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Dutch Elm Disease

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Quick Facts

- Dutch elm disease (DED) is a devastating disease of American elm and other large-leaf elms that has resulted in the loss of thousands of trees in Colorado.
- Dutch elm disease results from elm infection with a fungus.
- Dutch elm is primarily spread by the European elm bark beetle. Adjacent trees may become infected by transmission via root grafts.
- Strict sanitation to promptly identify and remove infected elms is the most important means of managing DED.
- Girdling and trenching may be needed to prevent transmission of DED through root grafts.
- Insecticide sprays to prevent transmission of the DED fungus through bark beetle feeding wounds in the twigs can supplement, but not replace, sanitation efforts.

Dutch elm disease (DED) results from infection of susceptible elm trees by the fungus *Ceratocystis ulmi*. It has caused devastating losses of elms throughout the eastern and midwestern states since it was discovered in Cleveland in 1930. Losses from Dutch elm disease also have been severe in many Colorado towns and cities, and DED continues to threaten remaining American elms in the state. Siberian elms (often referred to as Chinese elms) are occasionally infected by the disease but are much less susceptible than American elm.

Figure 1: Brown stain develops in outer annual ring of Dutch elm diseased twig.

Infected trees initially show a wilting and yellowing of leaves (flagging) on one or more branches. This is followed by a progressive dying of leaves, branches, and ultimately, the entire tree. These symptoms can occur rapidly and trees often die within a few months of initial infection.

Since several other causes (elm scale, squirrel injuries, storm damage, etc.) can produce leaf yellowing and wilting, it is important to properly

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Colorado State FOREST SERVICE

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diagnose DED. A brown discoloration of the wood is a useful indication of the disease (Figure 1). However, positive identification of DED requires that appropriately stained wood be cultured to detect the DED fungus. The Colorado State Forest Service is designated to perform these cultures.

Dutch Elm Disease Transmission

Spread by bark beetles. Dutch elm disease is spread to new locations by the European elm bark beetle, *Scolytus multistriatus* (Figure 2). (It should not be confused with elm leaf beetle, which chews elm leaves but *does not transmit* DED.) Beetles that emerge from infected trees and logs often carry spores of the DED fungus on their bodies. As they move to new trees, the beetles first feed in the crotch area of twigs in the upper crown area of the tree. Feeding wounds expose water conducting vessels of the tree (xylem) to contamination by the spores. The fungus then begins to grow and spread within the xylem from these inoculation sites.
Beetles then move from twigs to trunks and larger branches of elm trees that are weak, dying, or recently killed. Females excavate an egg gallery under the bark, **running parallel to the wood grain.** After mating she lays eggs along the gallery. Later the grub-like larvae hatch and tunnel away from the central egg gallery. This tunneling by the adult and larvae is characteristic of the European elm bark beetle (Figure 3).

Larvae that overwinter under the bark become mature by mid-spring, pupate and emerge as adults in May and June. Adults that feed during this period spread the disease to new trees. When an early

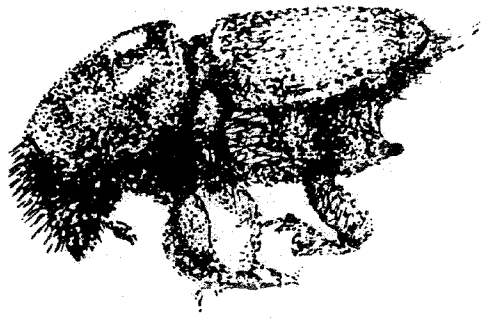

Figure 2: Adult European elm bark beetle (*Scolytus multistiatus*).

summer generation is complete, adults emerge in mid-late summer. New infections are rare during this second period of beetle activity since the xylem vessels of the summer wood are smaller and restrict movement of the fungus. The young bark beetles produced by this second generation spend the winter under the bark.

Spread by root grafts: Dutch elm disease also may be transmitted among adjacent trees by root grafts. Elm trees that grow in close proximity may have roots that contact and form a biological union between roots of adjacent trees. The graft is completely functional - water, nutrients, and, unfortunately, the DED fungus can be transmitted through it. It is through grafted roots that *Ceratocystis ulmi* can infect an elm tree without the European elm bark

