Simultaneous Laurel Wilt Biology and Resistance Research

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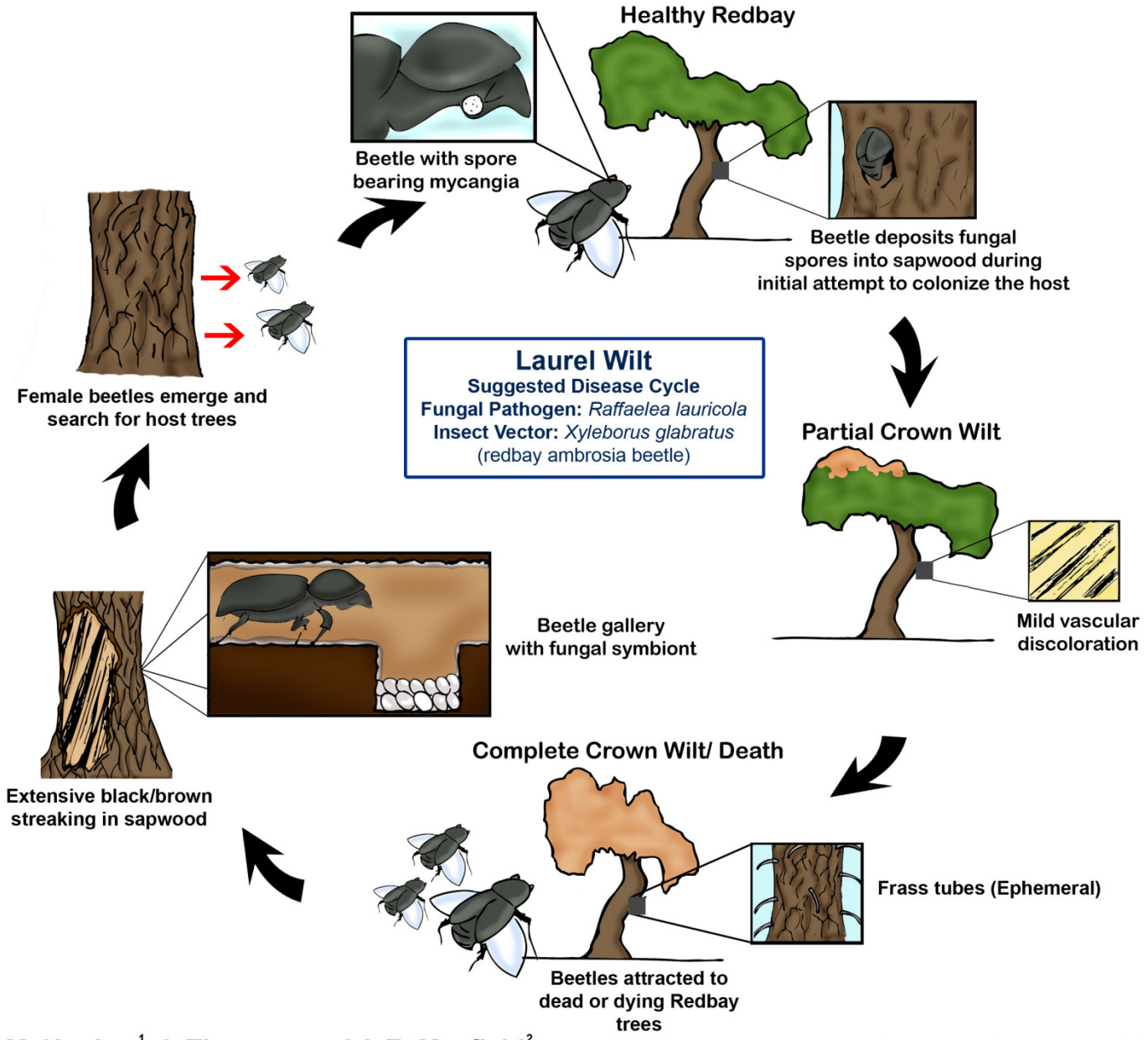
Fourth International Workshop on the Genetics of Host-Parasite Interactions in Forestry

August 1, 2011



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Last Revised 9/21/09

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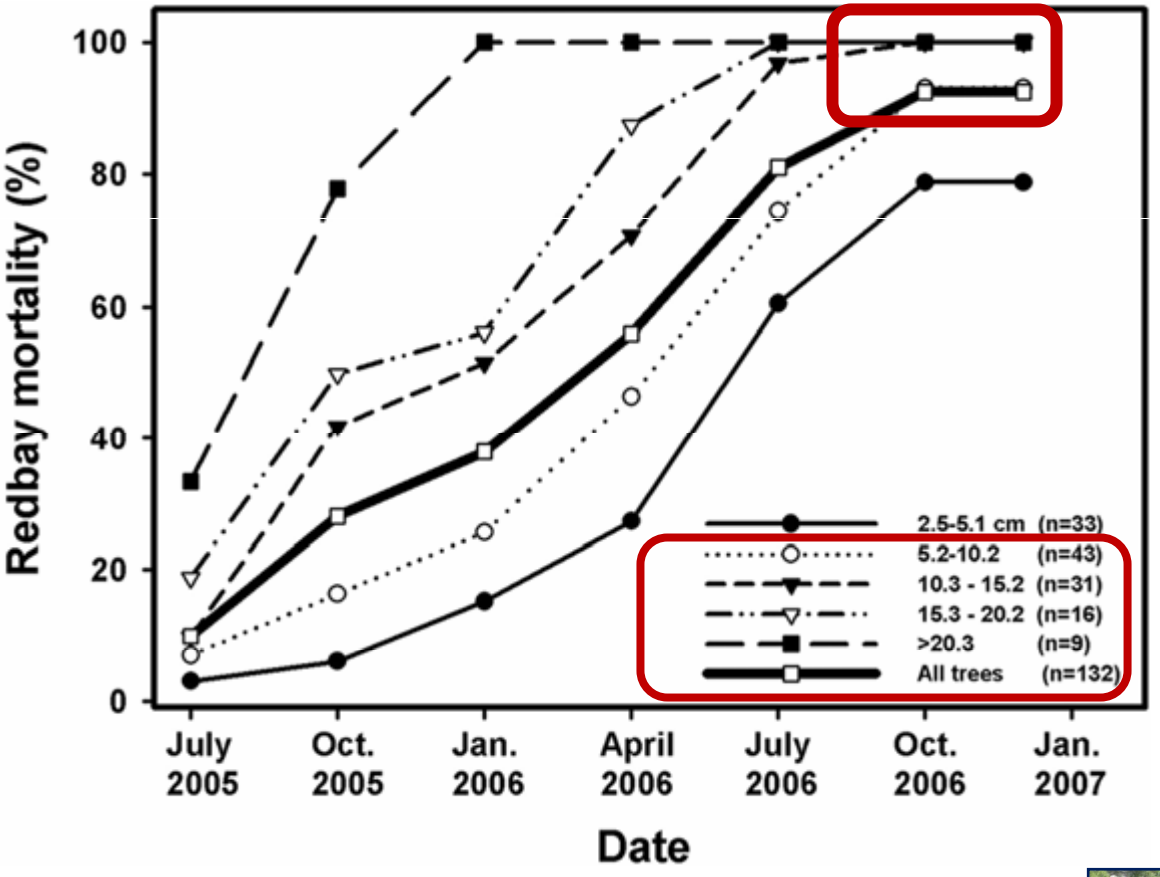
The redbay ambrosia beetle (*Xyleborus glabratus*)

