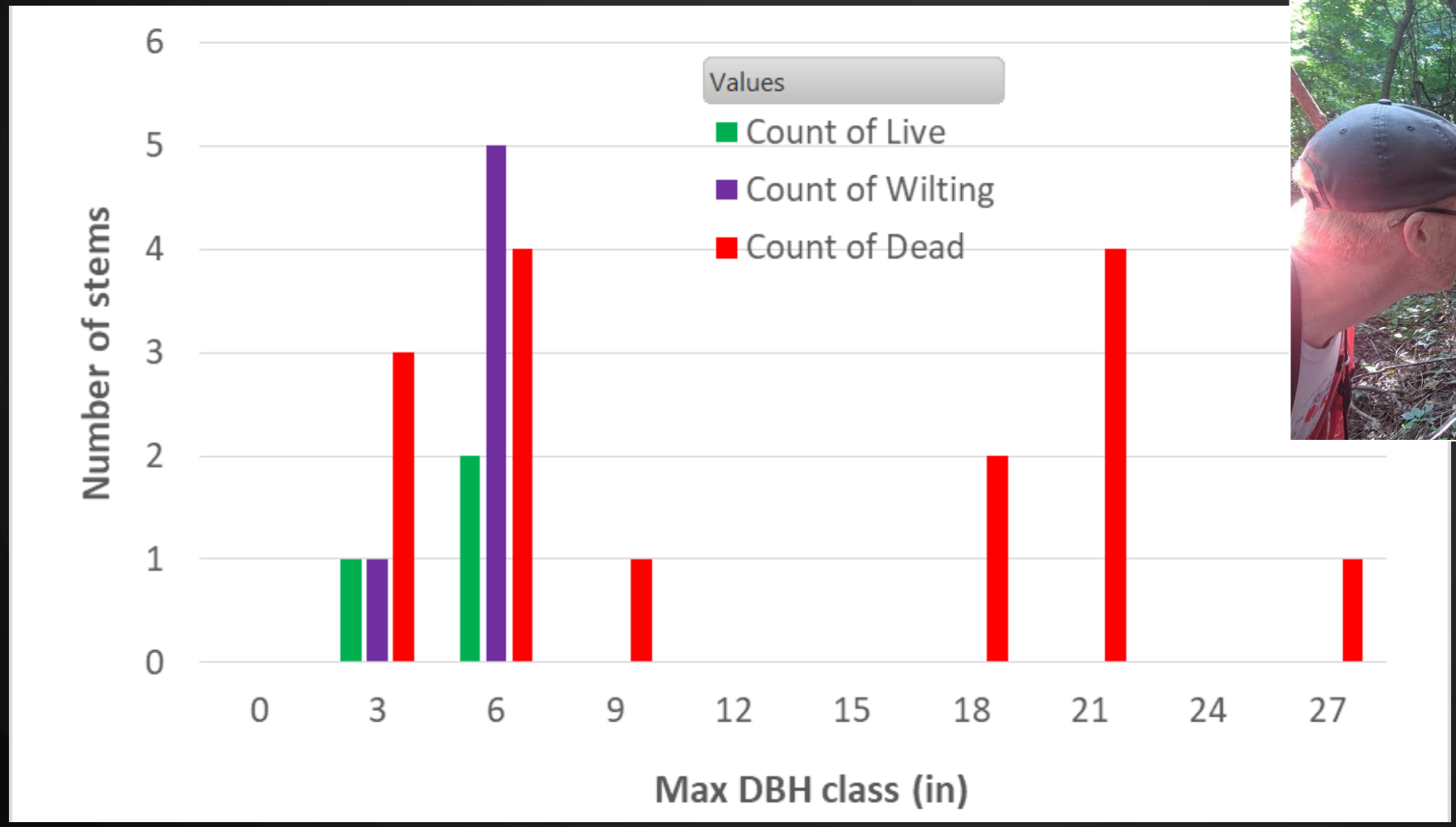
Mayfield and Brownie 2013 Env. Entomol. 42: 743



