State of Tennessee
Thousand Cankers Disease
Action Plan

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Prepared by:

Gray Haun and Steve Powell
Tennessee Department of Agriculture, Division of Regulatory Services

Clint Strohmeier and John Kirksey
Tennessee Department of Agriculture, Division of Forestry

The undersigned representatives of principal agencies involved in the development of the State of Tennessee Thousand Cankers Disease Action Plan do hereby acknowledge its value and support its intent.

Steven Scott, State Forester
TDA, Division of Forestry

11-3-10
Date

Jimmy Hopper, Director
TDA, Regulatory Services

11-17-2010
Date

Terry Oliver, Commissioner
Tennessee Department of Agriculture

11/18/10
Date

Ken Arney, Deputy Regional Forester
USDA Forest Service

12/8/10
Date

Table of Contents

Topic		Page Number
	Signature Page	2
I.	Introduction (History, Biology, Values at Risk)	4
II.	Purpose of Action Plan	9
III.	General Readiness	9
IV.	Reduction of Infestation Risk	13
V.	Detection and Monitoring	15
VI.	Response to Infestations	16
VII.	Mitigation of Potential Impacts	18
	Literature Cited	21
Appendix A - Tennessee TCD Action Team and Partners		22
Appendix B - Legal Authorities		23
Appendix C - Thousand Cankers Disease Regulations in Plain Language		24
Appendix D - Reporting Suspect Thousand Cankers Disease Infestation		26
Appendix E - Best Management Practices		27
Appendix F - Budget Proposal Template		28
Appendix G - An Urban Forest Response Plan Template		29
Appendix H - TCD Treatments in Urban Forests		30
Appendix I - TCD Rural Forest Response Plan		33
Appendix J - IPM Strategic Plan Principles		34

Tennessee Thousand Cankers Disease Action Plan

I. Introduction

Thousand cankers disease (TCD), recently discovered in Tennessee, poses a significant new threat to black walnut in Tennessee. Thousand Cankers Disease is a pest complex that is caused by the walnut twig beetle *(Pityophthorus juglandis)* and an associated fungus *(Geosmithia morbida)*. Black walnut *(Juglans nigra)* is highly susceptible to this disease (Tisserat et al., 2009).

A. History

The walnut twig beetle (WTB) is native to North America; its native range in the southwest appears to coincide largely with the distribution of Arizona walnut (*J. major*), the likely original native host (Cranshaw and Tisserat, 2008). Records from California suggest that the WTB may be native to that state also; *P. juglandis* was described from specimens collected in California on *J. nigra* (Bright and Stark, 1973) and *J. californica* (Bright, 1981), both of which are susceptible to thousand cankers disease. The first published record of a cluster of black walnut mortality associated with the walnut twig beetle was in the Espanola Valley of New Mexico where large numbers of mature black walnut died in 2001 (Cranshaw and Tisserat, 2008). Similar widespread decline also occurred about this time in the Boise, Idaho area where the insect was first confirmed present in 2003 (Cranshaw and Tisserat, 2008).

Black walnut mortality and the twig beetle have been noted in several Front Range communities in Colorado since 2004 and in most infested cities the majority of black walnut has since died. *P. juglandis* has been recorded from Oregon (Portland) since 1997, has been widely captured in funnel traps in The Dalles since 2004, and is suspected of being associated with recent widespread death of black walnut and black walnut hybrids in the Willamette Valley of Oregon (Cranshaw and Tisserat, 2008).

Fig. 1 – 1st black walnut diagnosed with TCD in Tennessee.

Prior to these recent reports, WTB was not associated with any significant *Juglans* mortality. In most areas where the die-offs of black walnut have occurred, drought was originally suspected as the cause of the decline and death of trees, with the beetle as a secondary pest. The widespread area across which *Juglans* spp. die-offs have been recently reported, combined with the documented presence of an associated canker producing fungal pathogen carried by the twig beetle, and the occurrence of black walnut death in irrigated sites not sustaining drought, all suggest an alternate underlying cause (Cranshaw and Tisserat, 2008).

The first confirmation of the beetle and fungus within the native range of black walnut was in Knoxville, Tennessee (July 2010) (Seybold, et al., 2010). *Geosmithia morbida* was confirmed in samples under regulatory controls in August 2010 (see Fig. 1). The potential damage of this disease to eastern forests could be great because of the widespread distribution of eastern black walnut, the susceptibility of this

tree species to the disease, the capacity of the fungus and beetle to invade new areas and apparent ability to survive under a wide range of climatic conditions (Cranshaw and Tisserat, 2008).

Publications relative to TCD are available online including pest alerts by Colorado State University http://www.ppdl.purdue.edu/PPDL/pubs/walnutthousandcankersdisease.pdf; and the USDA Forest Service http://na.fs.fed.us/pubs/palerts/cankers_disease/thousand_cankers_disease_low_res.pdf.

B. Biology

The walnut twig beetle *Pityophthorus juglandis* is the only *Pityophthorus* species associated with both *Juglans* and *Geosmithia*, and can be readily distinguished from other members of the genus by several physical features (Cranshaw and Tisserat, 2008). There are a number of bark beetles (Coleoptera: Curculionidae: Scolytinae) that have the potential to serve as alternate vectors of *Geosmithia* conidia (Newton and Fowler, 2009). For instance *Pityophthorus lautus* is known to attack black walnut (*Juglans nigra*) in its native range (Wood 1982). Adult beetles are very small (1.5 to 2.0 mm long or about 1/16 in) and are reddish brown in color. This species is a typical-looking bark beetle that is characterized by its very small size and four to six concentric ridges on the upper surface of the pronotum (the shield-like cover behind and over the head). Like most bark beetles, the larvae are white, C shaped, and found in the phloem. For this species, the egg galleries created by the adults are horizontal (across the grain) and the larval galleries tend to be vertical (along the grain) (Seybold, et al., 2010) (see Fig. 2).

Fig. 2 – WTB visible at the point of knife blade, found by Ned Tisserat in Knoxville. Note gallaries.

On *J. nigra* the beetle prefers to colonize the under-side of branches in rough areas and prefers branches larger than 3 cm (1 in) in diameter (Tisserat, 2010). Tunneling sometimes occurs in trunks (Cranshaw and Tisserat, 2008). It also prefers the warmer side of the tree (Cranshaw and Tisserat, 2008).

Recent studies conducted on *J. hindsii* in California have revealed that male beetles colonize newly cut branches in 4-9 days and are joined quickly by 1 to 2 females. Brood galleries are then created. Both sexes contribute to an aggregation pheromone that attracts both sexes to infested branches (Seybold et al., 2009).

Winter is spent, possibly exclusively, in the adult state sheltered within cavities excavated in the bark of the trunk. Adults resume activity by late April and most fly to branches to mate and initiate new tunnels for egg galleries; some may remain in the trunk and expand overwintering tunnels. During tunneling the *Geosmithia morbida* fungus is introduced and subsequently grows in advance of the bark beetle. Ultimately a nuptial chamber is produced from which one or more radiating eggs galleries are excavated. Larvae develop just under the bark and then enter the bark to pupate (Cranshaw and Tisserat, 2008). Larval development takes 6-8 weeks to complete. There are generally two overlapping generations per season in Colorado. Adult beetles can be observed flying from mid-April to late

October in Boulder (Cranshaw and Tisserat 2008; Cranshaw 2008). The adult WTB is estimated to fly one to two miles (USDA APHIS PPQ NPAG-Archives, 2008).

