How to

Identify, Prevent, and Control Oak Wilt

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Authors
Joseph G. O'Brien, *Plant Pathologist*
USDA Forest Service
Northeastern Area State and Private Forestry
Forest Health Protection
Manfred E. Mielke, *Forest Health Specialist*
USDA Forest Service
Northeastern Area State and Private Forestry
Forest Health Protection
Dale Starkey, *Plant Pathologist*
USDA Forest Service
Southern Region
Forest Health Protection
Jennifer Juzwik, *Research Plant Pathologist*
USDA Forest Service
North Central Research Station
Forest Disease Research Unit

Illustrations by
Julie Martinez, *Scientific Illustrator*
Minneapolis, Minnesota

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Pesticide Precautionary Statement:

Pesticides used improperly can be injurious to humans, animals, and plants. Follow label directions and heed all precautions on the labels. Store all pesticides in original containers, out of reach of children and foodstuffs. Apply pesticides selectively and carefully. Do not apply a pesticide when there is danger of drift to other areas. After handling a pesticide, do not eat, drink, or smoke until you have washed. Dispose of empty pesticide containers properly. It is difficult to remove all traces of a herbicide (weed killer) from equipment. Therefore, to prevent injury to desirable plants do not use the same equipment for insecticides that you use for herbicides.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure the intended use is still registered.

Introduction

Oak wilt is an aggressive disease that affects many species of oak (*Quercus* spp.). It is one of the most serious tree diseases in the Eastern United States, killing thousands of oaks each year in forests, woodlots, and home landscapes.

Distribution

Oak wilt was first identified in 1944. The fungal pathogen that causes the disease, *Ceratocystis fagacearum*, is thought by most to be native to the Eastern United States, but difficulty in isolating and identifying the fungus delayed recognition of the extent of its impact until the 1980's. Some plant pathologists think that oak wilt is an exotic disease, arriving in North America in the early 1900's, but the fungus has never been reported from any country other than the United States. The disease has also become much more apparent in some local areas since the 1980's because of increased tree wounding, due primarily to home construction in oak woods. The current known distribution of oak wilt is shown in red in figure 1.

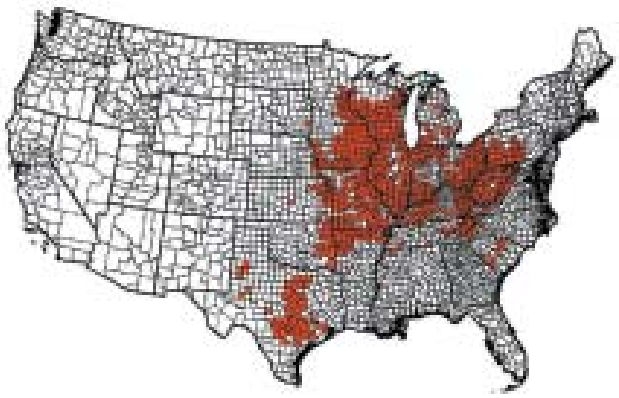

Figure 1.—*In 1999, oak wilt was distributed over much of the Eastern United States.*

Hosts

Oaks can be organized into three main groups based on leaf shape: red oaks, white oaks, and live oaks. Trees in the red oak group have fan-shaped leaves with sharply pointed tips; those in the white oak group have fan-shaped leaves with rounded or blunt tips; and trees in the live oak group have oval leaves with rounded tips (fig. 2). Oaks most commonly killed by the disease are listed in table 1.

All species in the white oak group are moderately resistant to oak wilt, but if infected, trees can be killed over a period of one to several years. Resistance in white oaks appears to be related to characteristics of physiology and morphology. Upon wounding, infection, or as a part of the natural aging process, white oaks tend to form minute plugs called tyloses in their sapwood vessels. These plugs make the wood of white oaks impermeable to water and appear to prevent the fungus from moving throughout the vascular system of the tree.

The tendency for white oaks to form tyloses also explains why these are the species of choice for wood used in cooperage for storing wine and whiskey. The presence of tyloses ensures that barrels made from white oak wood will not leak.

