

Oak Wilt in Minnesota

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Oak wilt, caused by the non-native fungus *Ceratocystis fagacearum*, is responsible for killing large numbers of oaks annually in Minnesota. Oaks are a valuable and abundant shade and forest tree in the state. Oak wilt is most severe in red oak group species such as northern red oak and northern pin oak (Fig. 1). Fortunately, this valuable resource can be protected by utilizing effective management techniques.

Oak wilt occurs in 24 states in the eastern United States and is not known to occur elsewhere. In Minnesota, the disease is currently found in an area bounded on the north by Pine County, on the west by Stearns and Nicollet counties, and south to the Iowa border (Fig. 2). The greatest concentrations of oak wilt are found in Sherburne, Anoka, Isanti and northwestern Dakota counties.

SYMPTOMS

Red oak group

Following infection, the fungus is quickly transported through the water-conducting system of red oaks and leads to rapid wilting. Wilting usually starts at the top or outer portions of the tree crown and quickly progresses downward.

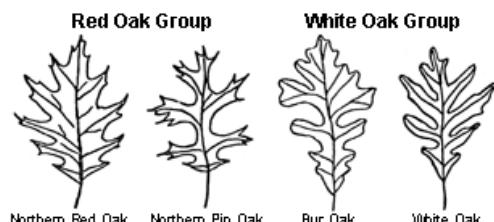


Fig. 1. The four most common species of oaks in Minnesota.

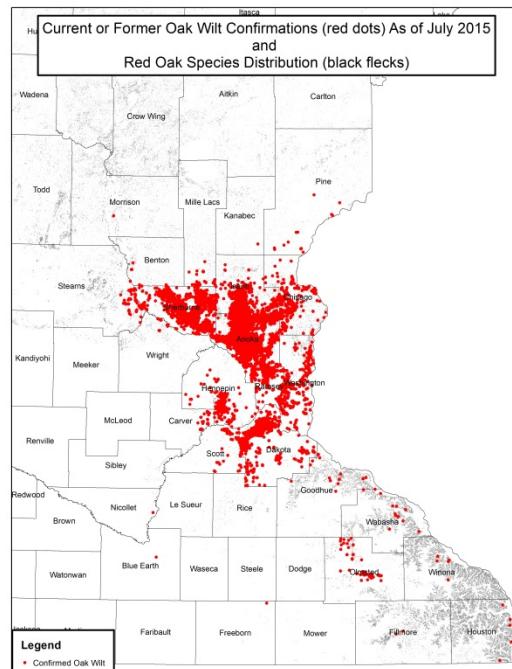


Fig. 2. Former or current oak wilt locations in Minnesota are shown as red dots (courtesy MN DNR).

Leaves take on a bronze to reddish brown discoloration beginning with the tip and margins, progressing toward the midrib and base of the leaf (Fig. 3A). A water-soaked appearance may develop on dark green leaves. Affected leaves are quickly cast and can be found on the ground around the dying tree.

Complete wilting and leaf loss can occur in as little as 4 weeks in branch infections or shortly after leaf-out the spring following root graft infection.

A dark bluish-gray discoloration may be observed on the wood surface when bark is peeled back from a branch with wilting leaves.



Fig. 3. Oak wilt symptoms on red (A), bur (B) and white oaks (C).

White oak group

Affected branches of bur oaks are scattered through the crown (Fig. 3B). Progressive development of the disease may occur year to year with tree death occurring between two and five years or longer after first symptoms develop. Bronzing and browning of leaves generally occurs from the tip and a portion of the leaf margin toward the midrib or base of the leaf, but symptoms may be irregular.

In white oaks, a single main branch or fork of the crown may exhibit wilting leaves during summer but no further symptom development may occur until the next year or following years (Fig. 3C). White oaks in Minnesota have been observed with very slowly progressing symptoms. A dark brown to black discoloration on the wood surface may be found when the bark is peeled back from a branch with wilting leaves. Walled-off fungal infections may also be observed in the cross section of an infected branch (Fig. 4).



Fig. 4. Cross-section of white oak branches show discoloration often seen as small dark dots in the wood just under the bark.