A single generation has been observed to be completed in less than two months. Yellow sticky trap sampling in Boulder, Colorado found adult beetles to be present from mid-April through early October, when sampling was discontinued. Peak adult captures occurred from mid-July through late August. These data suggest that two or more generations may be produced annually, which may increasingly overlap later in the growing season (Cranshaw and Tisserat, 2008). WTB populations can reach levels of 30 per square inch; a single black walnut tree may produce tens of thousands of beetles (Cranshaw 2010).

Small, diffuse, dark brown to black cankers, caused by *Geosmithia morbida*, initially develop around the nuptial chambers of the walnut twig beetle in small twigs, branches and even the trunk. *Geosmithia* spp. are associates of bark beetles of hardwood and conifer trees but have not previously been reported as pathogens of *Juglans* or fungal associates of *P. juglandis*. Branch cankers may not be visible until the outer bark is shaved from the entrance to the nuptial chamber; although a dark amber stain may form on the bark surface in association with the cankers. Cankers expand rapidly and develop more expansively lengthwise than circumferentially along the stem. On thick barked branches, cankers may at first be localized in outer bark tissue and extend into the cambium only after extensive bark discoloration has occurred. Eventually multiple cankers coalesce and girdle twigs and branches, resulting in branch dieback. The number of cankers that are formed on branches and the trunk is enormous; hence the name thousand cankers to describe the disease (Cranshaw and Tisserat, 2008) (see Fig. 3).

Fig. 3 – TCD cankers visible on bark on the first tree diagnosed.

Fig. 4 – There are indications that TCD has been present 10+ years.

The disease is scattered throughout western states and reports of walnut mortality are occurring simultaneously in areas that are connected by major highways. This distribution along major commerce routes suggests that movement of thousand cankers disease and its vector may be human assisted (Newton and Fowler, 2009).

The recent USDA APHIS (2009) pathway assessment on *Geosmithia sp. and Pityophthorus juglandis Blackman* movement from the western portion of the nation into the eastern United States, (http://www.ksda.gov/includes/document_center/plant_protection/Plant_Disease_Fact_Sheets/GeosmithiaPATHWAYRev1101909.pdf) characterized the approach rate of potential TCD pathways. Veneer logs, sawlogs, burls, stumps, firewood, wood packaging material, nursery stock, scion wood for grafting, nuts and natural spread are addressed in the report (USDA APHIS, 2009). The basic principles of

the report remain useful and valid. However, the unexpected discovery of TCD deep in native black walnut range, over one thousand miles from the nearest known infestation has confirmed some assumptions while diminishing others. It is important to keep in mind that the Tennessee infestation has likely been present for 10-20 years. An important question now is where else in the native range of black walnut this disease may be present but not yet detected (Newton, 2010) (see Fig. 4). Drought and other symptoms may have masked TCD from being readily detected.

C. Values at Risk

According to USDA [Forest Service, Southern Research Station, Asheville, NC, Forest Inventory Analysis (FIA)] the number of live black walnut trees on timberland in Tennessee is 25,532,000. This represents 0.3 percent of live hardwood timberland trees in Tennessee. It is noteworthy that black walnut is common in locations (riparian corridors, fencerows, field edges and yards) that are not included in the FIA survey. The number of urban walnut trees is estimated to be 1,380,000 (USDA Northern Research Station, Syracuse, NY).

Commercial value of black walnut in Tennessee is the highest per board foot of any native tree species. Black walnut has commercial value in numerous forms including veneer, lumber, and nut products. The wood is easily worked, durable, retains finish well, has a highly marketable appearance, and a long-standing reputation with consumers as being highly desirable. Final products made of walnut include furniture, cabinets, interior trim, wood carvings, and gun stocks. Nuts from walnut have a variety of uses from food products to polishing compound. Black walnut hulls are used for flavoring and health food extract for a variety of skin and intestinal ailments. The estimated value of black walnut trees in Tennessee urban areas is $ 1.37 billion. The value of walnut trees in Tennessee's forests is $ 1.47 billion (USDA Northern Research Station, Syracuse, NY).

Fig. 5 – Typical TCD infested tree in urban setting in Knoxville.

Black walnut is an important component of urban trees in streets, parks, and subdivisions. Being a highly valued, indigenous and ubiquitous part of Tennessee's forests black walnut trees have been spared during land use conversion from forest to residential. Consequently black walnut is found in many of Tennessee's urban and suburban environments. Loss of black walnut from backyards and streets would forever change the appearance of Tennessee communities. Costs associated with hazard tree removal and replacement tree planting would be very high (see Fig. 5).

Black walnut is a relatively important species for wildlife, mostly for its nutritious nut meat. Wildlife species that consume the nuts are generally rodents such as squirrels and mice. These species are expected to be moderately to severely affected should black walnut be lost from the landscape.

TCD is not a federally quarantined pest. This leaves to the states the role of making decisions regarding quarantines. Some states have established external quarantines that limit or prevent black walnut products

originating from states known to have TCD from entering their state. External quarantines prevent movement of Tennessee black walnut into these states, and is likely to have a detrimental effect on Tennessee walnut value. Internal quarantines are those that Tennessee regulatory officials have developed to prevent the movement of TCD infested materials within and out of Tennessee (see Fig. 6). A current map of TCD quarantined counties in Tennessee may be found at http://www.tn.gov/agriculture/publications/regulatory/tcd_map.pdf

Desired effects of the self-imposed internal quarantine are to slow the spread of TCD and maintain marketability of Tennessee walnut products. Quarantines, internal and external, are of great concern to the marketability and commercial value of black walnut in Tennessee.

Two important native species within the family *Juglandaceae* were exposed to the *Geosmithia morbida* in pathogenicity tests (Utley et al., 2009). These preliminary tests demonstrated that butternut (*Juglans cinerea*) developed cankers but pecan (*Carya illinoinensis*) did not, and appears to be resistant (or entirely immune) to the pathogen (Utley et al. 2009).