Cameron et al 2015 Southeastern Naturalist 14:650

Sassafras mortality at Oak Grove, Christian Co., KY

Snapshot of two, 0.2-ac plots on 8/23/2019



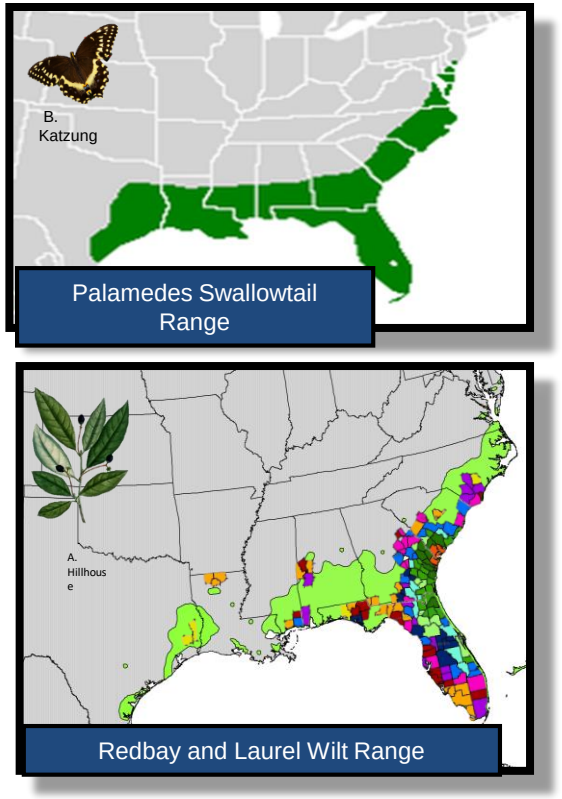
John Riggins, John Formby

MISSISSIPPI STATE UNIVERSITY

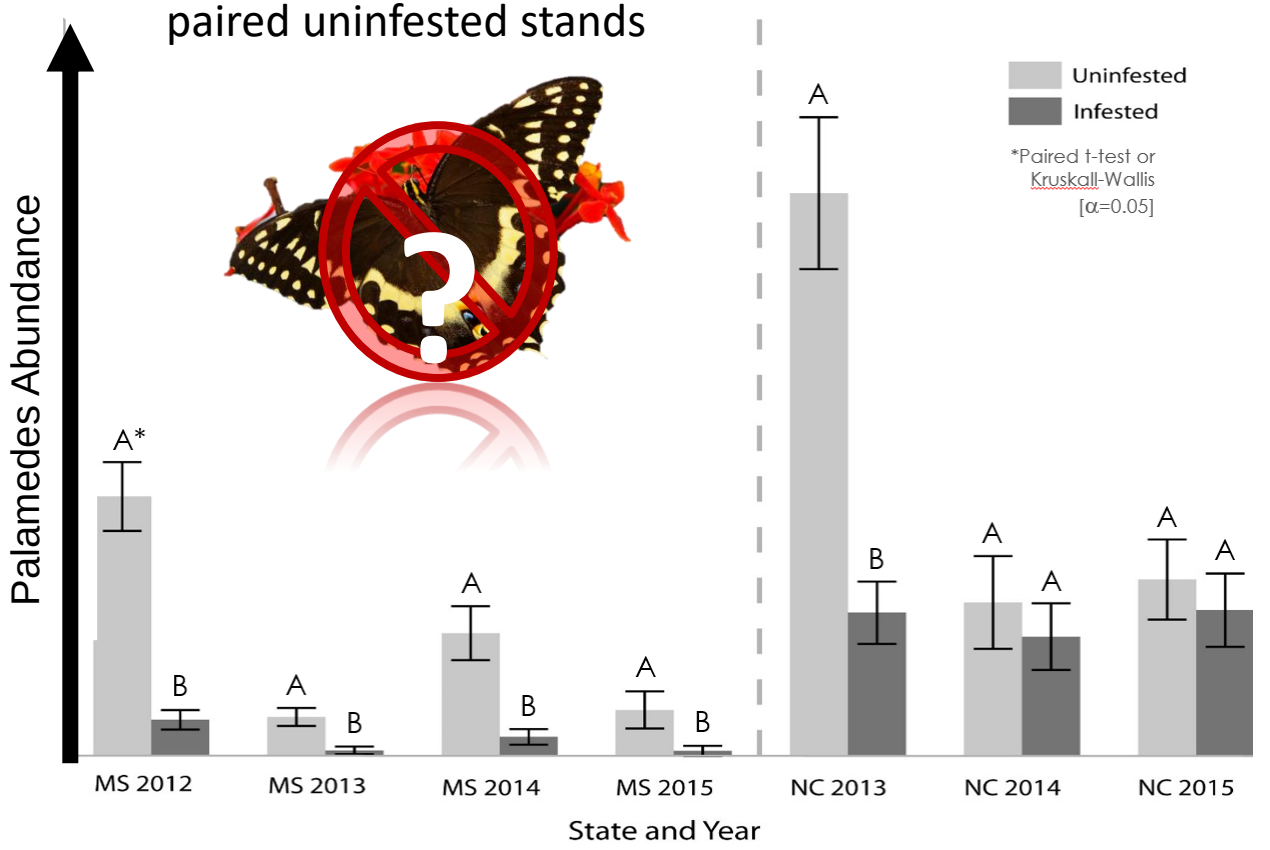
Examples of At-Risk Species: Palamedes swallowtail

