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THE OHIO STATE UNIVERSITY EXTENSION

Extension FactSheet

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Oak Wilt

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Oak wilt is a serious and often deadly vascular disease of oaks. The fungal pathogen, *Ceratocystis fagacearum*, is believed to be native to the United States and is distributed throughout the Midwest and Texas. In Ohio it has been reported from the majority of eighty-eight counties.

What the Pathogen Does

The fungus grows into and throughout the water conductive tissues (that is, the sapwood) of the host. The fungus plugs the vessels with its own body (mycelium) and spores, but it also causes a defensive reaction by the tree to stop the fungal spread by actively plugging its own vessels. These processes interfere with water uptake and cause a wilting syndrome which often results in death of the tree.

Susceptible Oaks

All oaks are susceptible. Those in the red-black oak group (black, blackjack, pin, northern and southern red, scarlet, shingle and shumard oak) (Fig. 1A) are extremely susceptible and can die within a few weeks of infection. Oaks in the white group (bur, chinquapin, post, swamp white, and white oak) (Fig. 1B) are more tolerant of the disease and may survive infection for one or more years while displaying decline symptoms.

Figure 1

Diagnostic Symptoms

Symptoms are typical of wilts (Fig. 2). Leaves usually begin withering in the upper canopy, producing “flags,” that is, whole branches or crown portions turning red-brown. Leaves of red oaks typically show yellowing and browning of the leaf margins (Fig. 3). White oak leaves usually show rather non-descript symptoms. Conversely, live oaks in the southern United States produce characteristic dead areas along the leaf veins. These dead areas generally expand until the whole leaf becomes brown. Eventually the leaves fall from the tree. If infections occur in late spring, trees usually begin wilting in mid-summer to late summer, when the plants often are subjected to water deficit due to increased transpiration demand and decreased rainfall.

Figure 2

Figure 3 (David French, with permission.)

A specific and sufficient diagnostic character is the appearance on dead and dying red oaks (but not white oaks) of spore-bearing fungal mats under the desiccating bark (Fig. 4). These fungal mats crack the bark open with pressure pads (Fig. 4) to facilitate dissemination of the pathogen (see be-

Figure 4 (David French, with permission.)

low). Sapwood streaking (Fig. 5) is also a good, but insufficient, diagnostic character. In all cases, however, conclusive diagnosis can only be made in specialized laboratories, such as The Ohio State University C. Wayne Ellett Plant & Pest Diagnostic Clinic (http://www.ag.ohio-state.edu/~plantdoc/cweppdc/cweppdc.html).

Figure 5 (David French, with permission.)

Factors other than *C. fagacearum* can cause similar symptoms, so proper disease diagnosis is critical. Among these factors are drought, construction damage, and insect attack. Other diseases, such as some wood decays and anthracnose (http://ohioline.ag.ohio-state.edu/hyg-fact/3000/3048.html), might be confused with oak wilt symptoms.

Disease Cycle and Conditions Favoring Disease

In order to properly manage oak wilt it is essential to understand its cycle. The pathogen spreads from diseased to healthy trees in two ways: overland and underground. Overland spread is mediated mainly by sap feeding (a.k.a. picnic) beetles (Coleoptera: Nitidulidae). However, there is some evidence that oak bark beetles (Coleoptera: Scolytidae) may also be involved. Nitidulids are attracted by chemicals emanating from the fungal mats described above. Once on the mats (Fig. 6), the beetles pick up fungal spores and can carry them, sometimes over distances of a few miles, to freshly wounded healthy trees (attracted by the smell of fresh sap). This results in new infections, thus closing the overland cycle.

Figure 6 (David French, with permission.)


Figure 7 (David French, with permission.)

While insect spread is an important medium to long range dispersal mechanism for this fungus, it is estimated that 90 percent of new infections occur between neighboring trees through root grafts (Fig. 7). In this case, the fungus grows down the trunk, into the roots of diseased trees, and then into healthy trees via the common root system. Once in the new tree the pathogen grows throughout the vascular system and spreads to other trees via the root system or the beetles. In this way, spread through root systems often results in disease centers that expand outward from the initially infected tree.

From the above, it follows that conditions favoring disease include the availability of susceptible oak species, trees growing close to each other, and the availability of fresh wounds for beetle-mediated infection. Pruning wounds are obvious culprits, but any fresh wound will function as potential infection gateway. The word fresh is emphasized because it is believed that wounds are attractive to Nitidulid beetles only for up to three days.

As with many plant diseases, other stresses (for example drought) can predispose trees to faster symptom development, and thus worsen the syndrome.

Control and Management of the Disease

The best control for oak wilt is through preventative measures that interrupt the disease cycle.

Prevention of Overland Spread

Overland spread can be hindered or interrupted by ensuring that trees are never wounded between April 15 and July 1. This is when most Nitidulid beetles fly to locate fresh sap and/or fungal mats. A more stringent approach is to avoid wounding the trees throughout the growing season (April 15-Oct.1), since additional summer flights of the beetles are possible. If pruning is absolutely necessary during the growing season, it is imperative to dress the wounds. This can be done with latex paint. Although this will slow wound healing, it will also deter beetles from landing on the wounds.