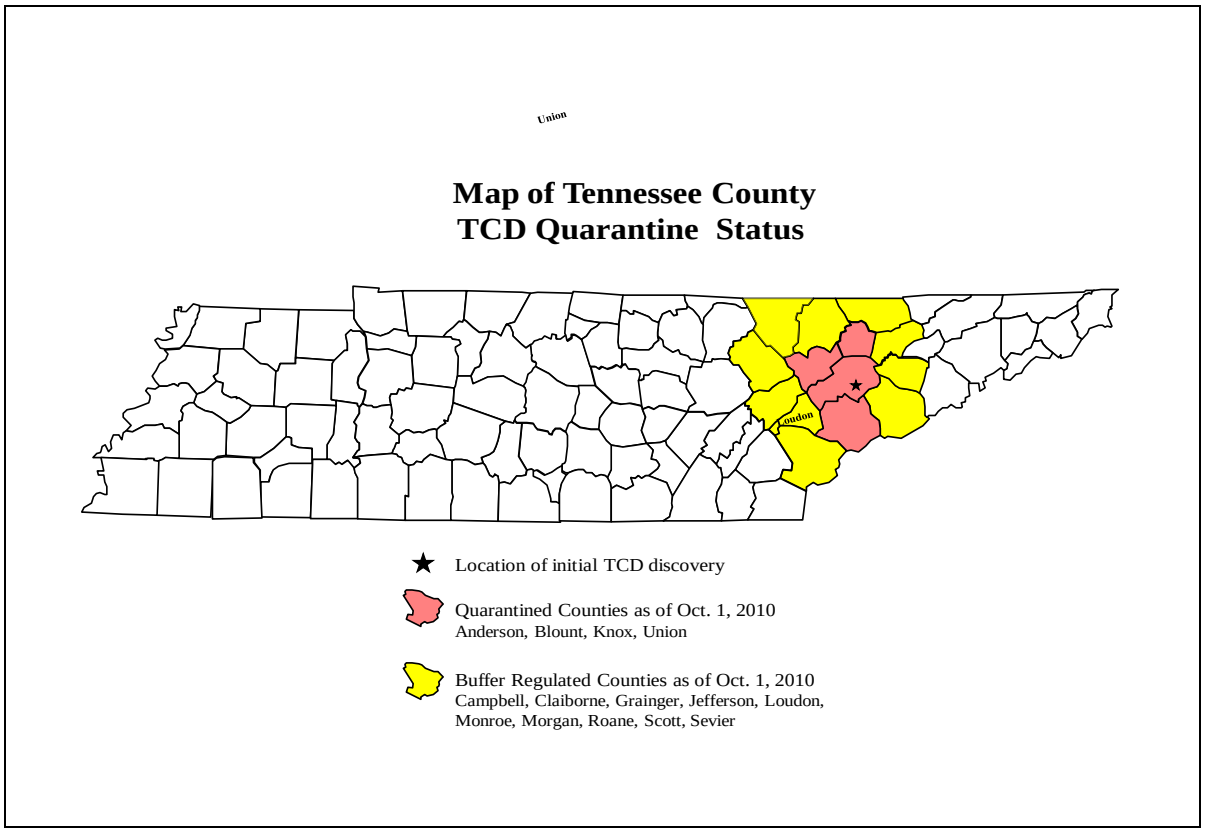

Fig. 6 - Map of Tennessee County TCD Quarantine Status as of October 1, 2010.

II. Purpose of Action Plan

The broad objective of the Tennessee Thousand Cankers Disease Action Plan (TCDAP) is to slow the spread of TCD. The primary goal of the Action Plan is to detect and contain walnut twig beetle and *Geosmithia morbida* then mitigate their impact. The TCDAP has been developed to provide a statewide coordinated response, and to help local communities plan to respond to the negative effects of the thousand cankers disease. The TCDAP should be considered a dynamic and evolving document that may change as new research and management information becomes available pertaining particularly to the eastern United States.

The TCDAP is intended to follow guidelines established in the National Framework for Thousand Cankers Disease developed by the USDA Forest Service, State and Private Forestry, Forest Health Protection section, and the TCD Technical Working Group.

III. General Readiness

Objective: To prevent spread, reduce risk, minimize impact, respond effectively to TCD and to use partnerships for maintaining overall health and sustainability of Tennessee's forests.

A. Establish a network of agencies and organizations that may be affected by TCD as the Thousand Canker Disease Action Team. The Team will draft an Action Plan and be responsible for advising, advocating, and leading in the implementation of the plan. The Action Team is comprised of a Technical Team and a Communications Team. See Appendix A for team composition.

The following agencies have, by law, the responsibility and authority to manage plant pest introduction. See Appendix B for details.

- Tennessee Department of Agriculture
- Affected local government(s) at sites of infestation

1. Technical Team – This team serves as the lead group in planning and coordinating all TCD readiness and response activities. Committee members are listed in Appendix A. The following serve as Committee Co-chairs:

    - Tennessee Department of Agriculture, Division of Regulatory Services (State Entomologist)
    - Tennessee Department of Agriculture, Division of Forestry (State Forest Pest Specialist)

2. Communications Team – This team supports activities of the Technical Team by communicating accurate information quickly and broadly in a manner that increases the effectiveness of efforts to prevent and control TCD infestations. Committee members are listed in Appendix A. The following serve as Committee Co-chairs:

- Tennessee Department of Agriculture, Division of Forestry (Resource Protection Unit Leader)
- Tennessee Department of Agriculture, Division of Forestry (Information & Education Program Specialist)
- Tennessee Department of Agriculture, Division of Regulatory Services (State Plant Regulatory Official)
- University of Tennessee, Agriculture Extension (Cooperative Agricultural Pest Survey Specialist)
- Tennessee Department of Environment and Conservation Division of Parks

B. Agency Roles and Responsibilities for major partners in the Thousand Cankers Disease Action Team include, but are not limited to the following:

1. Tennessee Department of Agriculture, Division of Regulatory Services (TDA-RS) is the lead State agency responsible for preventing the introduction and spread of harmful plant pests, such as insects and diseases, into and within Tennessee. It is also the lead Tennessee State agency responding to any type of harmful plant pest introduction. (http://tn.gov/agriculture/regulatory/tcd.html)

Prevention

a) Provide surveillance and detection, follow-up inspections on reported suspect invasive species, identification, assessment, and monitoring.
b) Notify and coordinate activities with the appropriate local, state, and federal agencies and private organizations related to program responsibilities and this Plan.
c) Confirm identification of samples and suspect organisms.
d) Cooperate with other members of the TCD Communications Team to develop specific messages and coordinate communication of invasive species information to the public, cooperators, and affected industries.
e) Implement and maintain state quarantines.
f) Review and coordinate pest control activities to ensure compliance with federal, state, and local laws.
g) Seize and destroy materials when warranted.
h) Oversee destruction of infested or potentially infested materials or vectors.
i) Provide or assist with the procurement of funding for survey, outreach, monitoring, and containment when appropriate.
j) Provide pest management expertise and advice to all cooperators (including nursery operators) and the public.
k) Implement compliance agreements for the movement of mitigated regulatory articles out of the buffer regulated and quarantine areas when possible.
l) Monitor compliance

Response

a) Assist in all response activities including quarantine, evaluation, identification, disposal, disinfection, epidemiology, trace-backs and trace- forwards, permitting, inspection, transportation control systems, and survey activities.
b) Collect, collate, analyze, and disseminate technical and logistical information and distribute to field staff and cooperators.

c) Cooperate with other members of the TCD Communications Team to develop specific messages and coordinate communication of invasive species information to the public, media, cooperators, and affected industries.
d) Define training requirements for those involved in response operations. Training may consist of survey, sampling, diagnostic, and regulatory procedures.
e) Cooperate in the declaration of the emergency area and assist in defining the emergency area and control of quarantined zones.
f) Acquire necessary funding to support emergency program activities.
g) Consult with State and local authorities regarding response operations.

2. Tennessee Department of Agriculture, Division of Forestry (TDA-DF) is the lead State agency responsible for providing forest and urban forest management information and technical forestry assistance to the people of Tennessee and protecting and managing Tennessee's forests for long-term resource sustainability. (http://www.state.tn.us/agriculture/forestry)

a) Provide forest management expertise and advice to private landowners, communities, forest products and tree care industries, consulting foresters, and the general public.
b) Provide information and assistance to Tennessee communities in planning community preparedness and response to TCD and other invasive forest species.
c) Manage forests on Division of Forestry lands to mitigate the impacts of invasive forest pests.
d) Lead the TCD Communications Team and, in partnership with other agencies, develop specific messages and coordinate communication of invasive species information to the public, media, cooperators, and affected industries.
e) Provide liaison with the USDA Forest Service, National Association of State Foresters, and Southern Group of State Foresters through the Tennessee State Forester to request further assistance and funding.
f) Assist in surveillance, detection, follow-up inspections on reported suspect invasive species, identification, assessment, and monitoring.
g) Assist with containment, restoration, and mitigation activities.
h) Serve as the liaison (Tennessee State Forester) to the Tennessee Forestry Commission.

