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Thousand Cankers Disease

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Overview

Thousand cankers disease (TCD) is an emerging disease causing widespread mortality of walnut trees in the western United States. TCD was first detected as a general decline of walnuts in Colorado in the early 2000s. Initially the symptoms were attributed to drought, but it is now widely accepted that a fungus, *Geosmithia morbida*, is the cause of the observed walnut mortality. The fungus is carried by an insect, the walnut twig beetle (WTB; *Pityophthorus juglandis*), which greatly enhances the infectious potential of *G. morbida*. TCD has now been found throughout the western United States, and more recently in the eastern United States (www.thousandcankers.com). In late 2012, WTB was found in southwest Ohio in a baited trap but the disease has not manifested itself in Ohio as of publication of this document.

Many species in the walnut family (Juglandaceae), including black walnut and butternut, are known to be susceptible to TCD, but others, such as hickory and pecan, are immune to the disease or resistant, such as Arizona walnut. Arizona walnut is believed to be the native host of WTB, and both WTB and *G. morbida* can be found on aging branches with no observable symptoms of overall tree decline. See Table 1 for a list of trees in the walnut family that have been tested for susceptibility to TCD.

Eastern black walnut is particularly susceptible to TCD, so the discovery of TCD east of the Mississippi River poses an ever-increasing threat to black walnut survival throughout its native range. This is especially true in Ohio, where oak/hickory forests, of which eastern black walnut is a member, comprise more than half of

Table 1. Susceptibility of trees from the walnut family to TCD. (Source: Utley et al. 2013)

Tree species	Susceptibility
Black walnut (<i>Juglans nigra</i>) Butternut (<i>J. cinerea</i>)	Very susceptible
Northern California walnut (<i>J. hindsii</i>) Southern California walnut (<i>J. californica</i>) Persian/English walnut (<i>J. regia</i>) Little walnut (<i>J. microcarpa</i>)	Intermediate
Arizona walnut (<i>J. major</i>)	Resistant
Pecan (<i>Carya illinoensis</i>) Shagbark hickory (<i>C. ovata</i>)	Immune

the forested land in the state. Eastern black walnut can be found in both natural and urban landscapes. Eastern black walnut is also of economic importance; it is used for wood products (such as lumber and veneer), nut production, and in the nursery/ornamental industry. Because of this threat, quarantines to prevent disease spread have been imposed in states throughout the Midwestern and north central regions.

Symptoms

The first symptoms of TCD are yellowing of the foliage and upper crown thinning (Figure 1). These symptoms are followed by dieback of twigs and branches. A tree must experience many sustained, separate attacks (infection events) over time by *G. morbida*-contaminated beetles for tree dieback and overall decline to become apparent. However, once external symptoms are detected tree death may occur in as little as three years.

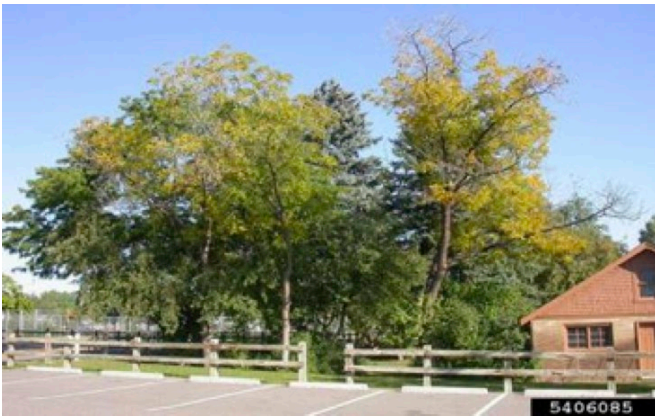


Figure 1. Black walnut in decline. (Photo by Ned Tisserat, Colorado State University. Source: Bugwood.org)

The progression of crown symptoms is preceded by the formation of many small areas of dead tissue (cankers) underneath the outer bark of branches and stems (Figure 2). This symptom gives the disease its name. Initially, small (a few mm to 3 cm), roughly circular or oblong cankers, caused by *G. morbida*, form at the feeding or tasting sites of WTB in twigs, branches, and tree trunks. During this phase of infection, cankers are restricted to the inner and outer bark tissues. In most cases, there is no external indication of tree damage except for tiny beetle entrance holes, but sometimes areas of outer bark surrounding holes may be darkly stained and smaller diameter branches may form cracks, giving them a rough appearance.