Riggins et al. (2019)
Biol Invasions 21:493

- "Pollard transects"



- 3-7 fold decrease in palamedes abundance versus paired uninfested stands

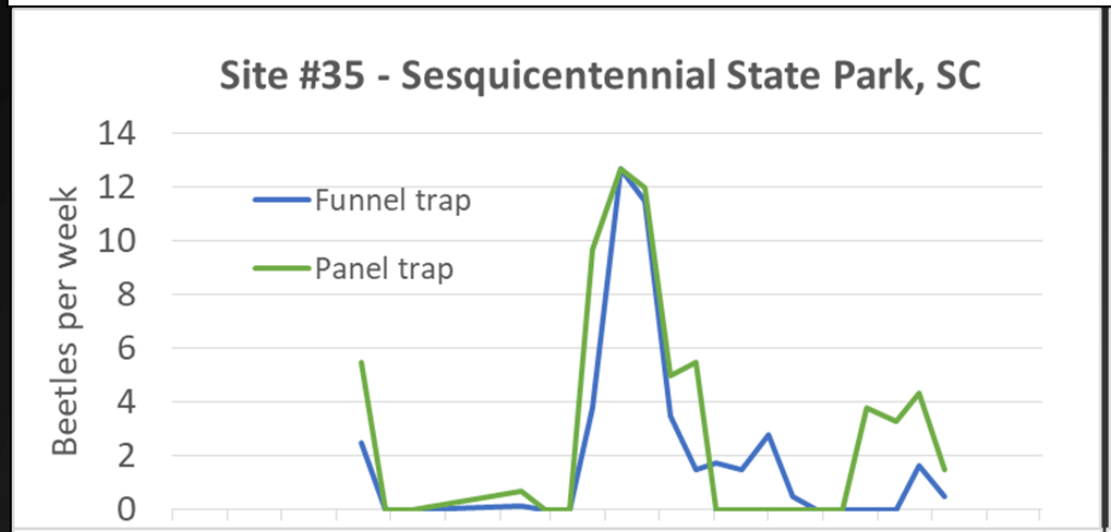


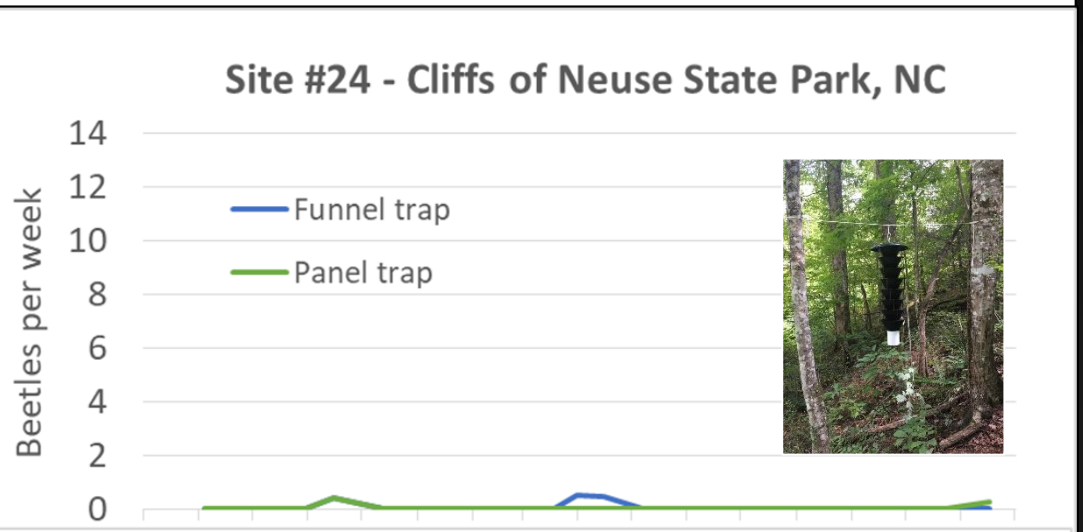
Monitoring for Laurel Wilt

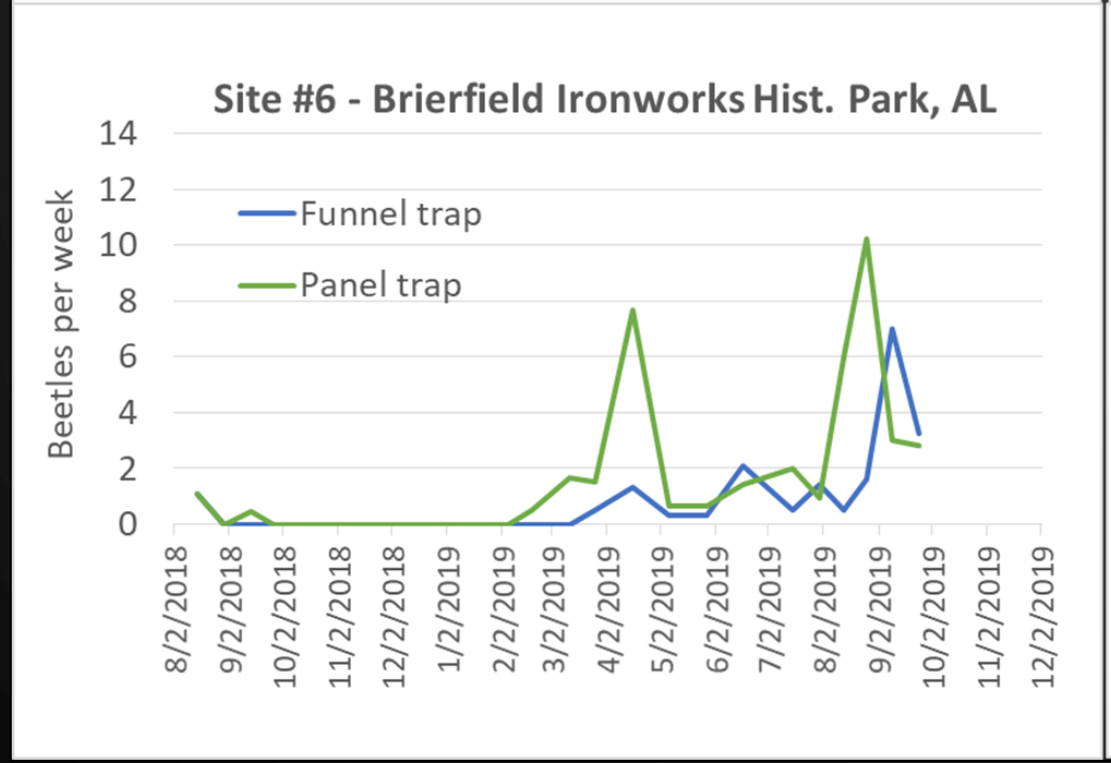