3. USDA Forest Service (FS) assists in the detection, evaluation, monitoring, suppression, restoration and management of invasive forest pests on all forest ownerships.

a) Assist other agencies with identifying and prioritizing which invasive species to control and to effectively develop and implement a management plan to minimize the impact and spread of these pests.
b) Cooperate with other members of the TCD Communications Team to develop specific messages and coordinate communication of invasive species.
c) Provide surveillance and detection, follow-up inspections on reported suspect invasive species, identification, assessment and monitoring.
d) Notify and coordinate activities with the appropriate local, state and federal agencies and other appropriate organizations related to program responsibilities and this Plan.

e) Confirm identification of samples and suspect organisms.

C. Facilitate Inquiries and Reporting of Suspect Infestations

1. Educate the general public to submit inquiries and suspect infestation reports to a natural resource professional to allow pre-screening for appropriate tree species and insect group. See reporting process details in Appendix C. (Communications Team)

2. Educate natural resource professionals (e.g. arborists, municipal foresters, nursery managers) to submit inquiries and suspect infestation reports to TDA-RS, or TDA-DF as described below. (Communications Team)

3. Inquiries and reports of suspect TCD infestations are to be submitted to one of the following individuals. Personnel from these agencies will inspect the suspected walnut tree(s) and identify the specimen(s).

   - State Entomologist, TDA-RS
   - Forest Pest Specialist, TDA-DF

4. Collected specimens will be forwarded by the TDA-RS State Entomologist or the TDA-DF Forest Pest Specialist.

5. If a collected specimen is initially suspected to be TCD the specimen will be sent to the TDA laboratory or the National Pest Diagnostic Network (NPDN) for positive identification

6. All Technical Team members are to be notified that a suspect TCD is in the system for identification. However, at this point, all information is not for public dissemination. The public will be informed after a positive identification has been made.

7. The identification result from either of the laboratories, either positive or negative for TCD, will be received by TDA, who will notify the Technical Team and the Communications Team.

IV. Reduction of Infestation Risk

Objective: Identify all major pathways of TCD introduction and ensure actions are taken to reduce infestations as soon as possible.

A. Assess Risk of Infestation

1. Assess the magnitude of the resource at risk. (TDA-DF)

2. Analyze density of walnut populations to identify high-risk. (TDA-DF)

3. Establish a TCD Pathways Committee.
   a) Members include TDA-RS, TDA-DF, TDEC-RM, Tennessee Urban Forestry Council, Tennessee Forestry Association, UT Extension Service, Association of Consulting Foresters and representation of the nursery industry, utility companies, and camping and recreational vehicle associations.
   b) Assess pathways and risks of TCD introduction into Tennessee.
   c) Track the spread of TCD in infested states. (Technical Team)

B. Reduce Risk of Spread

1. Raise public awareness about risks of moving infested wood. (Communications Team)
   a) Install educational posters at public and private campgrounds and highway rest areas.
   b) Develop and employ a variety of educational tools (e.g., media releases, billboards, public service announcements).
   c) Educate firewood dealers and buyers on the benefits of buying and selling locally produced firewood in Tennessee.
   d) Educate the public and implement (1) “Don’t move out of state firewood”, (2) “Use local sources of firewood”, (3) “If you have already brought firewood from home, don’t move it, burn it” firewood policy in Tennessee’s private and public campgrounds (4) dispose of yard waste properly.
   e) Educate state and national camping and recreational vehicle associations and youth scouting organizations about the risks involved with transporting firewood.

2. Educate industries about risks and regulations associated with movement of walnut logs and nursery stock. (Communications Team)
   a) Reach out to primary and secondary wood processors through landowner, industry, and professional associations.
   b) Educate municipalities, contractors, garden centers, and landscapers about importance of knowing the source of black walnut nursery stock.

c) Educate utility companies and others involved in tree management along rights-of-way.

3. Educate law enforcement agencies (Tennessee State Highway Patrol, Tennessee Sheriff's Association, and local Police Departments and Associations) regarding existing regulations. (TDS-RS)

4. Maintain an effective inspection program
   a) To ensure thorough inspection of black walnut nursery stock (TDA-RS)
   b) Do phytosanitary inspections of regulated items in a timely manner when necessary to allow movement when possible. (TDA-RS)
   c) Do compliance checks with compliance holders to make sure there are no breakdowns. (TDA-RS)

5. Promote planting selections that contribute to a diverse and sustainable urban forest. (Communications Team)

6. Seek legislative support to reduce risk. (Technical Team)
   a) Invite active participation by Governor's representative.
   b) Advocate for readiness funding from stakeholders.

V. Detection and Monitoring

Objective: To detect TCD introductions promptly and improve the probability of containing an infestation.

A. Survey high-risk black walnut populations to detect the presence of TCD following TDA developed survey protocols.

1. Continue state surveys of areas with high risk of TCD introduction. (Technical Team)

2. Annually plan and review TCD survey activities. (Technical Team)

3. Communicate survey results to stakeholders and the media by media releases and/or informational website. (Communications Team)

B. Educate the public and professionals to aid in rapid identification of an infestation.

1. Provide TCD training and outreach to natural resource professionals including TDA-RS, TDA-DF, TDEC, TWRA, UT Extension, naturalists, landscapers, consulting foresters, arborists, nursery personnel, and other plant industry workers. (Communications Team)

2. Educate the general public about TCD. (Communications Team)
   a) Obtain or develop educational materials for the general public.
   b) Pursue opportunities for speaking, publishing, and exhibiting educational material.

3. Recruit and enable volunteer observers. (Communications Team)
   a) Promote awareness with media releases and public appeals for help in scouting.
   b) Obtain/prepare kits and training to support volunteer observers by individuals and groups (e.g. Master Gardeners, Naturalists, County Forest Landowner Associations, Tennessee Urban Forestry Council, Arborists, TFA).

C. Coordinate State and National information to address professional and public inquiries from Tennessee and foster cooperation and communication.

1. Link web sites of Action Team agencies to USFS PPQ, and Cooperative Thousand Canker Disease related web sites. (Communications Team)

2. Coordinate with Thousand Cankers Disease interest groups to add Tennessee information to their web site. (Communications Team)

VI. Response to Infestations

Objective: To contain and manage TCD infestations such that the potential for new outbreaks is minimized. Prescribed treatments conform to the Integrated Pest Management concept described in Appendix H.

The Technical Team, with cooperation of affected local government(s) will implement coordinated efforts to contain the infestation according to current policies and scientific information.

A. Plan and implement containment action.

1. Coordinate response with affected local governments and other entities.
   a) Meet to discuss and determine the preliminary plan of action. (Technical Team).
   b) Schedule an emergency meeting with cooperators (e.g. regulated industries, city and county governments, utility companies, recreational areas, and others). (TDA-RS (lead) and Technical Team)
   c) Release accurate information to the media. (Communications Team)

2. Organize and conduct a delimiting survey to determine the infestation boundaries. (TDA-RS (lead) and Technical Team)
   a) Locate and assess as many walnut trees as possible within 1/2 mile of a positive find for TCD activity within a reasonable time frame.
   b) Initiate an expanded survey if additional TCD infested trees are detected.
   c) Focus surveys on counties closest to known infested area.

