An infection center of oak wilt as seen from a fire tower. Note how the trees are dying on the edge as oak wilt continued to spread in a circle. More than 19 states have been affected by this disease.

The Silent Tree Destroyer

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EACH year approximately 20 billion board feet of sawtimber are lost to disease.[16,18] This does not include losses to non sawtimber species and trees of smaller sizes.

Each year 45 percent of the total sawtimber loss is to disease with 20 percent to insects, 17 percent to fire and 18 percent to all other agencies. Once we add the hundreds of thousands of shade trees lost yearly to disease one can conclude that we are facing a mighty foe.

This is even more dramatic as the nation's population increases and our forest land is converted rapidly into urban developments, shopping centers, super highways and a variety of other uses. More and more we hear the cry from the ecologist that proper management of our timber and shade tree resources is a must.

As foresters and arborists we must take a closer look at what positive action is available before it is too late. The 20 billion board feet lost to disease each year represents a sizable timber loss. Indeed, it can best be described as the silent tree destroyer.

What we can do to reduce this 20 billion board feet of lost timber resource and the thousands of shade trees is a question that is examined very closely by many agencies. The solutions are as varied as the hundreds of diseases that affect our trees annually.

In order to objectively evaluate the problem we must examine the disease/plant relationship in detail.

First, we find that the majority of the forest and ornamental diseases associated with the nation's plants require a wound that has opened the tree to the infection. There are a number of ways in which a plant can be wounded. Perhaps fire is our greatest culprit, with man (mechanical damage) and environmental conditions (ice and etc.) causing their fair share.

Once the disease organism has entered the tree, decay and/or death is inevitable. Good management practices have been found to be most effective in reducing disease and in increasing the economic return from a forested site or increasing the value of a property upon which the tree is located.

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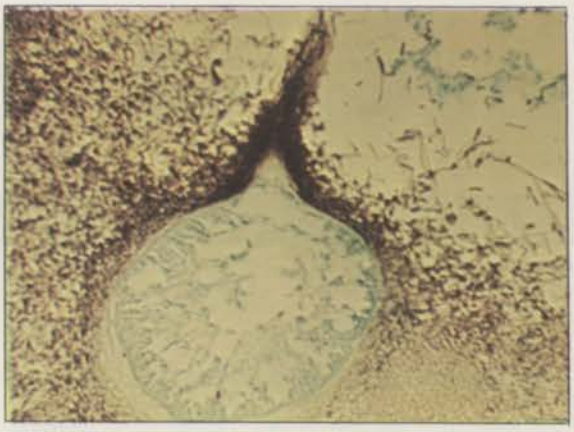
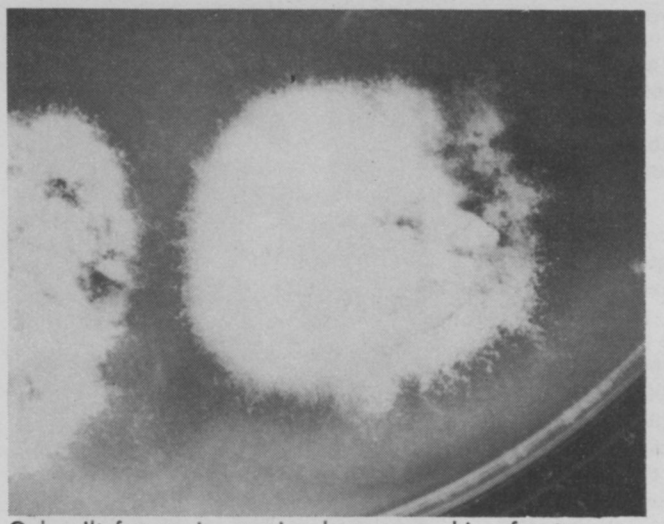
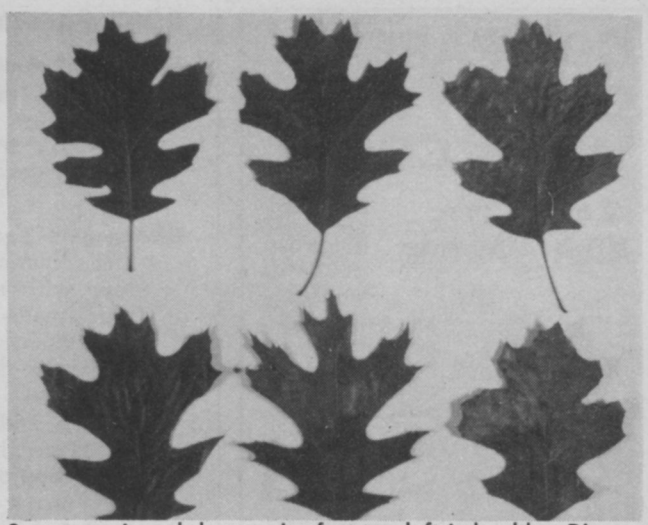
This is a longitudinal section of the oak wilt fungus. Magnified 100 times by an electro-micrograph, the section shows the sexual structure (Perithecia).



Here's a closeup of the photo at the left. It is magnified 200 times. Note the spores or inoculum inside the circular structure.



Oak wilt fungus is growing here on a chip of a tree previously infected. This is one of the cultural techniques used to identify the disease.



Symptoms in oak leaves. Leaf at top left is healthy. Disease progresses (l-r) until leaves become brown and lifeless as in the lower right.

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Close observation and removal of the infected areas or the entire diseased tree must be accomplished to prevent infection of healthy trees.

