45. Oak Wilt

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The oak wilt pathogen, *Ceratocystis fagacearum*, is believed to be native to the United States and to have originated in the Upper Mississippi Valley. Disease survey records as early as 1912 describe mortality in oak stands in Minnesota and Wisconsin similar to mortality now known to be caused by the oak wilt fungus. Mortality was attributed to several factors, such as drought or Armillaria root rot, until 1940 when the causal agent was identified as a vascular fungus.

Hosts and Distribution

Oak wilt ranges from Minnesota east to Pennsylvania, south to South Carolina and Tennessee, west to central Texas, and north through Kansas and Nebraska. The disease has been present in Nebraska for over 20 years, but it has been confirmed in only seven counties that border the Missouri River.

Known hosts of the oak wilt fungus include 36 species of oak and six species closely related to oak. All species of oak tested have proven susceptible to the fungus either by natural infection or by artificial inoculation. Species of the red oak group (black, northern red, pin, and scarlet) are more susceptible than are species of the white oak group (bur, post, and white). The six closely related species include Chinese, American, and Spanish chestnut, Allegheny and bush chinkapin, and tanbark-oak.

Figure 45-1. Typical bronzing symptoms on outer portions of leaves of red oak.

Figure 45–2. Foliage of entire crown of red oak wilted within a few weeks after appearance of initial symptoms.

Symptoms and Signs

Foliage symptoms of oak wilt occur from early June until leaf coloration begins in the fall. Symptoms in the red oak group are slightly different from those in the white oak group.

Early foliage symptoms in the red oak group include wilting, bronzing, and premature defoliation at the branch tips in the upper tree crown. Wilt symptoms rapidly progress down through the crown. Wilted leaves turn dull green, bronze, or tan beginning at the outer portions of the leaf. The base of the leaf and the portion around the main vein are the last to change color (fig. 45–1). Foliage of affected trees commonly wilts within a few weeks after first symptoms appear (fig. 45–2). Brown to black discoloration develops in vascular tissues in the outer sapwood where the tree produces tyloses and gums (fig. 45–3). Red oaks do not recover once infected. Trees infected late in the growing season may produce some leaves on the lower branches the following spring, but these soon wither and die.

Early symptoms in the white oak group are characterized by a wilt of foliage of individual branches in the crown. Leaves may turn yellow, but necrosis is usually limited to the margins of the blade. Affected leaves normally remain attached, and their coloration is similar to normal fall coloration (fig. 45–4). The eventual death of individual branches results in a stag-headed appearance of the crown over a period of several years. Some trees in this group of oaks may die within 2–4 years or longer after infection, but one third to one half of the infected trees may recover and grow normally.

Mycelial masses, or mats, of the fungus may form under the bark within several months after death of the infected tree (fig. 45–5). The fungus mats, which vary in size from one to four inches in length, raise and crack the bark as they enlarge. The black and gray fungus mats give off a fruit-like odor that is very attractive to insects. While the mats are common on infected trees in the red oak group, they are rarely produced on infected white oaks.

Disease Cycle

Oak wilt is caused by the fungus *Ceratocystis fagacearum*, which grows in the functional vessels of the sapwood. The tree responds to infection by producing

tyloses in the vessels; these occlusion bodies restrict the tree's water supply. Hence, the disease is strictly a vascular wilt.

By the time symptoms become apparent in the crown of an infected red oak, the fungus is present in the conducting vessels throughout the tree. The fungus in the branches dies a few weeks after the tree dies; the fungus remains alive for several months to a year in the trunk and root system. The fungus produces spores in fungal mats that develop under, and eventually rupture the bark of, recently killed trees. Several insects, particularly oak bark and sap-feeding beetles, are attracted to the fungal mats because of the fermenting odor. As the beetles crawl over these mats, spores of the fungus adhere to their bodies. The beetles fly to other oak trees, feed on the sap flow from fresh wounds, and thereby spread the fungus to these trees. Squirrels and birds may also be potential vectors of the fungus.

Insect transmission of the fungus among trees in the white oak group is very limited, because fungal mats are rarely produced on infected white oaks.

Root grafts are an important means of fungus transmission between trees. Roots of oaks form natural grafts. Once the fungus enters a tree it can spread to nearby trees through these grafts. This method of transmission has been observed in both red and white oak groups.

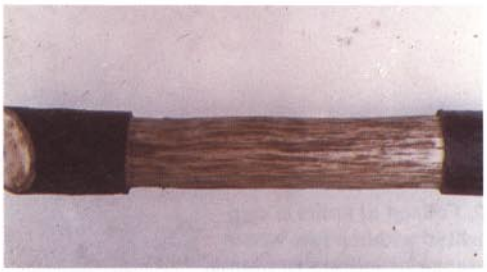

Figure 45-3. Brown discoloration of sapwood of infected stem.

Figure 45-4. Foliage symptoms on trees of white oak group. Leaves remain attached and their discoloration is similar to normal fall coloration.

