Thousand Cankers Disease: What is it and what do I look for?

Simeon Wright
Missouri Department of Conservation
April 18, 2013

Thousand Cankers Disease (TCD)

- Lethal disease of black walnut
- Combined effects of the walnut twig beetle (WTB) and fungus *Geosmithia morbida*

Ned Tisserat, Colorado State University

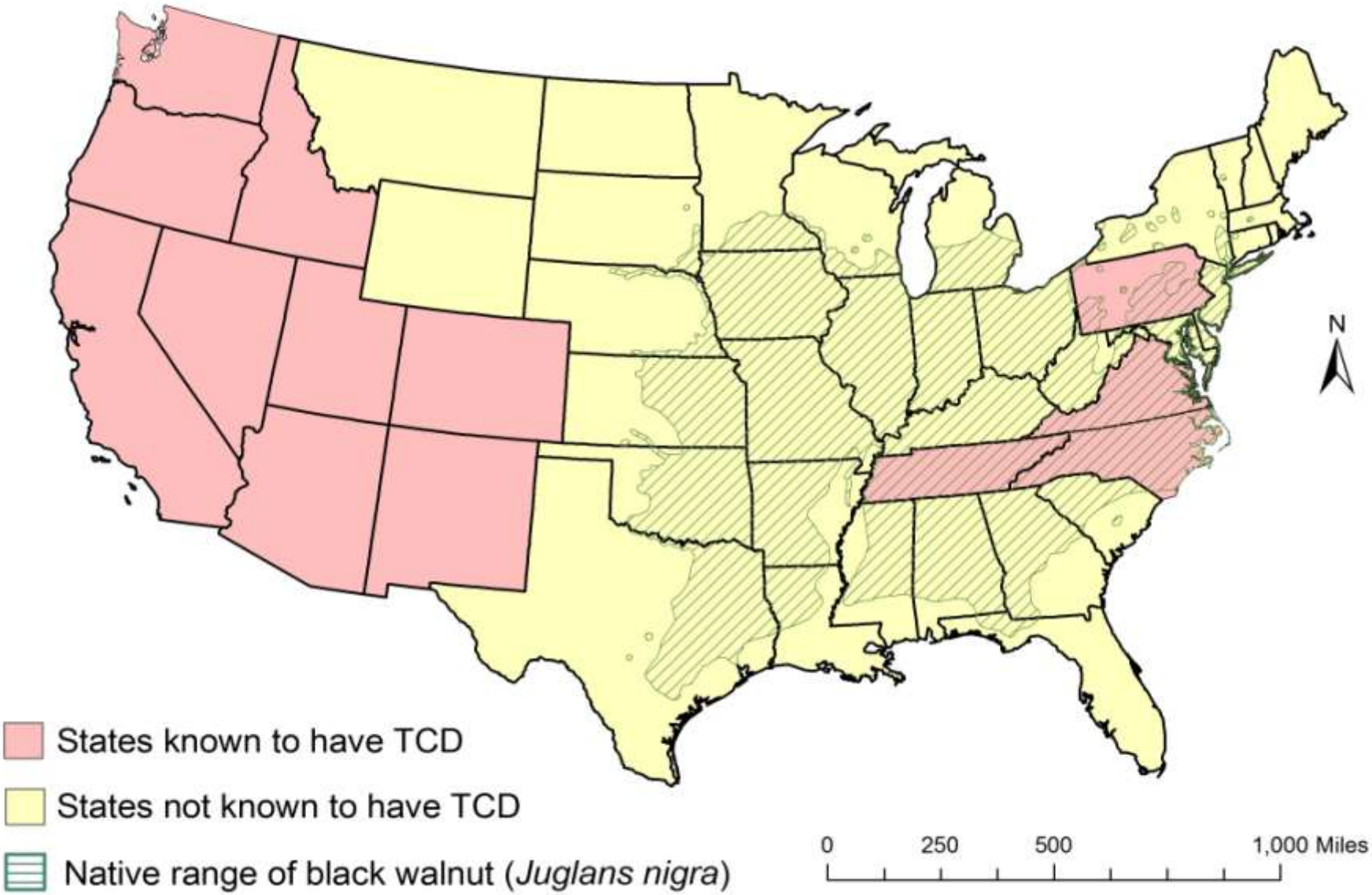
TCD - History

- WTB and *G. morbida* native to SW US and Mexico
- 1896 – WTB first collected
- 1990's – death of black walnuts in the West
- 2008 – TCD first described

Arizona walnut (*Juglans major*)

Arizona walnut native range

Native Range of Black Walnut and States Known to Have Thousand Cankers Disease (TCD)



How does TCD kill the tree?

Whitney Cranshaw, Colorado State University

G. morbida **fungus grows from WTB tunnels under the bark to create a dead area (canker)**

Branch and tree death is due to many cankers.

A single infection (canker) doesn't have much effect by itself.

Whitney Cranshaw, Colorado State University

UGA5024087

G. morbida is slow acting:

- Small cankers (and beetle tunnels) must become numerous
- Only destroys tissues responsible for nutrient transport, not water conducting tissues

TCD Progression

- Several years (4 to 6 ?) between initial beetle attack and first symptoms

- Repeated beetle attacks
- Cankers start to coalesce
- Tree health declines

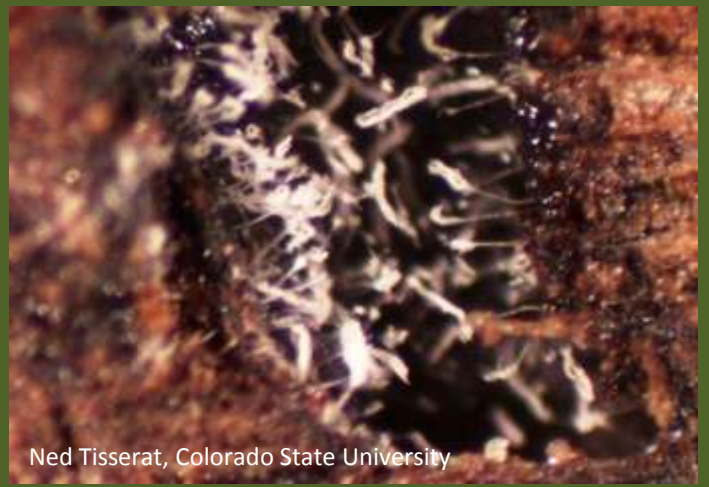
- First symptoms = end stages of disease

How does the fungus get around?

