

Oak Wilt In Wisconsin's Forests

Biology, Symptoms And Management

FOREST HEALTH FACT SHEET

Wisconsin Department of Natural Resources, Division of Forestry, Forest Health Program, April 2024

Locations

Oak wilt is a deadly disease that affects oak trees. First documented in 1944, oak wilt has since been confirmed in most of Wisconsin's counties (Figure 1).

Oak wilt is widespread and common throughout central and southern Wisconsin; however, the disease remains uncommon in northern Wisconsin (Figure 2).

Impact

Oak wilt kills thousands of trees each year in forests, woodlots and urban areas. Oak wilt can even attack and kill healthy trees.

The disease is a particularly serious problem for species in the red oak group such as northern red, northern pin and black oak. Once wilting systems become apparent on a red oak, the infected tree will lose most of its leaves and die within approximately one month.

Among the white oak group, bur and swamp white oaks demonstrate moderate tolerance to the disease, living several years after symptoms first appear. White oaks experience even slower progression of the disease and may live many years with infection.

Biology

Oak wilt is caused by the fungus

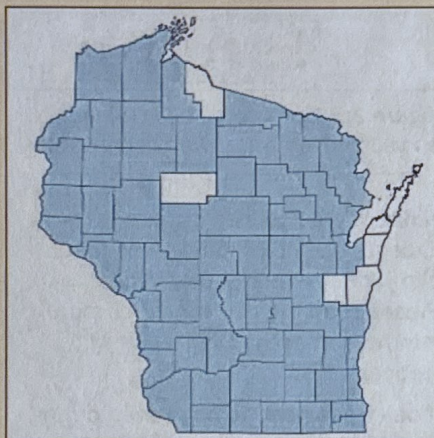


Figure 1: County distribution of oak wilt in Wisconsin.

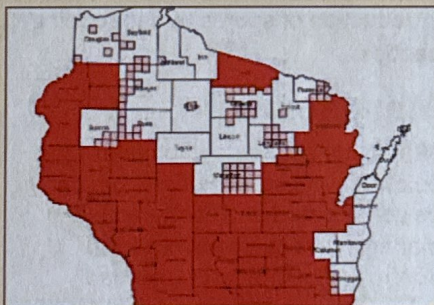


Figure 2: Known distribution of oak wilt in northern Wisconsin. Pink squares mark townships of 36 square miles where oak wilt is present in part. In red counties, oak wilt is common and widespread.

Bretziella fagacearum. The fungus grows through the infected tree's water conducting system, causing the tree to wilt and die.

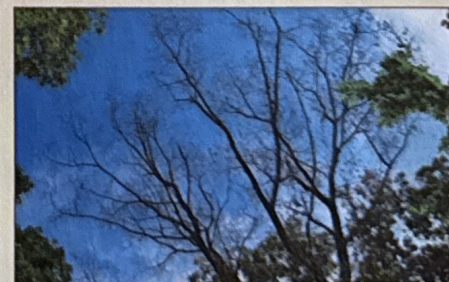
Oak wilt is introduced to an area by sap-feeding beetles that carry oak wilt spores to fresh tree wounds.



Fungal mats produce oak wilt spores and grow underneath the bark of trees killed by the disease.

Spore-bearing fungal mats develop under the bark in the fall or spring following the death of the infected tree. The sap-feeding beetles are attracted to the fungal mat and can transport oak wilt spores to fresh wounds or to recently cut oak stumps.

Once in an area, the disease can spread to nearby oak trees through interconnected (grafted) root systems, creating an expanding pocket of dead oak trees.



Leaves of infected trees will wilt and drop to the ground in summer.

Identification

Leaves will wilt and drop from the upper canopy first. Symptoms progress down the tree rapidly.

Wilting symptoms are observed from June through September, most commonly in July and August. Leaves of infected trees turn dull green or bronze and look water-soaked.



Leaves of trees infected with oak wilt turn dull green or bronze and look water-soaked.