Damage

Oak wilt continues to threaten oak forests and landscape plantings throughout their native range. Fortunately, catastrophic losses to the disease, feared by many in its early history, have not materialized. Still, thousands of oaks succumb to oak wilt annually, primarily in forest stands in Wisconsin, Minnesota, and Iowa. A number of States (Pennsylvania, West Virginia, Maryland, Kentucky, Tennessee, and North Carolina) implemented extensive oak wilt control programs in the 1950's and 1960's. Appraisal of these programs suggests that damage from oak wilt would have been much higher in the absence of such efforts, and therefore were justified.

Control

There is no known way of saving infected oaks, at least not red oaks. Control must be aimed at halting the spread of the fungus to healthy trees by (1) preventing root graft transmission, and (2) reducing fungal mat production on recently killed trees. Insect control is impractical.

Over 90 percent of diseased trees probably become infected through root grafts. Spread through such unions can be prevented by mechanically trenching around infected trees after first symptoms develop. A trench 3 feet deep and several inches wide between diseased and healthy trees immediately disrupts root grafts between these adjacent trees. The trench can be refilled because new root grafts will not form between the dead or dying tree and nearby healthy trees.

An alternative method of disrupting root grafts involves the use of SMDC (sodium N-methyldithiocarbamate), sold under various trade names as Vapam, or Trimaton. This fumigant kills the roots in a narrow strip and prevents the fungus from reaching healthy trees. Holes are dug 15 to 18 inches deep and an inch or two in diameter, spaced 6 inches to a foot apart, along a line midway between the diseased tree and adjacent healthy trees. One part of SMDC is mixed with three parts of water, and the diluted solution is poured into each hole. The holes must be closed immediately after application. Some temporary injury may occur in the healthy tree, particularly if the chemical barrier is closer than 10–15 feet from it, because of chemical uptake and limited root kill. Soil texture, temperature, and moisture influence the rate of uptake and effectiveness of treatment.

The second control technique is aimed at preventing spore formation on diseased trees. Spores are produced for only a brief period after the tree dies. The fungus cannot be isolated from the above-ground parts of dead trees when the moisture content of the wood is less than 20 percent. Therefore, any treatment that hastens the drying of wood tissue will tend to reduce sporulation. Deep mechanical girdling of the trunk soon after the disease is diagnosed will hasten drying of the wood and prevent mat formation. Experiments with chemical poisons, such as pressure-injected cacodylic acid, have demonstrated effective root kill and hastened drying.

Finally, infected trees should be cut down and destroyed. They may be burned, buried, or processed into chips for mulching purposes. Members of the white oak group can be used at any time, while red oaks should only be used when they are beyond the stage of producing or harboring spores. If there is potential for sporulation, firewood cut from infected trees should have bark removed or be covered with 4 mil polyethylene until used. Logs from freshly cut timber may be fumigated with methyl bromide under plastic cover for 3 days. Salvaged timber can be milled for lumber, but waste slabs and wood should be chipped, burned, or buried.

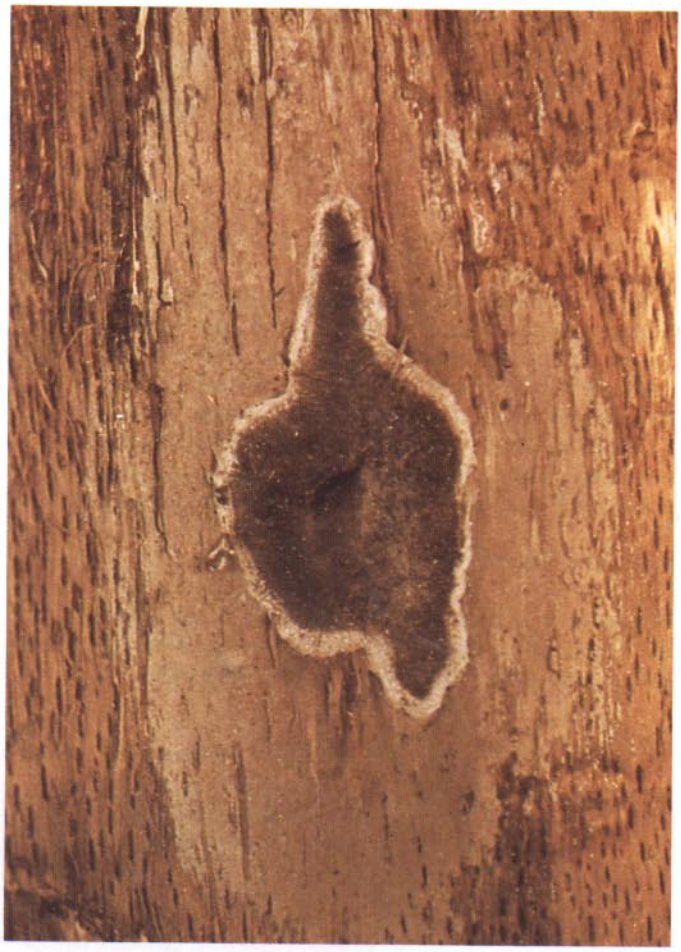

Figure 45–5. Gray mycelial mat of oak wilt fungus. The mat develops under the bark of dead trees.

Selected References

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