RAB Flight Traps

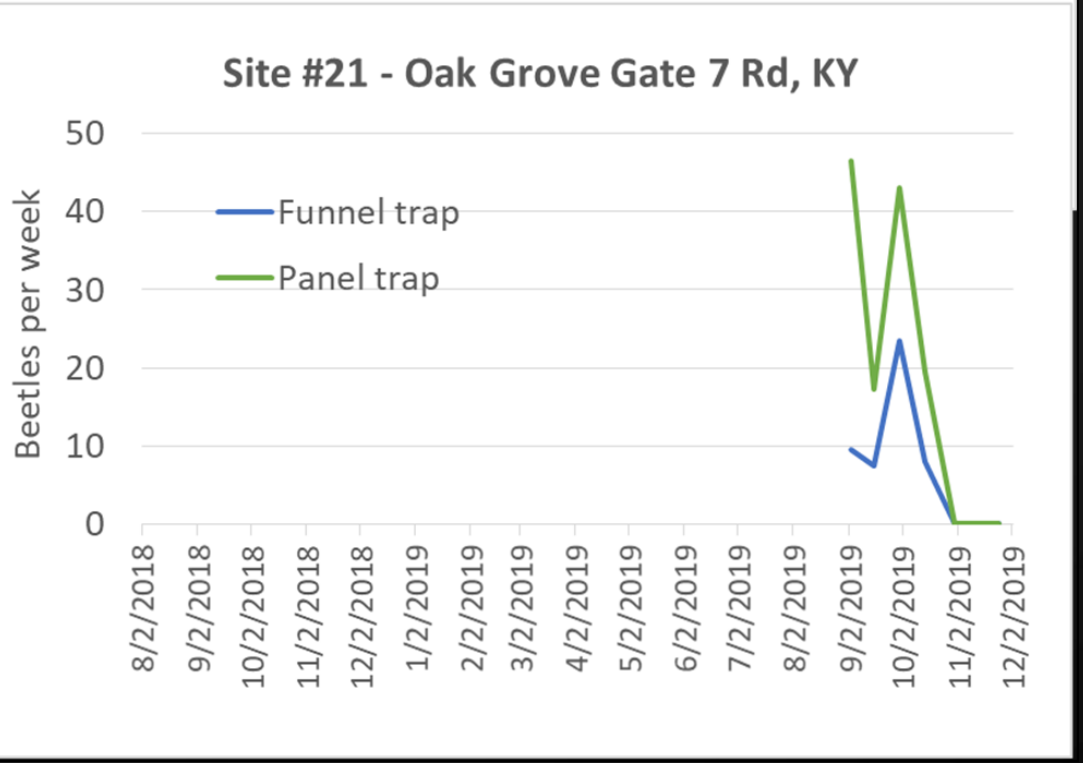
- Funnel, panel, sticky
- Mimic host silhouette
- Bait with host volatiles
  - Commercial essential oil lures
    - Alpha-copaene is a primary attractant
  - Fresh bolts of host trees
  - Short-range attraction