Unlike normal leaf fall, the leaves of infected trees drop to the ground when they are still partially green.

The symptoms of oak are similar to those of other pest, disease and abiotic issues. A symptomatic tree should be sampled and examined by a laboratory for proper diagnosis, especially if active management is being considered.

Prevention

Once the disease exists in a stand, it is difficult to control. **Prevention of this disease is the best approach.** The greatest risk of oak wilt transmission occurs in the spring and early summer, when oak wilt-carrying beetles are abundant and fungal mats are fresh.

To help reduce risk, the DNR has developed a separate [Oak Wilt Management factsheet](#) and [Oak Harvesting Guidelines To Reduce The Introduction And Spread Of Oak Wilt](#). The publications recommend harvesting only during the non-restricted period if your stand is in a county that has oak wilt or is within six miles of a county with oak wilt ([Figure 1, previous page](#)).

Harvesting-restricted periods are

dependent on your location in the state ([Figure 3](#)):

- North Zone: April 15 to July 15.
- South Zone: April 1 to July 15.



Figure 3: Map of counties in the north and south Harvesting Restriction Zones.

Note: The guidelines include Exceptions and Modifications that allow for stand-level flexibilities. Please read the guidelines for more information at the DNR's [oak wilt webpage](#).

If oak trees need to be pruned during the harvesting restricted periods, apply wound sealer immediately after the wound is made to prevent the introduction of spores by sap-feeding beetles.

Management

Although management to control the below-ground spread of oak wilt can be complicated and costly, active management can be successful. Controlling below-ground spread requires disrupting the movement of the fungus through root grafts from infected trees to healthy trees.

Physical severing of the root system using a vibratory plow or trencher has proven to be effective if plow lines are placed correctly. Recently, field trials have shown some promising results to contain the below-ground spread of oak wilt by using herbicides on healthy oaks, or uprooting the entire root mass of healthy oaks that border the infected pocket.

Trees that have died of oak wilt will

harbor spores for approximately one year after death. Once root grafts have been disrupted, dead and live trees inside a pocket should be harvested to limit the spread of the disease by beetles.

If you are interested in options for active management of oak wilt, please contact your local [DNR forester](#) or [DNR forest health specialist](#).



Keep firewood local.

Firewood

Moving infected firewood can spread oak wilt long distances to a previously disease-free area. Keep firewood local and consider covering it with 4-mil plastic until the bark is loose. Wood from dead trees with loose bark, and from apparently healthy trees with no wilting symptoms, does not pose a risk for the spread of oak wilt.

Wisconsin has developed requirements pertaining to the movement of firewood. For more information about firewood restrictions, please visit the DNR's [Firewood Rules and Resources webpage](#).



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Oak Wilt Management

Testing And Other Techniques

FOREST HEALTH FACT SHEET

Wisconsin Department of Natural Resources, Division of Forestry, Forest Health Program, May 2023

This factsheet outlines options for oak wilt management. For information about oak wilt distribution, impact, biology and identification, see [Publication FR-622a](#), "Oak Wilt in Wisconsin's Forests."

Testing To Confirm

The first step in developing a plan to manage unhealthy oaks is to first confirm that oak wilt is the cause. Landowners with 10 or more acres of forest can contact their local forest health specialist to collect samples for oak wilt testing. Yard tree samples should be submitted to the Plant Disease Diagnostic Clinic at UW-Madison to be tested for a fee. Branch or stem samples from trees with active wilt symptoms are preferred.

If your tree(s) do NOT test positive for oak wilt, examine them for other common fungal infections such as Armillaria, bur oak blight and leaf diseases. Also check for insects that attack stressed oaks, such as twolined chestnut borer, or abiotic issues such as flooding or lightning strikes.