Oak wilt lookalikes

Bur oak blight, another common and significant disease of bur oak in Minnesota, can be readily confused with oak wilt. Injury caused by **two-lined chestnut borer** can also be confused with oak wilt. **Anthracnose** may mimic some leaf symptoms of oak wilt, but usually occurs only in the lower crowns of trees.

OAK WILT FUNGUS SPREAD

The oak wilt fungus spreads from diseased to healthy trees either below-ground via connected roots or above-ground by insects. Most new infections are the result of fungus transmission through roots of adjacent trees that have grafted together. Frequency of root grafting depends on the oak species involved, the size of the trees, soil type and terrain. For

example, root grafting is very common among northern pin oaks on sandy soils in flat terrain. The maximum distance over which root grafting may occur is also dependent on these same factors.

As a general rule, the probability of root graft spread decreases with distance from the diseased trees. For example, the majority of such spread in a Minneapolis-St. Paul urban study was found to occur within 30 feet, but wilt did occur in some trees up to 50 feet from the nearest infected tree. Root grafts may occasionally occur between different species of oak, including species from different oak groups.

Two species of sap beetles (Family Nitidulidae) (Fig. 5) are the primary insect transmitters of *C. fagacearum* overland from diseased trees to healthy trees in Minnesota. Insect transmission is important as it is the means by which new oak wilt centers are started.

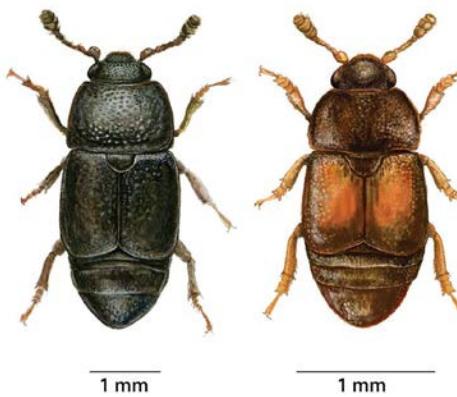


Fig. 5. *Carpophilus sayi* (left) and *Colopterus truncates* (right).

Sap beetles are attracted to the volatiles produced by the sporulating fungal mats in the bark-wood interface (cambium) of oak wilt-killed trees (Fig. 6). Although mats are commonly produced during the spring and fall, the mats that are produced April through mid-July on red oaks that wilted the previous year are most important in disease spread. This is the same time period during which red oaks produce large diameter springwood vessels that are particularly

susceptible to infection by *C. fagacearum*. In addition, the primary sap beetle vector species are strongly attracted to tree volatiles associated with fresh, wood-penetrating wounds. Thus, wounded oak trees visited by fungus-contaminated beetles can result in oak wilt spread, particularly during the spring months. Oak bark beetles (*Pseudopityophthorus* species) are important oak wilt vectors in some parts of the U.S., but are not considered important vectors in Minnesota.

