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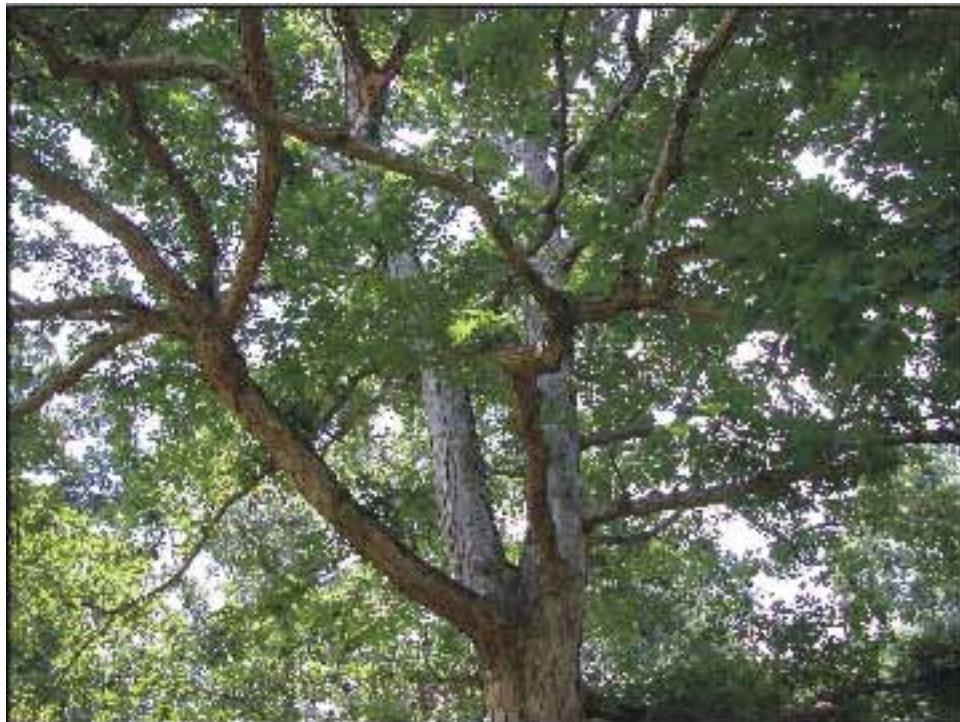
College of Agricultural and Environmental Sciences
College of Family and Consumer Sciences

Key to Diseases of Oaks in the Landscape

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Oak Leaf Blister

Taphrina caerulescens

Symptoms:

Oak leaves begin to show chlorotic, blister-like areas on the upper surface that can be as large as one half inch in diameter (Fig.1 & Fig.2). The lower surface has gray depressions that correspond to the raised blisters. As the disease progresses, the blisters turn brown and the leaf will curl as the blisters coalesce. Premature leaf drop also may occur. Trees are not severely damaged, but the appearance of the tree may be unsightly. All oak species are susceptible to this disease.



Figure 1. Chlorotic blister-like lesions

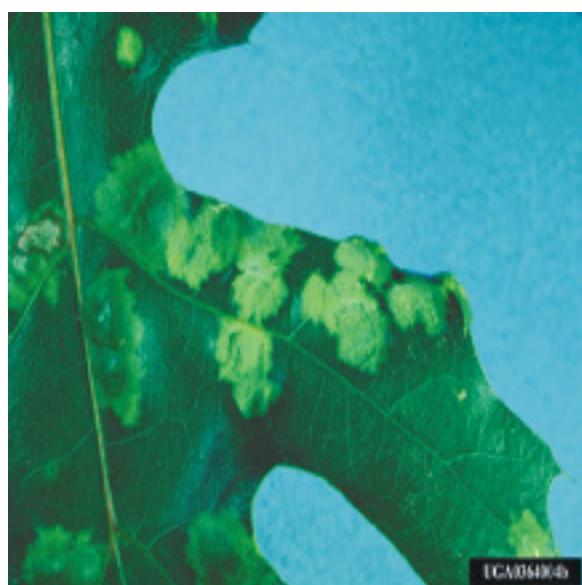


Figure 2. Puckered lesions of oak blister.

Anthracnose

Apiognomonia querciniae

Symptoms:

Symptoms vary with host, weather and time of infection. Shoot blight is one of the first symptoms seen in spring. Blighting causes leaves and shoots to brown and shrivel. Young leaves become cupped or distorted with necrotic lesions. Large lesions often follow leaf veins or are delimited by leaf veins (Fig. 3). Old lesions are papery and gray to white in color (Fig. 4). On the underside of an infected leaf, tiny brown fungal fruiting bodies may be visible on or near major veins. Premature leaf drop is common. Mature leaves are fairly resistant and the symptoms are simple necrotic spots. If infection is severe, branch cankers and twig dieback can occur during winter and early spring. The symptoms usually first appear on lower branches and then spread upward.