    See Hanula et al (2016)
    J. Econ. Entomol. 109: 1196
- No pheromone lures

Fig 4. *Xyleborus glabratus* trap catches at 4 selected sassafras monitoring sites.









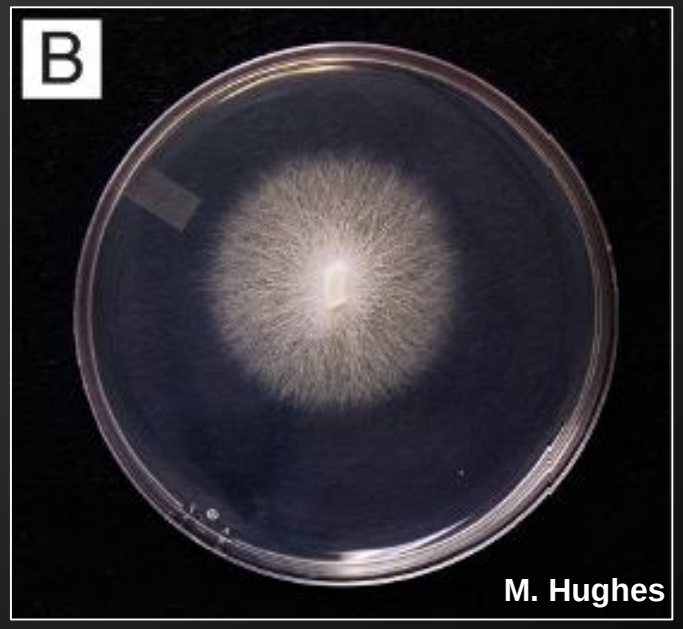
Ambrosia beetle monitoring traps at Oak Grove, KY