3. Initiate regulatory and control activities as necessary.
   a) Administer provisional quarantine established by TDA-RS consistent with Tennessee Rule 0080-06-11 – Emergency rules will be issued describing the quarantined area and regulated articles. (TDA-RS)
   b) Determine if removal of potential host trees is appropriate. (TDA-RS (lead) and Technical Team)
   c) Develop compliance agreements with stakeholders to restrict movement from TCD -infested (regulated) areas. (TDA-RS)
   d) The smallest political subdivision that can be quarantined for TCD is an entire county.

4. Dispose of wood debris in cooperation with local governments. (Technical Team)
   a) Establish processing facilities in the quarantine zone(s) to efficiently handle walnut debris and reclaim useable products as practical.
   b) Market mitigated reclaimed wood products.

B. Communicate information about response.

1. Provide accurate information and updates to the media through the core members of the Communications Team. (Communications Team)

2. Provide accurate information to affected residents. (Communications Team)
   a) Prepare information for customizing and distributing to affected area immediately after infestation is found.
   b) Cooperate with local governments to host local resident/landowner meetings to share information as soon as possible after finding an infestation.

3. Communicate with public and industry professionals to foster cooperation and maximize effective response. (Communications Team)

4. Communicate with other State Plant Regulatory officials about the infestation status of Tennessee.

VII. Mitigation of Potential Impacts

Objective: To develop processes and resources for mitigating potential impacts in the event of the establishment of TCD populations.

A. Response for urban forests

1. Develop TCD Response Plan for Urban Forests. (Technical Team)
   a) Distribute draft plan to stakeholders for review. See Appendix G.
   b) Team agrees to implementation of the plan.
   c) Educate internal stakeholders within cooperating agencies to promote common approach to plan implementation.

2. Identify resources and needs. (Technical Team)
   a) Evaluate human and technical resources required to effectively monitor for TCD and respond to introductions.
   b) Assess human and technical resources available among partner agencies (e.g. survey personnel, delimiting personnel, tree climbers) and acquire commitments for their participation.
   c) Identify sources of funding for readiness activities.

3. Educate the media to ensure accuracy of information (Communication Team).
   a) Identify key contacts (core members or Communications Team) as sources of current information.
   b) Develop a system among core members of the Communications Team for coordinating messages among agencies and providing expedited communications.
   c) Develop a media strategy to publicize the final Action Plan.

4. Explore wood waste utilization opportunities with the forest products industries and other partners to reclaim walnut material to its highest possible use in the event a large volume of material suddenly becomes available. (TDA-DF (Lead) and Technical Team)

B. Response for rural forests

1. Develop recommendations for silvicultural response. (TDA-DF) See Appendix I.

2. Distribute guidelines to appropriate stakeholders. (Communication Team)

3. Evaluate and encourage local market utilization. [TDA-DF (lead), Technical Team]

C. Technical Readiness – Ensure that policy decisions, actions, and education initiatives are guided by the best current science.

1. Review and distribute to stakeholders recommendations for remedial control

actions developed from recent government and university research. (Technical Team)

2. Transfer technology to field foresters, consulting foresters, arborists, extension and nursery professional as it becomes available. (Communications Team)

D. Administration Readiness – Ensure that current, relevant, and achievable policies are in place that allow the actions described in this plan to occur quickly and unencumbered.

1. Assist communities in developing local response plans. [TDA-DF (lead) and Technical Team]

2. Conduct training programs for local government staff. (Communications Team)

3. Develop and distribute relevant information (print media, web, public service announcements, etc.) for homeowners. [Communications Team]

4. Provide updated information on TCD management techniques to arborists, landscape professionals, utility companies, and other green industry personnel through publication and periodic workshops. (Communications Team)

5. Explore opportunities for potential reforestation programs. [TDA-DF (lead) and Technical Team]

E. Seek legislative support to cover cost associated with TCD management. [Technical Team]

1. Invite active participation by the Governor's representative.

2. Advocate for matching funds at state and federal levels to assist local government(s) in mitigation and recovery efforts.

3. Advocate for readiness funding from stakeholders.

4. Invite active participation by the general public from interested owners of black walnut trees.

F. Develop research infrastructure and project outputs (Technical Team)

1. Secure funding for research.

2. Learn more about the biology of TCD in eastern forests and urban areas.

3. Develop strategies for mitigation of quarantine regulated items.

4. Develop an economic impact assessment of TCD in Tennessee.

5. Develop effective trapping and detection methods.
6. Learn what the likely pathways for TCD spread are in the east and how to mitigate them.

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APPENDIX A - Tennessee TCD Action Team and Partners

Technical Team

TDA – Division of Regulatory Services (Co-chair: State Entomologist)
TDA – Division of Forestry (Co-chair: Forest Pest Specialist)
USDA Forest Service, Southern Region, State & Private Forestry, Forest Health Protection, Asheville, NC
University of Tennessee Extension Service Forest Health Program
University of Tennessee Agriculture Experiment Station, and other research institutions and individuals

Communications Team

Tennessee Department of Agriculture – Division of Forestry
(Co-chairs: Resource Protection Unit Leader, and Information & Education Program Specialist)
Tennessee Department of Agriculture, Division of Regulatory Services
(Co-chair: State Plant Regulatory Official)
Tennessee Department of Environment and Conservation
USDA Forest Service, Southern Region, State & Private Forestry, Forest Health Protection, Asheville, NC
University of Tennessee Extension Service

Collaborators

USDA Forest Service, Cherokee National Forest
National Park Service, Great Smoky Mountains National Park
National Park Service, Big South Fork National River & Recreation Area
USDA Natural Resources Conservation Service
Tennessee Urban Forestry Council
Tennessee Forestry Association

Stakeholders

Municipalities
Commercial Campgrounds
Tennessee Emergency Management Agency
US Department of Interior, National Park Service
Tennessee Nursery and Landscape Association
Tennessee Forestry Commission
University of Tennessee College of Agricultural Sciences and Natural Resources
USDA Forest Service, Land Between the Lakes National Recreation Area
Tennessee Recreation and Parks Association
Tennessee Department of Tourist Development
Tennessee Wildlife Resources Agency
Tennessee Farm Bureau
Tennessee Valley Authority
Oak Ridge National Laboratory
National Association of State Foresters
Association of Consulting Foresters
The Nature Conservancy
Walnut Council
USDA Forest Service, Northeastern Area, State & Private Forestry, Forest Health Protection

APPENDIX B - Legal Authorities

The following agencies have, by law, the responsibility and authority to manage plant pest introduction:

- Tennessee Department of Agriculture
  Rules of the Tennessee Department of Agriculture, Division of Regulatory Services 0080-6-11
(See http://www.state.tn.us/sos/rules/0080/0080-06/0080-06-11.20100901.pdf)

- Affected local government(s) at sites of infestation.

