

Thousand Cankers Disease of Black Walnut Action Plan

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Prepared by the
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Introduction – Thousand cankers disease (TCD) of walnut is a recently recognized insect/disease complex affecting walnut (*Juglans*) species. Eastern black walnut, *Juglans nigra*, appears to be the most susceptible species, with eventual tree mortality. The disease is the result of the combined activity of the walnut twig beetle (WTB), *Pityophthorus juglandis*, and canker producing fungus, *Geosmithia morbida*, transported by the beetle. Shallow cankers expand in phloem tissues around beetle galleries. As cankers expand and coalesce, the tree becomes unable to store and move nutrients, causing tree decline and mortality after several years. Detection is currently based on pheromone-baited WTB traps and observation of external tree symptoms including leaf yellowing and wilting restricted to single branches giving way to dieback of larger portions of the crown as the disease progresses. Branches from suspect trees are examined for evidence of WTB and *G. morbida* cankers.

TCD has been found in six eastern states (MD, NC, OH, PA, TN and VA) within the native range of black walnut, as well as nine western states (AZ, CA, CO, ID, OR, NM, NV, UT, and WA). *G. morbida* has also been detected in central Indiana on a weevil, *Stenomimus pallidus*, and walnut twig beetles have been detected at a mill in eastern Indiana, however the complete TCD complex has not been officially recognized in that state as of May 14, 2015. The potential for the weevil to act as a vector of *G. morbida* is unknown. Evidence suggests the disease has been present in these positive locations for several years prior to detection, with the potential for the disease to have been transported to other locations on TCD infested walnut materials. While the rate of natural spread of this disease is expected to be slow, it is likely that quarantine and containment efforts will not be sufficient to prevent TCD from getting to Missouri on logs, untreated walnut wood for woodworkers and commercial processors, firewood, nursery stock and scionwood. This prospect is largely due to the risk of TCD being introduced from areas not yet identified as positive for TCD. Quarantines are a tool to help slow the movement of TCD to new locations. Currently, no effective methods have been identified to successfully control TCD once it is established. Measured, organized responses by government agencies and cooperation by stakeholder groups will be required to help slow the spread of TCD.

¹ The Missouri Invasive Forest Pest Council is composed of representatives from agencies and institutions with responsibilities for public land management, plant regulatory activities or providing natural resource information to the public in Missouri. Represented agencies and institutions include: Missouri Department of Agriculture, Missouri Department of Conservation, Missouri Department of Natural Resources, University of Missouri Extension, USDA APHIS PPO, USDA FS Mark Twain National Forest, USDA FS State and Private Forestry, and USDA NRCS.

Current knowledge of this insect/disease complex is limited. Additional research for efficient detection methods and control measures is needed. Research is ongoing on the biology of the WTB and *G. morbida*, other insects and fungi attacking walnut, TCD detection methods, control measures and development of resistant walnut cultivars.

Missouri Perspective – Black walnut is an economically and ecologically valuable resource in Missouri. Forest Inventory and Analysis data (USDA Forest Service) suggests Missouri has about 40 million walnut trees over 5 inches in diameter, more than twice as many as any other state. Missouri imports some unprocessed walnut material and exports walnut lumber and unprocessed logs to other states and countries. Loss of walnut due to TCD would negatively impact the timber industry, nut production, native woodlands, riparian areas, wildlife habitat, plantations and urban plantings. MDC estimates that if TCD eliminates black walnut, the loss to Missouri in impacts to the forest products industry, the nut industry, and community trees could be \$851 million over 20 years. Missouri has a lot to gain delaying the establishment of TCD in the state and by slowing the spread of TCD in any areas where it is detected.

Surveys to detect the presence of TCD will be continued annually to help protect the resource and satisfy quarantine requirements from other states. In addition, MDA and MDC staffs are being trained to identify potential signs and symptoms of TCD and will follow-up on reports of suspect walnut trees from the public. Diagnostic facilities at MDA and MDC, as well as the University of Missouri Plant Diagnostic Clinic, will test samples as needed to confirm TCD. Delimit surveys will occur around positive detection locations.