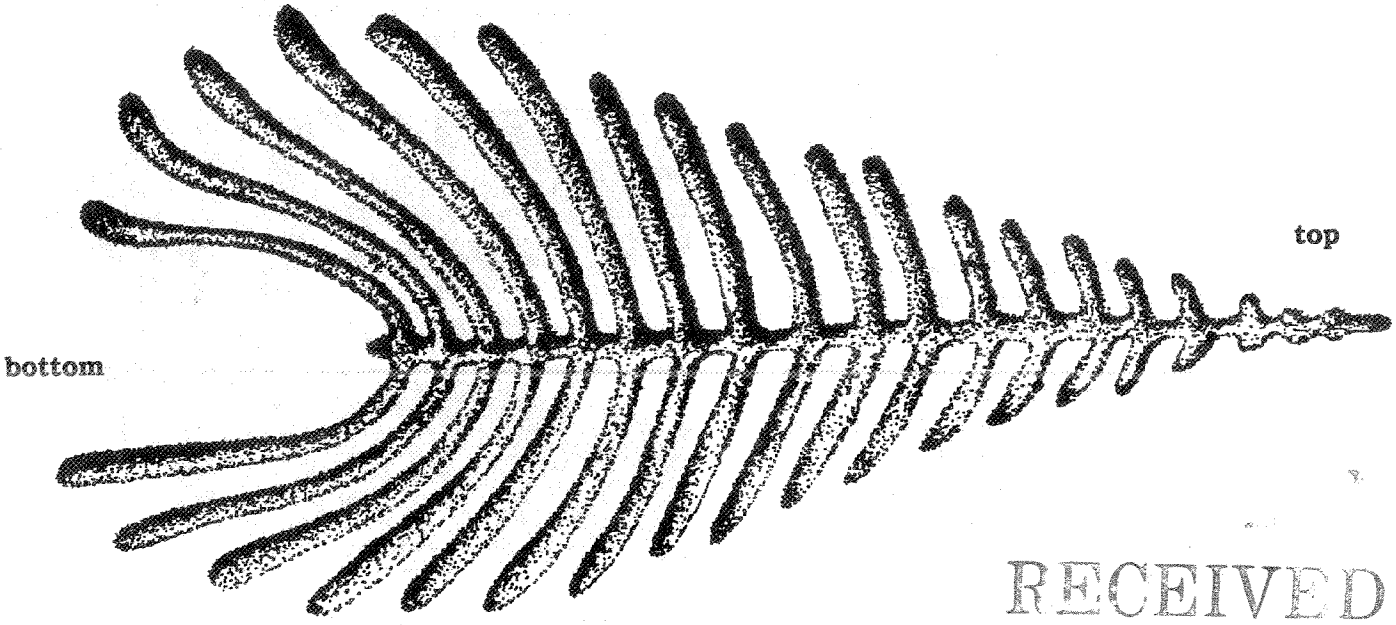

Figure3: Typical egg and larval gallery of European elm bark beetle. (Gallery runs up and down, parallel to the wood grain.

beetle vector. Mature elms within 30 feet of each other are at greatest risk of root grafts. Since American elm often has been planted in dense rows as a street tree, root graft transmission can be very important.

Root graft infected trees often wilt rapidly along the side where infection occurs, with leaf flagging first showing on suckers and lower branches. However, symptoms can be variable and include a more generalized yellowing. Root graft transmission also may show delayed symptoms, with the tree dying as a 'carryover' the following spring. This often occurs when root graft transmission takes place in late summer. Under these circumstances, movement of the fungus and production of symptoms are slowed by decreasing tree growth in late season.

Control

There is currently no known cure for Dutch elm disease. Realizing this, the best hope is to slow the spread of the disease. Management of Dutch elm disease requires the use of several different control approaches applied in an integrated manner.

Sanitation: Fundamental to *any* DED management plan is a program of strict sanitation. Prompt identification and removal of diseased elm trees prevents the development of large populations of beetle carrying the DED fungus. American elms should be regularly checked for symptoms of infection during the growing season. A tree infected late in the growing season may live through the winter. Early season (June) surveys can detect such trees and allow for prompt removal before the disease spreads to other elms.

Promptly treat infected trees to limit spread of the disease and beetle development. If possible, cut and treat within 20 days of detection. Where large numbers of infected trees prevent immediate disposal, the trunks should be girdled 2 inches into the wood with a saw to prevent movement of the fungus to the root system. If done shortly after infection, this can prevent infection of adjacent trees by root grafts.

Procedure for Submitting DED Samples: Send samples from trees suspected of having DED to the Colorado State Forest Service, Insect and Disease Laboratory, Forestry Building, Colorado State University, Ft. Collins, CO 80523, (303)-491-6303. Sample twigs should contain discolored wood and be about 6 inches in length and approximately 1/2 inch in diameter. Put 3-4 twigs from a single tree in a plastic bag and label each with: 1) name and address of the tree owner; 2) tree location; 3) name of the person taking the sample; and 4) a description of visible symptoms.

Elm bark beetle populations can increase rapidly in infested elm branches and trunks. As many as 2,000 adult beetles have emerged from a square foot of bark, although the usual number is closer to 400. Since beetles develop in dead and dying wood, prune dead or damaged branches to reduce beetle populations. Since beetles also may breed in elm logs in wood piles, either remove bark to kill beetles or do not use for firewood.