- Produces spores, carried on the beetle
- Spores must come in contact with a wound
- Unlikely to spread without wood boring insect

Ned Tisserat, Colorado State University

Katheryne Nix
Paris Lambdin lab University of Tennessee, Knoxville



Ned Tisserat, Colorado State University

Walnut Twig Beetle (WTB)

- Only insect known to spread *G. morbida*
- Inoculate tree with fungus everywhere tunneling occurs

Katheryne Nix
Paris Lambdin lab University of Tennessee, Knoxville

Whitney Cranshaw, Colorado State University

How do we confirm TCD?

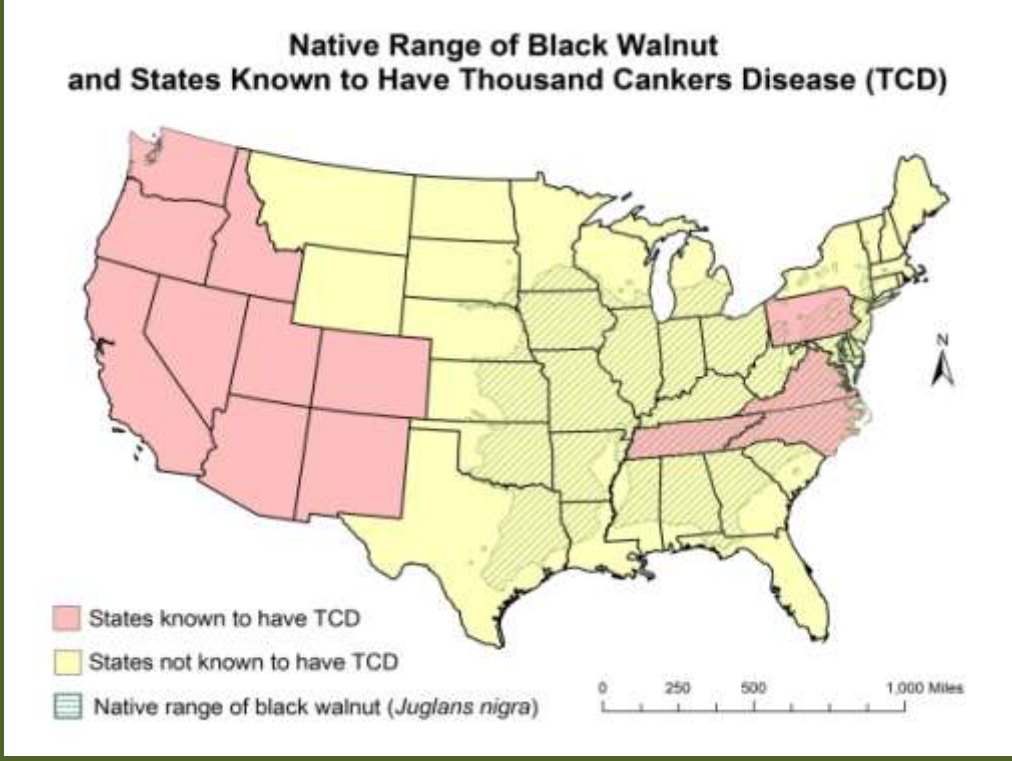
- Culture infected tissue
- Fungus grows out of tissue 2-5 days
  - Produce spores 5-10 days

Challenges

- Several labor hours to test a sample
- Many cankers negative
- Identification challenging

Where is TCD?

- TCD could be anywhere walnut is growing
- More likely near “high-risk” locations where wood movement occurs
  - Woodworkers
  - Mills
  - Campgrounds
  - Urban areas



What to Look For

If more than one walnut in an area displays branch dieback, investigate

Early TCD Symptoms

- Mid-summer
- Upper Crown
- Yellow flagging (branches with yellow leaves)
- Appear several years after initial WTB attack

Steve Seybold, USDA FS


Look for recently wilted branches and brown, dead leaves high in crown

Upper Crown First Affected

“Bushy trees” with vigorous sprouts below dieback

Evaluating a Symptomatic Tree

- Cut symptomatic branches
  - Likely high in the crown
- Focus on branches 1-2 inches in diameter

Examine branch material

Mark Windham, University of TN

Drought Damage

General Drought Impacts:

- Reduced tree defenses
- Increase in canker diseases

Walnut Drought Impacts:

- Increased dieback and decline
- Unknown effect on *G. morbida* canker development

Stressed Walnut: NOT TCD

TCD Symptom Confusion

Other things can look similar

Stressed walnut trees

- Attacked by larger native borers
- Multiple insect species possible

Sharon Reed, University of Missouri

Walnut Twig Beatle

Tunnels are tiny!

Whitney Cranshaw Colorado State University

Symptomatic Branch Evaluation

Challenges:

- Difficult to reach appropriate branches
- Professionals have resampled multiple times to confirm TCD
- Branch sample transport risks TCD spread

Notifying authorities about suspect trees:

- Additional information may be requested to determine if visit by trained staff is required
- Photos can be helpful:

Whole tree

+

ID characteristics

+

Other symptoms

Local Authorities

- State Department of Agriculture
- State Forester
- Cooperative University Extension
- Plant Diagnostic Clinic (www.npdn.org)