Aug 23-Oct 31, 2019 (2 months, 2 traps)

Ambrosia beetle species	Count	Percent
Xylosandrus crassiusculus	1050	55.6%
Xyleborus glabratus	322	17.0%
Xyleborinus saxeseni	298	15.8%
Xylosandrus germanus	109	5.8%
Dryoxylon onoharaensis	39	2.1%
Euwallacea validus/interjectus	9	0.5%
Monarthrum mali	6	0.3%
Cnestus mutilatus	5	0.3%
Xyleborus affinis	4	0.2%
Monarthrum fasciatum	3	0.2%
Xyleborus ferrugineus	2	0.1%
Unidentified	43	2.3%
Total	1890	100.0%

Laurel wilt pathogen confirmation

- Field collection of moist sapwood with xylem discoloration
- Isolate fungus on selective media
- Morphological ID (Harrington et al 2008 Mycotaxon 104:399)
- DNA extraction and PCR amplification (Dreaden et al 2014 Plant Dis 98:379)
- LAMP assay for DNA-based field confirmation (C. Villari, J. Hamilton, UGA)
- NPDN network has a protocol for diagnostic labs (Harmon et al 2014 NPDN)



Managing for Laurel Wilt

Challenges to regulation and management of redbay ambrosia beetle / laurel wilt

- New detections often = old infestations
- 1 female beetle = dead tree
- 1 female beetle = new population
- Females find geograph. isolated trees
- No evidence for pheromone
- Easily moved in wood
- Most of life cycle within tree
- Low economic value of forest hosts
- Hosts not completely eliminated, beetles remain after epidemics

Management Tactics

- Don’t transport untreated firewood, esp. stems of lauraceous species
- Don’t sell/transport wilted nursery stock of laurel family plants

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- Don’t transport untreated firewood, esp. stems of lauraceous species
- Don’t sell/transport wilted nursery stock of laurel family plants
- Sanitation: chipping trees may not kill all the beetles but could help reduce local populations, new infections