TCD is not subject to federal quarantines, because both WTB and *G. morbida* are believed to be native to the southwestern US. Missouri has enacted a state exterior quarantine to limit or prevent black walnut products originating in states known to have TCD from entering the state. The current Missouri quarantine can be found at <http://mda.mo.gov/plants/pests/TCDEmergencyRule.pdf>

This action plan should be considered an evolving document that will change as new information about thousand cankers disease becomes available. This plan references information and guidelines established in the National Response 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. The National Response Framework for TCD can be found at http://www.thousandcankers.com/media/docs/TCD_National_Response_Framework.pdf

Outreach Efforts - MDC, MDA and University of Missouri Extension are working cooperatively to raise public awareness about TCD through workshop presentations, webinars, informational websites (<http://extension.missouri.edu/treepests/thousandcankers.aspx>, www.mdc.mo.gov/thousand-cankers and <http://mda.mo.gov/plants/pests/thousandcankers.php>), FAQs, posters, brochures, trade show displays, mass-mailings to raise awareness of Missouri's quarantine and numerous media releases and interviews. Additionally, national outreach efforts

include a website and Pest Alert at <http://thousandcankers.com/> Primary audiences include landowners/plantation owners, loggers, green industry professionals, master naturalists, state nursery inspectors, woodworkers and others.

Some key messages used during outreach efforts include:

- Don't move firewood.
- Don't bring walnut trees or untreated walnut wood into Missouri from known TCD-infested states.
- Be aware of state quarantines.
- Identify walnut trees and recognize possible TCD symptoms.
- Investigate possible TCD infections or infestations².
- Contact MDC or MDA if suspect trees are found.

Monitoring – Survey work will be carried out by MDC and MDA personnel. Surveys will focus on black walnut in high risk areas, which include locations near sawmills, campgrounds and urban areas near yard waste/mulch sites and older neighborhoods. This early detection effort will also help fulfill phytosanitary requirements for black walnut exports. Current efforts to monitor Missouri walnuts for TCD will rely on pheromone baited traps for WTB hung in or near declining walnut trees in high-risk locations as well as a visual survey for symptoms and collection of branch samples for lab testing. Evaluation of trap catches will be done by trained personnel of MDA or MDC. Monitoring efforts will evolve as more effective or efficient survey and detection tools and methods become available. Efforts since 2010 are included in the “Missouri Response to Thousand Cankers of Black Walnut” document.

Detection of Thousand Cankers Disease – Branch sample collection and testing will be done after positive detection of WTB in pheromone-baited traps or as necessary from suspicious trees. The most up-to-date established protocol for identification of TCD will be used, based on the best available science developed by government and university research.

- Trees should be evaluated in midsummer.
- Symptoms in the upper canopy include thinning crowns, leaf yellowing, wilted brown leaves attached to branches.
- Epicormic sprouts may be present below affected branches, on the trunk or at the base of the tree.
- Areas where multiple trees display possible symptoms should get particular attention.
- Photos, descriptions and information about detecting and reporting TCD can be found at <http://extension.missouri.edu/treepests/thousandcankers.aspx>

² “Infection” refers to the presence of live fungal organisms (*G. morbida*) attacking live host trees or branches. “Infestation” refers to the presence of 1) walnut twig beetles in live or dead trees or other host material, 2) *G. morbida* in dead trees or branches (no active infection of live host tissue), or 3) thousand cankers disease in a geographical area.

Detection and Reporting for Homeowners, Landowners and Volunteers

- Information on identifying and reporting TCD can be found at <http://extension.missouri.edu/treepests/thousandcankers.aspx> Suspect trees can be reported using the online reporting form.
- Photographs of suspect trees and branches can be emailed to forest.health@mdc.mo.gov with tree location and contact information. Photographs should include the entire symptomatic tree and surroundings, a close-up of leaves and any other symptoms.
- Alternatively, suspect trees should be reported to local Missouri Department of Conservation foresters.
- Only trained resource professionals should submit samples to diagnostic labs for confirmation of TCD due to the difficulty in obtaining suitable samples and risk of spreading TCD in transport.

Detection and Reporting for Trained Resource Professionals

- **Call before sending any samples.** To prevent release of WTB, suspect samples should only be sent by trained resource professionals. After communicating with diagnostic lab personnel, properly prepared samples should be sent to the MDC Forest Health Laboratory, MDA Plant Pathology Laboratory or MU Plant Diagnostic Clinic.
- Diagnostic labs at MDC, MDA and MU will communicate about sample volume to avoid sample overload at any one lab.
- If evidence of WTB is suspected or *G. morbida* is thought to have been cultured from cankers, the diagnostic lab that examined the sample will send samples to specialists for additional confirmation.