- TCD negative states may not want samples transported

Walnut Twig Beetle: Identification, Biology, and Control Research

American Tree Farm System
Webinar Series April 18, 2013

Paul Merten
Entomologist
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Asheville, North Carolina
828.257.4845
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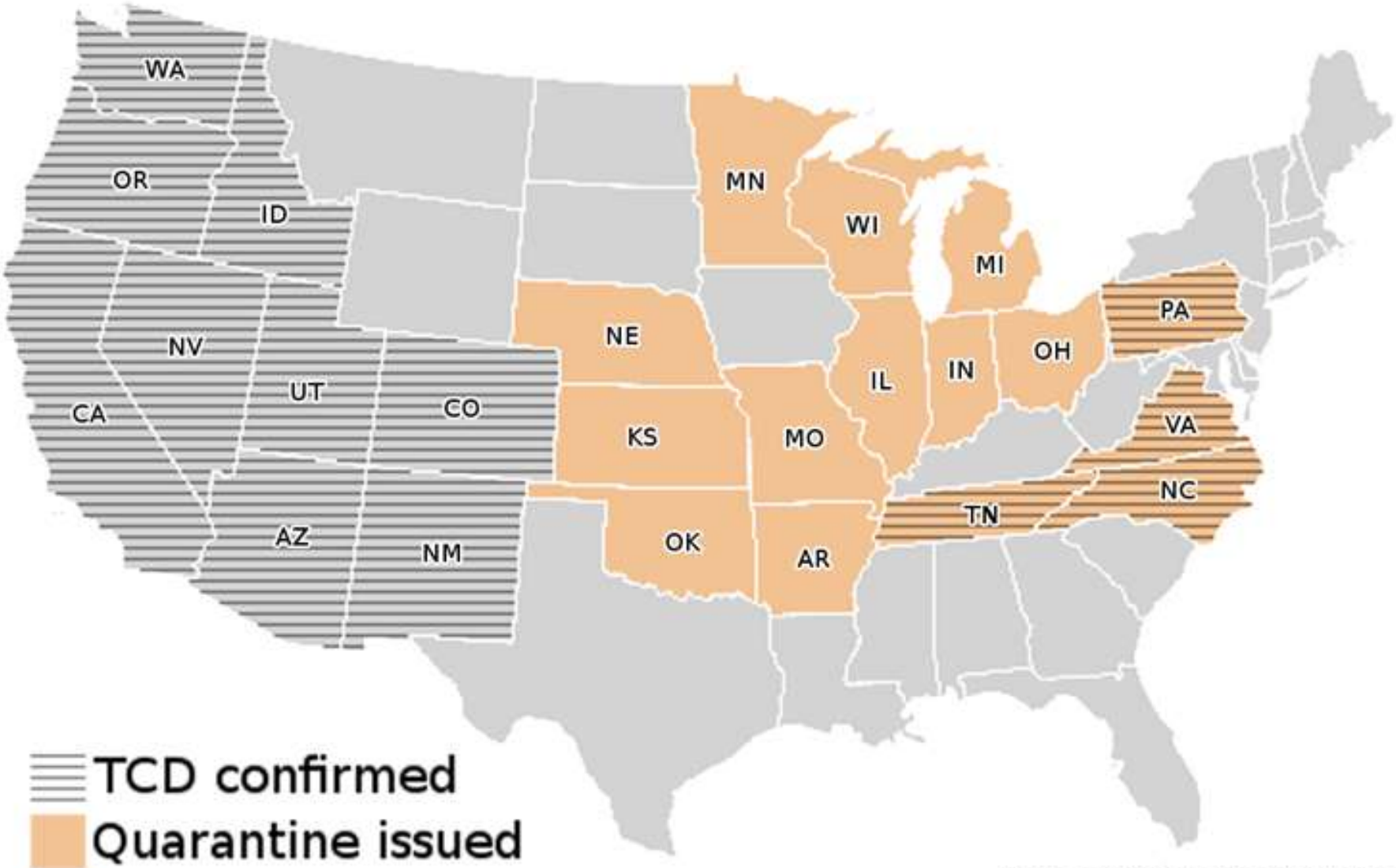
Distribution of Thousand Cankers Disease as of February 7, 2013