Figure 3. Anthracnose lesions following a leaf vein.

Favorable Conditions:

Anthracnose fungi overwinter in twigs and plant debris. If winters are mild, the pathogen is active causing cankers and dieback. Spores are spread by wind and rain during the spring and infect new shoots. This disease can have multiple cycles per year if the weather is moderately warm and wet.

Control:

Rake and destroy fallen leaves. Prune lower branches to increase air circulation and ensure proper tree fertility and irrigation. Chemical controls are rarely recommended unless trees are newly established.

Tubakia Leaf Spot (Actinopeltate leaf spot)

Tubakia dryina

Symptoms:

The symptoms caused by Tubakia are brown or reddish brown blotches on the leaves. Premature leaf drop and twig cankers are common if the trees are severely infected. Spots are well-defined on young leaves and enlarge to necrotic blotches on older leaves (Fig.5 & Fig.6). Small fungal fruiting bodies can be seen within the lesions. Lesions may cause leaves to collapse if they are on veins and restrict water movement.

Favorable Conditions:

The disease overwinters on twigs and plant debris. It favors wet, humid conditions and warm temperatures. Primary spore dissemination is by wind and rain. Red oaks are more susceptible than white oaks.

Control:

Rake and dispose of fallen leaves. Prune trees to increase air circulation and ensure proper fertility and irrigation.



Figure 4. Distorted leaves with papery lesions.



Figure 5. Newly developed circular lesions caused by Tubakia.



Figure 6. Brown lesions on older leaves on Tubakia leaf spot.

Bacterial Leaf Scorch

Xylella fastidiosa

Symptoms:

Symptoms of bacterial leaf scorch are described as marginal leaf burn and are very similar to drought stress symptoms (Fig. 7). In addition to marginal leaf burn, there is a defined reddish or yellow border separating the necrosis from green tissue. Symptoms are more noticeable in late summer after hot, dry conditions, but symptoms can be expressed all year. Symptoms first appear on one branch or section of branches and on the oldest leaves. Each year symptoms will reoccur and progress to other parts of the tree (Fig. 8).

Favorable Conditions:

The disease is spread by leafhoppers, spittlebugs and through root contact with neighboring trees. Since the pathogen is harbored within insects, warm temperatures and high populations of leafhoppers and spittlebugs are conducive for bacterial leaf scorch.

Control:

Remove severely infected trees and replant using resistant species. Control weeds (to minimize insect populations) and ensure proper tree fertility and irrigation to maintain health and vigor.

Oak Wilt

Ceratocystis fagacearum

Symptoms:

Oak wilt is rare in Georgia. The disease has not been positively identified at the UGA Plant Disease Clinic. Oak wilt is first observed near the top of the tree. Browning and bronzing of the leaves from the margins toward the petiole are the first symptoms of oak wilt. Eventually the leaves will drop prematurely and the tree will die. White oaks are moderately resistant to oak wilt. Red oaks often die within four weeks of the first symptoms. It may take years before other oaks die. The most reliable way to diagnose oak wilt on live oak is to observe leaf veins (Fig. 9). Veins are chlorotic and eventually turn brown. Oak wilt on red oaks simply wilts young leaves and they turn pale green and brown. Mature leaves may have water soaking lesions or turn bronze on the leaf margins



Figure 7. Marginal leaf burn due to bacterial leaf scorch.



Figure 8. Branch dieback due to bacterial leaf scorch.



Figure 9. Chlorotic veins on live oak.

(Fig. 10). Only individual branches or a portion of the canopy show symptoms. The fungus may cause brown streaking of sapwood (Fig. 11). Red oaks may have fungal mats that break through the bark (Fig. 12).

Favorable Conditions:

The disease is spread by oak bark beetles and root grafts. It is most active during moderate temperatures. Red oaks are more susceptible than white oaks. The pathogen cannot tolerate temperatures above 90 degrees F; so often, the pathogen dies in leaves and twigs. However, it may remain in the trunk and in the roots. Oaks are most susceptible in spring as new wood is forming.

Control:

Remove infected trees. Trenching may be used to prevent root grafting. Trunk injections using a systemic fungicide have had some effect in reducing oak wilt spread within newly infected trees; however, this method is not recommended for trees in the southeastern United States because incidence is limited and of little value once disease is identified.



Figure 10. Bronzing of leaf margins on red oak.