Response to Detection of Thousand Cankers Disease

- A delimit survey will be organized around detection locations to determine WTB infestation boundaries.
- Survey boundaries will be developed based on current knowledge of WTB biology and specific information about the detection site.
- Both symptomatic and healthy walnut trees should be identified near each positive detection and assessed for thousand cankers disease as described under monitoring efforts.
- Evaluate potential pathways for the introduction of TCD to the detection location and potential spread from the detection location.
- Initiate an expanded survey based on appropriate timing and biology of TCD and WTB, focusing on counties closest to known infested area.
- Regulatory activities will be initiated based on a systematic approach developed as data are collected from the delimit surveys.
 - MDA will seek input from stakeholders and assess impacts on businesses in the proposed regulated area prior to establishing state interior quarantines.

- Slow-the-spread activities will be initiated.
 - Education of the public about proper handling of potentially infected or infested material will be important to avoid enhanced spread of the disease.
 - Attempts at containment of TCD infestations by active management of infected trees (e.g., tree removal and destruction) are not justified with current existing technology. No detection tool exists that allows accurate delimiting of infestations, a prerequisite for effective and economically viable containment efforts. Furthermore, without accurate knowledge of the extent of an infestation, tree removal may risk further spread of TCD.
 - In the event that new technological developments or unique circumstances allow definitive determination that TCD has been detected in a newly established and isolated location, limited tree removal and destruction may be considered as one option in the State's response to the detection.
- Potentially infested woody debris will be produced if walnut trees within a regulated or known infested area are cut down due to hazardous structural conditions or other concerns. Disposal of woody debris should use approved methods in accordance with current research on effective treatments and any pertinent local, state or federal regulations.
- MDA and MDC will provide guidance to landowners who desire to remove infected trees on their own land, so that materials are handled in a manner that mitigates the risk of movement of the pest.
- A coordinated press release will be developed by state agencies.
- Outreach efforts will commence to keep stakeholders informed (Appendix A).

Appendix A. Stakeholders

Stakeholders to inform about TCD related activities. Additional stakeholders will be informed as they are identified.

Arborists

International Society of Arboriculture Midwestern Chapter (MW-ISA)

Local Arborist Associations

Missouri Community Forestry Council

Communities

Missouri Municipal League

Municipalities

Federal Agencies

US Army Corps of Engineers

US Department of Interior, National Park Service

USDA APHIS PPQ

USDA Forest Service Mark Twain National Forest

USDA Forest Service State and Private Forestry, Forest Health Protection

Forestry Organizations

Eastern Ozarks Forestry Council

Forest and Woodlands Association of Missouri

Missouri Consulting Foresters Association

Missouri ForestKeepers Network

Missouri Forest Resources Advisory Council

Missouri Society of American Foresters

Missouri State Tree Farm Program

Forest Products

American Walnut Manufacturers Association

Hammons Products Company

MDC forester local logger lists

Missouri Forest Products Association

Missouri Nut Growers Association

Primary Missouri Wood Processors

Walnut Council, Missouri Chapter

Horticultural Organizations

American Society of Landscape Architects
Federated Garden Clubs of Missouri
Missouri Botanical Garden
Missouri Landscape and Nursery Association
Powell Gardens

Natural Resource and Recreational Organizations

Commercial campgrounds
Conservation Federation of Missouri
Missouri Association of Soil and Water Conservation Districts
Missouri Parks and Recreation Association

State Agencies

Missouri Department of Economic Development
Missouri Department of Natural Resources Division of State Parks
Missouri Department of Natural Resources Soil and Water Conservation Program
Missouri Office of Administration
Missouri State Emergency Management Agency

Universities

Lincoln University, Department of Agriculture and Natural Sciences
Missouri State University, Department of Agriculture
University of Missouri, Division of Plant Science
University of Missouri, School of Natural Resources
Other institutions of higher learning

Appendix B. Research Needs

Cooperative support is needed from multiple federal and state agencies and academic institutions for continuing TCD-related research. A collaborative effort is necessary to achieve research objectives in a timely fashion with limited resources. The following science-based research objectives will improve TCD preparedness and enable Missouri to more fully enact the TCD action plan.