Throughout the range of oak wilt in the United States, red oaks are the most important hosts, but susceptibility varies somewhat by species. Mortality in red oaks can occur within 3 weeks after infection by the oak wilt pathogen under some circumstances. Recovery from oak wilt infections in red oaks can occur, but is rare. Texas live oak (*Q. virginiana*) is moderately susceptible to the disease, but because of its tendency to form large, root-connected clones through which the disease can spread, it is also considered to be an important host.

Although the disease is not known west of Texas, inoculation studies have shown that most oaks in the red oak group, including

Figure 2.—*The three main groups of oaks are organized by leaf shape.*

Table 1.—*Oak species commonly killed by oak wilt*[1]

Common name(s)	Scientific name
Northern species	
Black oak	*Q. velutina*
Bur oak[2]	*Q. macrocarpa*
Northern pin oak	*Q. ellipsoidalis*
Northern red oak	*Q. rubra*
White oak[2]	*Q. alba*
Southern species	
Blackjack oak	*Q. marilandica*
Scrub live oak	*Q. fusiformis*
Shumard oak	Q. *shumardii*
Southern red oak	*Q. falcata*
Texas live oak	*Q. virginiana*
Texas red oak (Spanish oak)	*Q. buckleyi*

[1] *All red oaks in the Eastern United States are considered susceptible to oak wilt.*
[2] *Infections are less common in these species and may take years to run their course.*

several western species, are susceptible to the disease, and are at risk should the fungus ever be transmitted to them in their native habitat (Appel 1994).

How Infection Occurs: The Disease Cycle of Oak Wilt

The oak wilt fungus moves from tree to tree in two ways: underground through the roots or overland by insect vectors.

Local spr ead of oak wilt

Most new tree infections occur as a result of the fungus moving from an infected tree to a nearby healthy tree through connected root systems, a process called “local spread” (fig. 3, lower pathway). The roots of trees in each oak group commonly graft to roots of other trees in the

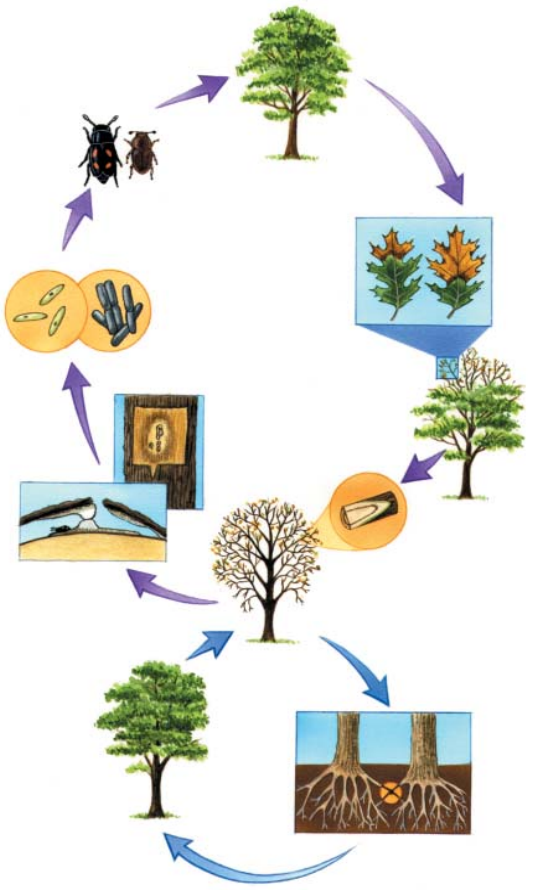

Figure 3.—*The disease cycle of oak wilt.*

Figure 3, upper pathway.—*Long-distance spread of oak wilt occurs when nitidulid beetles carry spores of the fungus from spore mats on infected trees to wounds on healthy trees, causing infection and death of the tree. Time from infection to mortality may be very short for red oaks and Texas live oak, or many years for members of the white oak group.*

Figure 3, lower pathway.—*Local spread of oak wilt occurs when the fungus travels through the interconnected roots of infected and healthy trees.*

same group, forming a continuous underground network. When one tree in a group becomes infected and dies, the fungus spreads through the connected root systems, killing more trees and creating an **"infection center."**

Root grafts do not commonly occur between trees of different species groups, although exceptions occur. Usually a mix of species in a given location will retard local spread and limit the impact of the disease. However, root grafts often do occur between Texas live oaks and red oaks in mixed stands.