Figure 11. Brown streaking in sapwood.

Fusiform Rust

Cronartium quercuum

Symptoms:

Lower leaf surfaces often have inconspicuous yellow to orange pustules and black hair-like clusters (Fig 13 & Fig. 14). However, the orange pustules can become very noticeable in summer and fall as rust infection continues on oak leaves. Leaves may have yellow spots or necrotic blotches and develop premature leaf drop. Symptoms on oak are not severe, but it is the alternate host to a more devastating disease in pines.

Favorable Conditions:

Fusiform rust is most damaging in slash and loblolly pines. During the spring, pine galls produce spores that are wind-blown to young oak leaves. The pustules on the bottom of oak leaves then release spores in late spring that are carried by the wind to branch tips and tender, green pine needles. Most pine infections occur in April and early May. One spore stage (urediniospores) produced on oak leaves can continue to re-infect new oak leaves throughout the summer during warm, moist, humid conditions. This stage of



Figure 12. Cracked bark due to fungal mats.



Figure 13. Yellow pustules.

the disease does not affect pines.

Control:

Disease is usually insignificant to oaks, except in tree nurseries where the orange pustules can make leaves unsightly. Fungicides can reduce rust development on young newly planted oaks, but control is directed mostly towards saving pines.

Powdery Mildew

Erysiphe spp.

Symptoms:

Powdery mildew is a white, powdery growth on the upper side of leaves (Fig. 15). Tiny black fruiting bodies are usually present in late summer or fall. Infection may also occur in the buds and shoots causing a witches' broom as in the case of live oaks. Symptoms appear to be superficial.

Favorable Conditions:

Powdery mildew survives the winter on fallen leaves and in the spring, wind and water disseminate spores to new leaves. Cool, moist weather conditions in the spring are ideal for infection. Powdery mildew prefers warm days around 80 degrees F and cool nights of 60 degrees F. Temperatures above 90 degrees F will reduce powdery mildew growth. Powdery mildew also requires high humidity but dry leaves. This pathogen usually attacks a crowded canopy with poor air circulation.

Control:

Irrigate early in the morning, improve air circulation and remove fallen leaves. Witches' brooming may be pruned from the tree. Fungicides are generally not recommended or needed as the disease is not lethal to the tree.

Sooty Mold

Various fungi

Symptoms:

Sooty mold is a crust-like or powdery black growth on the foliage and stems of infested plants (Fig. 16). Sooty molds grow superficially and do not penetrate the leaves. Sooty mold fungi grow mainly on the excrement of sap-sucking insects such as aphids, scales,



Figure 14. Black hair-like clusters.



Figure 15. White, powdery growth on the upper side of an oak leaf.



Figure 16. Black crust of sooty mold on foliage.

and whiteflies. Sooty molds do not attack the plant and it is mainly a cosmetic problem. Occasionally, severe build-ups can inhibit photosynthesis and reduce plant vigor. Sooty molds may persist long after the insects have left.

Favorable Conditions:

Sooty molds are present where there is a high insect population. Spores are dispersed by water.

Control:

Reduce insect population. No control is directed toward the sooty mold as its growth will stop when the insect population is controlled.

Crown Gall

Agrobacterium tumefaciens

Symptoms:

Roots, stems and crowns form large, rough galls (Fig. 17). Plants with large galls are often stunted and are the first to suffer from environmental stresses. Damage is greatest when galls encircle the root crown. Mature trees may survive, but severely stressed or diseased trees may be killed by secondary pathogens. Galls are initially spongy, becoming hard with age (Fig. 18). Dead surface tissue will decay and slough-off.

Favorable Conditions:

A crown gall bacterium is dispersed in soil and water and enters through wounds on roots and crowns. Once inside, the bacterium transfers some of its genetic material into the tree's cells. These cells form tumors and grow at a rapid rate. The bacteria may survive in the soil for two years and galls develop in temperatures near 72 degrees F. Temperatures above 86 degrees F stops normal cells from transforming into tumor cells but does not prevent galls after transformation.

Control:

Avoid introducing crown gall bacterium into an area. Use resistant varieties and avoid injuring tree roots and trunks. Control insects that feed on stems and roots. Disinfect tools when pruning infected trees.



Figure 17. An extreme case of crown gall.



Figure 18. Mature gall that is hard and rough.

Hypoxylon Canker

Hypoxylon spp.

