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Plant Disease Diagnostic Clinic
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Dutch Elm Disease: *Ophiostoma novo-ulmi; O. ulmi*

Introduction

The rise of Dutch Elm Disease has been a devastating event in the history of tree diseases. It is caused by the fungi *Ophiostoma novo-ulmi* and *O. ulmi* and is vectored by bark beetles. The disease is referred to as "Dutch" Elm Disease because it was first described in Holland in 1921, although the pathogen originated in the Orient. The disease began its destructive reign in the United States in 1930.

Before the arrival of this pathogen, many streets and parks were graced by the upright and spreading branch structure of American Elms. The appearance of a mature American Elm can make nature lovers stop and stare in awe. Due to the incredible interest in these trees, plant breeders have been trying to develop resistant American Elms for years. Unfortunately, many of those trees proved to be susceptible to other diseases such as Elm Yellows.

Figure 1: Characteristic streaking seen beneath the bark. (provided by Dr. Wayne Sinclair, Cornell University)

Symptoms and Signs

Symptoms develop quickly within a 4-5 week period and usually when the leaves have reached full size. The first visual symptom usually observed within the crown of the tree is referred to as "flagging". This occurs when one or more branches develop symptoms of wilting and/or yellowing of the leaves on an otherwise healthy tree. Prior to this occurring, symptoms have developed internally and include the death of xylem cells, the loss of water-conducting ability, and the browning of the infected sapwood in narrow streaks that follow the wood grain (Fig. 1). The fungus is present in the streaked wood, and isolations taken from this symptomatic tissue are needed to confirm infection by this pathogen. Occlusion of xylem vessels is due to the production of gums and tyloses. In the Western U.S. where summers are dry, water shortage and heat stress often mask symptoms.

Figure 2: Bark beetle galleries. (provided by Dr. Wayne Sinclair, Cornell University)

Disease Cycle

Spores of O. *novo-ulmi* are stored in xylem vessels and reproduce through budding. Dispersal of spores is via bark beetles that burrow under the bark and lay their eggs in wood galleries (Fig. 2). Elm bark beetles distribute O. *novo-ulmi* locally and over distances of several miles while the fungus may be distributed over longer distances in elm logs and firewood. There are two species of beetle vectors known in North America, *Hylurgopinus rufipes* and *Scolytus multistratus*. Insects are attracted to healthy elms by volatile chemicals produced by the trees. Beetles bore into the inner bark and while feeding deposit spores of O. *novo-ulmi*. *Scotylus multistratus* feeds in the crotches of twigs, therefore, most infections occur in twigs. *Hylurgopinus rufipes* bore in the bark of branches and small trunks causing infections in major branches.

From the point of inoculation, the fungus moves upward and downward in two modes: in the liquid within xylem vessels and by the growth of fungal hyphae between xylem vessels after germination. *Ophiostoma novo-ulmi* reaches the roots within one season of infection where it continues to grow. The fungus grows in the roots and ascends the trunk in a wave of infection that kills the entire tree or a major part of it. Where elms are planted close together and there is a possibility of root grafting, O. *novo-ulmi* may move from one tree into the next through the roots. The fungus can also survive as a saprophyte in dead plant tissue.

Management Strategies

Management of DED requires a combination of strategies including sanitation, control of the insect vectors, removal of root grafts, preventative fungicides, and use of resistant varieties.