If oak wilt is confirmed, you can decide between passive or active management of the diseased trees. Passive management is choosing to accept tree mortality as the disease continues to spread through the forest stand. Passive management



A hand saw is used to cut sections of wood from a wilting tree branch for oak wilt testing.

may be appropriate when:

- Oak wilt is already widespread in the stand.
- The stand is mostly white oak species.
- The stand only has large, scattered oaks.
- Oak is not an important species in the planned future forest.

If you choose passive management, consider the potential impact to neighboring forest landowners.

Active Management

Stopping below-ground spread

Several active management options have been shown to successfully

stop the below-ground spread of oak wilt through connected roots. These options include root severing, stump extraction and applying herbicide to stem girdles. A few experimental control methods also may be considered.

Management is most effective when below-ground spread is limited to a small number of trees. Active management is typically not needed for white oak species.

Note: It is important to avoid management activities during the high-risk period for overland transmission of oak wilt spores by sap beetles (April 1 to July 15 in southern Wisconsin, and April 15 to July 15 in northern Wisconsin).

Combined DBH (inches)	Potential root graft distance		
	Sandy soil	Loamy sand	Sandy loam
2	4	3	2
4	8	6	5
6	12	9	7
8	16	12	9
10	19	15	11
12	23	19	13
14	27	22	16
16	31	25	18
18	35	28	20
20	39	31	22
22	43	34	25
24	47	37	27
26	50	40	29
28	54	43	31
30	58	46	34
32	62	49	36
34	66	53	38
36	70	56	40
38	74	59	43
40	78	62	45
42	82	65	47
44	85	68	49
46	89	71	51
48	93	74	54

Table 1: Measure the diameters of an oak infected with oak wilt and a nearby healthy-looking oak at 4½ feet above the ground. Add the diameters to calculate the potential root-graft distance between them. Measure the actual distance between the two oaks and determine if the healthy-looking oak is within or outside the potential root-graft distance. Use the appropriate soil type for root severing methods but always use sandy soil distances for girdle herbicide methods. Adapted from Bruhn, J.N. and Heyd, R.L. 1992. *Biology and Control of Oak Wilt in Michigan Red Oak Stands*. *Northern Journal of Applied Forestry*, 9(2) 47-51.

Marking a pocket for control

For each of the following active management options, you will need to know which oak trees are root-grafted to dead and diseased oak trees. To determine the trees to manage:

1. Measure the diameter (in inches) of recently dead or dying oaks at 4½ feet above the ground (Diameter at Breast Height, or DBH). Then measure the DBH of nearby healthy-looking oak trees. DBH of multi-stemmed trees should be combined.
 2. Also measure the distances (in feet) between infected and nearby healthy-looking trees.
 3. Determine the soil type of the impacted stand (sandy, loamy sand or sandy loam/loam).
 4. Use Table 1 with the information gathered in steps 1, 2, and 3 to determine if apparently healthy trees are root-grafted to dead or diseased oaks. Add the diameter of a diseased oak with a nearby healthy oak and identify the distance in the appropriate soil-type column. If the distance between the trees is less than that shown in Table 1, then the healthy tree is root-grafted to the diseased tree.
- Note:** If an oak is just outside root-graft distance, it may still be appropriate to mark for management. Consult your local DNR forest health specialist, a forester or a trained arborist for advice.
5. Using flagging or paint, mark all oaks that are root-grafted to dead or diseased oaks. The treatment method, chosen from the following sections, should encompass all marked and diseased trees or encircle the outer edge of the group of oaks that have been marked.