Symptoms:

Yellowing and wilting of leaves often related to physiological stress may be the first symptom of this disease. Fungal mats (stroma) will develop beneath the bark of infected trees. Bark will begin to slough-off due to pressure from the stroma beneath it. Stroma exposed by sloughing bark is hard, tan to silver gray on the outside, and black within (Fig.19 & Fig.20). There may be small patches to elongated strips. Old stroma eventually loses the gray color and appears black. The sapwood becomes tan to light brown and has a definite black border.

Favorable Conditions:

Hypoxylon cankers are opportunists that attack trees weaken by other factors such as heat, drought, wound, root injury or other diseases. Oak species most commonly infected are black, blackjack, laurel, live, post, and white oaks. Hypoxylon can be present as a latent colonist in healthy trees and this may account for the rapid invasion of stressed trees. The fungus is favored by warm temperatures of 60 to 100 degrees F but the optimal temperature is near 86 degrees F. Spores are primarily wind dispersed.

Control:

Keep trees vigorous with proper fertility and irrigation. Prevent wounds from mechanical, weather and insect injury. Remove infected limbs or trees once they become hazardous to property or people, and to reduce disease spread to adjacent trees.

Heart or Canker Rot

Inonotus spp.

Symptoms:

The first symptom of this disease is a white rot of the heartwood and the eventual death of the cambium and sapwood. The decay removes lignin and the wood becomes spongy. The basidiocarps or conks of *Inonotus andersonii* exhibits dull brown peg like structures that may exceed 20 inches in length on the outside of



Figure 19. Gray and black patches.



Figure 20. Silver gray patches.



Figure 21. Smooth, shelf-like conk.

the tree. Conks of *I. hispidus* form in the summer and early autumn. The conks are smooth and shelf-like and are fully grown within one to two weeks (Fig. 21). The top of the fungus is yellow to rusty red and the porous bottom is rust color. After three weeks, they dry and fall to the ground. Conks of *I. dryadeus* form at the base of infected trees among root flares. Conks are initially white or light-colored and turn black and crusty with age. Infected trees show symptoms of general tree decline including branch dieback, loss of leaves and yellowing or browning of leaves in summer. Trees weakened by drought stress, wounding or other injuries are most susceptible.

Favorable Conditions:

Oaks in the red and black group are most often infected. Branch stubs within 16 feet of the ground are the most common infection sites, but entry also occurs through other injuries (Fig. 22). Optimal temperature for growth is 95 degrees F. Old conks or remnants may continue to fruit for up to five years.

Control:

Avoid unnecessary injury or stress to trees. Remove hazardous trees to protect property and people. Time pruning of infected branches to minimize exposure of susceptible tissues and when spores are not disseminated (late winter or spring).

Bacterial Wetwood

Symptoms:

A sour odor is often associated with wetwood as water-soaked wood with large numbers of dead bacteria begin to break down. The build-up of bacterial populations within the tree causes fermentation resulting in internal gas pressure of up to sixty pounds per square inch. Foliage sometimes wilts and branches may die-back. However, most of the time, wetwood is a minor problem that leaves a vertical streak on the bark where pressurized liquid escaped out of wounds (Fig 23 & Fig. 24). Many times, secondary fungi and bacteria infect the surface liquid and create a slimy texture on the bark.

Favorable Conditions:

Bacteria that cause wetwood tolerate low oxygen and are often found in soils and on plant surfaces. Bacte-



Figure 22. Conks beneath a trunk canker.



Figure 23. Staining of bark.

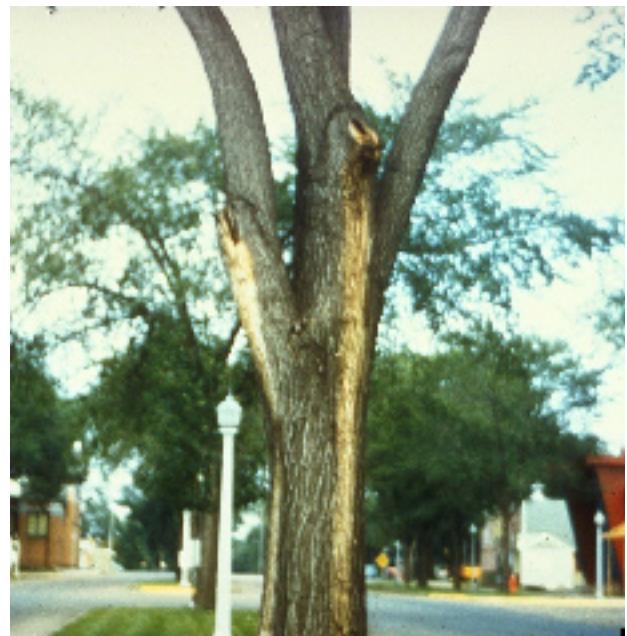


Figure 24. Bark stain due to wetwood.

ria enter through assorted wounds above and below the soil line. The bacteria may lay dormant during the greatest periods of growth and become active in mature or older tissues.