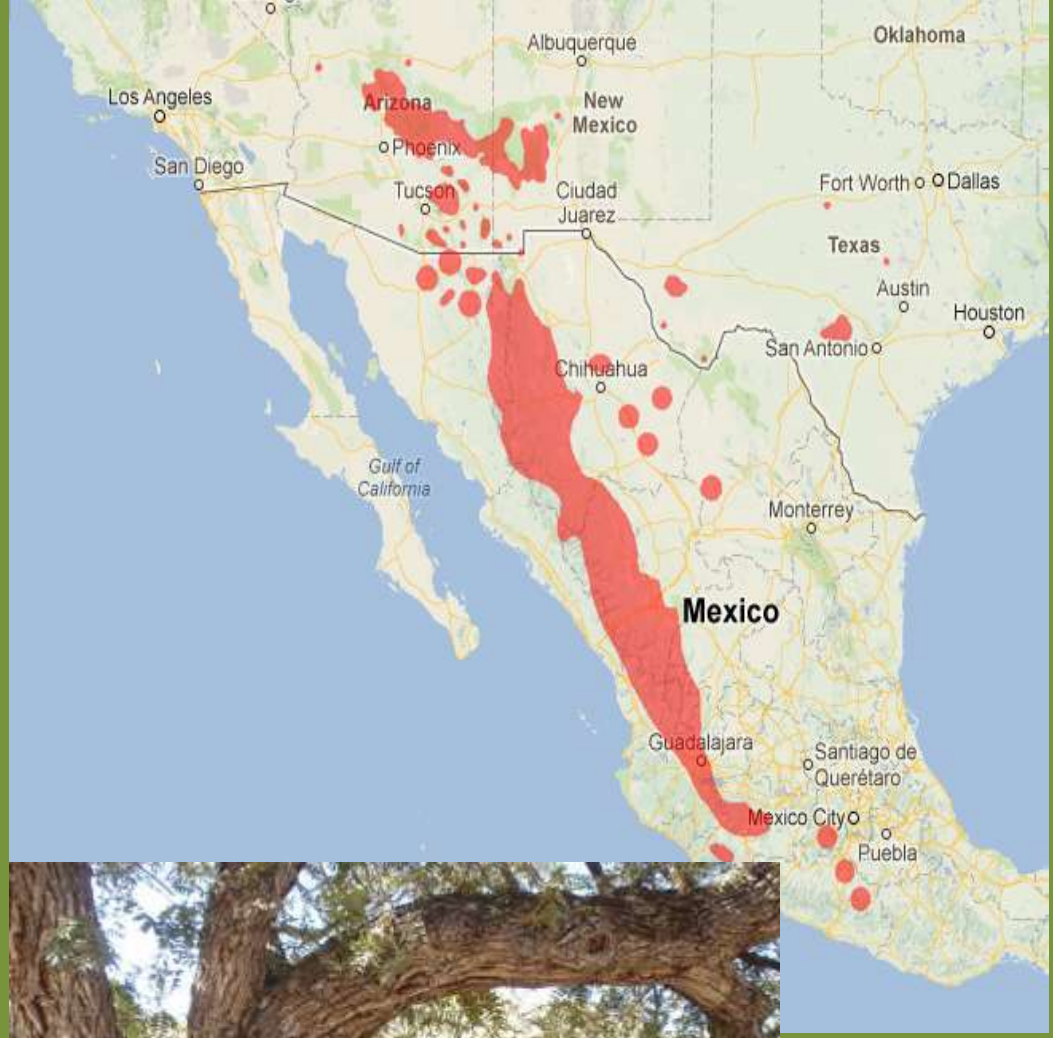
Source: www.thousandcankers.com

Walnut Twig Beetle
Pityophthorus juglandis

Photo: Katheryne Nix, University of Tennessee

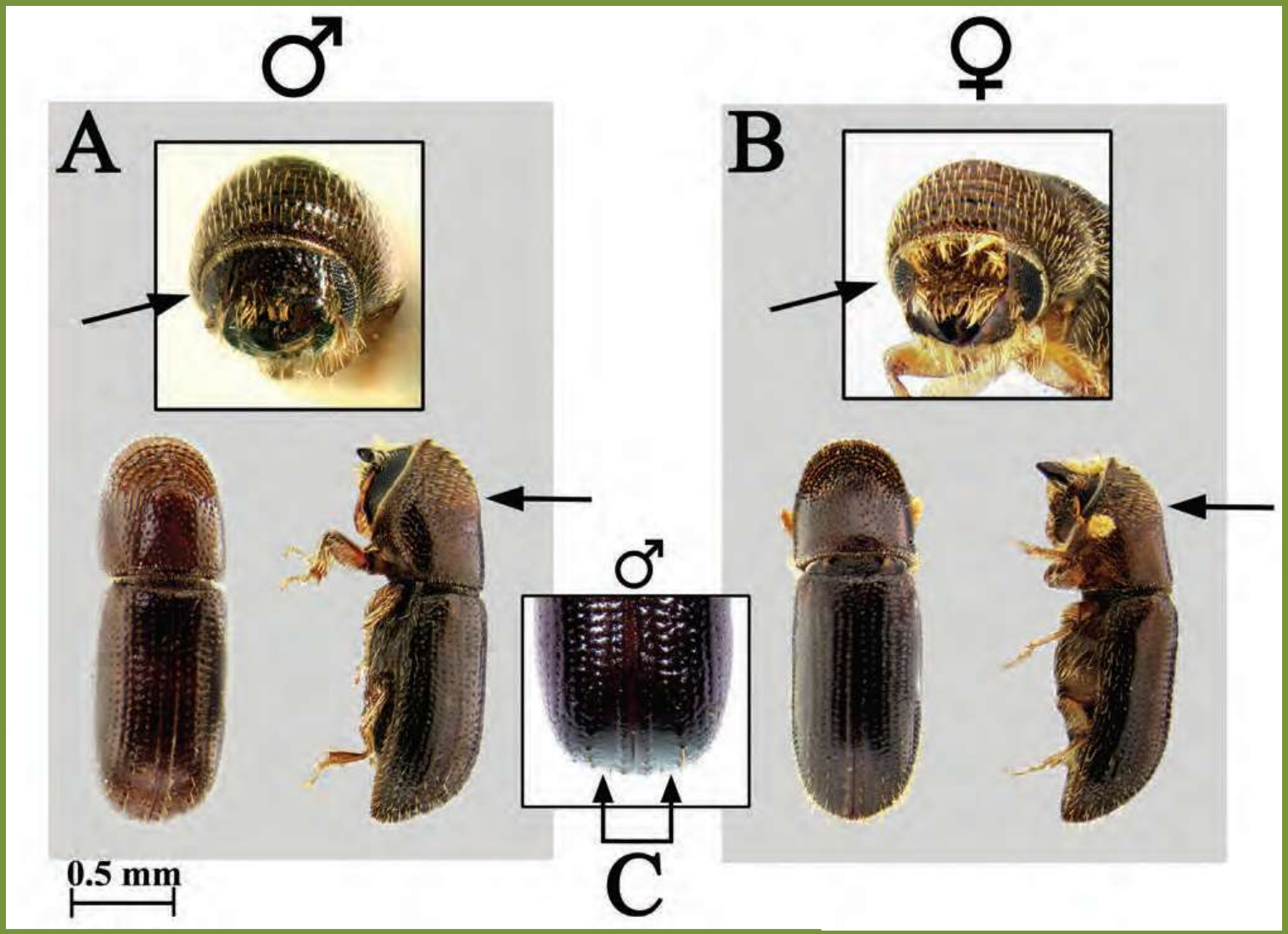
Walnut Twig Beetle:

- Native to Southwestern North America
- First described in 1928 from a specimen recovered near Silver City, NM
- The natural range of the beetle is believed to coincide with that its native host, Arizona Walnut
- In its native range, WTB acts like a typical twig beetle in that it infests small, overcrowded, or injured branches
- Little is known about the biology of WTB within its native range as no significant mortality has been reported



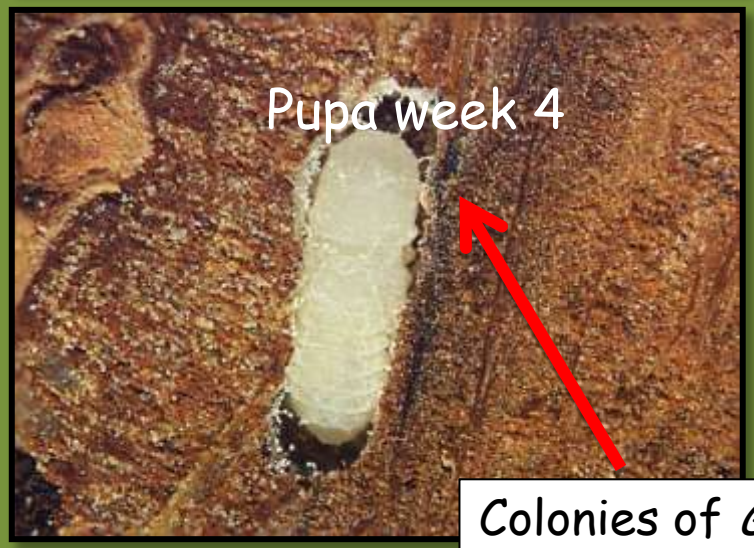

IBERTY
Photo by Steve Valley
Oregon
Department of Agriculture

Comparison of morphological characters of male (A) and female (B) WTB. Arrows indicate the degree of pubescence on the male and female frons; the apex, which occurs before the midpoint on the anterior half of the pronotum of males and females; and granules on the male elytral declivity (C).