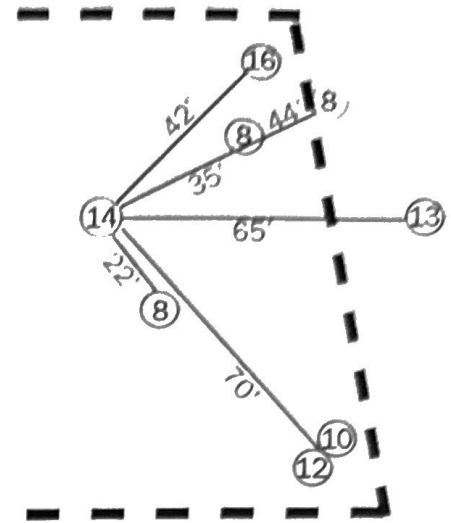


Figure 2: A red oak (left, red circle) of 14-inch DBH is confirmed to be infected with oak wilt through a lab test. Based on Table 1, the physical root barrier is represented by the dotted line. Red oaks that are included within the physical root barrier (green circles), going clockwise, measure 16 inches, 8 inches, 22 inches (double stem 12 and 10), and 8 inches. These should be girdled and treated with herbicide (always use sandy soil distances for this method). Another 8-inch DBH red oak (orange circle) is just beyond root-graft distance, but it has another red oak directly in line between it and the infected tree. The landowner or manager could be aggressive and include this tree during treatment. Or, they could keep the tree, deciding the reduced risk of it getting infected is acceptable. The 13" DBH tree in the middle is well outside root graft distance and does not need to be included during management.

Control method: Root severing

Root severing is an effective way to physically break root connections. Typically, a trencher, vibratory plow or other heavy equipment is used to cut roots to at least four (preferably five) feet deep. This method is costly and may not be possible in rocky ground or steep terrain.

Properly locating the root graft barrier is critical to successfully containing oak wilt. Work with your local DNR forest health specialist, a forester or a trained arborist



A vibratory plow with a large blade is used to cut roots below ground to stop the spread of oak wilt.

to ensure the barrier is correctly located.

It is best to choose the barrier location in late summer (August to October) when the majority of infected trees have wilted. Once the barrier location is set, root severing needs to occur before the soil freezes. Avoid root severing during the high-risk period for overland oak wilt transmission in the spring and early summer.

To determine the location for root severing:

1. Follow the instructions in the "Marking a pocket for control" section.
2. Install the root graft barrier with a trencher or vibratory plow.
3. Remove all oaks within the trench line only after root severing has been completed. Process the wood from diseased trees as described in the "stopping above-ground spread and spore production" section. Healthy oaks that were root-grafted but did not show any wilt symptoms can be utilized or left on the ground as coarse woody debris.
4. Consider applying herbicide to the stumps to prevent stump

sprouts, which may keep the infection active.

5. An alternative to steps 3 and 4 is to create a second root-graft barrier closer to the infected trees. Oaks between the barriers do not need to be cut, but should be monitored for symptoms and further action taken if the closer barrier fails.

Control method: Stump extraction

Stump extraction is another effective management method. Cut diseased oaks, and oaks that are directly root-grafted, and pull the stumps from the ground using an excavator. Alternatively, push trees over with a bulldozer to pull up the roots.

Stump extraction should be completed after leaf-fall and before the ground freezes. Consider whether the soil disturbance caused by this method may lead to establishment of invasive plants.

To determine the oaks for stump extraction:

1. Follow the instructions in the "Marking a pocket for control" section.
2. Cut all the oaks identified in step 1 and uproot the stumps.

3. Process the wood from diseased trees as described in the "Stopping above-ground spread and spore production" section. Healthy oaks that were root grafted but did not show any wilting symptoms can be utilized as needed or left on the ground as coarse woody debris.

Control method: Girdle and herbicide

The girdle and herbicide method has been shown to be effective at managing oak wilt but works best when the number of impacted trees is small.

Diseased and root-grafted oaks are girdled with a chainsaw, and herbicide is applied to the cuts to kill the tree and root system. This method is relatively inexpensive and does not require large equipment.

