

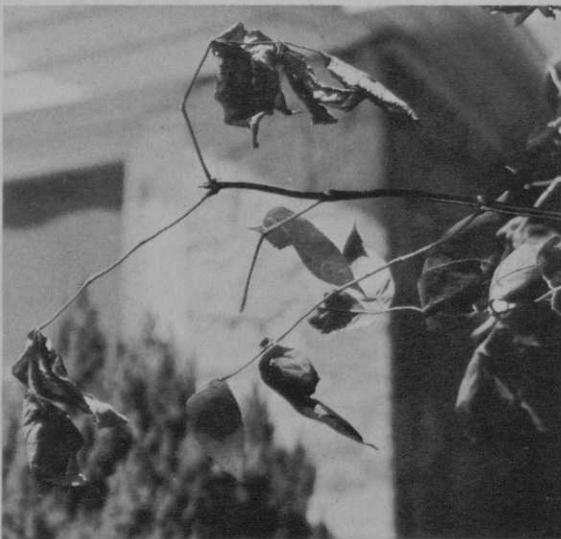
From Elms to Oaks to Maples to..

Superintendents who replaced elm trees felled by Dutch elm disease with oaks and maples may now be confronted with a new battle against Verticillium wilt and oak wilt

By E.B. HIMLICK

IF a nice big shade tree on the edge of the fairway suddenly turns brown and starts to lose its leaves in the middle of the summer, it is important to determine whether neighboring healthy trees need protection. Because there are several diseases that cause leaves to wilt suddenly and turn brown, the superintendent may need to consult a plant pathologist or an experienced arborist for an accurate diagnosis.

The three main vascular wilt diseases of trees are Dutch elm disease, Verticillium wilt and oak wilt. Each is caused by a different fungus that is extremely pathogenic on particular species of trees. Dutch elm disease has received a lot of notoriety, but little has been reported in popular literature concerning the other two wilt diseases. However, a great number of research reports on Verticillium wilt and oak wilt have been published by pathologists in scientific journals during the past 20 years.



Verticillium wilt leaf symptoms (above) on a twig of an affected blue ash tree. Wilting foliage (right) has advanced throughout the crown of this tree. Many leaves on the outer twigs have fallen off.



Verticillium wilt

Verticillium wilt, caused by the fungus *Verticillium albo-atrum*, has become increasingly prevalent among plantings of shade and ornamental trees and shrubs. The disease affects a wide variety of unrelated annual and perennial plants but seldom occurs in wooded areas or in forest stands. Verticillium wilt has been known to occur on planted trees for over 50 years.

New tree and shrub species are continually being reported as susceptible to this fungus. Presently, about 80 tree and shrub species and varieties growing in the United States are known to be susceptible to Verticillium wilt. It is probably safe to say that Verticillium wilt affects more kinds of ornamental plants than any other disease. The disease is not always fatal but does cause a large amount of branch kill so that ornamental value is often lost and many affected plants eventually must be replaced. The

disease is reported throughout the United States and in many other countries. (Refer to the table for trees and shrubs susceptible to *Verticillium wilt*.)

Disease symptoms—External and internal symptoms are variable and often difficult to recognize. Usually the first external symptom is sudden wilting of foliage on one or several twigs on a branch. Later the entire branch or the whole crown may show typical wilt symptoms. Most plants first show symptoms in June or July; however, some trees may wilt as soon as new foliage is produced in the spring.

Other external symptoms that may indicate Verticillium wilt are general decline in current twig growth, dieback of individual twigs and general yellowing of the foliage. Occasionally trees, such as the maple and the tulip, develop elongated dead areas of bark where the inner bark has been killed on

the diseased branches or trunks. Plants that develop a limited amount of branch wilt during the summer may show additional wilt and dieback the following year, and others may recover and not wilt in succeeding years. Plants having extensive or general wilt throughout the crown are often dead by the end of summer.

