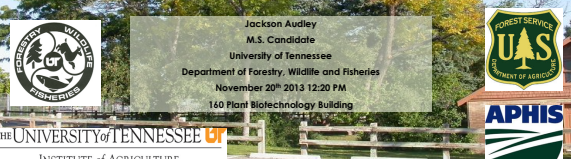


Utilization of black walnut trees and wood products by the invasive walnut twig beetle and the associated fungal pathogen *Geosmithia morbida*: Components of the Thousand Cankers Disease complex, in eastern Tennessee

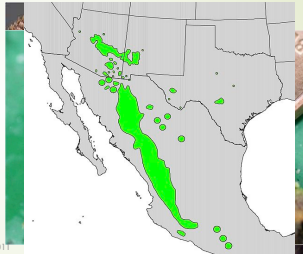
Jackson Audley
M.S. Candidate
University of Tennessee
Department of Forestry, Wildlife and Fisheries
November 20th 2013 12:20 PM
160 Plant Biotechnology Building



THE UNIVERSITY OF TENNESSEE
INSTITUTE of AGRICULTURE

2 **What is Thousand Cankers Disease?**

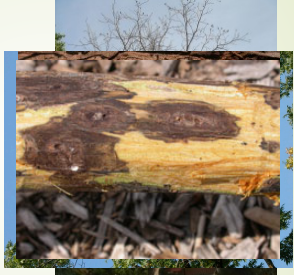
- Walnut twig beetle (*Pityophthorus juglandis*) + fungal pathogen (*Geosmithia morbida*)
- **Invasive**
- Native to the southwest on Arizona walnut (*Juglans major*)



Tisserat et al. 2009; Clanshaw 2011; Molzahn 2011

3

- Cankers form around WTG galleries in the phloem
- Not systemic
- Beetle feeding + cankers = girdle branches
- Top down dieback
- Symptoms: Yellowing leaves in the crown; flagging; branch dieback



Tisserat et al. 2009

4

A Brief History of TCD

- Walnut decline across the west since 1990's
- Walnut twig beetle (WTB) associated with decline in NM in 2001
- 2007 unk. *Geosmithia* spp. Recovered in CO
- Thousand Cankers Disease (TCD) confirmed in *J. nigra* native range – 2010 Knoxville, TN
- Now confirmed in TN, NC, VA, PA, OH

Tisserat et al. 2009; Kolarik et al. 2011; Grant et al. 2011; Seybold et al. 2012, Ohio Department of Agriculture 2013, North Carolina Forest Service 2013

5

Distribution of TCD as of June 2013

Legend

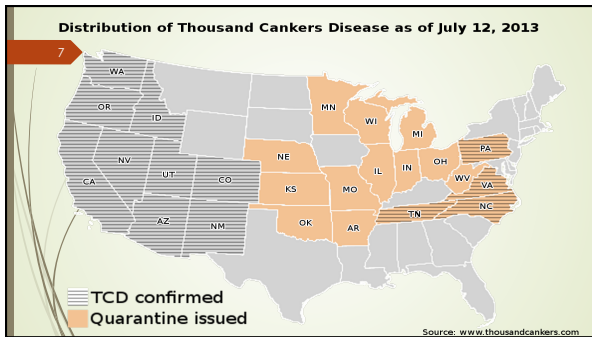
- States confirmed with TCD
- Walnut twig beetles detected in traps in a mill
- Natural range of black walnut

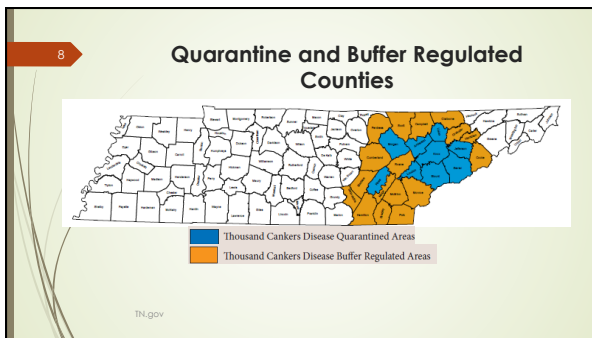
6

History continued

- Black walnut and butternut (*J. cinerea*)- most susceptible
- State quarantines: Wood; Firewood; Nursery Stock; Bark material
- Required: Steam treated; fumigated; squared edge, kiln dried, bark-free lumber; and finished wood products

Utley et al. 2009; TN.gov





9

Why do we care?

