DUTCH ELM DISEASE AND ITS CONTROL IN VIRGINIA

DISEASES OF LANDSCAPE TREES

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Dutch elm disease is the most devastating and economically important shade tree disease in the United States. It was brought to this country on veneer logs imported from Europe. Since its initial discovery in Ohio in 1930, then in Virginia in 1934, it has spread north and south from Quebec to Georgia, and east and west from the Atlantic coast to the Rocky Mountains where it has killed millions of valuable native elms.

Although this disease destroys many valuable trees yearly in Virginia, it can be prevented and controlled satisfactorily if proper steps are taken promptly. Sound control programs result in the saving of our stately elms, and thereby preserve the aesthetic beauty, summer comfort and property value which they impart. In addition, the saving in cost of dead tree removal is considerable.

SYMPTOMS: The first noticeable symptoms of the disease are wilting, curling and yellowing of leaves, occurring commonly on one or more branches in the upper portion of the tree, a condition often called "flagging." Later, dying and browning or premature falling of leaves is seen (Figure 1). Affected elms may die in a few weeks after the first symptoms are observed, or they may survive for one or more years. In rare instances, some trees have apparently made a complete recovery.

In early summer a dark streaking of the outer new sapwood can be seen when the bark is removed from an infected branch. In the cross section of an infected stem, the brown discoloration may appear as a series of dots in the outer wood ring (Figure 2).

HOSTS: All native species of elms in Virginia which include the American (Ulmus americana), winged (Ulmus alata) and slippery (Ulmus fulva) elms are susceptible to Dutch elm disease. The favorite American species is the most extensively devastated.

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CAUSE AND SPREAD: Dutch elm disease is caused by the fungus, *Ceratocystis ulmi*, which spreads rapidly through the sapwood vessels. The wilting process is believed to result from a complex action involving actual plugging of these vessels and a toxin produced by the fungus. Biopsy chips from diseased wood usually yield the fungus when placed on a laboratory agar (Figure 3).

The pathogen is transmitted primarily by elm bark beetles and also through root graft unions between diseased and adjacent, healthy trees. The smaller European elm bark beetle, *Scolytus multistriatus* (Figure 4), introduces spores of the fungus into small twigs as fungus-infested adults chew into the xylem (wood) of crotches, particularly on the previous year's growth. The native elm bark beetle, *Hylurgopinus rufipes*, introduces spores into the xylem of large branches and the trunk as it tunnels in the thicker bark of healthy trees to overwinter or feed in the spring.

Both species of bark beetles breed between the bark and wood of recently cut or dying elm wood. The fungus is present in diseased trees, and grows actively in the wood while beetle larvae are developing. Millions of spores are produced in the beetle galleries (Figure 5). When adults emerge to fly to healthy trees to feed, they become contaminated with the spores of the fungus. During the feeding process, the host tree is inoculated with the pathogen, and Dutch elm disease usually develops.

The most serious transmission period in Virginia is in late April, May and June when overwintering beetles emerge and are actively feeding on healthy trees. In addition to the peak infection period, transmission can occur throughout the growing season. Elm bark beetles require from 35 - 50 days for one life cycle; there are two or more generations each year (Figure 6).

CONTROL: Dutch elm disease can be controlled, although an individual tree cannot be cured once it becomes infected. Disease incidence can be reduced to a low level by community-wide control programs, and individual trees can be given a large measure of protection by spraying. In all cases, Dutch elm disease control is a preventive program. It is essential that control measures be carried out precisely and thoroughly or they can be a waste of time and money. A four-step program is required community wide to be effective: 1) sanitation, 2) supplemental spraying, 3) prevention of root graft transmission, and 4) use of resistant species. The work must be done at the right time, thoroughly, and under the supervision of a trained, experienced arborist if the program is to be successful. Adequate funding is essential to carry out the prescribed recommendations.
1) Sanitation. Bark beetles which transmit the fungus usually travel up to 900 feet or less from breeding sites. The elimination, therefore, of bark beetle-breeding wood throughout a large area is the most effective way to prevent bark beetle inoculation of healthy trees. Any elm wood that is 2 or more inches in diameter and has died or been cut within 1 year may provide breeding sites for bark beetles. Included is wood from dying trees, limbs, or branches and cut wood in piles. All such wood should be debarked, burned, or buried under at least 6 inches of soil prior to April 1 in Virginia. It is important similarly to dispose of wood again in July and August. Beetles may infest weakened or dying branches of trees in late summer and fall; these also should be removed. A continuing detection and disposal program should be carried out annually after the initial cleanup is completed. One of the most common problems in sanitation work is the storage of elm wood by residents for possible fireplace use. Wood should never be stored unless the bark has been removed.

An effective sanitation program should include sufficient educational and public relations activities to gain the support and cooperation of the public. Civic organizations have been helpful in providing for meetings and publicity.

2) Supplemental spraying. Depending on the availability of funds, spraying can be done on selected high-value trees or on all susceptible elms. Spraying alone, without a sanitation program, is of marginal effectiveness. Large beetle populations greatly reduce the success of spraying operation. In the past, DDT has been the most highly effective insecticide for control of elm bark beetles. Its registration and authorized use on shade trees in Virginia has been cancelled. Methoxychlor is recommended as an alternative for DDT.

