What is Thousand Cankers Disease?

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

Cankers form around WTB 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
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: 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

Distribution of TCD as of June 2013

- 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

History continued
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

Source: Newton and Fowler 2009; Dall et al. 2010; Haun et al. 2010; Aukema 2010
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

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

Methods

- n = 150, 70 cm (2ft) long pieces assigned to 1 of 5 treatments
- 90 walnut bolts (7-16 cm diam):
  - 30 heat treated; 30 fumigated; 30 no treatment
- 60 pieces of walnut lumber:
  - 30 bark on; 30 bark free
- Bolts hung in 30 trees at 11 sites around Knoxville, TN with a WTB lure
- Bolts hung for 30 days: from August 5th to September 5th 2013
- ½ placed into emergence barrel
- ½ gallery length measured and WTB life stages recorded
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
  - \( \alpha = .05 \)

Nursery Stock Study - Justification

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

Nursery Stock Study – Methods

- No - Choice
  - 24 seedlings; 8 per size class:
    - \( \leq 1 \text{cm}, 1.5 - 2 \text{cm}, \text{and} \geq 2.5 \text{cm} \)
  - 50 beetles (25M and 25F) caged
  - May 2014; 15 days in greenhouse
  - Remaining adults and attack holes counted
  - Emergence barrel
  - Repeated August 2014

- Choice
  - 24 seedlings by size class
  - 2 blocks of 12 seedlings – 3 clusters of 4
  - 1 infested bolt/cluster
  - Set the groups out in May 2014 for 30 days
  - Attack holes will be counted
  - \( \frac{1}{2} \) to emergence, \( \frac{1}{2} \) excavated for galleries
  - Repeated in August 2014

Seybold et al. 2012
Nursery Stock Study - Analysis

No-Choice Assay
- Response variables:
  - # adults in cage
  - # of attack holes
  - Emergence
- Means compared independently using SAS ANOVA
  - α = .05

Choice Assay
- Response variables:
  - # of attack holes/seedling
  - # of beetles emerged
  - Gallery length
- Means compared independently using SAS ANOVA
  - α = .05

Geosmithia Persistence Study - Justification

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

Geosmithia Persistence Study – Methods

- 80, 80 cm walnut bolts (n=80)
- 4 treatments (15/ treatment): Inoculated Outside; Inoculated Inside; Control Outside; Control Inside
- 4 wounds at 6 locations – agar plug
- Inoculation = Geosmithia morbida culture and
- Control bolts = ¼ strength Potato Dextrose agar (PDA) plug

Kölliker et al. 2011; Newton and Fowler 2009; Reed et al. 2013; Fraedrich personal communication
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 ½ PDA
- Incubated for 14 days
- Fungal growth assessed

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

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 test in SAS
  - α = .05
References


Questions?
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