Prevention of Underground Spread

Given the higher significance of underground spread, control of direct tree-to-tree transmission is much more important. Here, interruption of the disease cycle is accomplished by physically severing actual or potential root contacts between diseased and healthy trees. This is done by trenching or cutting through the soil with a trencher or vibratory plow. The latter is the preferred tool. Given the depth of oak root systems, it is advisable to use a 5 ft blade (Fig. 8). Trenching must

Figure 8 (Fred Baker, with permission.)

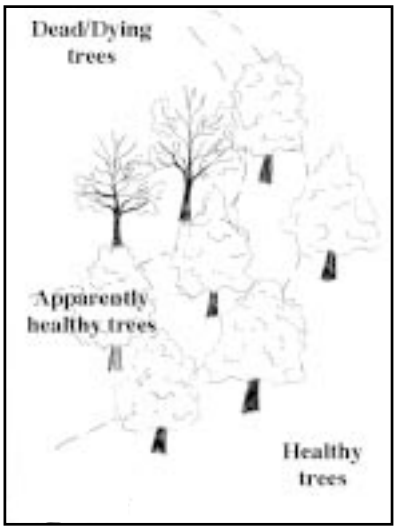

Figure 9

always be done before the diseased or dead trees are cut for removal (see below), to avoid sudden water tension imbalances that might "suck" fungal material from the infected trees into the healthy trees through the common root system. Trenching should be conducted by advice of specialists. This is due to the importance of locating the trenches appropriately between diseased and healthy trees. When possible, a double trench defining a buffer band of apparently healthy trees between diseased and uninfected trees should be used (Fig. 9).

On residential or commercial properties, always determine the location of buried utility lines which may affect the ability to completely sever the graft. Furthermore, walkways, paths, and roads must also be considered appropriately, as tree roots commonly grow under them. Due to all of these potential obstacles to proper trenching, it is advisable to undertake such operations under the supervision of tree care professionals with expertise in the management of oak wilt.

There is currently no evidence that the blade will spread the pathogen. However, it is good precautionary practice to spray the blade to runoff, between trenches and between plots, with an antiseptic such as Lysol or a 20% bleach solution.

Disposal of Dead and Dying Trees

Once the trenches are in place, diseased and dead trees should be removed as soon as possible by cutting them down to leave a 2-4 inch high stump. Because diseased trees with bark tightly attached may produce or harbor fungal mats, they should be disposed of promptly. Once the bark becomes loose or sloughs off, no mats can be produced and movement of the infected wood out of the diseased area is no longer a concern in an urban context. (However, strict restrictions apply for movement of diseased wood out of state and internationally.) Thus, either the trees are debarked mechanically, or the timber can be sold to a sawmill for cutting or chipping. Although no studies are known on the transmissibility of *C. fagacearum via* wood chips, the pathogen does not survive when exposed to desiccation and is very temperature sensitive. Composting the chips would further reduce or eliminate the pathogen. Thus, it is highly unlikely that wood chips will spread the disease. However, good precautionary practice suggests to avoid using infested chip mulch around healthy oaks.

If the wood cannot be disposed of as described above, it can be cut and split for firewood. Because this process does not involve debarking, firewood can still potentially harbor fungal mats and thus attract Nitidulids during the summer in which the trees died. The wood must be arranged in stacks and covered with 4 mil plastic tarp through the winter (if the wood is used then) or the end of the next season (Oct. 1 of the year following the death of the trees). By producing a greenhouse effect, tarping will kill the temperature-sensitive pathogen and prevent the beetles from accessing potential fungal mats. Tarping should be done with transparent plastic to produce the desired greenhouse effect. However, black plastic will also work, by concentrating the sun's heat. In both cases, the best results are achieved by placing the tarped pile in an un-shaded, possibly sunny area. When covering the pile, the tarp should be sealed to the ground to prevent beetles from accessing the pile. For this reason, all punctures in the tarp should be mended with duct tape. At the end of the second season the wood can be safely uncovered and disposed of as preferred, since it no longer constitutes a threat.

Chemical Treatments

Chemical treatments are usually not warranted, due to the high cost of intervention. However, application of systemic fungicides is an option when highly valuable trees are threatened by infected neighboring trees, or whenever a high risk of infection exists. High value may be attributed to individual trees or groups of trees in communities, or it may apply to individual trees in a homeowner's yard. Systemic fungicides have been demonstrated to be effective, particularly when applied as a preventative treatment. The only scientifically tested systemic fungicide showing any efficacy and labeled for use against oak wilt is propiconazole, available under the trade name Alamo.

If a decision is made to apply propiconazole, it must be done strictly according to label and should be carried out by experienced, professional tree service personnel. The product is injected directly into the sapwood on root flares just under the soil line. This is the best guarantee that the fungicide will be translocated throughout a tree, thus affording the maxi-

mum possible protection. In consideration of the disease cycle, the best time of the year to inject trees is early spring. However, application should occur as soon as the risk to a tree is realized, even if it is later in the growing season. Depending on the tree size and value, treatments should be applied every 12-36 months, with annual assessments. This treatment has virtually no hope of succeeding in infected red oaks, even in early infection stages. Chemical treatment has a higher chance of success, but only as a palliative measure, with the more tolerant white oaks. In this group, application of the fungicide to trees in early infection stages can result in delay of symptoms and eventual death. It will not, however, rid an infected tree of the pathogen.

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