Depending upon soil type and the mix of tree species in a forest or yard, infection of healthy trees through root grafts can occur at some distance (up to 100 feet or more) from an infected tree. Sandy soils are conducive to the formation of widespread root systems, increasing the likelihood of root grafts occurring farther away from a diseased tree. Some oak species, including northern pin oak and Texas live oak, often grow in large groups of similar-aged trees that share a common root system. Such situations can lead to rapid expansion of oak wilt centers if even one tree in the group becomes infected.

Long-distance spread of oak wilt

New infection centers can occur if the fungus is carried from an infected tree to a fresh wound on a healthy tree by an insect, a process called **"overland spread"** (fig. 3, upper pathway).

Under certain moisture and temperature conditions, compact masses of spore-producing fungal material, variously called **"spore mats," "spore pads," "pressure mats,"** or "**pressure pads"** are sometimes formed on oak trees that have been killed by oak wilt (fig. 4). These mats form just under the bark, in contact with both the bark and the infected sapwood of the tree. As the mats mature, they produce specialized structures that exert outward pressure on the

bark (the “pressure pads”) and cause it to split, providing a route for insects to reach the mats (fig. 5).

Oak wilt spore mats emit a strong fruity or wine-like odor that attracts many different species of **nitidulid beetles** (fig. 6), also known as sap beetles. As they feed on or tunnel through the spore mats, nitidulid beetles often accumulate fungal spores on the surface of their bodies.

Oak trees often sustain wounds caused by construction equipment, storms, pruning tools, or vandalism. Fresh wounds usually leak sap. The sap attracts insects, including nitidulid beetles that have visited oak wilt spore mats. The overland movement of nitidulid beetles from spore mats on infected trees to wounds on otherwise healthy trees thus creates most new infection centers.

Not all nitidulid beetles are vectors of the oak wilt pathogen. In the North, nitidulids in the genera *Carpophilus*, *Colopterus,* and *Epurea* are most often associated with both oak wilt spore mats and fresh wounds on healthy oaks. The common picnic beetle in the genus *Glischrochilus* (the larger beetle in fig. 6) has often been implicated in the oak wilt disease cycle, but does not appear to be an important vector of the disease.

Spore mats can form only within a year after tree death, and only when air temperature and wood moisture are within a certain range. In the Northern United States, this combination of wood moisture and temperature commonly occurs in spring of the year after the tree dies or sometimes in autumn of the year the tree dies. The period of time during which mats are formed increases with decreasing latitude. In Texas, mat formation occurs at any time during the year, but is most common in late fall and winter when the weather is cooler and wetter.

Figure 4.—*Bark section showing an exposed spore mat on both surfaces.*

Figure 5.—*Bark split caused by pressure pad of the oak wilt fungus.*

Figure 6.—*Nitidulid beetles are primarily responsible for overland spread of oak wilt.*

Spore mats usually do not form on trees smaller than 6 inches in diameter at breast height, although smaller trees can occasionally support mats. In Texas, spore mats are formed only on Texas red oak and blackjack oak, and never on Texas live oak. For this reason, the red oaks are important for establishing new infection centers in Texas.

Another group of insects, oak bark beetles (not pictured), can also carry spores of the oak wilt pathogen and help to create new infection centers. These beetles acquire spores of the fungus while feeding on infected branches, and subsequently transmit them when feeding on healthy trees.

Symptoms

Oak wilt disease symptoms progress differently in red oaks, white oaks, and Texas live oak.

Red oak group

Oak wilt is usually identified in red oaks by the symptoms of rapid leaf discoloration and wilting. Often the initial symptom is a subtle off-green color that may be visible in the upper

portion of the tree crown. This symptom is apparent in the northern part of the disease range in late June to early July. Shortly after this initial color shift, the leaves begin to wilt from the top of the crown downward. As the disease progresses, individual leaves quickly discolor, taking on a "bronzed" appearance. The discoloration progresses around the margins of the leaf from the tip to the base (fig. 7B). The progressing discoloration may be interrupted by the leaf veins, as shown in the white oak leaf in figure 7A, or may affect the entire upper portion of the leaf, as shown in the red oak leaf in figure 7B.

