Issues Surrounding Thousand Cankers Disease and Its Management

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Thousand Cankers Disease (TCD) – An Insect/Fungal Disease Complex affecting some Juglans spp.
A beetle – walnut twig beetle

A fungus – *Geosmithia “morbida”*
Unexplained decline of black walnut in eastern Colorado has been observed since about 2001.
In affected trees there was found an associated twig beetle – the walnut twig beetle (*Pityophthorous juglandis*). First records of this insect from Colorado were established in 2004 (Boulder, Westminster).
The walnut twig beetle is a minute bark beetle.

It is one of few *Pityophthorus* species that develop in hardwoods.

*Pityophthorus* bark beetles are collectively known as “twig beetles” because they normally restrict damage to small diameter twigs.
In black walnut in Colorado beetles were seen to regularly attack all diameter branches – and were even found in the trunk.
Arizona walnut (*Juglans major*) – Host associated with original descriptions of the walnut twig beetle
Published distribution of Arizona walnut
Arizona walnut is a common species found in canyons and along riverways.
In Arizona walnut the insect acts as a “typical” twig beetle
Observations on this black walnut problem have accelerated in Colorado since 2006.
The first published association of walnut twig beetle with black walnut in decline occurred in the Espanola Valley area of northern New Mexico (2002)
In New Mexico and Colorado the decline of black walnut and the involvement of walnut twig beetle was originally assumed to be associated with drought.
My personal epiphany:
Idaho Hort Expo, January 2008

• #1 topic of audience concern involved black walnut die-offs
  – Idaho – 2004 record of walnut twig beetle; associated with die-off of black walnut in Boise-Meridian area (Frank Merickel)
Other Recent New State Records for Walnut Twig Beetle

- **Idaho** – 2004 record; associated with die-off of black walnut in Boise-Meridian area (Frank Merickel)

Other Recent New State Records for Walnut Twig Beetle

• Idaho – 2004 record; associated with die-off of black walnut in Boise-Meridian area (Frank Merickel)
• Utah – Widespread die-off occurred in late 1990s in Provo area. State records from that time period (1996). State record of a single beetle August 22, 1988 from Provo. (Shawn Clark, Diane Allston)
• Oregon – Common in 2004 traps samples in the Dalles area. Review of samples identified 1997 sample from Portland (Jim LaBonte)
• WA – Recovered from Prosser area
The Big Question:

How can a little twig beetle be killing healthy trees???
Pityophthorus bark beetles are collectively known as “twig beetles” because they normally restrict damage to small diameter twigs.
A canker producing fungus (with vector) + A susceptible host =
How did this happen?

- Somehow the beetle jumped hosts.
Colorado Potato Beetle

(Jumped from buffalobur to cultivated Solanum – then moved across US and into Europe)
Apple Maggot

Jumped from hawthorn (*Cratageus*) to apple (*Malus*)
Boll Weevil

Jumped from wild cotton in Mexico to cultivated cotton – and spread throughout the US Cotton Belt.
The walnut twig beetle has “broken out” of its native range and dispersed to additional host plants.
Walnut Twig Beetle Range Expansion

“Big Bang” or “Butthead”
Spread of walnut twig beetle through the western states involved human transport of infested wood products.
In 2009 surveys, walnut twig beetle was repeatedly found in Arizona walnut at several sites in NM and AZ.
Walnut twig beetle in AZ walnut functions as a “typical” *Pityophthorus* species of twig beetle. Attacks are normally limited to small diameter branches and function as a form of natural pruning.
Progression to full-blowed Thousand Cankers Disease has not been observed in AZ walnut.
Geosmithia “morbida” is also likely to be a native fungus, similarly associated with Arizona walnut.
Geosmithia grows around tunnels of walnut twig beetles sporulating profusely around pupal chambers
The *Geosmithia* fungus is has been found consistently associated with the tunnels and frass of walnut twig beetles – regardless of *Juglans* spp. or site of collection.
Evidence suggesting *Geosmithia “morbida”* is a native fungus

- The fungus is consistently associated with walnut twig beetle – wherever walnut twig beetle occurs
- The genetics of *Geosmithia* strains collected over broad geographic areas appear to be showing diversity (data limited)
  - No apparent genetic bottlenecks
- *Geosmithia “morbida”* is a warm temperature fungus
  - Consistent with a warm climate of origin
How did this happen? - Somehow the beetle (and fungus) jumped hosts.
Emerald ash borer is to Osama bin Laden.......
An analogy for regulatory people

...as Walnut twig beetle is to Timothy McVeigh
What is Thousand Cankers Disease?