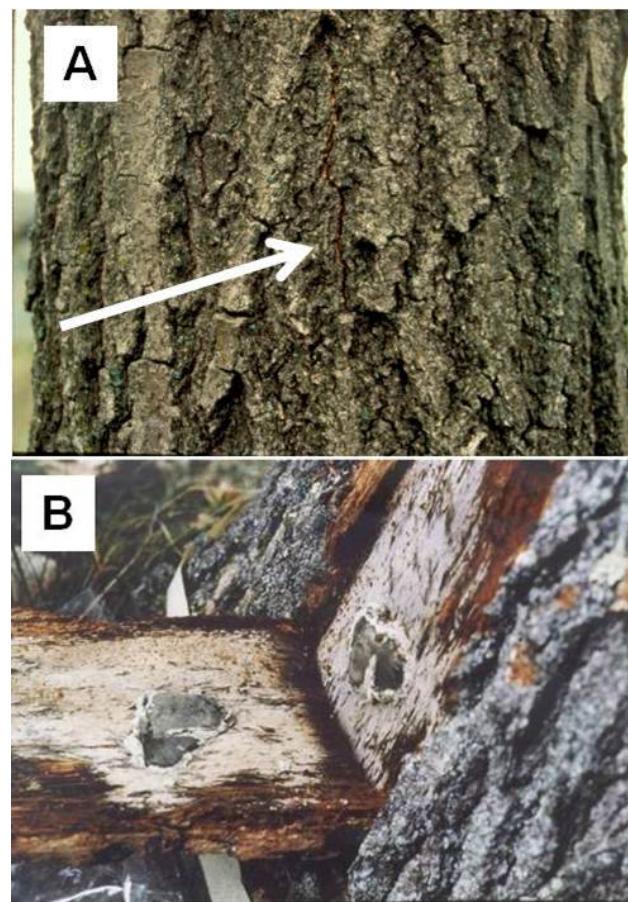


Fig. 6. Diagnostics of oak wilt damage showing bark crack (A) and mirror image of sporulating mats (B).

MANAGEMENT STRATEGIES

Individual control actions can be taken to stop the spread of the oak wilt fungus, but the coordinated use of several actions is the best strategy.

Accurate diagnosis of the disease is highly recommended before any control action is undertaken. Diagnosis can be done by an experienced tree care professional or by consulting the University of Minnesota's Plant Disease Clinic (pdc.umn.edu/)

Stopping belowground spread

Root grafts are most common between closely-related oak species (e.g., red oaks). Healthy trees of a different species can be found in oak wilt infection centers (e.g., bur oaks in a red oak infection center; Fig. 7). Cutting root connections between diseased and healthy oaks is the best way to prevent expansion of existing oak wilt centers. A vibratory plow with a 5-foot long blade is commonly used in Minnesota to cut the roots. Other equipment, such as a trenching machine, backhoe and mini-excavators can be used but are more disruptive to the site, require back-filling with soil, and often do not reach a 5-foot depth. In situations where oaks are near houses, retaining walls, or other structures, carefully digging with shovels has been done but is labor intensive.

Root cutting is done along pre-marked lines that are best placed by experienced tree care professionals. The primary control line is generally placed between the first and second ring (or tier) of healthy oaks out from the diseased trees (Fig. 8). This is because the healthy-appearing trees closest to the diseased trees may already have the fungus in their roots, even if they appear non-symptomatic. When only using a primary control line, the healthy oaks within that line can be removed after root cutting is finished. Alternatively, they may be monitored for several years and removed if they wilt.

A secondary control line may be placed between the diseased and healthy trees to preserve additional trees. This secondary control line often fails though and

complicates management efforts.

After establishment of control lines, wilting and recently wilted red oaks should be felled and eliminated by debarking, burning, burying, or wrapping and sealing in four to six mil plastic until the end of September the year following tree wilt.

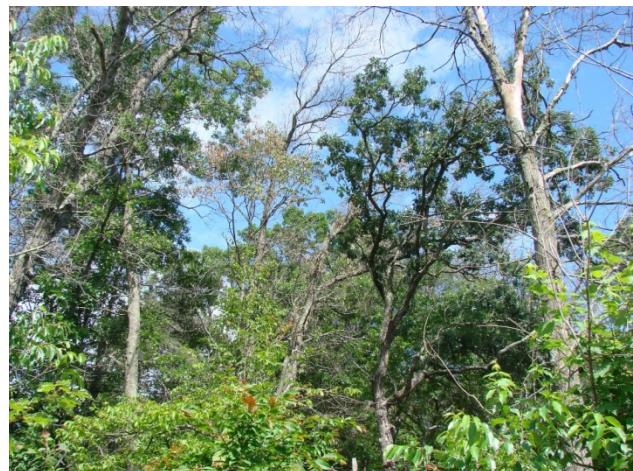


Fig. 7. A healthy bur oak in the middle of an oak wilt infection center impacting northern red oaks, Wabasha County.

If not destroyed, the spores that may form on these oaks the following spring could be carried by sap beetles to wounded oaks and start new infection centers.



Fig. 8. Diagram of root graft barriers around infected trees.

Preventing spread by insects

Avoiding wounding or cutting healthy oaks, particularly during spring and early summer, is important in preventing fungus spread by the sap beetles (Table 1). If branch pruning or tree felling must occur, immediate treatment of the cut surface with water-based paint, a pruning/wound sealer, or shellac is recommended.