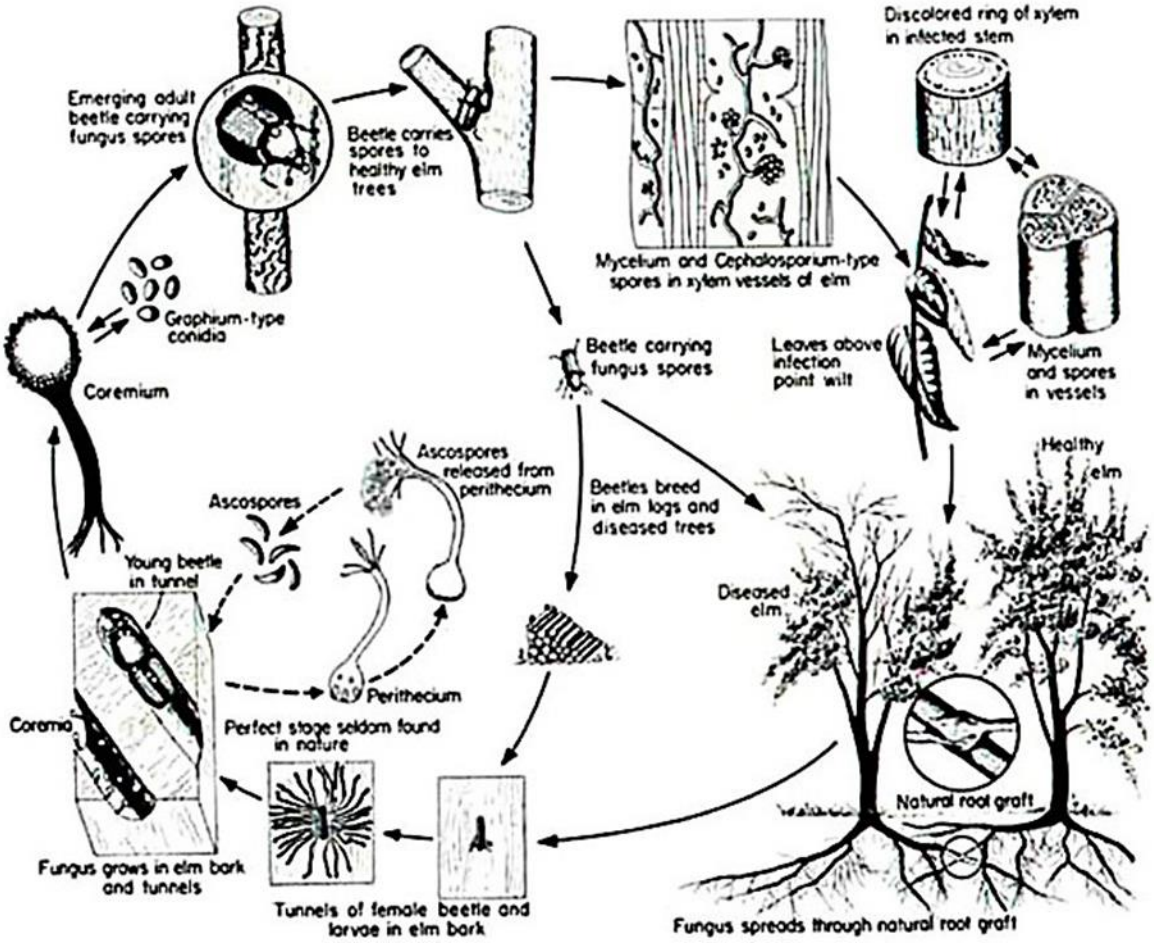
1. Sanitation: Quick removal of diseased trees and symptomatic branches is necessary in managing this disease. Removal of the damaged parts reduces breeding sites for the elm bark beetle and removes the fungus from the area. Wood from infected trees can be used as firewood but should be used before the elm bark beetles emerge in the spring or should have the bark removed from the pieces before stacking. Branches with "flagging" symptoms should be removed by cutting well behind (5-10ft) any visual symptoms.

2. Insecticides to kill bark beetle vectors: Another option for management is to attempt to control the insect vector population by applying an insecticide. Timing of the application may depend on the type of insecticide you have selected. Some insecticides may target the spring feeding sites while others target the overwintering sites and should be applied during late autumn. Use of this management option should be considered carefully. It is difficult to attempt control over this beetle population due to the timing factor, the complete coverage issue, expense, and pesticide exposure.

3. Root grafts: The fungus is capable of moving from tree to tree via root grafts. Trees planted within 25 to 50 feet of each other can easily develop grafted root systems. Breaking these root grafts is an important prevention measure but may be quite difficult for a homeowner to accomplish. A professional landscaper may have the necessary equipment, a vibratory plow, needed to perform this task. Breaking the root grafts before removing any diseased trees is recommended. Transmission of the pathogen may occur if the diseased tree's roots are pulled away or broken from the healthy tree's roots.

4. Preventative fungicide injections: Some fungicides are capable of protecting elm trees from infection, but this method of management should be considered very carefully. Fungicide injection must be performed by someone trained in the technique and may be expensive. Protection lasts only 1-3 years and then must be repeated. In addition, some researchers are concerned that repeated wounding of the tree (by drilling holes) for the injection may open trees to decay.

5. Resistant cultivars: Developing or finding a truly resistant American Elm has been quite difficult. Originally the best method for creating a resistant American Elm was to cross it with closely related European or Asian species that are known to be resistant. Unfortunately, most of the resulting crosses do not carry the upright, spreading growth habit of the true American Elm and, therefore, are not well accepted as an alternative. Still, planting resistant varieties derived from European or Asiatic elm species is advisable. In addition, after years of breeding and research, a number of clonal cultivars of American Elms with resistance have been made commercially available. These include 'Princeton', 'Independence', 'Valley Forge', 'New Harmony' and 'Jefferson'. Another group of resistant elms are collectively known as 'American Liberty Elm'. However, all these elms are susceptible to Elm Yellows and should not be used where that disease occurs on native elm.



Life Cycle Diagram of Dutch Elm Disease

(Provided by Dr. George Agrios from Plant Pathology, 3rd edition.)

Prepared by KLS, January 2001; Updated SLJ2 & LG658, November 2024

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