3. Bur Oak Blight

Thomas C. Harrington and Douglas L. McNew

Many species of *Tubakia* are capable of causing late-season leaf spots and necrosis of leaf veins on oak (*Quercus* spp.), chestnut (*Castanea* spp.), and other hardwood species in Europe, Asia, and North America. But the recently described fungus *T. iowensis* is also capable of causing petiole necrosis and death of whole leaves on bur oak (*Q. macrocarpa*), sometimes killing nearly every leaf on a susceptible tree. Damage to bur oak was first noted in the mid-1990s in the northern Great Plains and the Upper Midwest, and the incidence appears to be increasing in this region, perhaps due to more abundant spring rainfall.

**Hosts and Distribution**

Substantial necrosis of leaf veins and petioles by *T. iowensis* occurs only on bur oak. Bur oak blight is most common in Iowa and Minnesota, but the disease has been noted in western and southern Wisconsin, northern Illinois, eastern Nebraska, and eastern South Dakota, with isolated groups of affected trees in counties of Illinois and Missouri that border Iowa. This disease distribution roughly coincides with the limited distribution of a small-acorned, fire-adapted variety of bur oak, *Q. macrocarpa var. oliviformis*. Bur oak blight is most severe in relic savanna groves on upland sites (fig. 3-1). On bottomland sites, few trees show severe symptoms, and the disease has not been recorded where the large-acorned *Q. macrocarpa var. macrocarpa* is common. The disease does not seem to be present in eastern North Dakota, where *Q. macrocarpa var. depressa* predominates on sites with sandy soils. Ornamental plantings of bur oak trees with large acorns are not seriously affected, but planted bur oak with small acorns may have severe symptoms (fig. 3-2).

**Symptoms and Signs**

The first symptoms usually appear in June in the form of elongated, purple-brown lesions on veins of the leaf undersurface, sometimes with numerous small, reddish-brown necrotic spots on the leaf blade between veins (fig. 3-3). Sporulation is not evident until there is more substantial necrosis of the leaf veins in late June and throughout summer (fig. 3-4), when leaf symptoms could be mistaken for anthracnose caused by *Amphiporthe leiphaemia* (formerly *Discula quercina*). Fruiting structures that bear asexual spores (conidia) of *T. iowensis* appear on or near the necrotic veins. On the upper leaf surface, masses of conidia are typically covered with a shield of red-brown, radiating, setal-like structures (fig. 3-5). Unshielded conidial masses form on the veins on the underside of the leaves. The necrosis may expand down to the base of the leaves, and the leaves are shed. Substantial defoliation may be seen during wet summers (fig. 3-6). Veinal necrosis and fruiting structures with radiating shields are evident on the fallen leaves.
Coincidental with veinal necrosis and defoliation, necrosis on the base of the petiole and death of whole leaves appear in late July and into August (fig. 3-7). Such leaves may remain hanging on the tree, and black pustules begin to form in late summer on the necrotic petiole tissue. However, these pustules typically do not mature and produce conidia until the next spring, at the time of leaf emergence (fig. 3-8). Healthy bur oak branches typically shed all of their leaves heading into winter.

The fruiting structures and conidia of *T. iowensis* (fig. 3-5) are difficult to distinguish from those of other *Tubakia* species. However, the shielded fruiting structures along the veins on the upper leaf surface and naked conidial masses on the veins of the lower leaf surface are typical for *T. iowensis*. Only *T. iowensis* forms black, crustose fruiting structures on the lower 0.4 inch of overwintering petioles of bur oak (fig. 3-7), but other fungi, such as *Botryosphaeria* species, may form similar black structures on midveins, petioles, and twigs. A twig blight associated with *B. corticola* may also leave dead leaves hanging on branches throughout the winter, but in this case the dead leaves are clustered on dead branch tips instead of scattered among the twigs. The conidia of *Botryosphaeria* species are much larger than those of *T. iowensis*.
Dead leaves and leaves with veinal necrosis are typically most evident in the lower crown (fig. 3-2). Trees severely defoliated in consecutive years may have thin crowns, and twig death and branch dieback are sometimes seen. However, the branch dieback is most likely associated with the two-lined chestnut borer, *Agrilus bilineatus*. Branch dieback associated with the two-lined chestnut borer is commonly found on trees affected by drought, root rots, and other primary stresses, so branch dieback is not diagnostic for bur oak blight. It is likely that some trees with bur oak blight have been misdiagnosed as oak wilt, which may also result in dead foliage and branch dieback.