Timely removal and proper treatment or disposal of diseased oaks is also critical for preventing insect spread. This is most important for oak wilt-killed red oak species because fungus mats are commonly produced on them. Trees that wilted during the growing season should be felled in the fall or winter and either treated on the property or promptly transported to an approved wood waste utilization site. Options for treatment on the property include debarking of the trunk, burying the main stem and large branches, or cutting logs into firewood lengths and stacking to allow for drying. If diseased trees or firewood are not removed before spring, the cut and stacked logs should be covered with four to six mil clear plastic and sealed at the ground line by late March of the year following tree wilt to prevent beetles from reaching the spore mats. The plastic then can be removed at the end of September of the year following tree wilt and the logs can be safely used for firewood.

Firewood

In general, people should not move logs or firewood from recently wilted oaks to areas where oak wilt is not present. Oak wilt mats may form on these logs. Long distance movement of firewood has resulted in the establishment of oak wilt in distant areas that previously had been unaffected by the disease.

Table 1: Risk of oak wilt fungus spread by sap beetles and advisory comments by general time of year in Minnesota.

TIME OF YEAR*	RISK OF INSECT SPREAD	ADVISORY NOTES
April through mid-July	High	Don't wound, prune or fell oaks in oak wilt counties during this time period. Immediately cover unavoidable wounds with paint or shellac.
Mid-July through late October	Low	Depending on weather conditions and insect populations, infections could occur but would be rare. Immediately treat pruning wounds, stump surfaces of felled trees and other wounds if desired.
November through March	Safe	Fungal pathogen and insect vectors are inactive.

*Exact dates for beginning and end of each time period may vary from year to year. See z.umn.edu/oakwilt for current risk status.

Chemical protection

Systemic injection with propiconazole by qualified arborists may prevent oak wilt symptoms for up to two years in healthy oaks if the oaks are not already infected with oak wilt. Propiconazole will not prevent movement of oak wilt through oak roots, and is not a substitute for severing root grafts. Propiconazole treatment of white oaks already exhibiting early symptoms of oak wilt (less than 30% of crown affected) can prevent further disease development for at least two years, but treatment of red oaks already showing symptoms is not recommended.

Integration of control methods

Early detection and accurate diagnosis of oak wilt should always precede implementation of on-site treatments. The greatest success in oak wilt control is obtained with coordinated

use of multiple management actions. For example, an integrated management approach for a property with oak wilt could involve root cutting, treatment of high value trees with fungicides, removal of wilted red oaks that are potential oak wilt mat producers, and proper disposal of logs from wilted trees.



Fig. 9. Keep up-to-date on the current oak wilt risk status at MyMinnesotaWoods: z.umn.edu/oakwilt

SUMMARY

- In Minnesota, oak wilt covers a large area. Check the Minnesota DNR website for an up-to-date oak wilt disease map.
- Management strategies include stopping belowground spread, preventing spread by insects, not moving firewood from oak wilt-infected areas, and chemical protection.
- Pruning, wounding, or felling oaks should be avoided from early April to mid-July.

ADDITIONAL RESOURCES

Oak wilt risk status in Minnesota (MyMinnesotaWoods):
z.umn.edu/oakwilt

Plant Disease Clinic (University of Minnesota, Department of Plant Pathology): pdc.umn.edu/

How to recognize common diseases of oaks in the Midwest: a quick guide (US Forest Service-Northeastern Area, State and Private Forestry):
z.umn.edu/oakdiseases

What is oak wilt? (Minnesota Department of Natural Resources):

http://www.dnr.state.mn.us/treecare/forest_health/oakwilt/index.html

Managing oak wilt: what are the options? (University of Wisconsin Extension):

<http://learningstore.uwex.edu/Assets/pdfs/G3590.pdf>

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This publication was reviewed by Joe O'Brien (US Forest Service) and Kyoko Scanlon (Wisconsin Department of Natural Resources).

For more information:

www.myminnesotawoods.umn.edu