APPENDIX C - Thousand Cankers Disease Regulations in Plain Language

TCD Quarantine Counties: *Anderson, Blount, Knox, and Union Counties*
TCD Buffer Regulated Counties: *Campbell, Claiborne, Grainger, Jefferson, Loudon, Monroe, Morgan, Roane, Scott, and Sevier Counties in Tennessee*

Walnut Logs

Walnut Logs in TCD Quarantined Counties
Walnut logs can move within the TCD quarantined counties without treatment or a compliance agreement as long as the counties are adjacent to each other. *Note – if walnut logs are moved into a quarantined county they must meet the quarantine requirements to move back to a buffer regulated county or into non- regulated areas.*

Walnut Logs in TCD Buffer Regulated Counties
Walnut logs can move within the TCD buffer regulated counties and into TCD quarantined counties without treatment or a compliance agreement as long as the counties are adjacent to each other. *Note – if walnut logs are moved into a quarantined county they must meet the quarantine requirements to move back to a buffer regulated county or into non- regulated areas*.

Walnut Logs in Tennessee outside the TCD Quarantined or Buffer regulated Counties
Walnut logs outside the TCD quarantined or buffer regulated counties can move within and out of the state of Tennessee without treatment or a compliance agreement. *Note - Some states may require a state inspection and phytosanitary certificate (phyto) to enter their state. Check the website or call for current information: http://nationalplantboard.org under Summary of Laws and Regulations or call TDA at 615-837-5137*

Walnut Lumber

Kiln Dried Walnut Lumber in TCD Quarantined Counties and Buffer Regulated Counties
Walnut lumber that is kiln dried, square edged and 100 % free of bark is not a regulated item. No compliance agreements are needed.

Walnut Lumber in TCD Quarantined Counties and Buffer Regulated Counties
Walnut logs can be processed into lumber and move within the quarantined counties as long as the counties are adjacent to each other, without the need of a compliance agreement. Walnut logs can be processed into lumber and move within the buffer regulated counties as long as the counties are adjacent to each other, without the need of a compliance agreement. *Note – if lumber is moved into a quarantined county it must meet the quarantine requirements to move back to a buffer regulated county or into non- regulated areas.*

Walnut Lumber moving Outside TCD Quarantined Counties and Buffer Regulated Counties
Within the state of Tennessee if walnut lumber is to be taken outside of the quarantined or buffer regulated counties it must be square edged and be 100% free of bark and the cambium layer. Green walnut lumber cannot move out of the TCD counties without the mill having a compliance agreement and the shipment moving under certificate. Some states require a state inspection and PHYTO certificate to enter their state. Check the website or call for current information: http://www.nationalplantboard.org under Laws and regulations or call TDA at 615-837-5137.

Walnut Lumber in Tennessee outside the TCD Counties moving to other states
Some states have regulations that require a state inspection and PHYTO certificate to enter their state. For information on requirements of other states check the website: http://www.nationalplantboard.org under Laws and regulations or call TDA at 615-837-5137

Firewood

Movement of Firewood within the <u>TCD Quarantine Counties</u>
Hardwood firewood may be moved without treatment only within the TCD quarantined counties as long as the counties are adjacent to each other.

Movement of Firewood within the <u>TCD Buffer Regulated Counties</u>
Hardwood firewood may be moved within the TCD buffer regulated counties as well as TCD quarantined counties without treatment or a compliance agreement as long as the areas are adjacent to each other. *Note – if firewood is moved into a quarantined county it must meet the quarantine requirements to move back to a buffer regulated county or into non- regulated areas.*

Movement of Firewood from the TCD Quarantine Counties or Buffer Regulated Counties into non regulated areas
A company will need a Compliance Agreement that requires a heat treatment for firewood and required safeguarding the firewood from re-infestation or a Firewood Distributor Compliance Agreement to move firewood outside the regulated counties.

Hardwood Mulch

Ground Hardwood Mulch in TCD Quarantine Counties
Chipped mulch may move freely within TCD quarantine counties without a treatment or compliance agreement as long as the counties are adjacent to each other. There is no movement allowed of chipped hardwood mulch outside of the quarantine counties at this time.

Ground Hardwood Mulch in Buffer Regulated Counties
Chipped mulch may move freely within TCD buffer regulated counties and into TCD quarantine counties without treatment or a compliance agreement as long as the counties are adjacent to each other. There is no movement allowed of chipped hardwood mulch into TCD unregulated counties at this time. *Note – if Mulch is moved into a quarantined county it will not be allowed to move back to a buffer regulated county or into non- regulated areas.*

Composted Hardwood Mulch outside Quarantined Counties
A company will need to enter into a compliance agreement listing the requirements of composting, shipping requirements, and permit issuance and the receiving company will need to have a compliance agreement on how the materials will be treated.

Further information and compliance agreements can be obtained by calling:

Tennessee Department of Agriculture
615-837-5137

APPENDIX D - Reporting Suspect Thousand Cankers Disease Infestation

Reporting Process:

General public:

1. Suspect TCD infestations may be reported by calling 615-837-5137. Provide name, location, phone number, date and site/tree characteristics and symptoms.

   Information may also be submitted online at http://www.tennessee.gov/agriculture/regulatory/tcd.html.

2. A representative of the Division of Forestry or Division of Regulatory Services will contact the caller and arrange for a site visit. If the walnut tree is suspect, samples will be collected for analysis. If DRS is present they will take custody of the samples. If TDF is the sole representative the procedure below will be followed.

TDF:

1. Inquiries should be investigated as soon as practical.

2. In non-quarantine counties a walnut survey form will be completed and faxed or emailed to the contact on the form, and a copy of the form included with the samples.

3. In quarantined counties the documentation procedure is the same as in step 2 except it is not necessary to collect samples.

4. Samples will be double bagged at the collection site, frozen for a minimum of 48 hours, triple bagged, and shipped to the appropriate lab for analysis.

APPENDIX E – Best Management Practices

Management options are currently limited since this newly emerging insect/disease complex has only been recently described (2008). A vigorous program to identify black walnuts showing early symptoms and their subsequent removal may slow-the-spread of TCD within an affected community if implemented early (Cranshaw 2009).

Urban

The wood from TCD-infected trees should be removed as soon as possible to prevent further spread of walnut twig beetles. Chipping is considered the best management approach, although some twig beetles may survive this treatment on larger fragments. The chipping process will likely make host material unsuitable in a much shorter time (i.e., months) rather than leaving whole logs (i.e., years) on site. The wood may be buried or held in a secure location isolated from areas where TCD is not present. (Cranshaw, 2009)

Forest

Preemptive harvesting of black walnut is not recommended except to contain a known infestation. Walnut in forest settings has not been observed to have TCD. This is possibly because of the problems of observing and detecting TCD in a forest location rather than any inherent resistance that forest walnut trees may have. There is every reason to believe that walnut in a forest setting is susceptible to TCD. Woodland walnut trees near known infestations should be monitored for TCD. When TCD occurs in forest walnut trees they should be removed with an appropriate harvest scheme such as a sanitation cut. All walnut trees in the stand or property should be harvested to insure that trees harboring TCD are not left behind. Walnut tree tops should be left in the woods. Walnut logs should be separated from other logs when loaded for hauling. Walnut logs in a quarantined county cannot be taken outside the quarantined counties. Walnut logs in a buffer county cannot be moved outside the regulated counties.