Black walnut  Arizona walnut
A canker producing fungus (with vector) + A susceptible host =
A canker producing fungus (with vector) + A nonsusceptible host =
Thousand Cankers Disease (TCD)
– An Insect/Fungal Disease Complex affecting *Juglans* spp.
Symptoms of Thousand Cankers Disease develop following *sustained introductions* of *Geosmithia* by walnut twig beetles in susceptible hosts.
Other Vectors?

• Other insects (e.g., ambrosia beetles, wood borers) may – or may not – incidentally move *Geosmithia* from TCD-involved trees.

• Habits of other insects preclude their being significantly involved in TCD-development
  – Limited to point introductions
  – Incapable of producing large numbers of infection courts
Walnut twig beetle life history?

Great picture by Jim LaBonte, OR Dept. Agriculture!
A spring colonization by adult beetles occurs in late April and early May.
Larval development takes about 6-8 weeks to complete.
Adults emerge from trees. Minute emergence holes are produced by the exiting beetles.

A second cycle of tunneling and larval development occurs.
Larva and pupae become uncommon in early fall. Most appear to overwinter in the adult stage - in Colorado.
Primary overwintering site?

Excavated shelters in thicker bark of trunk.
At the end of the summer, the adult beetles move into the trunk and hibernate within chambers excavated in the bark.
Can overwintering tunneling serve as an important source of *Geosmithia* introduction into the trunk?
Walnut twig beetles readily breed in logs
Two logs, ca 5 1/2-in diameter, 18-in length
23,040 Beetles/2 logs

= 35+
Beetles/inch²
Crudely debarked (chain saw) – larval development continued and life cycle successfully completed.
Thoroughly debarked (draw knife) – adults continued to be recruited to log and would initiate tunneling. Successful reproduction unlikely due to drying.
What about chipping?
Walnut twig beetles were able to complete development in larger pieces following chipping.
Areas with Walnut Twig Beetle
Native Distribution of Black Walnut, *Juglans nigra*
2009 Colorado *Juglans* Survey

Goals

- Locate all *Juglans* spp. in Colorado east of the Continental Divide
- Do preliminary assessment of TCD incidence
- Do follow-up on suspect trees in “edge” areas
2009 Colorado *Juglans* Survey Goals

• Locate all *Juglans* spp. in Colorado east of the Continental Divide
  – Priority #1 – define the edge
  – Priority #2 – communities without known TCD
  – Street address/GPS/Google Earth reference

• Do preliminary assessment of TCD incidence
• Do follow-up on suspect trees in “edge” areas
2009 Colorado *Juglans* Survey Goals

- Locate all *Juglans* spp. in Colorado east of the Continental Divide
- Do preliminary assessment of TCD incidence
  - 0-2 rating scale
  - Best period for symptoms from early July through early September
- Do follow-up on suspect trees in “edge” areas
2009 Colorado *Juglans* Survey Goals

- Locate all *Juglans* spp. in Colorado east of the Continental Divide
- Do preliminary assessment of TCD incidence
- Do follow-up on suspect trees in “edge” areas/new communities
Thousand Cankers Colorado “hot spots” - 2009
Thousand Cankers NOT spots - 2009
Management of Thousand Cankers Disease - Some Points to Consider
It is probable that in areas of the western US where Thousand Cankers/Walnut Twig Beetle is currently established black walnut will be essentially exterminated within the decade.
Juglans future in the western US?

Arizona walnut is not threatened.
Natural spread of Thousand Cankers within a region is unknown. Outbreaks may remain localized.
Good News: Other *Juglans* species are not as susceptible to TCD as is *Juglans nigra* (black walnut). Pecan (Carya) are apparently TCD resistant.
Good News: It takes a long time (Decade? More? A bit less?) for a tree to die following initial colonization by walnut twig beetles.
Dutch elm disease has different epidemiology
DED fungus grows in and results in the plugging of the xylem.
Root grafting is a concern with Dutch elm disease.
Tree death from Thousand Cankers results from overwhelming numbers of individual infections – not a single inoculation.
Bad News: Visual symptoms of Thousand Cankers only develop in the last 2-3 years of the life of the tree.
Symptoms of Thousand Cankers Disease develop following sustained introductions of *Geosmithia* by walnut twig beetles in susceptible hosts.
Good News:
Theoretically, effective control of walnut twig beetle could arrest disease progression.
Bad News: Prospects for effective chemical control of walnut twig beetle are poor.
Drenching branch sprays for walnut twig beetle
The beetle attacks all areas of the tree. Attacks can occur over a period of several months (mid-April through mid-September). Establishment and maintenance of coverage will be very difficult.
Soil treatments and Walnut Twig Beetle - Anecdotes

- **Imidacloprid** (Merit, Touchstone) may assist in *slowing spread* of walnut decline – if it is applied prophylactically
Imidacloprid soil drenches/injections?