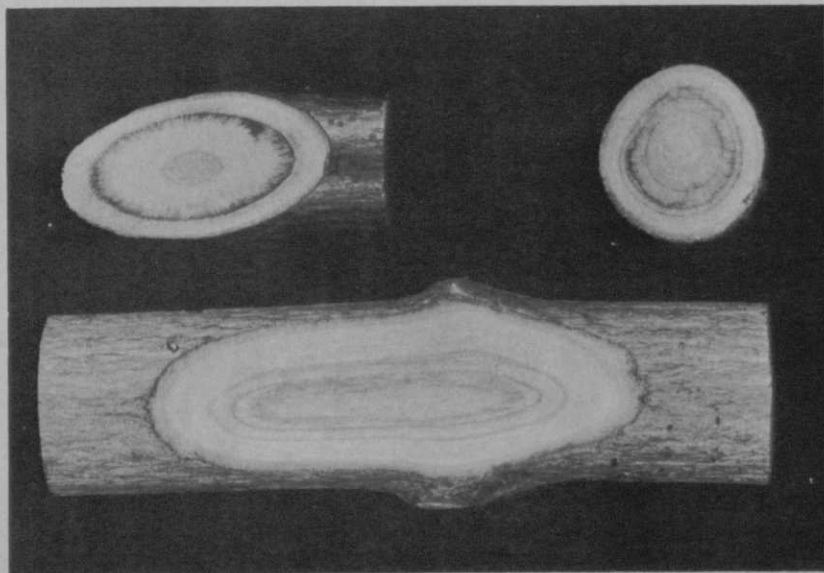
Sapwood discoloration often occurs in twigs and branches showing advanced stages of foliage wilt. The discoloration is found by making a long slanting knife cut across the end of a branch sample. In most trees the sapwood discoloration occurs as streaks of various shades of brown. Infected maple, magnolia and sumac show light to dark green streaks.

The Verticillium wilt disease can only be positively identified by having a laboratory diagnosis made from infected branches. This service can usually be obtained by sending two or three branch sections cut from recently wilted branches to the plant pathology department of a local college or university. Immediately after the material is collected it should be placed in a plastic bag and mailed.

Care of infected trees—The fungus is parasitic on living tissue of many plants and can live over a year in dead organic matter in the soil. The fungus spores or microscopic filaments, known as hyphae, gain entry into the vascular systems of plants through wounds made on the roots, branches or trunk. Wounds on the trunk caused by lawn mowers afford excellent areas for infection to occur. Such wounds should be treated by cutting away the damaged bark and painting the exposed wood and injured bark area with a standard tree dressing paint.

Trees or shrubs suspected of having Verticillium wilt should be watered immediately. Susceptible plants occasionally show symptoms of the disease while they are in a weakened condition following

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Typical discoloration is often observed in the diseased sapwood of twigs and branches cut from infected Norway maple trees.

MAPLES

(Continued)

transplanting. Drought conditions may cause wilt symptoms on affected trees to be more severe. Affected trees should be watered every 10 to 14 days with the equivalent of two inches of rainfall. A portable water sprinkler may be used. If the affected plant survives, regular watering at two to three week intervals should continue during dry periods in the summer of the succeeding year.

Also, affected plants should be fertilized to stimulate vigorous growth. For quick response, the fertilizer should be injected into the soil in liquid form or applied to the soil surface and watered in well. Urea can be applied on the surface or injected at the rate of 13 pounds per 1,000 square feet.

Branches killed by the disease can be pruned. Pruning diseased branches will not eliminate the fungus that is present in the trunk or roots of the affected plant. All pruning tools should be carefully sterilized with rubbing alcohol before using on any other plants.

Future tree and shrub selections—Tree and shrub species most frequently affected with Verticillium wilt are: ash, barberberry, catalpa, elm, magnolia, maple,

redbud, Russian olive, smoke tree, sumac, tulip tree and viburnum. Any of these plants mentioned should not be used to replace plants killed by the disease. Generally, narrow and broadleaf evergreen trees and shrubs may be considered safe replacements. (See table for a complete list.)