Wood Using Industry

Since early 2010 several states have established quarantines that prevent the movement of certain walnut products. It is likely that more will follow given the extent of the Tennessee find within the natural distribution of eastern black walnut. These measures regulate raw walnut wood material with bark intact, although details may differ regarding accepted means of disinfestations. Most do allow transport of wood that has been milled to remove all bark and wood that had been incorporated into finished products. Also, nuts do not harbor walnut twig beetles and are not regulated by quarantines. These management limitations make it extremely critical that the walnut twig beetle and associated fungus not be allowed to spread from infested areas. (Cranshaw, 2009)

APPENDIX F – Budget Proposal Template

The responsibility of developing a budget resides with each agency. Agencies will combine efforts at the Team level. Agencies and Teams may need to develop budgets. Considerations for the budget are: 1) additional agency costs in training and response 2) additional staffing needs 3) support for local government for mitigation/containment treatments such as tree removal 4) educational outreach.

Five Year Budget Plan

Year	State	Federal	Total
2011			
2012			
2013			
2014			
2015			

Itemized Annual Budget Plan – TDA Division of Forestry

Item	State	Federal	Total
Salaries & Benefits			
Travel			
Supplies			
Printing/media			
Equipment			
Total			

Itemized Annual Budget Plan – TDA Division of Regulatory Services

Item	State	Federal	Total
Salaries & Benefits			
Travel			
Supplies			
Printing/media			
Equipment			
Total			

APPENDIX G – An Urban Forest Response Plan Template (excerpts from *A Proposed Action Plan for TCD Management in Urban Forests* – W. Cranshaw)

1. Identify the location of all *Juglans* species within the area.

2. Identify the location of all TCD-symptomatic trees.
Trees suspected of TCD should be confirmed by examining limbs for presence of the cankers and/or beetle presence. Culture of *Geosmithia morbida* or the presence of walnut twig beetle can be used for positive identification.

Note: Verification of the disease by culturing is not necessary if the walnut twig beetle is observed in the wood. The assumption is that all beetles are infested with *Geosmithia*; therefore beetle infested bark will contain the fungus. . Remember that flagging on walnut, the earliest diagnostic symptom of TCD, may be caused by squirrel damage or other limb injuries.

3. Inform all owners of *Juglans* sp. trees of the nature of thousand cankers disease. In particular, educate tree owners of the importance of handling infective wood to prevent spread to new locations.

4. Establish a means to properly handle and store/destroy infective wood.

5. Decide on an action plan.
If the disease is widespread and Juglans plantings occur throughout the municipality, there is little opportunity to affect the course of the disease via directed tree removals. Education and proper handling of TCD-infective wood should be the primary focus. If TCD is present in isolated pockets within a community then containment can be considered as having potential value in slowing spread. Tree removal should focus on these sites, eliminating all Juglans that can reasonably be suspected of containing infective walnut twig beetles. Establishment of a *Juglans*-free barrier between the TCD site and areas of healthy trees not already colonized by walnut twig beetle may substantially retard spread. Education and proper handling of TCD infective wood should be emphasized.

TCD - Prevention: The Best Strategy

Prevention of TCD establishment in a community is the only means to effectively manage this disease. This no longer is an option where TCD is already present. If the disease can be contained, most importantly by restricting beetle-containing wood or bark, then the ultimate course of Thousand Cankers Disease may be limited to the destruction of walnut trees within communities where the disease has already become established.

Since Thousand Cankers Disease has become established within the native range of this tree the results could be a catastrophic - possibly even leading to the functional extermination of this species in the manner that Chestnut blight or Dutch elm disease destroyed American chestnut and American elm, respectively. Prevention of spread by preventing the movement of TCD infective walnut wood is critical to the protection and future survival of *Juglans nigra* (black walnut) in North America.

APPENDIX H - TCD Treatments in Urban Forests

(excerpts from *A Proposed Action Plan for TCD Management in Urban Forests* – W. Cranshaw)

Arborists have made attempts to manage this disease, primarily involving use of various bark applied sprays (e.g., permethrin, bifenthrin) or soil drench systemic insecticides (e.g., imidacloprid) to kill the walnut twig beetle (*Pityophthorus juglandis*). The walnut twig beetle is the vector of *Geosmithia morbida*, the fungal associate that produces bark cankers that most define the course of TCD infections. These beetle-targeted insecticide applications have apparently had only limited effectiveness and, at best, have been able only to slow the TCD progress.

Sanitation has also been considered for TCD management. The effectiveness of sanitation for managing some shade tree diseases is well illustrated with Dutch elm disease (DED), a devastating disease of American elm (*Ulmus americana*) that similarly involves a pathogenic fungus (*Ophiostoma novo-ulmi*) and a bark beetle vector (*Scolytus multistriatus*; probably *Scolytus schevyrewii*). Indeed, the adoption of sanitation and other management practices for DED was a key event in the development modern urban forestry.

Epidemiology - Thousand Cankers Disease/Involvement of the pathogen

Geosmithia morbida is restricted to the phloem and outer tree bark (and later the cambium) producing localized cankers.

Role of Root Grafts

Root graft transmission does not occur.

Association of the Pathogen with the Beetle Vector

Geosmithia morbida is consistently associated with the walnut twig beetle. It is a very common and perhaps invariable fungal associate of walnut twig beetles. It is possible that the two organisms have a mutual association, as occurs with some bark beetles.

Speed of Symptom Development

Symptoms develop from the cumulative effects of multiple canker production, resulting from very large numbers of individual inoculations by *G. morbida*-carrying walnut twig beetles. External symptoms of infection, e.g., flagging, will not occur until sufficient numbers of cankers have been present to produce girdling.

The speed at which walnut trees are killed is still unknown and will depend on many factors, notably the number of infective beetles initiating infections as well as host susceptibility to *G.morbida.* However, if plantings are originally colonized by only small numbers of walnut twig beetles, it may take a very long time (i.e., more than 3-4 years), before sufficient numbers of cankers have developed to produce external symptoms. However, trees usually are dead within 2-3 years after symptoms such as branch wilting or dieback are observed.

Overwintering of Beetle Vectors

The overwintering habits of the walnut twig beetle need more attention. Presently, we believe beetles overwinter primarily as adults in cavities excavated in outer bark. These overwintering chambers may be in the same tree within which the beetle developed or may be a nearby walnut tree.

Survival in Cut Wood

Freshly cut wood is highly attractive to and can support development of walnut twig beetles. Successful larval development will require wood of sufficient moisture and drying ultimately will make wood unsuitable. However, because of the small size of the beetles, development may occur in small pockets within drying logs. It is possible that under conditions where drying is slow, logs may remain suitable for breeding for 2 or even 3 years after felling.

Debarking may kill some developing larvae. However, bark may contain live adult beetles. Chipping likely will kill most beetles, but some small pieces of wood with bark intact remain after chipping that can support surviving walnut twig beetles and allow successful development of some larvae.

Role of Bark-Sprayed Insecticides

Trunk/branch sprays applied in a manner typically used for bark beetle control do not appear to be effective in preventing TCD-progress. The large number of walnut twig beetles present over an extended period (May-September) and the large areas of the tree that may be attacked are all significant impediments to effective coverage.

It is possible that late summer trunk sprays directed at beetles seeking overwintering shelter in the trunk may be useful in reducing populations. This may have some value in slowing TCD development and spread. However, this method has not been demonstrated.