Photo Credit: A. Mayfield

Extensive Redbay Mortality



Fort George Island, FL

Fraedrich et al. 2008

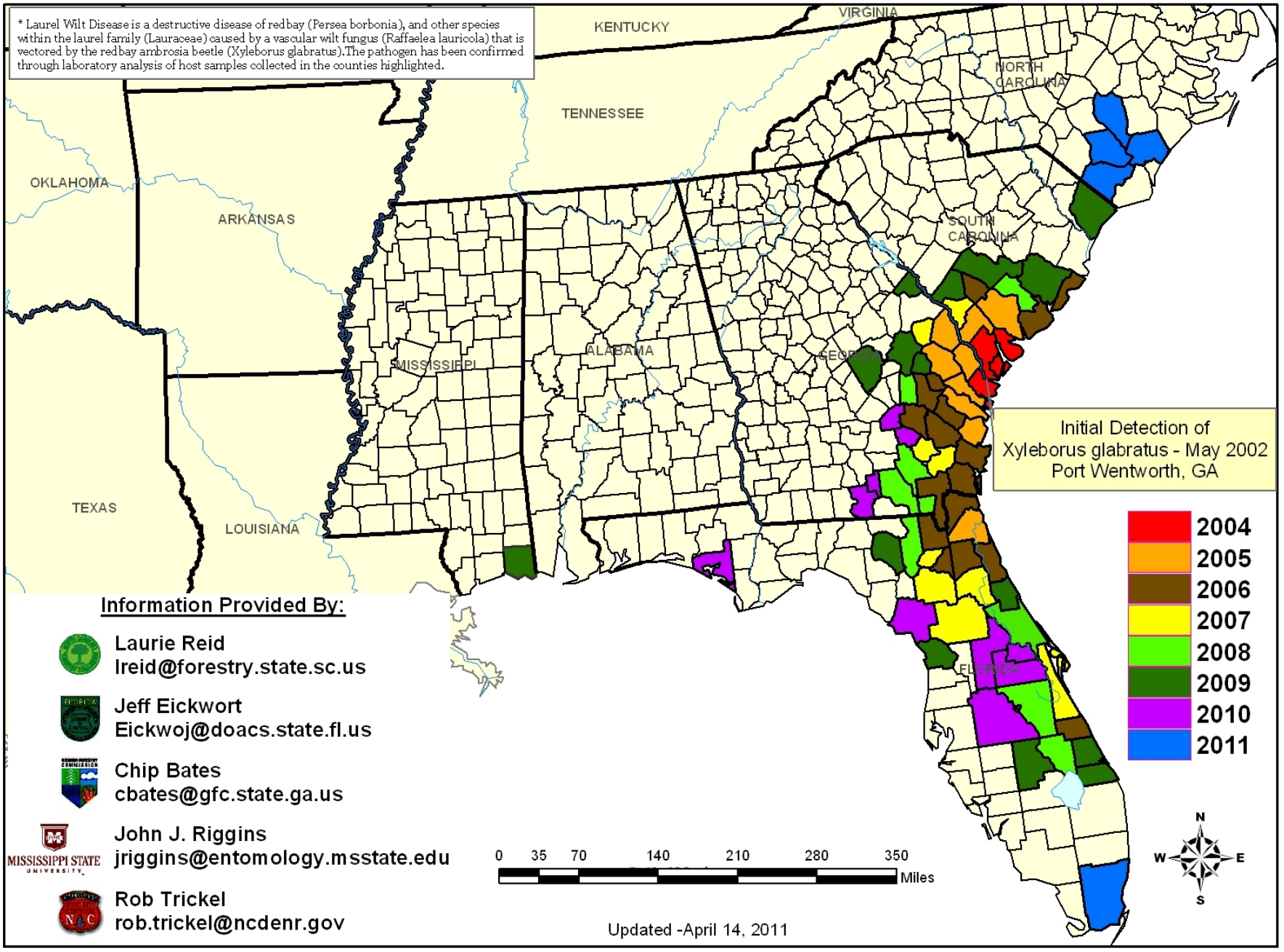
"By December 2006, all redbays greater than 10.3 cm DBH were dead"
Fraedrich et al. 2008

-Changed species composition of Little Talbot Island, FL
Goldberg and Heine 2009

Photo Credit: A. Mayfield

Avocado symptoms
(Merritt Island)