Photos: S. M. Hishinuma, UC Davis and A. D. Graves, USDA FS

Development



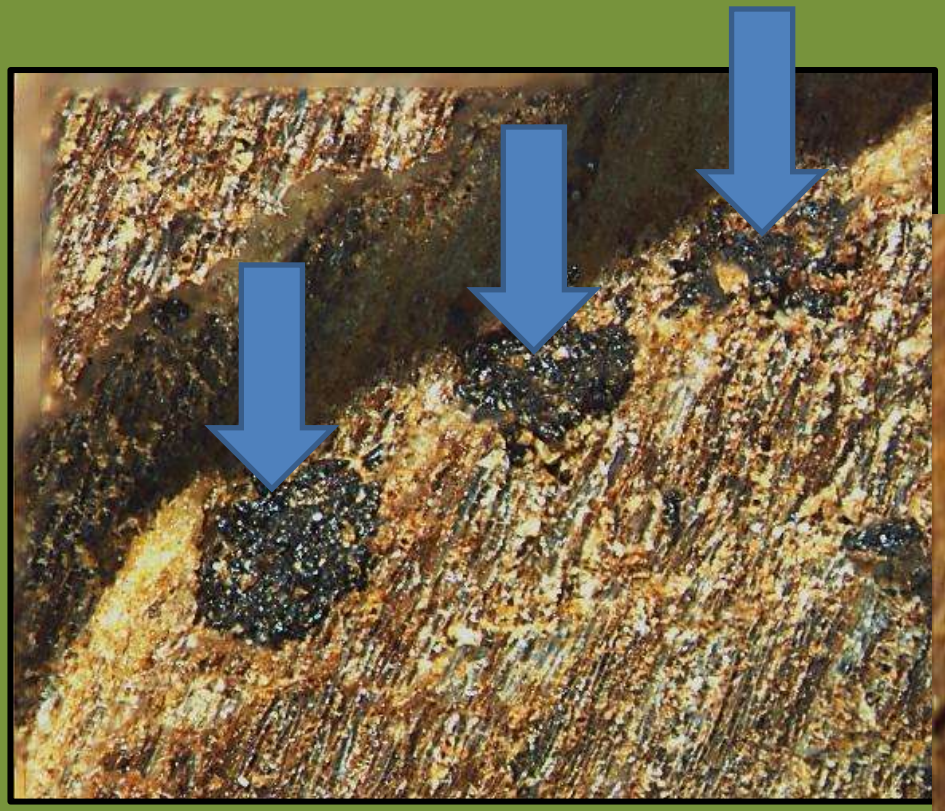
Colonies of *G. morbida*

Photos: Katheryne Nix, University of Tennessee

WTB Egg

Photo: Katheryne Nix, University of Tennessee

WTB Frass caps



Photos: Katheryne Nix, University of Tennessee

Larval Tunnels

Photo: Katheryne Nix, University of Tennessee

Larvae – no quick way to identify them as WTB’s

Gallery Structure

Photo: Katheryne Nix, University of Tennessee

Fungal cankers often extend beyond WTB galleries

Photo: Katheryne Nix, University of Tennessee

Colonies of *G. morbida* within WTB galleries

Photos: Katheryne Nix, University of Tennessee

Walnut twig beetles carrying *G. morbida*

Photo: Mark Windham, University of Tennessee

- Both male and female beetles carry *G. morbida*
- Nearly 100% of walnut twig beetles are infested with *G. morbida*
- Fungus can be hard to isolate from beetles from storage (even those stored in refrigerator for short periods of time)

Living with TCD

Madoniella dislocatus

Pyticeroides laticornis

- Since black walnut can be a nut crop, EPA pesticide registrations are restrictive
- Predators and parasitoids of the beetle have been found and exploitation is possible
- In TN, where predator populations have increased, WTB populations have decreased

APPENDIX B

University of California
Agriculture and Natural Resources
UC IPM
Statewide Integrated Pest Management Program

DETECTING AND IDENTIFYING WALNUT TWIG BEETLE:

Monitoring Guidelines for the Invasive Vector of Thousand Cankers Disease of Walnut

STEVEN J. SEYBOLD, USDA Forest Service, Pacific Southwest Research Station, Davis, Calif.;
PAUL L. DALLARA, Entomology, UC Davis; **STACY M. HISHINUMA**, Entomology, UC Davis;
MARY LOUISE FLINT, Entomology, UC Davis and UC Statewide IPM Program

Walnut twig beetle (WTB), *Pityophthorus juglandis*, (Figure 1) is a small native phloeophagous (phloem-feeding) insect recently associated with the fungus *Geosmithia morbida* (Kolařík et al. 2011). This fungus and WTB are the principal agents involved in thousand cankers disease (TCD) (Seybold et al. 2013). Walnut and butternut are the primary hosts (Utley et al. 2013). This disease is fatal to walnut trees and is responsible for the gradual decline of several species of black walnut in the western United States during the past decade (Cranshaw et al. 2009; Flint et al. 2010; Tisserat et al. 2011). The disease has spread widely in the western United States and has been detected in eastern states—including Tennessee in June 2010, Virginia in May 2011, and Pennsylvania in August 2011—threatening the highly valuable native timber stands of eastern black walnut, *Juglans nigra* (Newton and Fowler 2009).

S. M. Hishinuma, UC Davis

Figure 1. Adult male WTB, lateral profile.

The beetle is now distributed discontinuously in the United States from eastern Pennsylvania to western Oregon and from northern Idaho to southern New Mexico in the West (Seybold et al. 2012a). It was trapped in southwestern Ohio in July 2012. Populations of WTB have been invariably associated with the fungus: this type of dieback of walnut has been found only where the beetle is present. Thus, capturing and identifying the tiny beetle is the key to early detection of the disease in new areas.