Leaves are cast rapidly as the infection progresses. Commonly, infected trees are almost entirely defoliated within a few weeks of symptom onset. Fallen leaves usually are brown at the tips and margins, and sometimes green at the base and along the lower veins. Trees are often killed in groups or disease "centers," when infection occurs through grafted roots.

Occasionally the outer ring of vessels of diseased trees will be plugged with a brown substance that may be visible in cross sections as a ring or a series of dark spots through the outer sapwood, and in tangential cuts as longitudinal streaking of wood exposed after removing the bark. However, this is not always obvious to an untrained observer, especially in the red oaks. The discoloration may be very light or appear as flecks in such sections. Discoloration is most readily seen in tangential cuts on branches.

White oak group

White oaks usually die slowly, one branch at a time, over a period of one to many years. Wilting and death of leaves on individual branches occurs in a similar fashion to the disease in red oaks, but usually progresses much more slowly. Affected leaves exhibit a pattern of discoloration similar to that seen in red oaks, with discoloration proceeding from the margins to the base,

sometimes interrupted by the leaf veins (fig. 7A). Brown streaking in the outer growth rings is often readily apparent, even to an untrained observer, in infected white oaks and bur oaks, but may be missing.

Texas live oak

Texas live oaks can wilt and die rapidly or slowly, depending on the timing of infection and weather conditions, but generally succumb within 1-6 months of infection. Diagnostic leaf symptoms are usually produced somewhere on the tree (especially in spring and fall). Leaves develop yellow **("chlorotic")** veins that eventually turn brown ("necrotic"), a symptom termed **veinal necrosis** (fig. 7C). Affected leaves fall, and the tree crown progressively thins out until the entire tree is dead. Fallen leaves under the tree may show darker brown veins for months. Sometimes just the tips, margins, or interveinal portions of leaves will turn yellow or brown, but these symptoms are not necessarily the result of oak wilt, and not as useful in diagnosing the disease. A small percentage of Texas live oaks may survive oak wilt infection indefinitely, while suffering varying degrees of crown loss.

Diagnosis

Accurate diagnosis of oak wilt is essential before costly control efforts are begun. Foresters, arborists, or pathologists experienced with oak wilt can often diagnose the problem in the field using host species, symptoms, and mortality patterns. Properly sampling suspect trees and culturing in a qualified laboratory may be necessary in some cases. See the publication "How to Collect Field Samples and Identify the Oak Wilt Fungus in the Laboratory" for additional information.

Other Disorders of Oaks

These oak disorders may sometimes be confused with oak wilt: anthracnose, decline, and infestation with twolined chestnut borer.

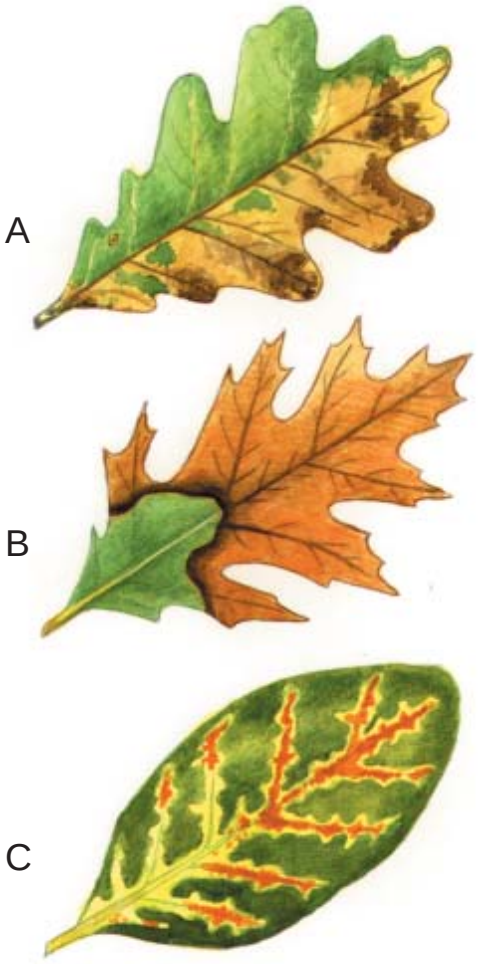

Figure 7.—*Symptoms of oak wilt in A. white oak, B. red oak, and C. Texas live oak.*

Oak anthracnose

Trees in the red or white oak group are susceptible to a group of fungal leaf diseases collectively called “anthracnose,” which may be locally severe if weather conditions in the spring are cool and wet for an extended period during leaf expansion, which favors development of such diseases. Anthracnose diseases are usually more severe in the lower portions of the crown, often causing the affected leaves to fall early in summer. Leaves in the upper portion of the crown may remain attached. Leaf symptoms usually include brown spots or patches that expand outward to the leaf margins. Although the leaves may be curled and distorted, they usually do not wilt.