To determine which oaks to girdle and herbicide:

1. Follow the instructions in the "Marking a pocket for control" section. Always use sandy soil distances for this method. Oaks that have been dead for more than one year do not need to be included.
2. Cut two girdles around each marked tree, using a chainsaw. The cuts must go through the bark but should go no more than 1 inch into the wood. The first cut should be close to the ground; the second should be about 6 inches higher. Start work from the trees farthest out and progress toward the infected tree(s). Be aware of any hollow trees or trees with decay that may fail if you cut too deeply.
3. Immediately after girdling, apply a triclopyr-based herbicide (at least 60 percent active ingredient) to the cuts and the bark, from the cuts to the base of the tree. Follow label directions to determine how much herbicide to

apply and the formulation (typically mixed with diesel fuel or bark oil).

4. Trees treated with herbicide should stand a minimum of one month to allow the herbicide to work.

5. Process the wood from the diseased oaks as described in the "Stopping above-ground spread and spore production" section. Healthy oaks that were root-grafted but did not show any wilting symptoms can be cut and utilized or left standing for wildlife benefits. Consider if girdled trees would pose a hazard to nearby structures.

The girdle and herbicide method is recommended from mid-July through September. However, application as late as November may be effective.



An oak within root-graft distance of an oak wilt-infected oak has been girdled twice with a chainsaw and is being sprayed with a triclopyr-based herbicide.

Control methods: Experimental

Several additional methods need further scientific testing to confirm their effectiveness but may be considered if the above methods are not feasible. These methods include:

- **Cut stump and herbicide.** Follow the instructions in the "Marking a pocket for control" section. Then apply a triclopyr based herbicide (at least 60 percent active ingredient) to the stump immediately after cutting each marked tree. Follow label directions to determine how

much herbicide to apply and the formulation to use (typically mixed with diesel fuel or bark oil).

- **Rapid response.** This is an option only if there is a single, actively wilting oak that appears to represent a new infection due to overland spread. Rapid response utilizes the girdle-and-herbicide method, the cut-stump-and-herbicide method, or root-severing method on a single, actively wilting oak to kill it before the disease can reach the roots and begin spreading to nearby oaks. Consult your local DNR forest health specialist, a forester or a trained arborist with experience managing oak wilt to evaluate whether your tree is a candidate for rapid response.

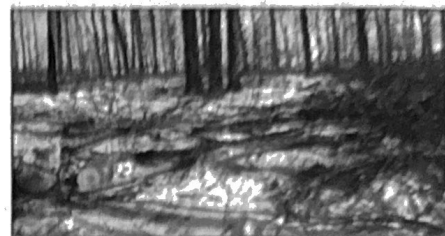
Preventative fungicide treatments

Fungicides containing the active ingredient propiconazole can be injected by professional arborists to prevent mortality of healthy oaks from oak wilt. Consult a certified arborist about treatment options and cost. This treatment method is typically only used for high-value urban or yard oaks and must be repeated multiple times to properly protect the trees.

Stopping Above-ground Spread, Spore Production

Regardless of the method used to stop the below-ground spread of the oak wilt fungus, it is critical to remove and properly utilize oak wilt infected trees before they produce spore mats in the spring following tree mortality. Oak wilt infected trees can be chipped, debarked, buried or burned.

Logs may be sold to a sawmill or other wood-utilization business if they can be processed prior to the following spring. Properly utilizing infected trees will stop the production of spore mats which could



Trees that have been cut down must still be tended to, in order to prevent the spread of oak wilt to remaining trees.

cause new oak wilt infestations via overland spread by sap beetles. No treatment is needed for oaks with loose bark because they are no longer able to produce spore mats.

If you plan to use infected oaks for firewood, keep the wood local and consider covering it completely with plastic at least 4 mil in thickness until the bark is loose.

Regenerating Oak

Oak can be successfully regenerated in stands where oak wilt has been properly managed. Acorns, seedlings, and saplings growing within a disease pocket will not be root grafted to the large diseased root system and can successfully continue to grow.

Consult a professional forester for advice on what regeneration options will work best for your stand. See Wisconsin's ["Oak Harvesting Guidelines to Reduce the Risk of Introduction and Spread of Oak Wilt"](#) for additional information.



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