Prevention of Root Grafts: To prevent root graft transmission, a girdling cut extending at least 1 inch into the sapwood of the lower trunk can be made. This cut should be made **immediately** after a positive DED diagnosis.

If the fungus has spread to the root system, as indicated by discoloration of wood in the lower trunk, transmission of DED through root grafts to adjacent trees is possible. In these instances it is recommended that *roots* be cut to prevent spread.

Prevention of root graft transmission is most commonly done by mechanically cutting roots by trenching. A trench should be 18 inches deep and 2 inches wide.

Ideally, a trench should be located halfway between the infected tree and adjacent healthy trees that are at risk of root graft transmission. Unfortunately, the presence of utilities, sprinkler systems, TV cables and other obstructions often prevents trenching. In these cases, prompt girdling of the trunk with a chainsaw is the first and only line of defense against DED root graft transmission.

Root grafts also can occur under sidewalks and roadways. In these instances special trenching patterns can provide indirect isolation of roots. Figure 4 illustrates trenching patterns that can be used to avoid common obstructions.

Consider secondary trenches between nearby elms in dense plantings. This insures that an unsuccessful primary barrier will not allow DED to spread along an elm row.

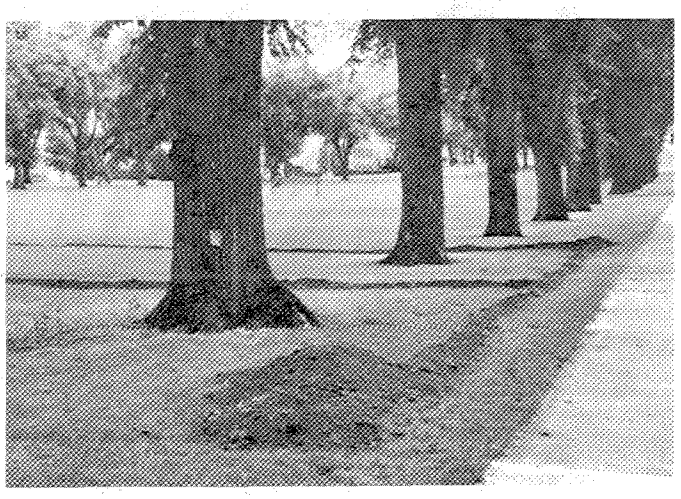

Figure 4: The trench parallel to the sidewalk provides protection against Dutch elm disease as do the trenches between the trees.

Insecticidal Control of Beetle Feeding: Combined with a sanitation program, elms may be further protected from Dutch elm disease infection by use of protectant insecticide sprays. The purpose of these treatments is to kill adult beetles before they chew twigs and introduce fungus spores into the trees.

Preventive insecticide sprays need to thoroughly cover the crown area of the tree. Apply treatments before late April to catch the first emerging beetles. However, persistence of the insecticide on the bark is fairly long and applications made as early as November should remain effective for control of beetles in May and June.

Several insecticides are registered for prevention of European elm bark beetle feeding. Methoxychlor has long been the standard treatment; carbaryl (Sevin) and chlorpyrifos (Dursban) are alternatives. When used as preventive bark beetle sprays on dormant trees, these insecticides are used at more concentrated rates than when applied for leaf feeding insects. (See product labels for specific use instructions.)

Systemic Fungicides: Inject systemic fungicides into the trees as preventive treatments or for attempts to 'rescue' trees that show early DED symptoms. Successful use of injected fungicides on infected trees is limited to those where less than 5 percent of the crown area is showing symptoms. This practice has little effect on overall disease incidence. Consider systemic fungicides only when an effective sanitation program also is in place to prevent new infections.

These fungicides do not kill the DED fungus, but only keep the disease in remission. Repeat applications to insure continued protection with fungicides. Furthermore, the high cost and erratic performance of the treatments make them suitable only for very high value trees. Injections produce considerable wounding.

Pruning: When insect-caused DED infections are detected early, prompt pruning can prevent spread of DED throughout a tree. If less than 5 percent of the crown area shows the flagging symptoms of DED infection, pruning at least 10 feet below the area on the branch showing discoloration may salvage the tree.

Resistant Varieties: Researchers have worked for years to develop elm varieties that are resistant to Dutch elm disease. These are primarily crosses between various Asiatic elms and the American elms. Many of these show good resistance to DED but these hybrids do not have the impressive growth and form of the American elm. Recently, a resistant American elm, known as the 'Liberty Elm', has been introduced and distributed. Liberty Elms are reported resistant to DED, although they have not been grown long enough to show if they remain resistant when mature. Until there is more experience with these varieties, replanting in large numbers is not recommended. However, the development of resistant trees provides a very promising future means of reintroducing the American elm as a premier shade tree.