Oak decline

Oaks throughout the Eastern and Southern United States are susceptible to a “decline” syndrome, which is defined as a disease caused by the interaction of several injurious agents working simultaneously. In the case of oak decline, these factors can include drought, defoliation, fungi that cause stem cankers or root diseases, and wood-boring beetles. The interaction of these factors may result in the decline and death of oak trees over a local or regional area.

Symptoms vary greatly, and differentiating oak decline from oak wilt can be quite difficult. The absence of the typical leaf symptoms of oak wilt and the retention of dead leaves on the tree are indicators of oak decline. Trees killed by oak wilt are usually completely defoliated and retain few living or dead leaves, but this may not be a consistent symptom for red oaks in the South.

Oak wilt usually occurs in discrete, spreading pockets of mortality, with trees on the margins of the infection center becoming infected over time. Declines may occur in discrete pockets, or over a fairly large area, but do not typically spread outward from an initial infection center.

Trees in decline may die over a period of years or may ultimately survive a decline episode with only dead branches in the crown.

Twolined chestnut borer

The twolined chestnut borer (*Agrilus bilineatus*) is an insect that attacks oaks, especially those weakened by drought or defoliation. Larvae of the insect make tunnels in the inner bark, causing branch or even tree mortality. Symptoms usually begin in the upper portion of the crown and proceed downward, but this pattern is variable. The insects leave a distinctive "D-shaped" exit hole about 1-2 mm in diameter when they mature and leave the tree. Initial symptoms are usually single or scattered dying branches that often retain brown leaves until autumn.

Integrated Management of Oak Wilt

Oak wilt can be managed by a variety of strategies that prevent new infection centers and limit the expansion of existing infection centers. A good management program for oak wilt will include all of these strategies for combating the disease.

1. Preventing new infection centers

Once an oak tree becomes infected with oak wilt, there is no known chemical treatment that is capable of "curing" the disease; however, fungicide research is continuing. The development of new oak wilt pockets can be avoided, however, either by preventing the development of spore mats of the fungus on diseased trees or by preventing the transfer of fungal spores by beetles to healthy trees. In practice, this involves removing dead or diseased trees and avoiding injury to healthy trees.

Remove infected trees

Trees that are infected with or have died from oak wilt should be removed and properly treated to prevent development of spore mats. These treatments include debarking, chipping or splitting, and drying the wood. Covering dead wood with plastic, burying the edges for 6 months, and then air-drying for a similar time will kill the fungus and any associated insects. Trees that die in summer should be removed and treated before the following spring, when new spore mats can develop. If the wood is sufficiently dried, however, spore mats will not develop.

A word of caution: Removing a diseased tree that is still living may actually spread the infection by accelerating the movement of the fungus into adjacent trees that are grafted to it by the roots. To avoid this problem, before removing living diseased trees, disrupt interconnected roots as described in the section on "Controlling existing infection centers."

Avoid injuring healthy trees

Trees with fresh wounds outside existing oak wilt centers are visited by beetles transporting spores of the fungus. Because open wounds create avenues for infection, damage to trees from construction, pruning, or severe storms may lead to new infection centers. Avoid injury to oaks during favorable conditions for infection, which occur in spring and early summer in the North, when spore mats are present and the beetles are flying. Favorable conditions usually occur between April 15 and July 1 in the Lake States, and over a correspondingly longer period of time to the South. In Texas, avoid damage to oak trees from February through June.

Preventing injury caused by human activity is especially effective in avoiding the establishment of new infection centers. In particular, pruning

or construction activities in or near oak woodlots during the susceptible period often result in injury to oak trees that leads to infection.