Oak Wilt

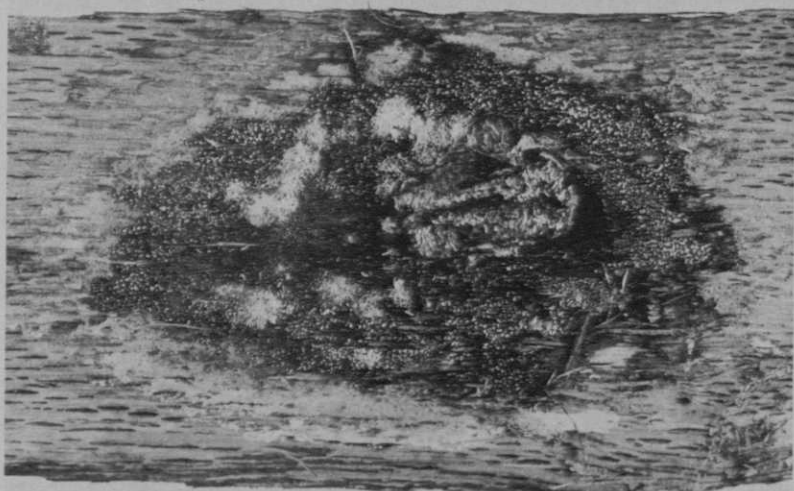
Although Verticillium wilt is common on many kinds of ornamental trees and shrubs, oak wilt presents a threat only to species of oak. The fungus causing oak wilt is technically called *Ceratocystis fagacearum*. Once the oak wilt disease becomes established in a wooded area it can steadily progress until a large number of valuable trees eventually are killed. At present the disease is restricted to the eastern part of the United States. It has been reported in 19 states ranging from Pennsylvania in the east, Arkansas in the south, Nebraska in the west and Minnesota in the north. The disease is believed to be native to the United States and is not known to occur in any other country. Fifteen years ago it was thought to be a serious threat to the entire oak timber population, but intensive national sur-

veys indicate that it is not spreading to new areas as rapidly as plant pathologists had believed it would.

Recognition of the disease

—Oak wilt symptoms may appear any time from May until frost occurs in the fall. Known hosts of the oak wilt fungus include 36 species of oak and six tree species closely related to oak: Allegheny and bush chinquapin, tanbark-oak and American, Chinese and Spanish chestnut. In early stages of the disease wilting and browning of the foliage usually appear in the upper crown. Among trees of the red oak group, which includes red, black, pin and shingle oak, wilting rapidly progresses downward until the entire tree is affected. Partial to complete defoliation occurs within a few weeks after the first leaf symptoms start to show. Some leaves that are still green fall and have typical muddy green or brown margins. Frequently, brown discoloration may be found in the outer sapwood of wilting branches.

White and bur oaks usually have only a few branches that wilt the first year. In succeeding years other branches may die, giving the tree a stagheaded appearance. Infected white and bur oaks may persist for several years, whereas infected red and black oaks usually die in one growing season. As in



Once oak wilt becomes established (left) in a wooded area, it can steadily progress until a large number of valuable trees are killed. The oak wilt fungus (above) on the wood surface has produced a fungus mat under the bark. The center raised portion is part of the fungus growth that apparently pushes the bark loose to help form a crack through which insects enter.



Picnic beetles and larvae feeding on an oak wilt fungus mat. The insects become contaminated with the fungus spores and fragments and carry them to wounds on healthy trees.

the case of *Verticillium* wilt, it may be necessary to consult an extension specialist to get a positive diagnosis.

Oak wilt symptoms can be confused with those caused by other problems that occasionally affect oak. Lightning-struck trees usually turn brown in a few hours after they are struck and leaves are retained on the branches. Most oak trees, particularly white and bur oak, are very sensitive to even an inch or two of soil fill that may be placed over the original soil surface. Wherever there have been soil disturbances or applications of weed killers, tree troubles can usually be predicted.

Preventive and control measures—No treatment is known that will cure a tree once it becomes infected by the oak wilt fungus. Trees become infected in two ways: 1) by insects transmitting the fungus from diseased trees to wounds made on healthy trees and 2) by the spread of the fungus through grafted roots between diseased and healthy trees. Abundant natural grafting of roots occurs between trees of the red oak group. Root grafting between trees of the red and white oak group is believed to be uncommon. White oaks in mixed stands often remain unaffected even though the number of red and black oaks in the area has been substantially reduced by the oak wilt disease.

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Verticillium Wilt

Susceptible

Almond
 Apricot
 Ash, Black, Blue, European, Green, White
 Azalea
 Barberry, Japanese
 Boxwood, Korean
 Camphor tree
 Carob
 Catalpa, Western
 Cherry
 Chestnut, Spanish
 Coffee tree, Kentucky
 Cork tree
 Dogwood
 Elder
 Elm, American, Chinese, English, Scotch, Slippery
 Goldenrain
 Guayule
 Hawthorn, India, Yeddo
 Holly olive
 Honeysuckle
 Horse chestnut
 Judas-tree
 Laurel, Cherry, Portugal
 Linden, American, Little leaf