The fungus grows ahead of the beetle. Cankered areas may prevent movement of insecticide to the beetle feeding site.
Soil treatments and Walnut Twig Beetle - Anecdotes

- **Imidacloprid** may assist in *slowing spread* of walnut decline – if it is applied prophylactically
  - Registration status *suggests* allowance on black walnut
    - Registered for shade trees
    - Registered for nut-producing crops
  - Use rates on individual trees are very high compared to agricultural use rates
Soil treatments and Walnut Twig Beetle - Anecdotes

- **Imidacloprid** may assist in *slowing spread* of walnut decline – if it is applied prophylactically

- **Dinotefuran** (Safari) may work better for this application
Relative Water Solubility of Neonicotinoids:

**Water Solubility (Active Ingredient)**

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Solubility (Active Ingredient)</th>
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<tbody>
<tr>
<td>Clothianidin</td>
<td>327</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>2950</td>
</tr>
<tr>
<td>Acetamiprid</td>
<td>2950</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>4100</td>
</tr>
<tr>
<td>Dinotefuran</td>
<td>39830</td>
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</tbody>
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Information sources:
- Clothianidin (Celero), Acetamiprid (Tristar), Dinotefuran (Safari) – EPA Pesticide Fact Sheet
- Imidacloprid (Marathon), Thiamethoxam (Flagship) – MSDS for Products

Slide information courtesy J. Chamberlin/Slide prepared by Casey Sclar
K_{oc} Values of Neonicotinoids:

Source Data: EPA Pesticide Fact Sheets/Slide prepared by Casey Sclar
Soil treatments and Walnut Twig Beetle - Anecdotes

- **Imidacloprid** may assist in *slowing spread* of walnut decline – if it is applied prophylactically.

- **Dinotefuran** may work better for this application
  - No food crop tolerance exists for dinotefuran.
Bad News: Prospects for effective control of walnut twig beetle are poor. Insecticides may slow, but will not stop TCD.
Bad News: No effective traps for walnut twig beetle have been identified.
Good News: Walnut twig beetle has likely not yet reached the native range of *Juglans nigra*
Bad News: Long distance movement of walnut wood killed by 1000 cankers disease will be a huge issue due to the high value of the saw logs.
Bad News: **Walnut wood with bark intact is extremely infectious.**
A walnut log in Denver waiting for Uncle Benny from Chicago
Beetle infested black walnut from Boulder area with bark attached as advertised on the internet
Sanitation issues
Walnut twig beetles readily breed in logs
Care must be taken in handling wood chips from TCD trees as they can be a source of walnut twig beetle spread.
How should we handle trees that are in end stage decline with Thousand Cankers?
What Needs to Be Done

- Strong public education on the threat of Thousand Cankers Disease to black walnut in its native range
- Immediate restriction, aided by national quarantine, of all *Juglans* material that may spread walnut twig beetle into the native range of black walnut.
Demographic for Outreach/Education

Lumber mills

Beetle infested black walnut with bark attached as advertised on the internet
Demographic for Outreach/Education

#1 - Woodworkers
Demographic for Outreach/Education

Tree Removal Operations
Demographic for Outreach/Education

Smoker Wood Distributors
Firewood Distributors
2009 Colorado *Juglans* Survey Goals

- Locate all *Juglans* spp. in Colorado east of the Continental Divide
  - Priority #1 – define the edge
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- Contact all eastern Colorado municipalities with walnut on survey results and provide educational materials
Thousand Cankers Colorado “hot spots” - 2009
Immediate Action Needed:

Institute quarantine of all *Juglans* wood of western origin
A *Juglans* Quarantine

- Would affect logs/wood with bark intact
- Would not need affect
  - Milled wood without bark
  - Logs that have sufficiently dried so live beetles cease production (3 years?)
  - Nuts
Value of the *Juglans* Quarantine

- Announcement of quarantine would vastly increase public awareness of issue
- National quarantine would empower state and local officials to develop effective containment actions
TCD and black walnut in the western US – the canary in the coal mine
Will black walnuts in the West allow us a chance to save black walnut .....or will the canary die in vain?
This information gleaned from many people including:

Curtis Utley,
Ned Tisserat,
Don Bright,
Dave Leatherman,
Kathleen Alexander,
Steve Seybold….