- Research on the life history, biology, and behavior of the WTB and *G. morbida* to facilitate other applied research efforts.
- Research and development of improved WTB traps and other TCD survey tools to improve early detection of TCD.
- Evaluation of best management practices and integrated pest management approaches including treatments for infected high-value trees to mitigate impacts of TCD introductions.
- Research on phytosanitary treatments for wood products to facilitate movement of regulated articles from quarantined areas.
- Evaluation of biological control organisms to slow the spread of infestations or the progression of symptom development.
- Evaluation of other insects and fungi associated with stressed walnut trees for potential roles in TCD development.
- Long-term research to evaluate all aspects of disease progression and risk to resources, to determine impacts of TCD and how quickly they will occur.
- Long-term research on potential host plant resistance mechanisms, including screening tools for identifying resistant or tolerant trees to be included in long-term TCD management programs.

Appendix C. Public Input Summary

The draft Thousand Cankers Disease of Black Walnut Action Plan was available for a public comment period August 22-September 22, 2014. The Missouri Invasive Forest Pest Council (MIFPC) received comments from 11 respondents. Several lengthy comments were received. MIFPC members carefully reviewed and considered these ideas as they revised this document. A brief summary of public input themes, including how they were incorporated or why they were not, follows below.

MIFPC responses to themes and issues identified through the public comment period

Suggest broadening contacts with Thousand Cankers Disease (TCD) experts in other states and inviting further review of TCD planning materials by experts and stakeholders across the U.S.

Missouri has led the way in many respects in engaging other state, federal and university contacts on this issue. MIFPC members have kept in personal contact with researchers and regulators literally from coast to coast about this topic since 2008, hosted the first national TCD conference in St. Louis in 2009, and served on the national TCD technical working group. In 2009-2010, Missouri Department of Agriculture staff worked on uniform TCD regulations with regulatory agencies in other states and in consultation with TCD researchers, and continued work again in 2014-2015 to make needed revisions. MIFPC members have attended and presented reports at several regional and national TCD conferences and receive frequent scientific input from leading TCD researchers.

MIFPC's position statement on TCD (a supplement to the TCD Action Plan) was developed based on the collective comments from experts in the native walnut range. The current version of that document has been forwarded to the state plant regulatory officials of the eastern TCD-infested states for review.

Suggest additional forest resources organizations to be added to the TCD stakeholder list.

Organizations recommended by respondents have been added to the TCD stakeholder list to receive communications from MIFPC.

Respondents express both support for and opposition against the concept of sanitation activities (tree removal and destruction) as a response to a TCD detection in Missouri. Supporters of tree removal suggest the tactic is justified if the TCD-infested area is detected early, is still relatively small in size, and is in a high-risk setting such as a mill or campground.

The suggested approach for implementing tree removals is based on false assumptions that: 1) we have the ability to determine whether or not we have detected an infestation at an early stage, and 2) a detection at a high-risk site indicates the infestation is still localized in that area. Available evidence about TCD detection in other states does not support these assumptions: 1) Current detection technology is not sensitive to low-level infestations. The extent of TCD infestations cannot be determined. 2) Many years pass between the time when trees are infected with TCD and when they are diagnosed, due to slow expression of symptoms, thus allowing an extended period of time when infestations can spread. 3) In two known cases of possible point source introduction (Buck County, PA and Butler County, OH), the areas of the TCD infestations were quickly

determined to have extended many miles beyond the initial detection sites. 4) The scientific evidence and the experience in eastern states indicate that even limited tree removal efforts are not worth the investment.

However, to keep response options flexible, a statement has been added in the TCD Action Plan that indicates the conditions that would need to be present in relation to TCD detection before tree removal could be considered as a response option. MIFPC members are continually monitoring researchers' reports and remaining alert for new information or technological developments that would enhance our ability to detect or respond to a TCD infestation.

Concern that sanitation is not being considered for possible use in Missouri, although it is used in other states to contain the spread of TCD, and some experts believe that approach has merit.

Not advocating for tree removal is a position based on science and experience of the professionals here and in other eastern states. Stakeholders are encouraged to share contacts they have that can provide additional information about this topic. Sanitation and eradication are viable management options under certain conditions for some pests such as the Asian longhorned beetle (*Anoplophora glabripennis*), because of the different biology of the organisms involved and availability of more effective technology specific to those pests. Unfortunately this is not the case with TCD. MIFPC's position statement on TCD (a supplement to the TCD Action Plan) provides more detailed explanations about this topic.

Concern that monitoring, outreach, and regulatory actions have not prevented or contained TCD in other states, so why should anyone expect these actions would prevent or contain this disease in Missouri?