If construction activity or pruning are unavoidable, or if storms injure oak trees during the critical period, the wounds should be treated immediately with a commercial tree paint or wound dressing. Tree paints are normally not recommended for general use, but in this instance, use of these products can protect trees from oak wilt. In the North, if trees are wounded during the dormant season tree paints are not necessary, but judicious use during the rest of the year is acceptable. From Missouri to Texas, tree paint should be used immediately after trees are wounded at any time of the year.

2. Controlling existing infection centers

Once the oak wilt fungus becomes established in a stand that includes a high proportion of oak, it will often continue to spread through the grafted root systems of the trees, causing infection in healthy oaks.

Disrupting the connections between roots of infected and healthy trees limits the spread of oak wilt and is an effective control measure. Infected trees and their roots will usually die before root grafts can be reestablished. The fungus that causes oak wilt does not survive in the root systems of dead trees for more than a few years.

The potential for spread of oak wilt through grafted roots is especially high after a diseased tree is removed or dies. While a diseased tree is still living and intact, there is some resistance to fungal spores moving through root grafts into roots of healthy trees. Either removal or death of a diseased tree removes this natural resistance to spore movement, and spores may then travel more freely through interconnected roots. Therefore, timing of root disruption treatment is

critical. Roots should be disrupted before an infected tree dies or is removed, or within a short time of tree death for maximum protection of healthy trees.

Interconnected root systems can be disrupted with a trencher, vibratory plow, or other equipment.

Trenching and vibratory plowing

Cutting roots by using a trenching or cutting tool effectively controls the expansion of oak wilt pockets. In the Lake States, using a vibratory **plow** with a 5-foot blade (fig. 8) is the most common method of disrupting grafted root systems. The vibratory plow consists of a mechanical shaker unit with an attached blade that is pulled behind a tractor. The blade penetrates to a depth of about 5 feet and cuts through the roots of oaks that may be grafted together. While oak roots may extend deeper than 5 feet in the soil, most root grafts are disrupted by trenching or plowing to that depth. Standard trenching tools do considerably more damage to the site, and the result is a much more apparent plow line than that caused by the vibratory plow. In Texas, shallow, rocky

Figure 8.—*The vibratory plow is sometimes used to disrupt grafted roots to prevent local spread of oak wilt.*

soils and even layered rock often make the use of a rock saw necessary for disrupting oak roots. A chain trencher, backhoe, or ripper bar can sometimes be used. Trench depth should be at least 3 feet, although this may be difficult to achieve.

The lines cut by these trenching implements are usually referred to as **"barrier lines"** (fig. 9). Successful disruption of root grafts to protect healthy trees close to an oak wilt infection center often requires that two or more parallel or intersecting lines be made. **Primary barrier lines** are those expected to have a good chance of protecting trees outside the lines. In addition, **secondary barrier lines** are often used to help ensure that the root graft disruption is effective (fig. 9).

The efficacy of root graft disruption can be enhanced by removing all oak trees inside the barrier lines following plowing or trenching. Removing these trees and optionally treating the stumps with an herbicide helps to ensure that all of the oak roots inside the barrier will die before root grafts can be reestablished. This practice is sometimes referred to as "cut to the line." Although this is a radical treatment, it may be useful in areas where oak wilt eradication is the goal. Assume that all trees removed are infected with the oak wilt fungus, and destroy or treat them on site.

Chemical root disruption

Biocidal chemicals have been used in the past to disrupt root grafts in trees, including oaks. These chemicals are very dangerous and difficult to work with, but can sometimes be used in areas where vibratory plowing or trenching is not an option because of buried utilities, septic tanks, or steep slopes. Holes are drilled into the soil at prescribed intervals, and the chemical is poured into the holes, where it diffuses into the soil and kills the roots in a localized area. These chemicals are restricted-use pesticides; they