Sprays must be applied with equipment large enough to treat the tops of the tallest trees thoroughly. Either a high volume (hydraulic) or a low volume (mistblower) sprayer can be used. If a mist-blower is used effectively, applications must be made when there is NO wind. Partial coverage with insecticides is unacceptable. Infection of a tree is often caused by the feeding of one or a few fungus-contaminated beetles. Complete coverage is essential.
Methoxychlor should be applied while trees are dormant, from March 1 until leaf buds have begun to open. Sprays applied earlier will not have as long a residual period of effectiveness. It is not necessary for a miticide to be added to this spray, since it is of little or no value at that time of the year. Methoxychlor should be applied as an emulsifiable concentrate for elm bark beetles. Do not use wettable powder formulations.

3) Root Graft Treatment.
Functional root grafts may occur between American elms situated within 35 to 50 feet of each other. The fungus can pass from a diseased to a healthy tree through these unions. The spread of the fungus by this means can be prevented by killing segments of possible root graft unions with Vapam or VPM (32.7% sodium methyldithiocarbamate). The chemical should be applied as soon as the earliest wilt symptoms are observed.

The Vapam is diluted (1 part chemical and 3 parts water) and poured in 3/4 inch holes in the soil, 15 inches deep and 6 inches apart, in a straight line equidistant between the diseased and healthy tree. The line of holes is generally about 15 feet, and should not be closer than 10 feet to the trunk of the healthy tree. About 1/2 cup of the solution is placed in each hole slowly after which the hole is tramped shut to prevent loss of vapors. After 2 weeks, the diseased tree can then be removed and burned. Vapam will kill the lawn along the barrier, but this can be repaired by reseeding or sodding 2 weeks after treatment. HANDLE VAPAM CAUTIOUSLY! AVOID SKIN CONTACT AND INHALATION! If there exists any doubt or possible safety hazard in application, it is suggested that a commercial arborist or other qualified personnel perform the job. Figure 7 illustrates a root graft treatment model.

4) Disease-resistant Species are recommended as substitutes in new plantings where, for some reason, disease control measures are not observed.
None of these, however, exhibit the spectacular large size and vase-shaped elegance of the American elm. The following resistant species and varieties are suggested for planting in Virginia:

- **Buisman elm** - *Ulmus carpinifolia*  
  'Christine Buisman'

- **Groeneveld elm** - *Ulmus hollandaica*  
  'Groeneveld'

- **Chinese elm** - *Ulmus parvifolia*

- **Siberian elm** - *Ulmus pumila*

It is generally recognized that the extensive planting of one tree species (monoculture) constitutes a potential hazard should a native or exotic disease become rampant, as in the case of Dutch elm disease. It is suggested, therefore, that any one species of shade tree should not compose more than 10% of the total tree population of a planted area. This sound philosophy should be kept in mind either when replanting or establishing new plantings of trees.

In many communities and outlying areas, a municipal Dutch elm disease control program may not be in effect. This infection hazard for shade trees around homes is great. There is no preventative for Dutch elm disease other than by observing sanitation procedures and spraying with *methoxychlor* between March 1 to late April when leaf buds begin to open in Virginia.

Trees must be sprayed with equipment large enough to provide thorough coverage throughout the tops of all trees. The services of an arborist or custom applicator should be employed for the spraying. As a record and assurance of proper spraying, the job should be done under contract with a reputable, experienced firm. The contract should specify the make, model, and spraying capacity of the spray machine, the insecticide used, the concentration of the insecticide applied, and number of gallons per tree and the date of treatment. The date can be a period of time within the recommended timing for application.

All county extension agents in Virginia are supplied with current information on Dutch elm disease, including diagnostic and control procedures. They can provide professional advice in your area.
COMMUNITY DUTCH ELM DISEASE CONTROL PROGRAMS:

Encourage and support a community-wide Dutch elm disease prevention program:

1) Ask if your municipality has a Dutch elm disease control program.

2) Ask if a general tree and disease survey has been made and a status report filed in your community.

3) Request and support a municipal arborist position for a trained, experienced man who can plan a thorough overall tree maintenance program.

4) Encourage adequate funding of a local tree planning and maintenance program.

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KEYS TO PROPER USE OF PESTICIDES

1. Read the label on each pesticide container before each use. Follow instructions to the letter; heed all cautions and warnings, and note precautions about residues.

2. Keep pesticides in the containers in which you bought them. Put them where children or animals cannot get to them, preferably under lock and away from food, feed, seed, or other material that may become harmful if contaminated.

3. Dispose of empty containers in the manner specified on the label. If disposal instructions are not printed on the label, burn the containers where smoke will not be a hazard, or bury them at least 18" deep in a place where water supplies will not be contaminated.

SEE YOUR DOCTOR IF SYMPTOMS OF ILLNESS OCCUR DURING OR AFTER USE OF PESTICIDES.