Locust, Black
 Magnolia, Saucer, Southern, Star,
 Maple, Amur, Black, Boxelder, California Boxelder, Japanese, Norway and varieties, Red, Oregon, Painted, Striped, Sugar, Sycamore
 Oak, Pin, Red, Turkey
 Osage orange
 Pagoda tree
 Peach
 Persimmon
 Pepper tree
 Pittosporum
 Plum, Canada
 Privet, Amur
 Redbud
 Rose, Multiflora
 Rose daphne
 Russian olive
 Sassafras
 Smoke tree
 Sour gum
 Sumac, Fragrant, Smooth, Staghorn
 Tree of heaven
 Tulip tree
 Viburnum, Doublefile, Nannyberry, Wayfaring tree
 Yellowwood

Not known to be susceptible

Bald cypress	Hardy rubber	Juniper	Pine
Beech	Hickory	Larch	Poplar
Birch	Holly	Mountain ash	Spruce
Fir	Honey locust	Mulberry	Sweet gum
Ginkgo	Hop hornbeam	Oak, white and bur	Sycamore
Hackberry	Hornbeam	Palm	Willow
		Pecan	Zelkova

Combating Oak Wilt

Where oak wilt is a problem a five-point program should be followed:

1. If oak wilt is suspected, obtain professional advice or send suitable branch samples to a laboratory for diagnosis. Branch pieces six inches long and one-half inch in diameter should be collected from living branches on which there are wilting leaves. The samples should be mailed in a plastic bag to a plant disease laboratory for testing;
2. Trench between diseased and healthy trees as soon as possible;
3. Immediately cut and destroy

the diseased tree by burning;

4. Protect wounds that may be made on healthy trees and prune only when trees are dormant;
5. Survey the oaks periodically throughout the spring and summer for any new cases of diseased trees.

Conscientiously following this program will prevent further loss of valuable trees, and the trees will be around for future generations to enjoy their beauty and shade.

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MAPLES

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Healthy trees can be protected by trenching between diseased and healthy trees using a small trenching machine of the kind used in laying irrigation and telephone lines. It is desirable to trench about half way between a diseased oak and all contiguous healthy trees. Such trenching should be done as soon as the disease is discovered. The trench should be from two to three feet deep in most soils. By severing the roots, the natural pathway for the fungus to pass through is destroyed. Once the roots are severed the trench can be immediately filled.

After the trenching has been accomplished, the diseased tree should be removed to prevent insects from transmitting the fungus to healthy trees. The entire trunk and branches should be removed and burned. The wood should not be stored for firewood unless all bark has been removed.

The oak wilt fungus forms a

fungus mat between the bark and wood. Cracks in the bark form over these aromatic fungus mats, and insects, often referred to as picnic beetles, are attracted to the fungus. This type of insect is also attracted to fresh wounds made on healthy trees. When the insects have eaten the fungus growth, they leave and carry microscopic spores to other tree wounds they may visit. For this reason, immediately paint all natural or man-made wounds with a tree-wound dressing to prevent infection. Oaks in areas where the disease may be prevalent should be pruned when the trees are dormant and there is no insect activity. □

Dr. Himlick has been a research pathologist at the Illinois Natural History Survey in Urbana for the past 18 years. Much of his research has been on vascular wilt diseases, leaf diseases and various physiological problems of forest and shade trees.

BACK UP

(Continued from page 41)

tomed to this "account" arrangement. Periodically, he must bill them for the merchandise. This, of course, is not good for the professional, because it doesn't provide him with the ready cash when he needs it. What might the professional do to break down this traditional system at country clubs without offending the members whose good will is necessary to the success of his business?

McCullough: I think there is a prestige problem. If it's a private club, there is little likelihood that the pro can break traditional custom down. He can introduce a banking credit card plan and tactfully publicize it, but he cannot in any way imply that he prefers not to extend credit to his member cus-

tomers. But I think the charge card is particularly suited to public, semi-private and resort courses. It also could work well at private clubs where there might be many guests.

GOLFDOM: Actually, the bank credit card may be new to the pro shop, but to their customers, it probably is common.

McCullough: That's right. Some 50 million people carry one or the other, or both, of the major bank credit cards—among them many golfers. They already are accustomed to using them. In pro shops that accepted the cards, these people might be more inclined toward impulse buying or purchasing more expensive items than they would if they had to pay cash. □