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



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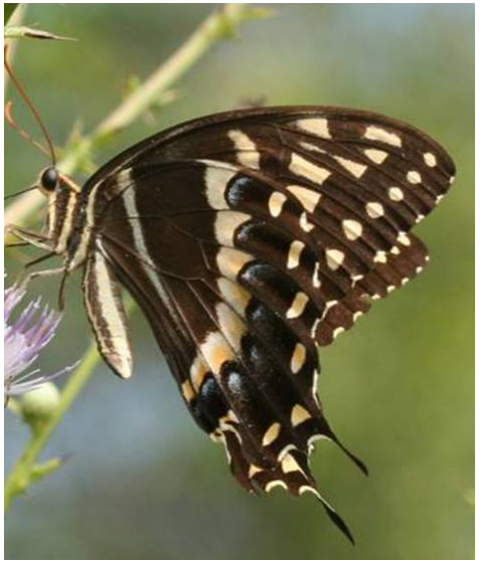
LW Disease Management

- Some success w/ systemic fungicides (propiconizole) for high value redbay trees (not avocado)
- Sanitation may be important
- Host range needs to be elucidated
- Long term disease management will rely on resistance



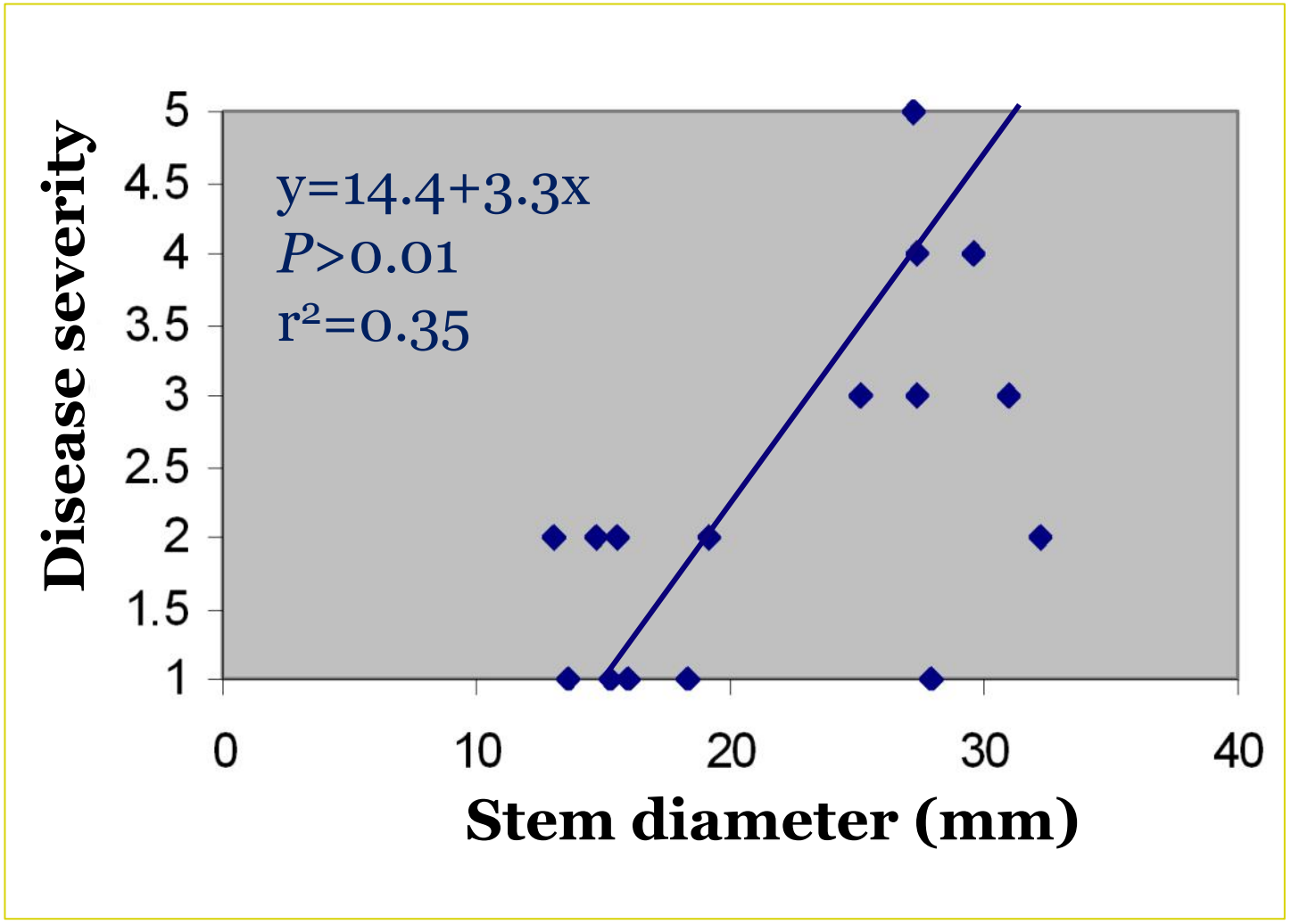
Laurel wilt disease screening

- Surveying natural redbay stands for survivors
  - Screening of propagules (more later from M. Hughes)
- Screening avocado germplasm – 41 cultivars have been tested so far
- Delineating host-range - 35 taxa in the Annonaceae, Fagaceae, Lauraceae, Magnoliaceae, Moraceae and Sapindaceae
  - Based on known hosts of vector in Asia
  - Relatives of known suscepts
  - Only Lauraceae develop LW, and North American spp. most susceptible
  - Certain hosts are systemically colonized, but develop no symptoms