See Spence et al (2013) J. Econ. Entomol. 106:2093

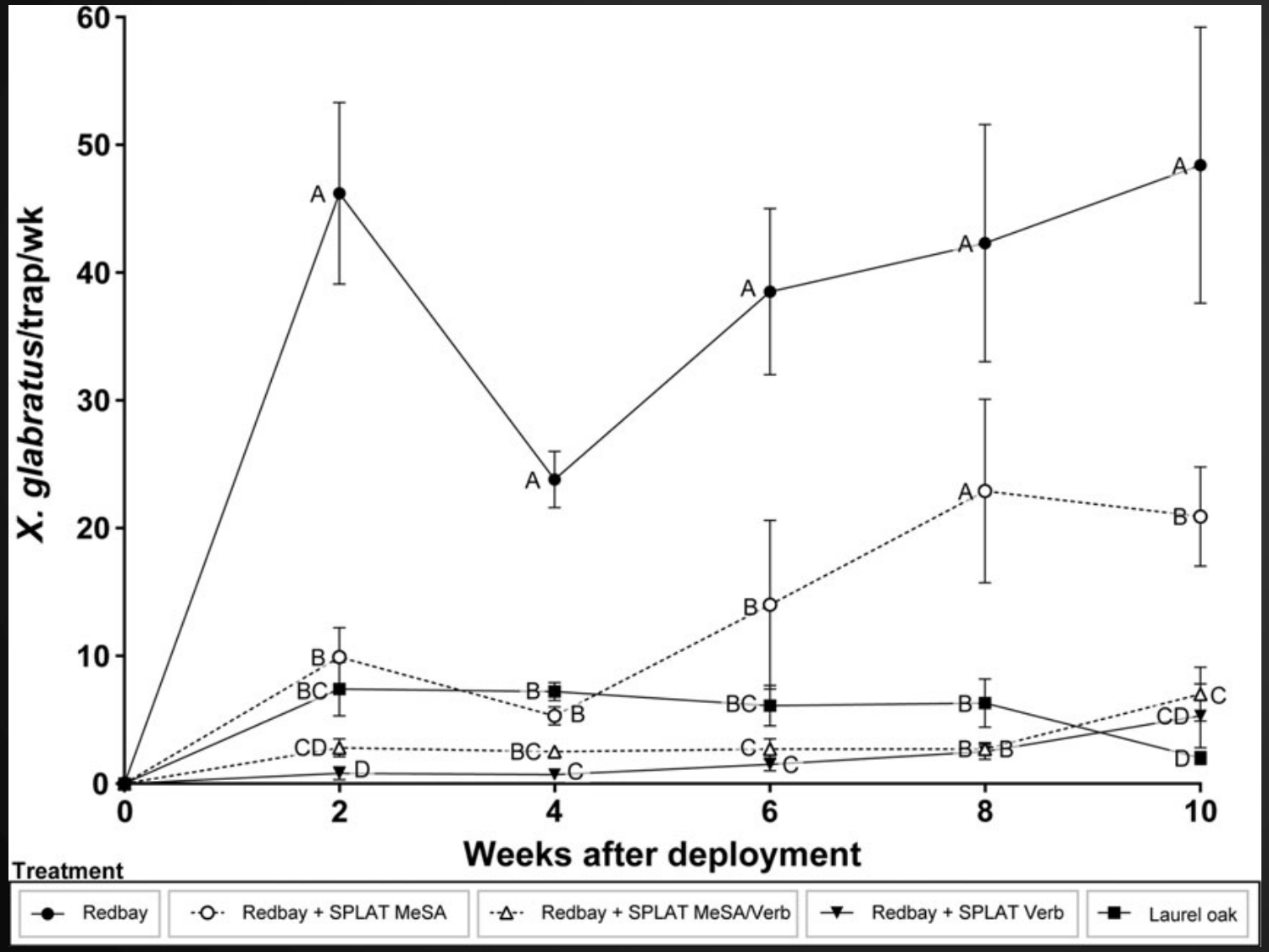
Photos: Don Spence

Management Tactics

- Don’t transport untreated firewood, esp. stems of lauraceous species
- Don’t sell/transport wilted nursery stock of laurel family plants
- Sanitation: may not kill all the beetles but could help reduce local populations, new infections
- Fungicide infusion: Has been demonstrated to protect redbay, trials in sassafras pending (Andrew Loyd- Bartlett Tree, Rabiu Olatinwo - SRS)

Evaluation of repellents for the redbay ambrosia beetle, *Xyleborus glabratus*, vector of the laurel wilt pathogen

M. A. Hughes[1,a], X. Martini[2,3,a], E. Kuhns[2,*], J. Colee[4], A. Mafra-Neto[5], L. L. Stelinski[2] & J. A. Smith[1]



Compound verbenone, applied using SPLAT, repels RAB

Reduces RAB landing rates on trees

Martini et al (2019) Ag. For. Entomol. 22: 83

Marc Hughes
dissertation on
redbay resistance
at UF with
Jason Smith

Tyler Dreaden:
Lingering sassafras
project STDP
proposal for similar
approach

Closing Points

- Laurel wilt is a vascular wilt disease that has killed hundreds of millions of trees (Laurel family) in the SE Coastal Plain
- It is moving into more upland regions of the eastern US causing sassafras mortality, and is likely to continue spreading, including through wood movement.
- Management options are limited and the potential for negative impacts on Lauraceae in the Americas and beyond is high.

THANKS!

Bud Mayfield

USDA Forest Service SRS

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