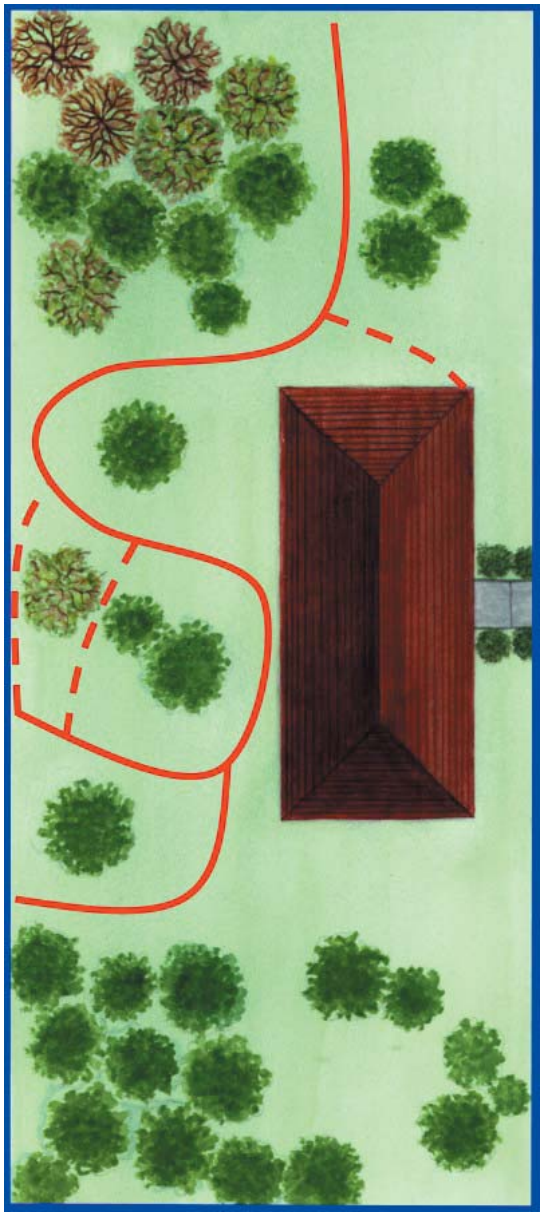

Figure 9.—*This plan of a home landscape shows possible locations of vibratory plow lines for control of oak wilt. All trees are oaks. Brown trees are infected or dead; green trees are healthy. The solid red lines indicate primary barriers; the dotted lines are secondary barriers.*

must be applied by a licensed pesticide applicator, who has been trained in their use. In addition, these chemicals are costly, may cause damage to the trees, and are effective only in uniform-textured soils where the chemical distribution is even and predictable.

3. Chemical control using fungicides

Fungicides have been developed that may be effective in preventing oak wilt when injected into living oak trees without active symptoms. These fungicides are apparently unable to stop an already infected oak tree from dying. Those currently available utilize some form of a chemical called propiconazol in the formulation. Such treatments create their own problems, including the necessity of wounding the tree to inject the fungicides.

The cost of the fungicide is high, so only high-value trees should be considered for treatment. Contact your county extension office for current advice on the use of chemicals for control of oak wilt.

Summary of integrated oak wilt management strategies

Effective oak wilt management programs use a variety of strategies to limit the spread of oak wilt. Some of the practices and policies that can be used in combination to effectively manage oak wilt include the following:

Avoid wounding oaks during critical infection periods.

- If pruning is necessary, or if wounds occur on oak trees during the critical infection period, use tree wound dressings or paints to prevent transmission of oak wilt.

- Develop and enforce construction ordinances and utility pruning guidelines that minimize wounding of oak trees.

- Use public service announcements, billboards, and flyers to raise awareness of the dangers of wounding oaks during susceptible periods.

Use vibratory plow line, trench barriers, or chemical disruption of roots to isolate pockets of oak wilt.

- Communities and neighbors should join together to lower the cost of these tools and achieve more complete and effective local control.

- Use root graft disruption, cut-to-the-line practices, and treat stumps with herbicides to greatly reduce or eradicate oak wilt in local areas.

Remove and properly treat oaks killed by oak wilt by debarking, chipping or splitting, and drying the wood before the spring following the tree's death.

- Do not move infected wood off-site without debarking, chipping, or properly drying it. Do not move or store firewood from infected stands near healthy oaks without proper treatment.

- Use and enforce city codes and ordinances that mandate removal and treatment of dead oak trees. Such ordinances can significantly reduce the chances for long-distance transmission of oak wilt.

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Glossary

Anthracnose
A fungal disease of the leaves of many tree species. On oak, this disease may be confused with oak wilt.