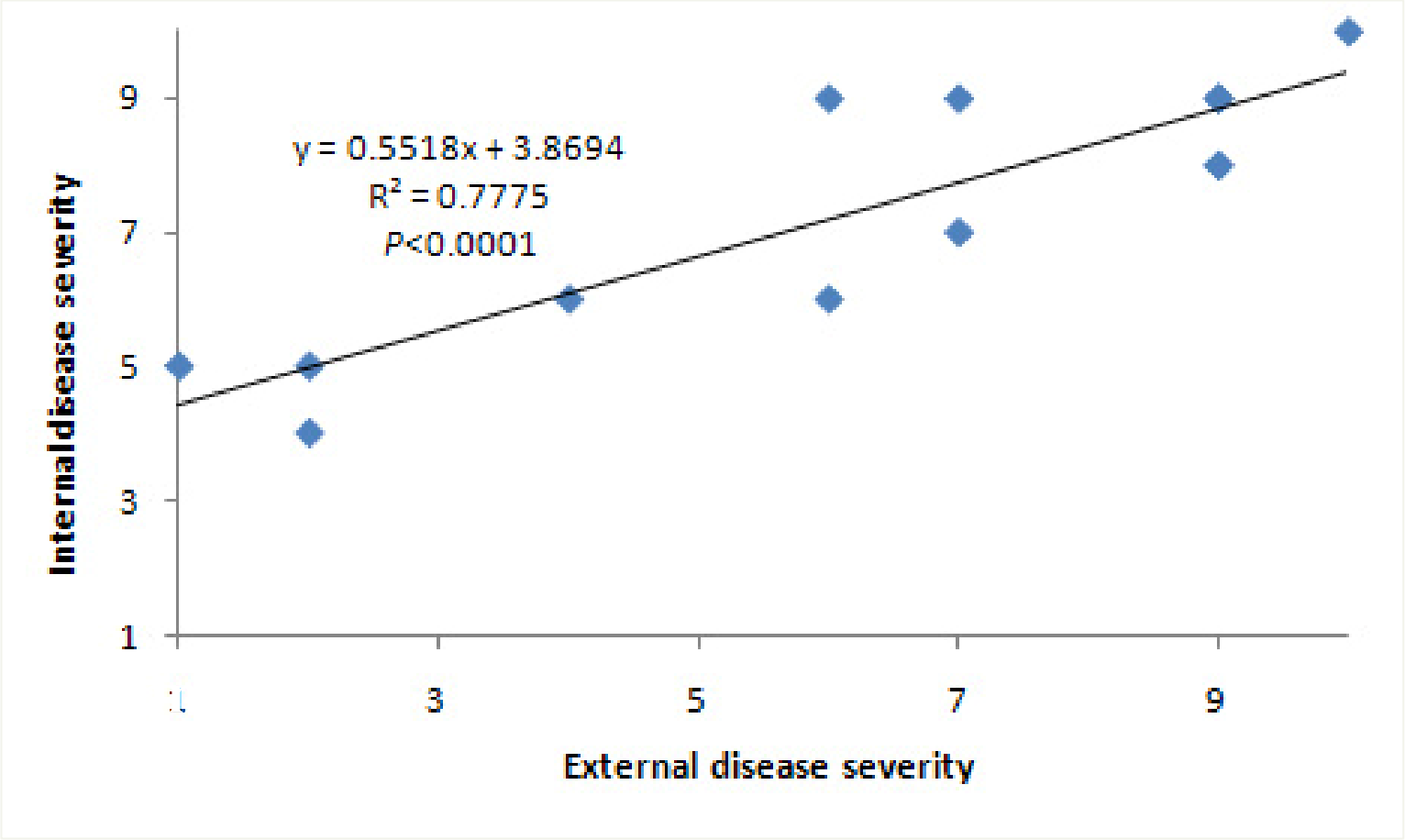
Laurel wilt disease screening

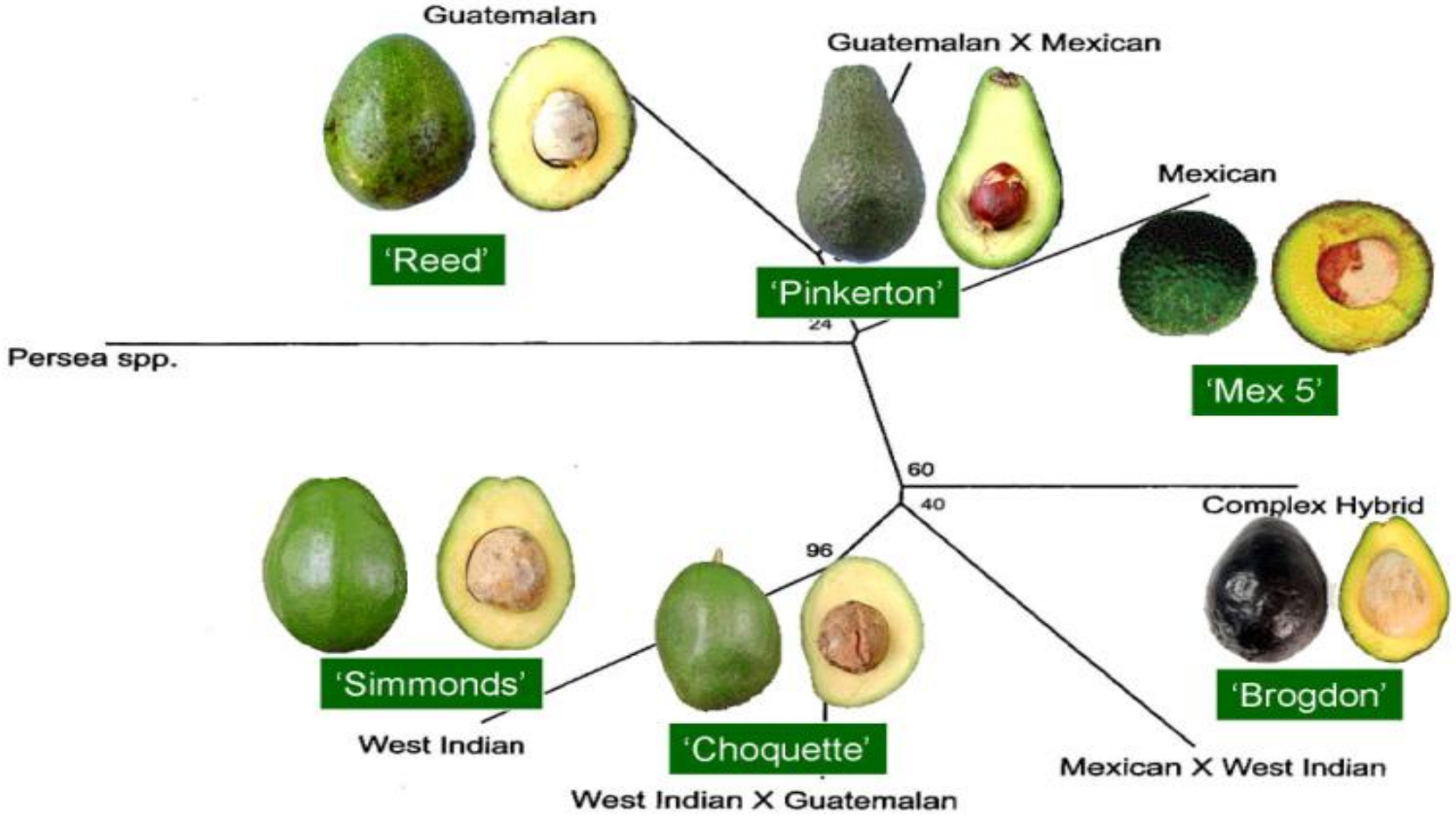
- Effective screening methods being developed
- Age of host material?
  - Evidence for “juvenile resistance”
- Inoculation methods?
  - Inoculum threshold (currently use 10^6 spores/mL)
  - Single isolate is sufficient (no genetic diversity present – more later)
  - Drill wounding works well
- Disease severity rating system?
  - Different responses in different taxa (defoliation, wilt etc.)
  - Internal vs. external symptoms (some hosts develop only internal symptoms and no wilt)
  - Multiple infections and longer evaluation times needed?