Role of Systemic Insecticides

The value of systemic insecticides in TCD management has not been well evaluated. Limited observations indicate that imidacloprid (i.e., Merit, Marathon, Touchstone, etc.) is ineffective after symptoms have developed. Anecdotal accounts suggest that disease progress may be slowed by imidacloprid if applications are made before extensive cankers have been formed. However, it is unlikely that systemic insecticides can prevent TCD. Successful inoculations of *G. morbida* likely can occur even if the walnut twig beetle is subsequently killed. Cankers resulting from infection will produce pockets within the tree where future movement of systemic insecticides will be limited, allowing some successful development of twig beetles at these sites. These areas under the bark where beetles will be protected from systemic insecticides will increase with time as cankers expand and new cankers are initiated. It is possible that the more water soluble insecticide dinotefuran (Safari) may provide improved coverage. However, it has not been evaluated.

Pesticide labeling restrictions will be an important limitation to the use of systemic insecticides in most walnuts. Any pesticide (insecticide, fungicide) considered in TCD management may need to comply with use restrictions of walnuts grown for nut-crops. At present, there are food crop tolerances for imidacloprid in walnut meat, as this insecticide (Provado formulation) is used in commercial nut production. Dinotefuran has no established tolerance for walnut meat and no formulations are labeled for this crop.

The Role of Sanitation in TCD Management

For urban forestry, sanitation will have a modest role in management of thousand cankers disease. This is largely due to two factors: 1) the long lag time between tree infestation and TCD symptom expression, allowing undetected local spread; and 2) the consistent association of the pathogen with essentially all bark beetles. Because of this, once TCD has become established in a city, eradication is unlikely; some slowing of spread is the best potential outcome.

Where black walnut trees within a city occur in contiguous plantings, elimination of TCD symptomatic trees will have minimal effects. Nearby non-symptomatic trees can be assumed to very likely also be infested whenever a TCD-symptomatic tree is detected. Although tree removal will result in some removal of infective walnut twig beetles within the cut tree, these will constitute only a portion of those already present among the plantings, perhaps only a small portion. Elimination of these beetles through tree removal will likely only modestly slow the course of disease development in remaining nearby trees, probably by only a couple of years at most.
Sanitation may be most effective if plantings of black walnut within the city are widely separated, by several city blocks at a minimum. If it is assumed that normally the beetles disperse short distances, then removal of all TCD infected trees, symptomatic or not, may provide local TCD-eradication within an isolated pocket of black walnuts. If infective walnut twig beetles have not already spread beyond this area, TCD spread to more distant uninfected plantings of walnut may be substantially slowed.

Also extremely important in TCD-containment is the proper handling of TCD-infective wood. Recently cut trees that showed TCD symptoms likely will contain many thousands of walnut twig beetles. If this infective wood is moved in a manner that these beetles can invade new, healthy stands of walnut, new pockets of TCD will develop and ultimately destroy these plantings.
As walnut wood may support development of walnut twig beetles until thoroughly dried, beetle-containing wood must be either destroyed or isolated.

Chipping will largely achieve beetle destruction, but not completely, so that chipped TCD-infected wood should also be handled with care. (During warm periods, active beetles potentially may even disperse from cut wood as it is moved from the site. Therefore, care should be given in routing trucks hauling TCD-infective wood to avoid areas of healthy, uninfected walnut.)

Because of the very high value of black walnut logs, salvage often will be attempted. If logs cut from TCD-infective trees are recovered, they should be handled in a manner that prevents beetle dispersal until the wood no long supports further walnut twig beetle development. Until sufficiently dried (2, perhaps 3 years under normal conditions) they should be isolated. Isolation can be achieved largely by stockpiling wood in a site that is distant from healthy walnuts, particularly walnuts located downwind. Storage of logs in buildings can achieve beetle containment. Tarping logs with clear plastic also may contain beetles within logs. Tarping to achieve solarization also would likely be a means to kill developing beetles.

Reference:
Cranshaw, Whitney, Thousand Cankers Disease Management in Urban Forestry - Draft. 2009.

APPENDIX I – TCD Rural Forest Response Plan

There are many unknowns about managing forestland for preventing and treatment of TCD. Utilizing the best science in practical and economic methods is perhaps the best guiding principle.

It will be important for those in the forest industry to follow quarantine guidelines to prevent spread of TCD. And to insure that walnut products from Tennessee can be trusted to be free of TCD.

With the widespread presence of black walnut in Tennessee's forests, it is assumed that walnut is present in most woodlots and forests. Deep, moist, well drained and fertile soils below 4,000 ft. are typical of where black walnut is found. It is often found as single trees or in groups of scattered walnuts intermixed with other species.

Information and Education – owners of forestland and woodlots should be informed of the threat of TCD. The latest research and location of TCD should be disseminated to forest owners and managers. Forest industry must be kept abreast of changes in quarantine areas and product treatments.

Detection and Monitoring – known infestations will become the center of detection activity. Nearby forests having black walnut will be examined for TCD symptoms. Examinations may begin with landowners or other non-professionals and escalate to site visits by foresters or others trained to take tree samples if the situation dictates. When infested trees are removed periodic monitoring of nearby forests is warranted.

Treatment – Preemptive harvesting of black walnut is not recommended except to contain a known infestation. Removal of infested black walnut, and potentially infested black walnut within the stand or on the same property is advised. Sanitation harvests, other partial harvests or clear-cuts are appropriate methods of treatment. Walnut tree tops should be left in the woods. Walnut logs should be separated from other logs when loaded for hauling. Walnut logs or products with bark intact in a quarantined county or buffer county cannot be taken outside the quarantine area. Walnut lumber in a quarantined county or buffer county cannot be taken outside the quarantine area unless certified to be TCD free.

It is not yet known if the removal of black walnut in an area would result in the demise of TCD in that vicinity. Logically the absence of a host would apparently result in the loss of the pest, however much is yet to be learned about TCD.

Because of the regenerative quality of black walnut, (seed reproduction, root and stump sprouts, etc.) it is likely that open areas will retain some element of black walnut in their stand composition. However, black walnut does not tolerate shade well so those stands that are partially harvested through a thinning scheme will likely lose most or all of their black walnut.

APPENDIX J – IPM Strategic Plan Principles

Although specific treatment for TCD is undetermined at this time, the Integrated Pest Management process should be used to guide the thousand cankers disease (TCD) management activities in Tennessee.

Integrated pest management is a decision process that uses all available pest management strategies to economically control pests and weeds. IPM is a process of using the least invasive control method or combination of methods that will reduce the risk, created by both the pest and the treatment of the pest, to human health and the environment. IPM is a continual process of refining appropriate treatments based on the level of pest infestation and new information and technology.

Strategic Goals:

- Minimize damages caused by TCD (such as economic, aesthetic, public safety).
- Reduce negative ecological impacts resulting from TCD infestations.
- Minimize potential negative impacts of treatments used to manage TCD.

In the strategic plan implementation, actions are taken only after evaluating whether or not TCD poses a significant problem..

Injury Levels:

- Economic Injury Levels - Control measures should be implemented when damage is predicted to reach a level that is severe enough to cause a net economic loss.
- Environmental Injury Levels – The levels of damage at which TCD is expected to become a threat or cause harm to the environment or public safety.
- Aesthetic Injury Levels - Damage at which TCD is predicted to become a problem by negatively impacting viewsheds. Aesthetic injury levels are subjective and will vary depending on the situation.

Components of strategic response:

- Identify, monitor and evaluate TCD populations and damage along with other relevant factors.
- Determine injury levels and thresholds that trigger treatment.
- Select the least disruptive yet effective tactics.
- Time the appropriate treatments.
- Spot-treat for thousand cankers disease where appropriate.
- Evaluate the effectiveness of treatments to guide future treatments.
- Educate those involved with TCD control measures.