TCD was only identified a few years ago. The available evidence indicates that TCD had already spread to the known positive states long before TCD was first detected and monitoring, outreach and regulatory actions began. A true test of the effectiveness of these actions is only just beginning. Studies have shown that outreach about pests hitchhiking in firewood does reduce firewood movement, and thus reduces the pest threat. Monitoring is a basic tool that allows better outreach, regulation and forest management. By using monitoring to identify where infestations exist, we can slow walnut movement out of those areas through quarantines and by focusing outreach messages in those areas. Also, by knowing where infestations exist, walnut producers can manage their stands accordingly and make decisions about when to harvest.

Suggest that some municipalities and landowners may be willing to voluntarily cut down and destroy TCD-infected walnut trees to protect other trees or contain the spread of TCD.

A statement has been added to the TCD Action Plan indicating that the Missouri Department of Agriculture (MDA) and Missouri Department of Conservation (MDC) will provide guidance to landowners who desire to remove infected trees, so that materials are handled in a manner that mitigates the risk of movement of the pest.

Suggest that where landowners are not willing or able to carry out sanitation of infected trees, the plan should describe options for dealing with those situations and who pays the cost.

MDA has the authority to force landowners to remove trees when appropriate. This role is included under "Agency roles and responsibilities" in the Missouri Invasive Forest Pest Plan. But with the current state of

technology, there is no justification to force tree removal because of TCD. No state or federal funds are currently available for reimbursing landowners for tree removal costs.

Suggest that the plan should include a timeline for specific actions that will be taken and by whom, once TCD is detected.

It is not possible to define a specific timeline in advance of a detection event, because timing is dependent on the circumstances of the individual event. Timing of some response activities is dependent on the type of location and the biology of the insect, fungus and tree. For example, delimit survey activities will be most effective at certain times during the growing season.

Suggest that if TCD is detected in Missouri, the economic concerns and impacts associated with transport of black walnut products should be carefully studied and discussed with industry leadership before regulations are implemented.

MDA will seek input from stakeholders and assess the impact to businesses in the proposed regulated area prior to establishing state interior quarantines. A statement on this point has been added to the TCD Action Plan.

Concern that the current primary focus of TCD planning has been on impacts to homeowners and municipal governments rather than woodland landowners.

The overwhelming impacts of current infestations in other states thus far have occurred in urban areas. The concerns of forest landowners will be addressed through outreach activities to landowners and loggers, providing them with information about detecting, reporting and managing TCD-affected stands.

Concern about statements in the TCD Action Plan and the Missouri Invasive Forest Pest Plan regarding the economic impact of TCD, when respondents compare them with other economic reports.

The plans cite a potential impact of TCD in Missouri of \$851 million over 20 years as estimated in a study by Treiman and Tuttle (2009). Data for that analysis were taken from U.S. Forest Service Forest Inventory and Analysis plots, Missouri Timber Product Output surveys, Missouri Timber Price Trend reports, and recent street tree inventories from Missouri communities. Persons interested in more details are encouraged to consult that 2009 report: <http://mdc.mo.gov/sites/default/files/resources/2010/10/21128.pdf>

Caution is required when comparing this estimate with other economic analyses to avoid comparing apples and oranges. For example, forest economic analyses may be based on numbers of trees or tree volume. Costs may be a one-time cost, fixed annual costs, or costs that change over time. The amount of estimated losses can also vary depending on the economic value of the wood at the time the data were collected or on assumptions one makes about future economic conditions.

Concern that the TCD Action Plan contains no assessment of potential environmental or ecological impacts by TCD across Missouri's landscape over time.

There is little data on landscape level impacts elsewhere in the eastern US to help us predict potential environmental impacts across Missouri's landscape. Impacts thus far have occurred in urban areas, but these

impacts are not well understood. In an evaluation of TCD symptoms on eastern black walnut at two urban locations in the eastern US, TCD symptom severity changed very little over 3 years, suggesting environmental stress or other poor site factors may be required to initiate symptom development (Griffin 2014).

The potential impact of TCD in rural forested areas remains unknown. The available evidence indicates that TCD has been present for many years and spread over large geographic areas in states such as Tennessee and Virginia (at least nine counties in each). TCD has not killed large numbers of trees nor eliminated black walnut over large areas in the eastern U. S. as of early 2015. Among the research needs itemized in the TCD Action Plan (Appendix B) is the recommendation for more long-term research to evaluate risks to resources and determine impacts of TCD.

Literature Cited

Griffin, G. J. 2014. Status of thousand cankers disease on eastern black walnut in the eastern United States at two locations over 3 years. For. Path. doi:10.1111/efp.12154