One of the best guards against disease is a rapidly growing tree. This can normally best be accomplished in the forest stand by removing the poor trees and allowing the remaining trees to maintain a high degree of vigor. Valuable shade trees and ornamentals should be planted on the proper site, be relatively free of competition and be given adequate fertilization and water.

To further clarify the host/disease relationship that may occur let's look at oak wilt disease in detail. As an illustrative disease, it will enable us to understand the concept of a tree disease more thoroughly. It will also help in initiating programs to reduce the loss of valuable plantings.

Oak wilt is thought to be native to the United States. It is not known to occur in any other country.[1] It was first reported in 1942. The fungus now has spread from Wisconsin to as far south as Texas, east to Pennsylvania, and west to the Great Plains.[27]

Oak wilt disease is caused by a fungus, *Ceratocystis fagacearum* which invades the water-conducting vessels of the sapwood through fresh wounds or by root grafts connecting healthy and diseased trees. The fungus has been found affecting and causing the death of all our native oaks as well as chinkapin,[9] Spanish and Chinese chestnut,[8] ash,[12] beech,[2] dogwood,[2] hophornbeam,[2] hickory,[2] sassafras,[2] sourwood,[2] and wild cherry.[12]

The symptoms or plant expression to the disease organism tend to vary little throughout the United States. The first symptom observed is a crinkling of the leaves with the leaf stem turning black. Leaves at the top of the tree or towards the tip of lateral branches nearly always wilt first. The affected leaves become dull and somewhat lighter in color as compared to healthy ones. Upper leaves turn brown at the tips and margins. This produces a sharp line between the healthy tissues and the infected, killed reddish-brown tissue.

This reddish-brown or bronze color progresses downward in the leaf toward the petiole. The affected leaves curl inward with the petiole drooping and turning black. Young leaves may not show the reddish-brown color but may just turn black and drop from the tree. Infected trees may defoliate any time after infection occurs, but usually they defoliate four to five weeks after the first symptoms are observed.

Trees in the red oak group usually die in the first year[23] while white oaks may take years to die.[5]

(Editor's Note: Research conducted by the University of Wisconsin on oak wilt indicates that in some cases white oaks recover after one season of infection. Microscopic examination shows that new wood has been laid down over the infected

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annual ring. The fungus is thus walled off, or "buried" and the tree recovers.)

Little is known about the penetration of the oak wilt fungus into the tree. It has been reported that the fungus probably needs a wound caused by man, insects, animals, weather, or any number of ways to gain entrance into the tree,[10] and that infection can occur through the roots, stems, twigs, buds, leaves or flowers if a wound is present.

The fungus survives the winter by living in the bole of trees infected late in the summer. It later spreads throughout the plant and causes death the next spring; thus, serving as a source of innoculum for reinfection of other trees.[28]

The local spreading of the oak wilt fungus from one infected tree to another is thought to be caused in a great part by root grafts between the oak trees.[4,24] The fungus is also thought to be spread long distances as well as in the localized area by different species of beetles in the Nitidulidae family.[14,20,21,26] It has also been confirmed that the fungus can be spread by mites,[19] wind,[12] squirrels,[15] pomace fly,[3] tools,[17,22] and the fruit fly.

(It should be pointed out that oak wilt can often be confused with anthracnose. Early symptoms of each disease are quite similar. Anthracnose turns lower leaves brown and they curl badly in early June, but the trees are seldom killed. New foliage usually replaces the infected leaves by midsummer. The big difference is that oak wilt usually affects the upper part of the tree first while anthracnose attacks the lower leaves. Additionally, oaks are sensitive to changes in soil levels about their roots. Thus, in areas where new housing exists, trees may appear to have wilt symptoms but may actually be suffering from excavation, soil compaction or soil smothering. Cir. G1693, Oak Wilt In Wisconsin, G. L. Worf and J. E. Kuntz)

An effective control for the oak wilt disease has not been established to date. Local spread of the fungus by root grafts may be controlled to a limited extent by removing all the trees 100 feet on all sides of the diseased tree.[24,25] Killing all trees around an infected tree or trenching around infected trees to a depth that all root grafts between the trees are severed will normally control the local spread of the fungus.[24] A vigorous pruning of infected white oaks has been effective in saving individual trees.[13]

(Editor's Note: Investigative studies are underway to determine whether Benlate benomyl fungicide has activity on oak wilt. Because it is a vascular wilt like Dutch Elm Disease, it is believed that Benlate holds promise in the control of the fungus.)

Due to the slow rate of spread of the oak wilt disease, it does not appear to be of great economic importance. However, given an effective agent to spread the fungus, it has the potential to be of great economic importance. A forest in Illinois of 1800 acres was estimated over a period of eight years to have lost a total volume of timber equal to 50 acres of prime red oak.[11] Young,[24] in 1945, reported that at Pilot Knob State Park in Iowa 4,895 oak trees were killed by oak wilt with a resulting 38 percent mortality. Perhaps even more dramatic is the possibility of entire oak populations within a predominantly oak planted community being infected. The result could be more devastating than that created by Dutch Elm Disease.

Therefore, it can be concluded that on the national scale the disease

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may not be of great economic importance, but in localized areas it could be very destructive. Should the disease infect timber resources, foresters could salvage the tree for market as the fungus does not destroy the structural qualities of the tree.[6,7]

We have taken a brief look at one disease affecting oaks and a variety of other tree species. Multiply the diseases into the hundreds and add in the hundreds of different species of plants affected by the diseases and the stage is set for a series of events that occur daily wherever trees grow.

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