Control:

There are no known controls for bacterial wetwood. A 10% bleach solution may be used cosmetically to clean stains off the bark.

Armillaria Root Rot

Armillaria spp.

Symptoms:

There are several general symptoms that accompany Armillaria root disease, including crown dieback, growth reduction, premature leaf drop or death of the tree. Because these fungi commonly inhabit roots, their detection is difficult unless characteristic mushrooms are produced at the base of the tree. Removing the bark will expose the characteristic, white mycelial rhizomorphs that grow between the wood and the bark (Fig. 25). Short-lived mushrooms may be found growing in clusters around the bases of infected trees. They are honey brown to reddish in color (Fig. 26). The fungus breaks down lignin and cellulose causing the wood to become spongy.

Favorable Conditions:

Spread occurs when rhizomorphs contact uninfected roots. Rhizomorphs can grow for distances of up to ten feet and penetrate the roots by a combination of mechanical pressure and enzymatic action. Mushrooms are produced in late summer or autumn, and are most abundant during moist periods.

Vigorously growing trees often confine the fungi to localized lesions and limit their spread up the roots by secreting resin and rapidly forming callus tissues. But when infected trees are in a weakened condition, Armillaria spreads rapidly through the roots.

Control:

Because these fungi are indigenous to many areas and live on a wide variety of plants and woody material, their eradication is not feasible. Management should be directed toward increasing tree vigor through proper irrigation and fertility.



Figure 25. White rhizomorphs of *Armillaria*



Figure 26. Honey-colored *Armillaria* mushrooms.

Root Rot

Phytophthora spp.

Symptoms:

Above-ground symptoms vary, but generally include reduced tree vigor and growth, yellowing or chlorosis of leaves and eventual collapse or death of the tree. Infected trees may decline slowly over one or more years, or they may collapse and die rapidly after resuming growth in the spring. Rapid death of trees usually occurs following excessively wet periods. On trees that decline slowly, leaves will yellow or brown while leaves on healthy trees remain green. To observe below ground symptoms, you need to remove several inches of soil around the base of the declining tree. A diagnostic reddish-brown discoloration of the inner bark and wood can be observed after cutting away the outer bark layer (Fig. 27). Similar symptoms can be found on roots, but it is generally difficult to see root symptoms without removing the tree (Fig. 28).

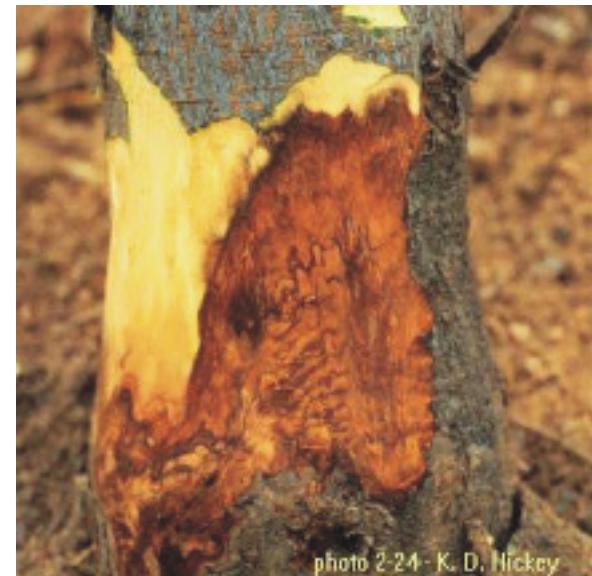


photo 2-24 - K. D. Hickey

Figure 27. Reddish brown wood discolorations.

Favorable Conditions:

Phytophthora root and crown rots are caused by several *Phytophthora* species. While some species are much more destructive than others, all species require extremely wet or saturated soils in order to infect and cause significant damage. These fungi over-winter and persist in soil as mycelium in infected wood and can remain viable in the soil for years. When soils are wet, the fungus germinates and spreads to susceptible plant tissue where they infect. They may also spread to the soil surface and move over longer distances in runoff water. Trees appear to be most susceptible during spring and autumn, which are also the times of year when soil temperatures are most conducive to fungus growth and zoospore production. Fungal activity is low in the winter when trees are dormant.



Figure 28. Brown discoloration of roots.

Control:

Control of *Phytophthora* root rot is most successful using an integrated program of cultural practices including good soil drainage and proper irrigation. Avoid planting trees too deep as this also contributes to disease development and decline.

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Reviewed June 2012

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