**Disease Cycle**

Black, crustose pustules formed on last season’s petioles provide the initial inoculum in spring. The fungus may produce sexual spores (ascospores) in spring, but these have not been found and are not likely of major importance. The petiole pustules on hanging leaves expand and break open with wetness in spring, and the conidia are dispersed by rain, leading to endophytic and symptomless infections of expanding shoots and leaves (fig. 3-8). After wet springs, nearly every leaf on a susceptible tree is endophytically infected but remains symptomless for two months or more, when petiole necrosis may become evident. This petiole necrosis apparently prevents normal leaf abscission in the fall.

When mature leaves are infected during the summer, veinal necrosis and leaf death may be conspicuous, and the fungus produces abundant conidia on both the upper and lower leaf surfaces. Many leaves infected during the summer are shed, and it is not clear if summer-infected leaves remain attached and produce petiole pustules the next spring. Wet summers tend to lead to more veinal necrosis and defoliation, but dry summers following wet springs may lead to more petiole necrosis and many dead leaves hanging on the tree. Consecutive years of normal or above-normal spring rainfall seem to lead to buildup of the disease in individual trees. The conidia are dispersed by rainsplash, which might be why the lower crowns of the trees are typically more seriously affected than the upper crowns (figs. 3-2 and 3-6).
Damage

Bur oak blight has been most severe in former savanna groves. However, both the host and pathogen appear to be native, and even in the most severely affected groves, many of the trees show few or no symptoms (fig. 3-1), presumably because of resistance. Within the known range of the disease, fewer trees appear to be affected on bottomland sites as compared to upland sites, perhaps because bottomland ecotypes of bur oak tend to be more resistant. Most ornamental bur oak trees do not show symptoms of bur oak blight, but some planted trees are seriously affected (fig. 3-2). When acorns have been seen on planted bur oak trees with bur oak blight, the acorns have been small, typical for *Q. macrocarpa* var. *oliviformis*.

Severe symptoms in late summer appear to follow periods of high rainfall during the previous spring, and a recent shift in climate towards more spring rainfall is believed to be responsible for the relatively high incidence of the disease in Iowa and Minnesota. Consecutive years of high spring rainfall may lead to buildup of overwintering inoculum (pustules on petioles) in the crown of susceptible trees. High summer moisture may also lead to an abundance of secondary infections with veinal necrosis and defoliation. In contrast, summer drought following normal spring rains may lead to more dead leaves hanging on the trees.

Some trees with repeated defoliation may show twig and branch dieback, generally attributable to the two-lined chestnut borer. Aside from the borer damage, relatively few trees affected by bur oak blight appear to die from the disease. In most areas, root rots and stem decays are more commonly associated with branch dieback and mortality of mature bur oak trees.

Management

Because the initial inoculum is produced in the tree crown, sanitation of leaves on the ground is not believed to be an effective control. Experimental injections of fungicide have been found to be effective in controlling the disease in some high-value trees, but only trees showing moderate to severe levels of disease should be treated. Injection of dilute formulations of propiconazole, following directions for oak wilt control, have been most effective and may reduce symptoms for two or more seasons. Inject trees as soon as the leaves are fully formed in late May or early June, before symptoms appear. However, leaves and small branches of some trees may show phytotoxicity with propiconazole treatments, and not all treated trees show reduced disease levels. In some treated trees, severe symptoms did not return until the second year after treatment, and individual trees need not be treated more than once every three years.

For ornamental plantings in regions with bur oak blight, grow bur oak trees produced from large acorns as these seem to be mostly free of the disease, as are other species of oak. In management of existing groves, the most susceptible trees should probably be removed, especially if they have substantial branch dieback. In mature groves, practice sanitation to reduce populations of the two-lined chestnut borer. In the absence of the borer, the frequency of mortality from bur oak blight alone is quite low.

Selected References


Abstract

Hosts, distribution, symptoms and signs, disease cycle, and management strategies are described for 84 hardwood and 32 conifer diseases in 56 chapters. Color illustrations are provided to aid in accurate diagnosis. A glossary of technical terms and indexes to hosts and pathogens also are included.

Keywords: Tree diseases, forest pathology, Great Plains, forest and tree health, windbreaks.

Cover photos by: James A. Walla (top left), Laurie J. Stepanek (top right), David Leatherman (middle left), Aaron D. Bergdahl (middle right), James T. Blodgett (bottom left) and Laurie J. Stepanek (bottom right).

To learn more about RMRS publications or search our online titles:
www.fs.fed.us/rm/publications
www.treesearch.fs.fed.us/
Diseases of Trees in the Great Plains