This publication provides detailed guidelines for using pheromone-baited traps to detect and monitor WTB. A two-page guide for field use and instructional videos are also available at http://extension.entomology.ucdavis.edu/thousandcankers. The purpose of this trapping is to detect an incipient population of WTB or delimit a known population of WTB where it has been recently discovered.

S. J. Seybold, USDA Forest Service

Figure 2. Four-unit funnel trap.

The trap and guidelines described here were developed in Northern California walnut orchard ecosystems with high population densities of WTB. Subsequently, however, the trapping methodology has been field tested and demonstrated in a variety of urban and wildland landscapes in California, Idaho, Pennsylvania, Tennessee, Utah, and Virginia with low to intermediate population densities of WTB. The system uses a small multiple-funnel trap (Figure 2) baited with the male-produced aggregation pheromone (Seybold et al. 2012b). The trap captures both sexes of the WTB while attracting few other insect species, including only low numbers of most other bark or ambrosia beetles (Coleoptera: Scolytidae) (Tables 1 and 2), making detection of WTB easier.

Thousand Cankers Disease Survey Guidelines for 2013

United States Department of Agriculture: Forest Service (FS) and Plant Protection and Quarantine (PPQ)

March 2013

Photo Credits: Damage: Ned Tisserat, Colorado State University, Bugwood.org; WTB: Kathy Keatley Garvey, UC Davis; Symptoms: Whitney Cranshaw, Colorado State University, Bugwood.org

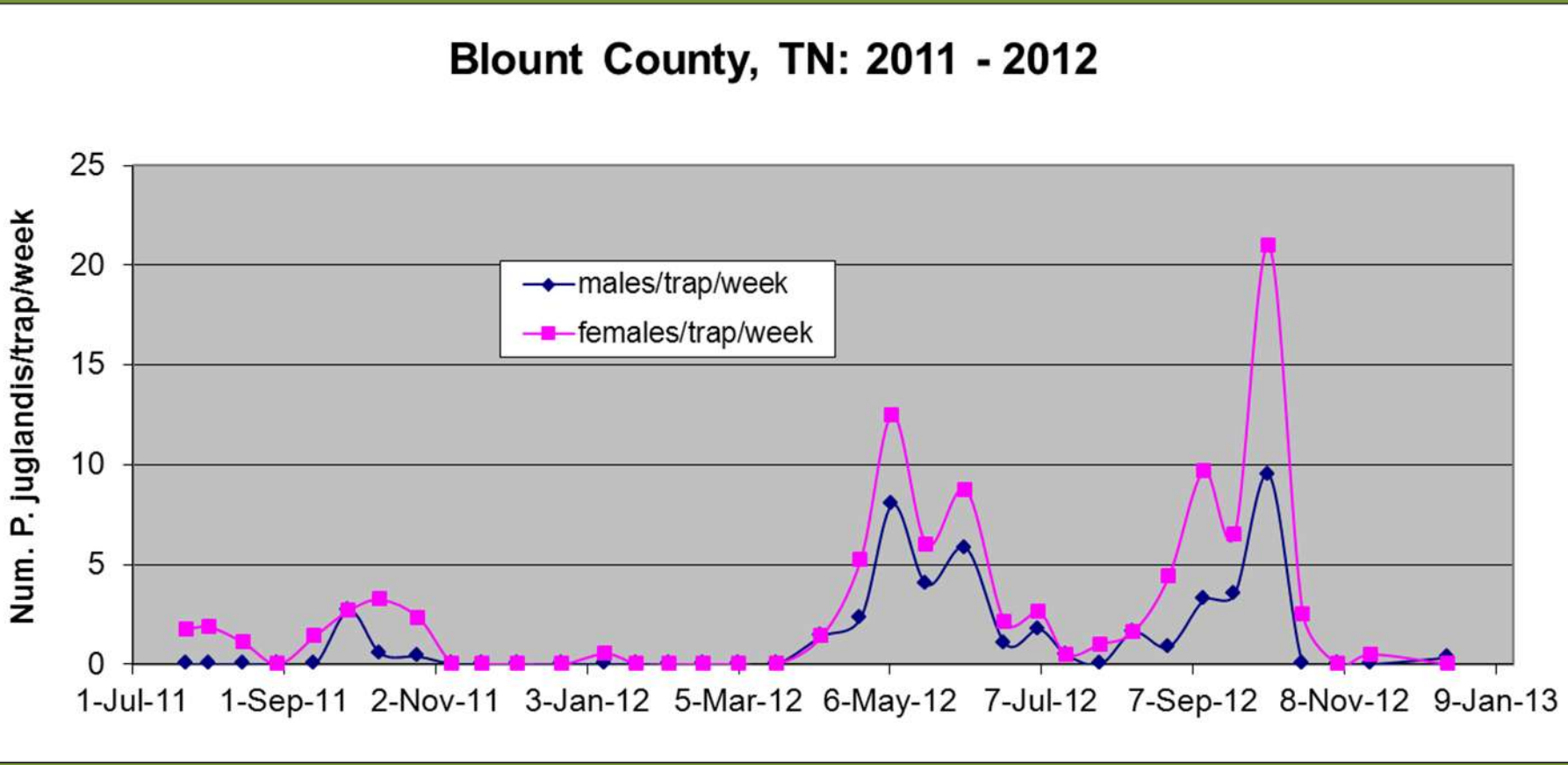
Photo: S Hishinuma, UC Davis

Photo: Steve Seybold USDA FS

Trap selection sites:

- Place trap 9 to 15 feet from stem of suspect walnut tree
- Look for trees near areas of high human population near:
  - Campgrounds
  - Wood processing facilities
  - Transportation distribution centers
  - Green waste collection centers
  - Other vectors associated with walnut products

Eastern Tennessee Trap Catch Data



Data from one trap maintained by the Tennessee Department of Agriculture

Phytosanitary wood treatments for the walnut twig beetle and thousand cankers disease pathogen

Albert E. (Bud) Mayfield - USDA Forest Service, SRS
Scott W. Myers – USDA-APHIS-CPHST
Adam Taylor - University of Tennessee, CRC
Stephen Fraedrich - USDA Forest Service, SRS
Paul Merten - USDA Forest Service, FHP