As fungal colonization progresses, cankers spread and eventually reach the actively growing layer of tree tissue (cambium) between the inner bark and the wood (turning tissue brown or black). During the later phases of infection, multiple cankers coalesce. Once coalescence occurs

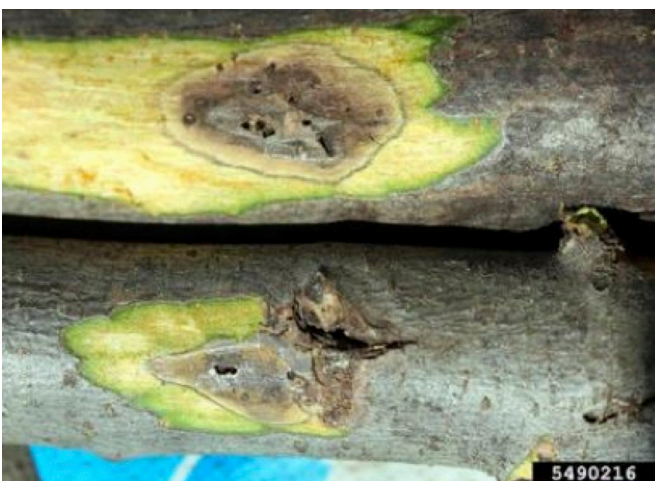


Figure 2. TCD canker on Southern California walnut. (Photo by Whitney Cranshaw, Colorado State University. Source: Bugwood.org)

the supply of nutrients and water to twigs and branches is cut off, resulting in dieback. Severe dieback and multiple main stem cankers eventually result in tree death.

Causal agents

To date, *G. morbida* has been found exclusively in association with WTB. It is the first species of the *Geosmithia* genus to be a documented plant pathogen, and was only recently discovered with the emergence of TCD. *G. morbida* grows inconspicuously as white to tan fungal threads (mycelium) within the tunnels (galleries) of WTB and in the adjacent inner bark (phloem) tissue. While both branches and main stems can become infected, there is no evidence of infection of the nuts. *G. morbida* produces dusty, light colored spores (conidia) on microscopic structures called conidiophores (Figure 3). Spores are carried by adult WTB (Figure 4) to other trees and introduced into uninfected inner bark tissue during the formation of beetle tunnels, with warmer temperatures favoring fungal growth (optimal fungal growth at 77–90°F).



Figure 3. *G. morbida* conidia and conidiophores. (Photo by Ned Tisserat, Colorado State University. Source: Bugwood.org)



Figure 4. Walnut twig beetles are very small and are generally around 1.5 mm (1/16 in) long. (Photo by Steven Valley, Oregon Department of Agriculture. Source: Bugwood.org)

Spread of the fungus across the United States has been attributed mainly to human transport of beetle-infested wood (including firewood). The aggressive feeding behavior of the beetles may also play a role in the spread. Beetles are typically active between the months of April and October, and trees appear to be most susceptible to TCD when they are actively growing.

Disease management

There are no known effective treatments for trees affected by TCD. As a result, management efforts focus on disease prevention and sanitation.

1. Avoid moving firewood, since infected beetles may be present in the bark.
2. Maintain overall tree health by watering in situations of low water availability and avoid physical damage whenever possible.
3. In some cases, chemical control of WTB with insecticide sprays or soil injections may limit the transmission of the fungus to new hosts by preventing initial WTB attack; however, the effectiveness of chemical control is limited at best and only feasible for high-value trees. Currently, there are no known fungicides that can be used in the treatment of landscape trees that are effective against *G. morbida*.
4. Regularly inspect walnut trees on your property for symptoms of TCD. If you suspect TCD is present on your property, contact an Ohio Department of Natural Resources (ODNR) service or urban forester, an Ohio Department of Agriculture (ODA) nursery inspector, or an OSU Extension specialist from The Ohio State University. The C. Wayne Ellett Plant and Pest Diagnostic Clinic at The Ohio State University will provide up-to-date guidelines for sample

submission, which are essential for proper diagnosis of TCD, since the disease can only be confirmed by laboratory examination. Sampling instructions can be found at the Clinic's website: <http://ppdc.osu.edu>. If TCD is confirmed by ODA, ODNR, an OSU Extension specialist, or a plant disease clinic, you will receive directions on how to properly dispose of any dead or dying trees or tree material.

5. Use your smart phone to help discover new TCD infestations. Scan the QR code below or go to <http://go.osu.edu/GLEDN> to download the Great Lakes Early Detection Network (GLEDN) app for free. Using the app, upload pictures and location information for trees suspected of having TCD for verifiers to confirm. Data collected using the app will then be added to the Early Detection and Distribution Mapping System (EDDMapS) site to help track invasive species, like WTB and *G. morbida*, across the country.



Literature cited

- Utley, C., Nguyen, T., Roubtsova, T., Coggeshall, M., Ford, T. M., Grauke, L. J., Graves, A. D., Leslie, C. A., McKenna, J., Woeste, K., Yaghmour, M. A., Cranshaw, W., Seybold, S. J., Bostock, R. M., and Tisserat, N. 2013. Susceptibility of walnut and hickory species to *Geosmithia morbida*. *Plant Dis.* 97:601–607.

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