Plant size/age vs. disease development in ‘Simmonds’ avocado



Internal vs. external symptoms in ‘Simmonds’ avocado





Diverse avocado germplasm has been tested with an initial focus on Florida cultivars

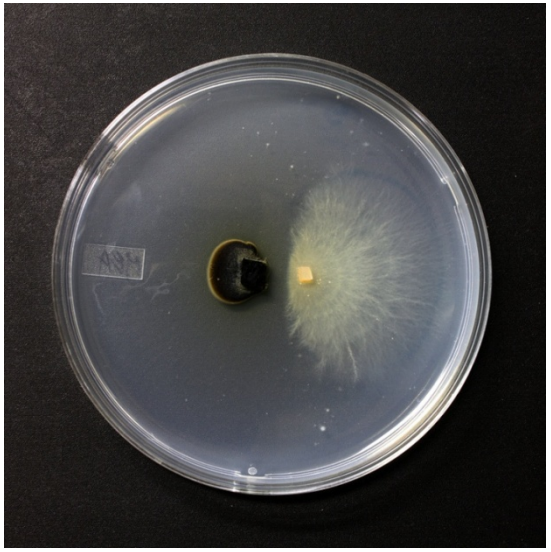
Response of different avocado cultivars and genomes to laurel wilt						
		Disease severity				
Cultivars	Genome	2008	2009	2010	2008-2010 mean	Genome mean
'Ettinger'	GxM	n/t	2.8 efg	n/t	-	
'Hass'	GxM	3.8 bc	2.7 efg	2.7 fghi	3.1 bcdef	
'Pinkerton'	GxM	n/t	n/t	3.3 defghi	3.3 bcdef	
'Winter Mexican'	GxM	n/t	1.8 g	2.3 hi	2.1 f	2.8 b
'Bacon'	G	n/t	2.2 fg	2.0 i	2.1fe	
'Marcus Pumpkin'	G	n/t	n/t	2.3 hi	-	
'Reed'	G	n/t	3.5 cdefg	n/t	-	2.5 b
'Brogdon'	GxMxWI	4.0 bc	4.1abcdef	4.1 bcdefg	4.1 abcdef	-
'Oro Negro'	MxWI	n/t	n/t	2.5 ghi	-	-
'Beta'	GxWI	n/t	3.5 cdefg	4.5 abcde	4.0 abcdef	
'Choquette'	GxWI	3.4 c	3.6 cdefg	2.6 fghi	3.2 bcdef	
'Hall'	GxWI	3.2 c	4.9 abcd	n/t	4.1 abcdef	
'Lula'	GxWI	5.7 a	3.1 defg	5.0 abcd	4.6 abcd	
'Miguel'	GxWI	6.0 a	3.7 bcdefg	n/t	4.9 abc	
'Monroe'	GxWI	5.2 ab	2.9 defg	3.3 defghi	3.8 abcdef	
'Tonnage'	GxWI	n/t	3.5 cdefg	3.0 efghi	3.3 bcdef	3.9 ab
'Bernecker'	WI	5.2 ab	4.2 abcde	3.8 efgh	4.4 abcde	
'Catalina'	WI	4.8 ab	5.4 abc	3.5 cdefghi	4.6 abcd	
'Day'	WI	n/t	4.3 abcde	n/t	-	
'Donnie'	WI	6.2 a	4.5 abcde	5.4 ab	5.4 ab	
'Hardee'	WI	n/t	n/t	4.3 abcdef	4.3 abcdef	
'Pollack'	WI	n/t	3.7 bcdefg	n/t	-	
'Russell'	WI	n/t	5.6 ab	5.1 abc	5.4 ab	
'Simmonds'	WI	6.3 a	5.8 a	5.8 a	6.0 a	
'Trapp'	WI	n/t	3.3 defg	n/t	-	
'Waldin'	WI	n/t	4.3 abcde	n/t	-	4.8 a

Future goals: Understand relative contributions of M, G and WI races, and identify laurel wilt tolerance in new and existing lines.

Coldest winter in years…

Host-pathogen interaction

- Water conductance assays revealed loss of xylem function
- Why do trees die so rapidly?
  - Little evidence for toxin involvement so far
  - Host may be “over-reacting” in a non-specific way
- Histology (inc. GFP strains) revealed very little fungal colonization
- Tyloses were observed in avocado, but not redbay
  - Vessels are not occluded by pathogen presence
- Molecular characterization of interaction is underway
- Endophytes in “survivor” trees may hold promise for biocontrol



‘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

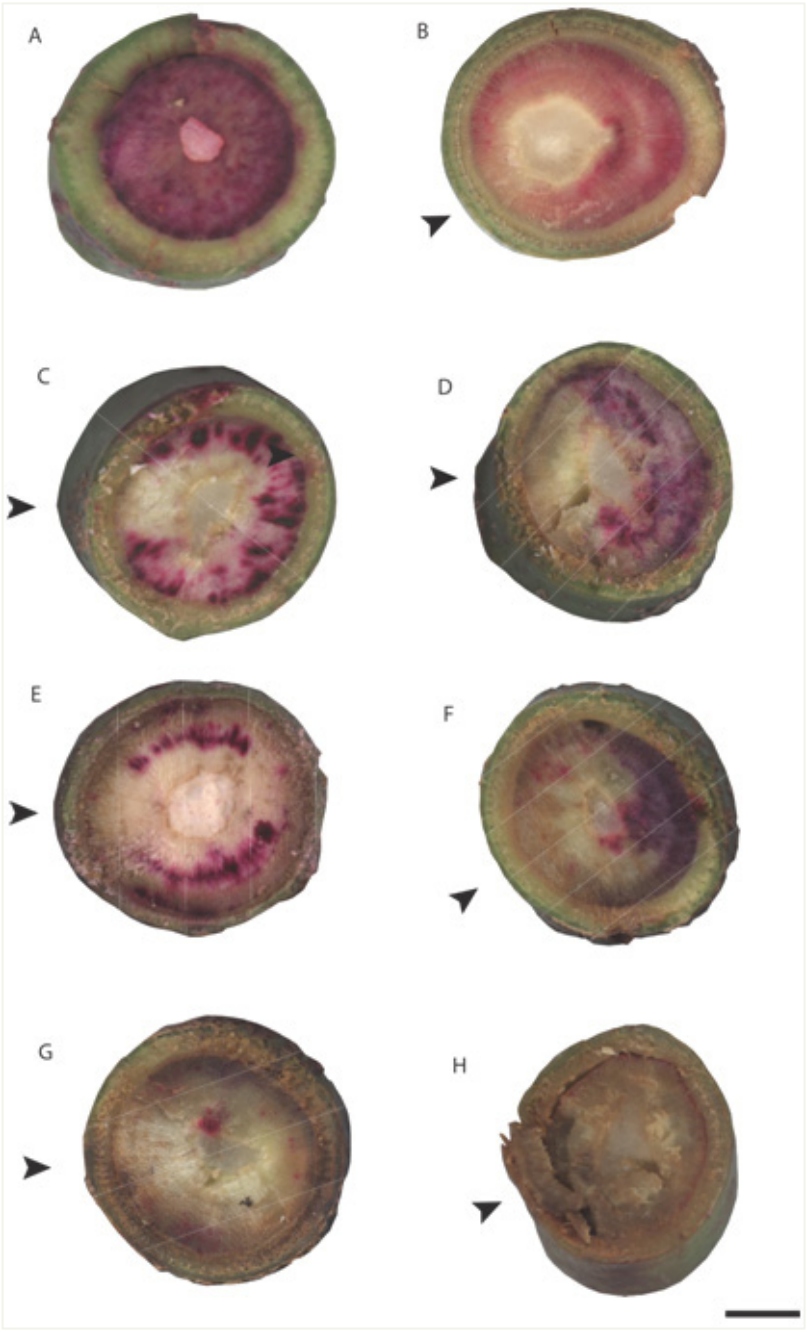
E. 21 dai, es = 3, is = 5

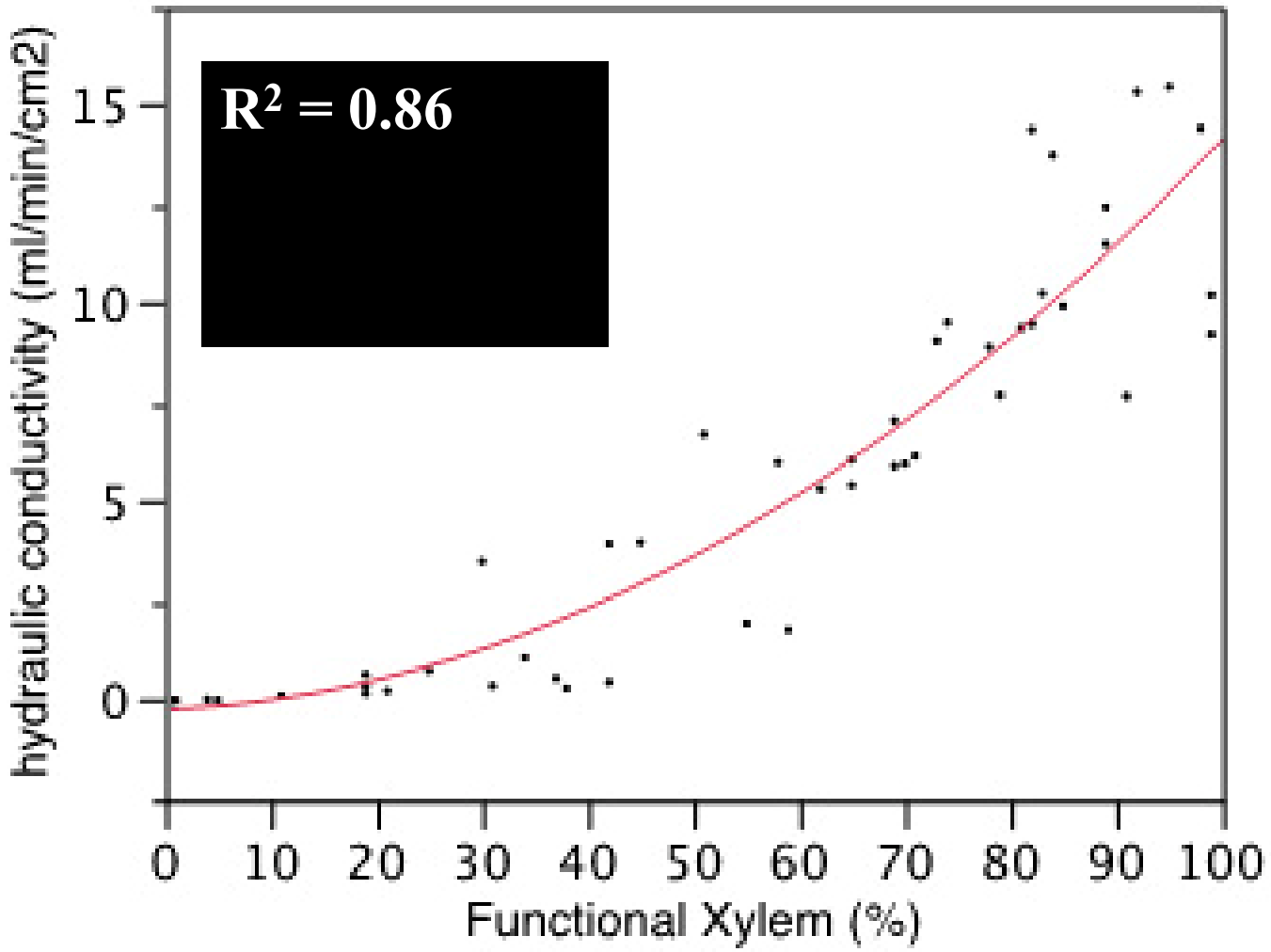
F. 21 dai, es = 5, is = 6

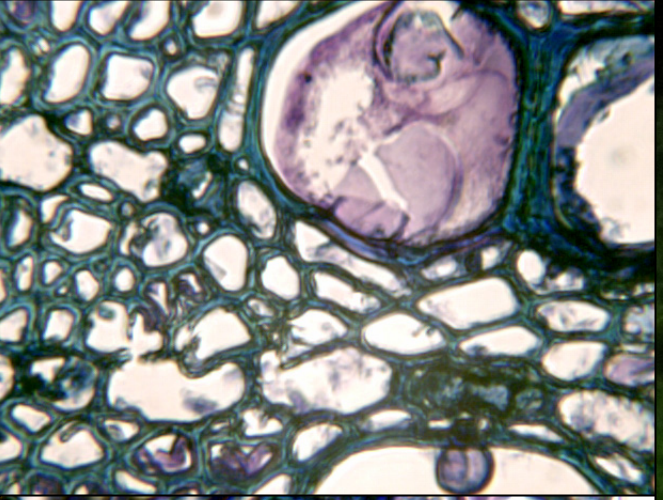
G. 42 dai es = 8, is = 9

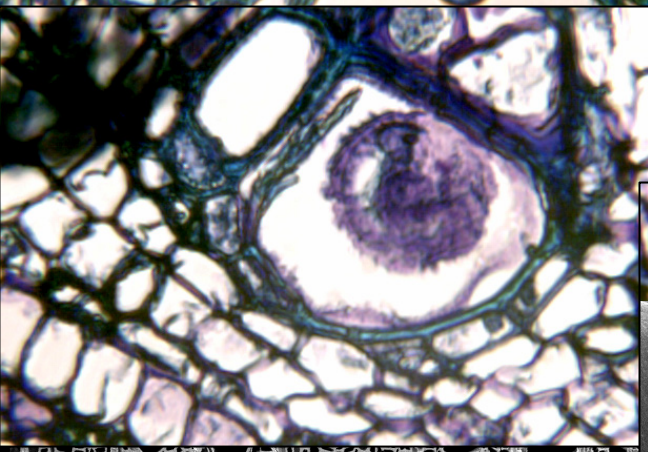
H. 42 dai, es = 9, is = 9

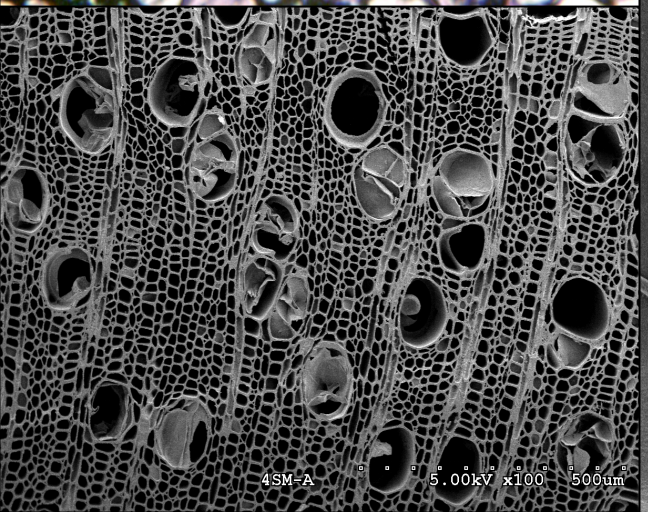
Scale bar = 0.5 cm. Arrows denote side of stem that was inoculated.

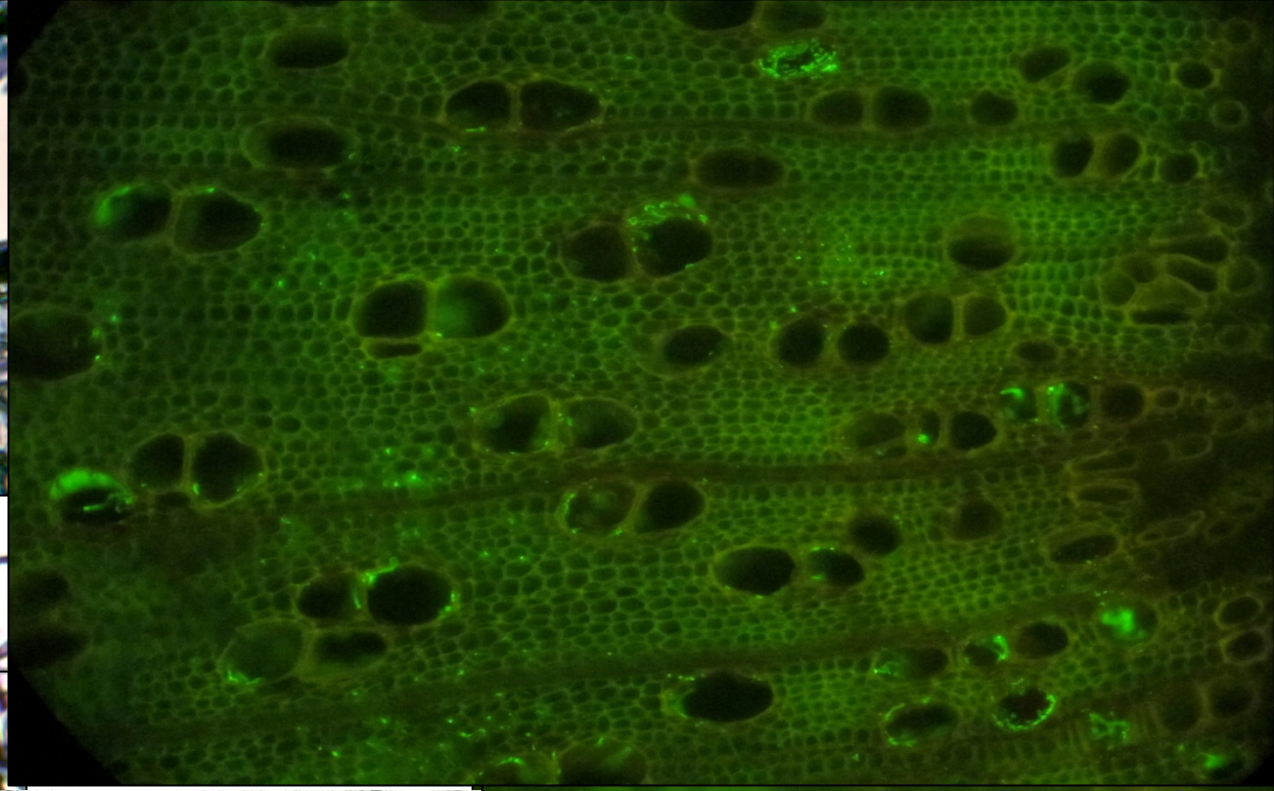



R² = 0.86
hydraulic conductivity (ml/min/cm2)
15
10
5
0
0
10
20
30
40
50
60
70
80
90
100
Functional Xylem (%)

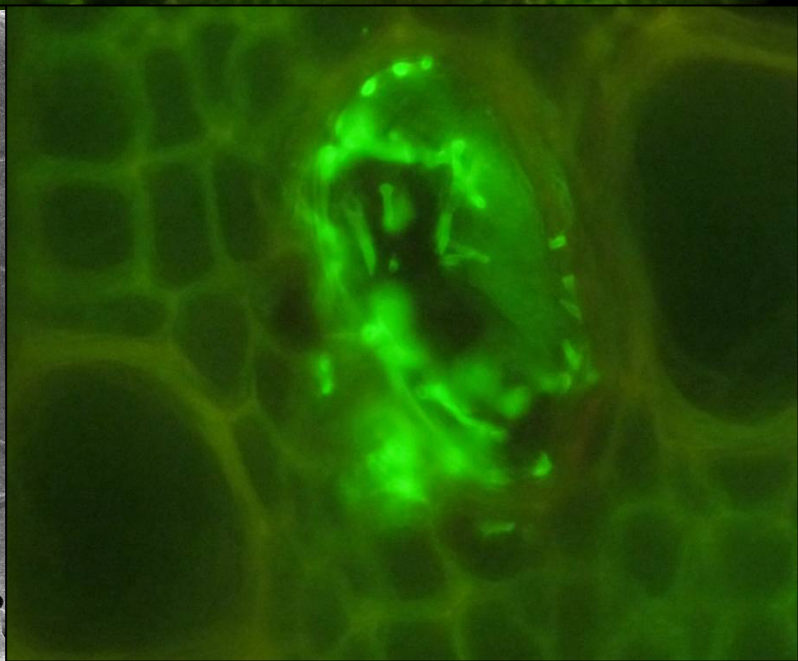





4SM-A
5.00kV x100 500um




5.00kV x1.2k 25um
4SM-A



Future Directions

- Gain insight from native range
- Elucidate mechanisms of “resistance”
- Screen selected clones in natural environment over long term
  - NIFA proposal w/ J. Hulcr to look @ persistence of LW in landscape
- Establish seed orchard and study inheritance

“Our Team Says Thank Ya’ll”

- Tyler Dreaden, Ph.D. student - molecular diagnostics
- Fred Beckman, M.S. student - pruning transmission
- Don Spence, Ph.D. student - mulch and beetle and fungus survival
- Keumchul Shin, Ph.D. student - host-pathogen interactions
- Collaborators - Randy Ploetz, Lukasz Stelinski, Jiri Hulcr, Sharon Inch, Bud Mayfield, Jeff Eickwort, Grechen Pruett, Ben Held, Tom Harrington, Jorge Pena, Alina Campbell, Gurpreet Brar
- Funding - USDA (AFRI, Critical Issues and SCRI), UF/IFAS Research, USDA Forest Service
- **Many of the slides/photos in this presentation are not mine – we have a good team!**