- Walnut: estimated >\$500 billion standing timber
- TN: \$1.37 billion in urban areas and \$1.47 billion in forest lands
- **Veneer**, furniture, gun stocks, cabinetry, and other specialty items
- Important ecological species; nuts = human and wildlife food source
- Invasive phytophagous insects on the rise
- Another iconic American hardwood species is threatened

Newton and Fowler 2009; Haun et al. 2010; Moltzan 2011; Aukema 2010

10

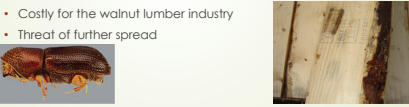
Research Objectives

1. Determine the ability of *Pityophthorus juglandis* to colonize treated black walnut wood – Post-treatment Colonization Study
2. Determine the ability of *Pityophthorus juglandis* to colonize black walnut seedlings – Nursery Stock Study
3. Determine the length of time *Geosmithia morbida* remains viable in cut black walnut wood – Geosmithia Persistence Study

11

Post-treatment Colonization Study - Justification

- Successful phytosanitation: Heat and Methyl Bromide fumigation treatment
 - Once treated, further protection?
- Regulations – invasives still introduced
- Wood boring and bark beetles colonize slivers of bark left on WPM
- Costly for the walnut lumber industry
- Threat of further spread



Aukema et al. 2010; Haack and Pettice 2009; Mayfield et al. 2013; Myers et al.; Newton and Fowler 2009



13

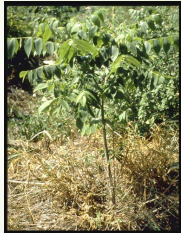
Post-treatment Colonization Study - Analysis

- Response variables:
 - Densities of beetles/treatment
 - Gallery length/treatment
 - WTB life stage count/treatment
- Means compared independently using analysis of variance (ANOVA) in SAS
- $\alpha = .05$

14

Nursery Stock Study - Justification

- Are seedlings at risk of WTB attack?
- Possible TCD pathway
- Seedlings are currently restricted under quarantine
- No method to treat



Aukema et al. 2010; Newton and Fowler 2009; thousandcankers.com

15



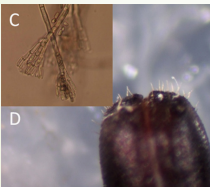
16

Nursery Stock Study - Analysis

<p>No-Choice Assay</p> <ul style="list-style-type: none">• Response variables:<ul style="list-style-type: none">• # adults in cage• # of attack holes• Emergence• Means compared independently using SAS ANOVA• $\alpha = .05$	<p>Choice Assay</p> <ul style="list-style-type: none">• Response variables:<ul style="list-style-type: none">• # of attack holes/seedling• # of beetles emerged• Gallery length• Means compared independently using SAS ANOVA• $\alpha = .05$
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17

Geosmithia Persistence Study - Justification

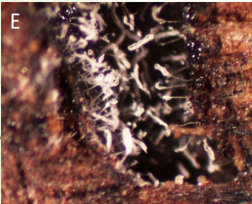


- How long will cut walnut wood remain a potential source?
- *Geosmithia morbidia* spores possibly "picked-up" by other species
- Several ambrosia beetle spp on walnut – potential vectors
- Recovery attained 12 weeks post cutting

Kalorik et al. 2011; Newton and Fowler 2009; Reed et al. 2013; Friedrich personal communication

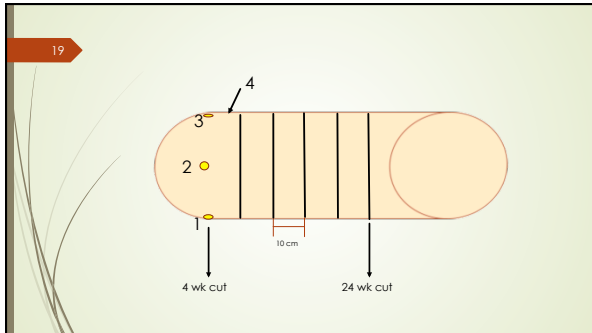
18

Geosmithia Persistence Study – Methods




- 60, 80 cm walnut bolts (n=60)
- 4 treatments (15/treatment): Inoculated Outside; Inoculated Inside; Control Outside; Control Inside
- 4 wounds at 6 locations – agar plug
- Inoculation = *Geosmithia morbidia* culture and
- Control bolts = 1/2 strength Potato Dextrose agar (PDA) plug

Utely et al. 2012; Klepzig et al. 1995



20

Geosmithia Persistence Study – Methods



- The Outside bolts in mesh cages
- Inside in climate controlled room
- A cookie cut every 4 weeks
- Bark chipped and plated on 1/2 PDA
- Incubated for 14 days
- Fungal growth assessed

Utely et al. 2012; Klepzig et al. 1995; Froedrich personal communication

21

Geosmithia Persistence Study - Analysis

- Response variable: Proportion of plates with GM growth per treatment
- Mean proportions analyzed using a Chi Squared test in SAS,
 - Significant differences – pairwise comparisons using Fisher's Exact tests in SAS
- $\alpha = .05$



25

Questions?

Or email me @ Jaudley@utk.edu