- Movement of infested logs: a potential pathway for spread of TCD vector & pathogen
    - -Walnut twig beetle (Pityophthorus juglandis)
    - -Pathogen: Geosmithia morbida
- Management Need:
    - -Tools that will help prevent the movement of WTB/TCD while allowing walnut log transport and commerce
- Advantages to moving logs vs. only squared edged lumber
    - -Lumber processing utilize more of the resource
    - -Veneer logs bring higher value

Heat and Debarking Treatments

Min. temp thresholds based on 1 cm below sapwood surface, 30-40 minutes

2011 (bolts per treatment: n=20 insect, n=10 pathogen)

1. Control
2. Debarked (all bark peeled, no heat)
3. 60°C (140°F)
4. 65°C (149°F)
5. 70°C (158°F)

2012 (bolts per treatment: n=30 insect and pathogen)

1. Control
2. 36°C (140°F)
3. 42°C (149°F
4. 48°C (158°F)
5. 52°C
6. 56°C

Fumigation Treatment 2011

- Methyl bromide
- Treatments: 6 doses x 2 temps
  - Dose (mg/L): 0, 32, 64, 96, 128, 160
  - Temp (°C): 5, 15
- Stainless steel chambers housed in refrigerated unit
- 24 hours

Preliminary Conclusions

- Walnut Twig Beetle emergence prevented and *Geosmithia morbida* eliminated from logs when:
  - Heat:
    - Outer sapwood (1 cm below cambium) at least 52°C for 40 min
  - Fumigation:
    - At least 64 mg/L at 15°C for 24 hrs
    - Higher rates or duration needed to develop a treatment for cold/winter at 5°C
  - Debarking:
    - Doesn’t remove included bark

Concentration levels of imidacloprid in walnut twig beetle infested black walnut trees in eastern Tennessee

Katheryne Nix – University of Tennessee
Paris Lambdin – University of Tennessee
Carla Coots – University of Tennessee
Jerome Grant – University of Tennessee
Mark Windham – University of Tennessee
Joseph Doccola – Syngenta Crop Protection
Paul Merten – USDA Forest Service, FHP
Albert Mayfield – USDA Forest Service, SRS

Study of treatments consisting of:

- CoreTect (Imidicloprid)
- Safari (Dinotefuran)
- potassium phosphite
- combination of CoreTect/potassium phosphite
- combination of Safari/potassium phosphite
- untreated control.

- Investigation consists of the efficacy of the pesticides, translocation of the compounds and persistence.
  - Imidicloprid - preliminary results indicate that concentrations are highest in the lower portions of the tree. There may be issues of pesticide concentrations in nut meat when applied in the spring. Control rate for WTB is not yet determined, but has shown to control walnut husk maggot.
  - Dinotefuran – uptake is rapid but little to no detectable residue after as little as one month after application.
  - More results coming soon

Emamectin Benzoate and Propiconazole for Protection of Black Walnut from Walnut Twig Beetle and Thousand Canker Disease

Donald Grosman - Arborjet
David Cox - Syngenta Crop Protection
Steve Seybold - USDA Forest Service, PSRS
Paul Merten - USDA Forest Service, Forest Health Protection

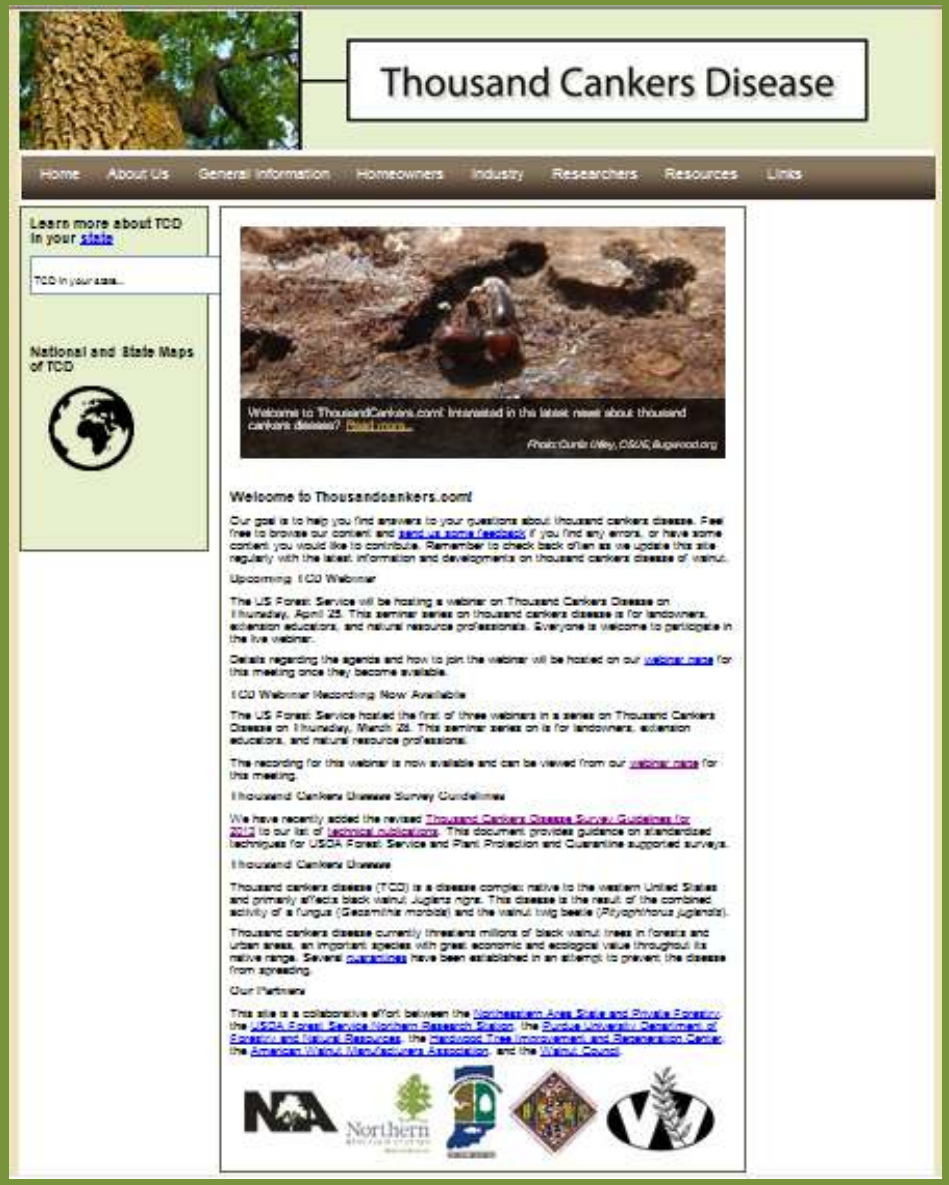
Study of treatments consisting of:

- TREE-age (Emamectin benzoate)
- Alamo (Propiconazole)
- TREE-age and Alamo
- Untreated control

- A black walnut stand containing 140 trees was found in Seymour, TN. The presence of WTB had been confirmed in 2011.
- In early April 2012, 40 trees each were treated with one of the three injection treatments using the Tree IV.
- 20 trees monitored as untreated controls
- **Treatment Evaluation**
  - Condition of trees (Apr. and Sep.)
  - Branch and nut samples (Jun. and Oct.)
  - Phloem, xylem and nut tissue are being analyzed for chemical concentration.
  - Branch samples in fall evaluated for WTB attack success.

Future Plans

- Complete tissue (phloem, xylem and nut) analyses
- Complete evaluation of branch samples
- Collect and evaluate condition of nut samples
- Bait individual branches with pheromone to focus WTB attack.
- Continue evaluations of tree condition



For more information on Thousand Cankers Disease and Walnut Twig beetle please visit this website

http://www.thousandcankers.com/


Questions?
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Managing Black Walnut in the Shadow of TCD

Lenny Farlee, Extension Forester

Hardwood Tree Improvement and Regeneration Center,
US Forest Service Northern Research Station,
Purdue University Dept. of Forestry and Natural Resources

Should I still manage for black walnut?

- The answer depends on a knowledge base that is incomplete -
- What is the risk to forest trees from TCD?
- What role does tree vigor, age, location play in susceptibility to and progression of TCD in the east?
- What is the natural rate of spread for TCD?
- Can we slow the spread through quarantine and education?

Risk Assessment

- Proximity to a known TCD find
- In an area where walnut wood from other locations may be brought in – veneer or sawmills, campgrounds, major transport corridors
- Growing conditions are not well-suited for black walnut

Reducing your Exposure

- Don't move firewood
- Beware of bark-on, live edge, green wood products
- Beware of wood waste and mulch materials of unknown origin
- Report suspect trees or wood products
- If you see high-risk behavior, educate or report.

Managing to Moderate Risk

- Manage for healthy and vigorous trees
- Opt for diversity in plantation and forest management
- Monitor your trees to catch problems early

Black Walnut is Shade Intolerant – needs full sunlight

Intolerant	Intermediate	Tolerant
Black Walnut	White Oak	Sugar Maple
Butternut	Red Oak	Beech
Tuliptree	White Ash	Hemlock
Aspen	Shagbark Hickory	Paw-paw

Range and Preferred Sites

- Landscape Position
- Prefers:
- coves
- stream bottoms with short flood duration (alluvial soils)
- lower portion of north- or east-facing slopes

Soil conditions for black walnut

- Black walnut prefers deep, well drained, fertile soils with near-neutral pH

- Loams, silt loams, clay loams, silty clay loams with at least three and preferably 4 feet of suitable rooting depth

Soil conditions for black walnut

- Avoid sites with shallow soils due to high water tables or impermeable or unsuitable substrates
- Avoid sites with excessive drainage or subject to extended duration ponding or flooding – >3 days.

Photos from Mel Baughman

Planting/Managing Black Walnut

Site Selection Considerations

- Soils must be suitable for long-term growth
- Soils information – NRCS offices and NRCS Web Soil Survey
- Walnut Suitability Index
- Consult Local Forestry Experts
- Soils tested for pH and nutrients to correct deficiencies where possible

Plantation design and management

- Select well-suited sites
- Use windbreaks
- High tree density
- Diversify
- Manage vegetation
- Manage deer
- Timely thinning
- Crop trees are only 5-10% of the total trees planted

Vegetation control

- Highly competitive plant species like tall fescue and Asian bush honeysuckle can reduce tree growth and health through root-zone competition and allelopathy – plant to plant chemical warfare

- **Thinning** helps us retain the most desirable trees and grow them at an increased rate.
- Thinning helps maintain individual tree vigor through reduced competition between tree crowns

- Select and thin around crop trees

Crown Touching Release

View from above

BEFORE TREATMENT

View from side

View from above

AFTER TREATMENT

View from side

- Kill cull trees
- Poor form
- Damage/defects
- Slow growers

Work with your forester to make the best choices on timing of thinnings and selection of trees to thin.

When should I thin?

Potential Crown Width (ft) = 2 X d.b.h. (in) + 5

An easy field guide:

Divide Actual Crown Width by PCW to get a Crown Width Ratio (CWR)

CWR = 1 = 100% potential growth

CWR = 0.8 = 75% potential growth

CWR = 0.7 = 53% potential growth

Considerations when pruning

The WTB does not appear to be strongly drawn to cut branches.
WTB emergence can happen almost anytime the temp is over 60 deg. F.
Emergence patterns in TN indicated peaks in April-June and Sept-early Nov.
Consider pruning after the fall WTB emergence peak once temps are regularly below 60 F.
Don’t prune during the heavy sap flow period in spring.
Prune conservatively – remember that leaves are life for a tree. Prioritize your work for your objectives and spread the work over longer periods to keep trees vigorous.

Photos from Mel Baughman

Marketing Black Walnut Timber

- Professional forester assistance
- Advertise to local and regional markets
- Use a competitive process – sealed bid sales usually
- Ask for certifications, training, insurance, references
- **Be aware of quarantines**
- TCD does not impact wood directly

Selection of the Trees to Market

- Get assistance from a forester who knows the local/regional markets
- Selecting the right trees to market now and the right trees to retain can improve future income potential and forest conditions

Make sure everybody is on the same page – and the page is signed

- Have a timber sale contract
- Indicate what is being sold
- Spell out payment schedule
- Outline requirements for operating on the property - BMPs

Resources for Managing Black Walnut

- The Walnut Council
- www.thousandcankers.com
- USDA Forest Service Walnut Notes
- Your forester
- Extension publications from your land grant university
- Hardwood Tree Improvement and Regeneration Center

Questions?