Chlorosis (chlorotic)
A loss of green color in leaves that results in a yellow discoloration.

Cut-to-the-line
The practice of removing all oaks, living or dead, inside the primary barrier line when using trenching for controlling local spread of oak wilt.

Infection Center
A localized group of trees that has been affected by a disease. The disease may spread from the margins of the infected group.

Local Spread
Spread of oak wilt from diseased to healthy trees through root grafted, interconnected root systems.

Long-distance Spread
Spread of oak wilt by nitidulid beetles from spore mats on infected trees to open wounds on healthy trees. Oak bark beetles can also facilitate the spread of oak wilt.

Nitidulid Beetles
Beetles in the family Nitidulidae, sometimes called sap beetles. These beetles have been implicated as the primary carriers of fungal spores of the oak wilt pathogen to healthy trees.

Necrosis (necrotic)
A brown discoloration of leaves that indicates dead tissue.

Overland Spread
(See "Long-distance Spread.")

Pressure Mat, Pressure Pad
(See "Spore Mat," Spore Pad")

Primary Barrier Line
A trench cut to disrupt grafted roots of oak. If two lines are used, the primary barrier line is the one expected to have the better chance to protect trees outside the line (see "Secondary Barrier Line").

Root Graft
Roots that have grown together so that a graft union is made between the conducting tissues of both roots. The oak wilt pathogen can move through grafted roots between infected and healthy trees to cause new infections.

Secondary Barrier Line
A trench cut to disrupt grafted roots of oak. If two lines are used, the secondary barrier line is the one expected to have the lesser chance to protect trees outside the line (see "Primary Barrier Line").

Spore Mat, Spore Pad
A structure produced by the oak wilt fungus at the bark-wood interface in oaks killed by the disease. Development of the structure causes the bark to split, exposing the mat below. The mat is covered with the spores of the oak wilt pathogen, which are picked up by visiting nitidulid beetles.

Tyloses
: Microscopic structures that are produced in the conducting vessels of white oaks, which block the movement of water and fungal spores within the tree. The rapid development of tyloses may explain the difference in susceptibility between white oaks and red oaks.

Vector
: An organism such as an insect, mite, nematode, or a higher animal such as a bird or rodent that carries a pathogenic agent to a susceptible host.

Veinal necrosis
: Dark yellow or brown discoloration that occurs along the veins of leaves.

Vibratory Plow
: A shaker unit with a 5-foot blade pulled behind a tractor, that is used to disrupt the grafted root systems of oaks to prevent spread of oak wilt.

Companion Publication

Pokorny, J. 1999. How to Collect Field Samples and Identify the Oak Wilt Fungus in the Laboratory. NA-FR-01-99. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 12 p.

Northeastern Area State and Private Forestry Offices:

Headquarters Office

Northeastern Area State and Private Forestry
USDA Forest Service
11 Campus Boulevard, Suite 200
Newtown Square, PA 19073

Durham Field Office

Northeastern Area State and Private Forestry
USDA Forest Service
Louis C. Wyman Forest Services Laboratory
P.O. Box 640
Durham, NH 03824-0640

Morgantown Field Office

Northeastern Area State and Private Forestry
USDA Forest Service
180 Canfield Street
Morgantown, WV 26505-3101

St. Paul Field Office

Northeastern Area State and Private Forestry
USDA Forest Service
1992 Folwell Ave.
St. Paul, MN 55108-1099

North Central Research Station:

North Central Research Station
USDA Forest Service
1992 Folwell Ave.
St. Paul, MN 55108-1099

Forest Service Southern Region State and Private Forestry Offices:

Headquarters Office

Southern Region
State and Private Forestry
USDA Forest Service
Forest Health Protection
1720 Peachtree Road, NW
Room 862 S
Atlanta, GA 30367-9012

Asheville Field Office

Southern Region
State and Private Forestry
USDA Forest Service
Forest Health Protection
Asheville Field Office
P.O. Box 2680
Asheville, NC 28802

Pineville Field Office

Southern Region
State and Private Forestry
USDA Forest Service
Forest Health Protection
Pineville Field Office
2500 Shreveport Hwy.
Pineville, LA 71360

Notes:

How To Identify, Prevent, and Control Oak Wilt

For further information, contact: