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Dutch Elm Disease Control

Michigan State University

Cooperative Extension Service

Farm Science Series

W.E. Wallner, Extension Specialist in Entomology and J. H. Hart, Extension Specialist in

Botany and Plant Pathology

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Dutch Elm Disease Control

COOPERATIVE EXTENSION SERVICE
Michigan State University

by W. E. Wallner and J. H. Hart¹

Dutch elm disease was first described by plant pathologists in the Netherlands. This disease came to the eastern United States from Europe about 1930. It is now found in 20 northeastern and central states where native elms are grown.

The first elms known to die of Dutch elm disease in Michigan were found in Detroit (Wayne County) during the summer of 1950. Since then, it has spread to other parts of the state.

To control Dutch elm disease in Michigan, property owners and others interested in growing elm trees must know: (a) the cause of the disease, (b) how to recognize it, and (c) what to do about it.

To keep the disease from spreading in a community, the first infections must be found soon after they occur, and control measures must be promptly applied. Necessary control measures require a program of sanitation and spraying over an indefinite period of time.

The Fungus and How It Kills Elm Trees

No matter how you try to solve your Dutch elm disease problem, it is going to be expensive. Dutch elm disease control is a community problem. The wider area over which controls are carried out the better the results will be. Citizens must care for their own trees as well as follow the program carried out by their city or town. Under an organized program it is the law that all diseased elms (public and private) be removed and destroyed. However, this isn't the whole story; removed trees will need to be replaced if you desire shade. It will be years before new trees give suitable shade. By conducting a

¹ Extension Specialists in Entomology and Botany and Plant Pathology, respectively.



community control program you will minimize elm losses and replacements over an extended period of time. By doing nothing you face the high cost of removal and replacement of many trees during a short period of time.

The scientific name for the fungus that causes Dutch elm disease is *Aspidiotia ulmi*. The tiny spores (seeds) of this fungus germinate in the water-conducting tissues of the living elm tree. As the fungus grows, it causes the tree to form gums which plug the water-conducting tissues. This condition causes the tree to wilt and die.

Many trees die in the same season that infection occurs—some are killed within a few weeks. Only a few live longer than the second or third season. All elms are susceptible, but the native elms more so than the Asiatic species.

How Healthy Elm Trees Get The Disease

When adult bark beetles leave diseased elm trees, fungus spores are likely to cling to their bodies. These spores enter healthy trees through the feeding wounds (punctures) made by the adult bark beetles. Such wounds are usually made in the crotches of 1- and 2-year-old twigs of healthy elm trees.

Many Michigan communities have continued to lose elms even though the conventional control measures of sanitation and spraying are being conscientiously followed. Much of this loss can be attributed to the fungus passing through natural root grafts between diseased and nearby healthy trees. The extent of this type of transmission will vary with the spacing distance between trees. Elms over 30 feet apart are seldom united by a graft while trees less than 20 feet apart are frequently connected.

Be Suspicious of Unhealthy Elm Trees

The most noticeable sign of Dutch elm disease is the wilting of one or more branches of infected trees. The wilting leaves become yellow and, later, turn brown when dead. Branches with dead, brown leaves may hang among the green foliage of healthy branches, a further sign that the trees may have the disease.

A second way to check suspicions that elm trees

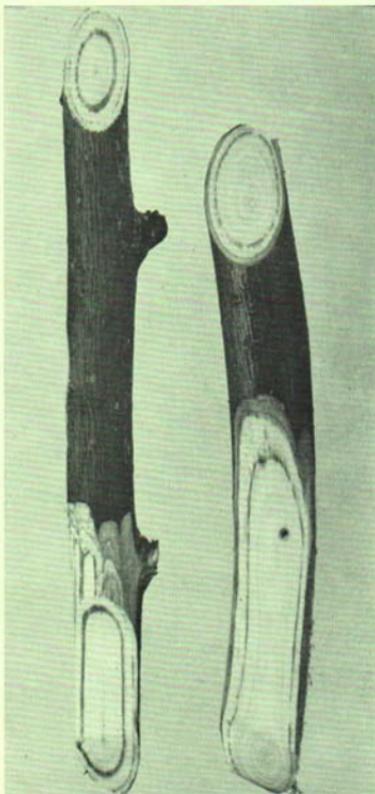


Fig. 1. Typical appearance of branch pieces from a Dutch-elm-diseased tree. The discoloration appears as a ring of BROWN DOTS in the diagonal cross sections, and as long BROWN STREAKS in the longitudinal sections. This BROWN DISCOLORATION is located in the wood just beneath the bark.

may have Dutch elm disease is to examine the crochets of 1- and 2-year-old twigs for the oval, depressed feeding punctures of the beetles.

How To Be Sure About Your Trees

There is only one way you can be sure about your trees having Dutch elm disease. Diseased twigs and branches must be examined for the fungus by a plant pathologist using laboratory methods.

You go about getting this examination in the following way.

1. Cut six twigs or small stems about 7 inches long and $\frac{1}{2}$ to 1 inch in diameter from the diseased branches of each tree. (See Fig. 1 for the appearance and description of Dutch-elm-diseased twigs and stems.)

2. Carefully mark the twigs or stems from each tree.

3. Wrap and bind securely in a suitable cardboard box for mailing. Do not send material that has been dead for some time, or which does not show the discolored ring under the bark.

4. Send all samples for Dutch elm disease testing to the Dutch Elm Disease Identification Laboratory, Michigan Department of Agriculture, Laboratory Division, Lansing 13, Michigan.

If you have further questions on sending in samples for identification, check with your county agricultural agent or other responsible agencies.

NOTE: It is very important that you mail the samples immediately after collecting. Delay in getting the twigs to the laboratory only makes the problem of identification harder.

A report on the sample will be made to you in about 14 days. If the disease is found in the sample, your tree or trees should be cut down and burned immediately.

Description of the Bark Beetles

Two bark beetles are the important carriers of Dutch elm disease.

THE SMALLER EUROPEAN ELM BARK BEETLE (*Scolytus multistriatus*) first entered the United States in 1909. Since that time, it has become more and more widespread and is now the most important carrier of Dutch elm disease.

This beetle is about $\frac{1}{12}$ to $\frac{1}{8}$ inch long. Its color is brownish to black. (See Fig. 4 for a picture of this insect.) The female lays her eggs in niches in the side of simple, unforked egg galleries under the bark of dead or recently cut elm wood. The galleries run with the grain of the wood. The larvae (worms) bore small tunnels around the trunk or branch and away from the centrally located egg gallery. (Fig. 5 shows the egg galleries and larval tunnels of the smaller

European elm bark beetle.)

Adult beetles emerge in May or early June, fly to healthy trees, and feed in the crotches of the twigs. It is during this time—if they have emerged from the bark of diseased trees or wood—that they may introduce the fungus spores from their bodies into healthy trees. The fungus fruits abundantly on diseased wood and the sticky spores frequently adhere to the beetles. (Fig. 2 shows the spore-producing structures of the fungus.) This habit of feeding on healthy trees, after emerging from the bark of diseased elm trees, makes this insect a major carrier of the Dutch elm disease.

This insect seems to have at least one full and a partial second generation a year in Michigan. The smaller European elm bark beetle usually overwinters as a grub in the bark of unhealthy elm trees or recently cut logs or fire wood.

THE NATIVE ELM BARK BEETLE (*Hylurgopinus rufipes*) is small, only 1/16 to 1/12 inch long. Apparently it has one generation a year in Michigan. This beetle overwinters as an adult in the bark of elm trees. Its color is brownish, and its body is moder-



Fig. 2. Enlarged photograph of diseased elm wood on which fruiting bodies of the fungus have developed. White globular areas contain spores in a sticky matrix.

ately stout. The wing covers of this beetle are coarsely punctured with small depressions.

The female of the native elm bark beetle lays her eggs in galleries that run across (around) the grain of the wood. Remember, the smaller European elm bark beetle bores it galleries lengthwise of the wood. (Fig. 6 shows the egg galleries and larval tunnels of the native elm bark beetle.)

How to Control the Disease

The only known method of Dutch elm disease control is to prevent the fungus from moving through root grafts and to keep the bark beetles from carrying the fungus from diseased to healthy trees. Three things are important: **SANITATION**, destruction of root grafts, and chemical control with insecticides.

SANITATION means keeping all old and dying branches pruned out of elm trees. In addition, remove elm trees that have died and those in low vigor from insect attack, flooding, soil fills, lightning, ice injury, or other causes promptly before the beetles breed in them.

Destroy beetle breeding places either by: (1) burning dead elm wood; (2) peeling tight bark from elm wood and stumps; (3) burying logs at least 6 inches deep; (4) using mechanical branch clippers; or (5) spraying bark of felled trees with 1 percent dieldrin emulsion spray or 1 percent DDT in oil. Note: Dieldrin is preferred to DDT for this purpose. (See Fig. 7 for the breeding places of the elm bark beetles.)

Spray the bark of diseased elm trunks and branches with 1 percent dieldrin emulsion spray or 1 percent DDT in oil before hauling them to the place where they will be burned. To make an approximately 1 percent dieldrin emulsion spray, use 1 gallon of a



Fig. 3. Smaller European Elm Bark beetle feeding in a twig crotch. Spores of the fungus are carried from diseased to healthy trees by this feeding habit.

liquid material containing 1½ pounds of actual chemical per gallon to 20 gallons of water. To make 1 percent solution of DDT in oil, mix 1 quart of a commercial elm bark beetle spray with the number of quarts of kerosene or diesel oil corresponding with the stated percentage of DDT on the label. Example: Mix 1 quart of 25 percent DDT emulsion with 25 quarts of kerosene or diesel oil.

As a supplement to other sanitation practices, chemical treatment of diseased and healthy elms is now possible in wooded areas where the usual sanitation and spraying practices are impractical. Often elms in such areas become infested with bark beetles before they can be destroyed. Healthy elms or trees in an early stage of wilt can be rendered unsuitable for beetle colonization by treating them with either of two silvicides. One compound is Atlas D herbicide which contains sodium arsenite. Since this material is highly toxic to humans and other animals, it should not be used in populous areas.

The other compound is potassium iodide. A solution of potassium iodide (one-half pound per pint of water) can be easily prepared from the crystalline form of the chemical. It has a very low toxicity to humans and animals and can be used safely in populated areas. The most effective means of introducing the material into the tree is by means of a gir-

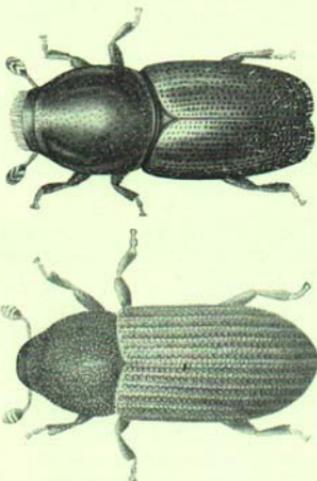


Fig. 4. The Smaller European elm bark beetle (top) is from 1/12 to 1/8 inch long. The native elm bark beetle (bottom) is about 1/16 to 1/12 inch long.

dling ax frill. Ax frills are made by chopping a continuous angling cut which penetrates to the sapwood around the entire trunk. Dispense approximately one pint of solution per tree in the frill while slowly circling the tree three or more times. Treated trees will brown and die within two to four weeks.

Trimming

Heavy trimming (removal of healthy branches) during July through September may increase the in-

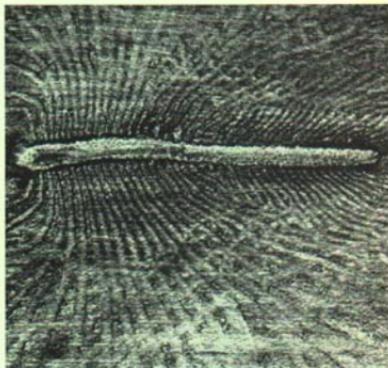


Fig. 5. Enlarged photograph of wood infested with the Smaller European elm bark beetle. Note that the egg galleries are constructed WITH the grain. This insect is the most important carrier of Dutch elm disease.

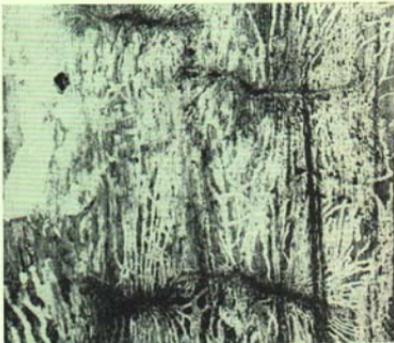


Fig. 6. Egg galleries of the native elm bark beetle (greatly enlarged) run ACROSS the grain—not lengthwise to the grain as those of the European variety.

cidence of Dutch elm disease. This type of trimming is employed by certain communities once every 7 to 9 years, to shape trees and remove branch obstructions above streets, houses, wires, etc. As a result, trimmed trees are attractive to the smaller European elm bark beetle which invades the main trunk to lay eggs. Beetles introduce the fungus and, while the trees may appear vigorous in the fall, trees wilt and die rapidly the following spring. If trimming is necessary it should not be done during July through September.

Destruction of root grafts can be best accomplished with the soil sterilant, Vapam. This chemical has been found to kill elm roots in a limited zone thus providing a method for chemical root pruning. Vapam should be applied immediately after a tree is diagnosed as having Dutch elm disease if it is within 30 feet of a healthy elm. If trees are less than 20 feet apart or if a diseased tree has advanced wilt symptoms, it may be necessary to treat at two sites: one between the diseased and the first healthy-appearing tree and one between the first and the second healthy-appearing tree. This is advisable because the fungus may have already passed from the diseased to the first healthy-appearing elm before Vapam was applied.

Place the line of treatment so as to kill all elm roots of the two adjacent trees that are likely to be grafted. This can best be accomplished by applying the chemical in an unbroken straight line equidistant between the diseased and adjacent healthy elm. If sidewalks, hedges, or other plant material prevent application in a straight line, then apply the chemical in a T-shaped or L-shaped pattern.

Use Vapam diluted one part Vapam to three parts water. Fill holes drilled approximately $\frac{3}{4}$ inch in diameter, 18 to 24 inches deep, and 6 to 9 inches apart with this solution. Seal each hole carefully by tamping to prevent gas dissipation. Usually a circle of grass 3 to 6 inches in diameter is killed around the point of injection. After 4 to 6 weeks the dead spots can either be resodded or reseeded. Allow two weeks after treatment before removing the diseased tree.

CHEMICAL CONTROL means misting or spraying trees with an insecticide that will kill the beetles before they infect healthy trees. Fixed-wing aircraft application of Dutch elm disease control chemicals is not suggested in Michigan. However, recent research indicates that helicopter application can effectively be employed. Areas inaccessible to standard mist blower equipment or those with large numbers of streetside elms are necessary to justify such a method. Treating with chemicals is an aid to beetle control but not the only answer. (See "Sanitation" above.) **ONLY THOROUGHLY MISTED OR**

SPRAYED TREES WILL BE PROTECTED FROM THE DISEASE. Partial or careless treating will only lead to disappointment and discouragement.

The Food and Drug Administration is becoming increasingly conscious of side-effect residues on pastures, crops and water supplies resulting from poor application procedures. Spray operators should take all possible precautions to prevent undue contamination of non-target areas. Failure to observe such precautions may result in a tightening of policies governing certain shade tree pesticide applications.

Suggested Spray Materials

There are two ways to apply Dutch elm disease treatments. One uses the insecticide in large quantities of water. This is called the **dilute** or **hydraulic** method of application. It takes 20 to 30 gallons of this mixture to treat a 50-foot tree.

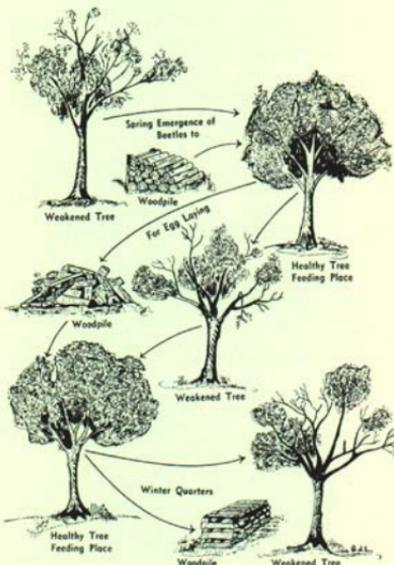


Fig. 7. This shows how bark beetles, by their feeding habits and in the normal life cycle, spread Dutch elm disease. As the beetles move from infected wood into healthy trees, they carry the fungus spores with them. **DESTROY BREEDING SITES** to help control Dutch elm disease!

The other method uses the insecticide in small quantities of water. It is called the **concentrate** or mist-blower type of application. It is preferred to **hydraulic** type applications. Two or three gallons of this material will treat a 50-foot tree.

Put a dormant spray on the trees any time between leaf-drop in the fall and bud-swelling in the spring.

Use the following suggestions for the amounts of DDT and methoxychlor.

MIST-BLOWER SPRAYS†: For the dormant treatment, use one part of a 25 percent DDT emulsion to one part of water. This makes a 12½ percent concentrated mist-blower spray. Apply any time between leaf-drop in the fall and bud-swelling in the spring when the temperature is 40°F, or higher, or when the temperature at the time of application is at least 35°F and rising. Mist blower applications should be made under windless conditions. Winds greater than 5 mph result in poor deposit on the trees and cause undue insecticidal drift. Avoid weaving or moving the column of air rapidly. It is best to build up a column of air, inject the spray into the air stream and move the column slowly through the tree.

Methoxychlor can also be used for Dutch elm disease control but, because of its short residual effectiveness, should be applied only in the spring. Apply the same **FORMULATIONS AND DOSAGES AS GIVEN FOR DDT**. When using methoxychlor apply it as close to bud-swelling in the spring as is possible. Methoxychlor is less toxic than DDT to wildlife.

NOTE: 1. Use only emulsion type insecticides against Dutch elm bark beetles; wettable powders are not effective. 2. Be sure to use a DDT or methoxychlor emulsion specially manufactured for Dutch elm disease control. Several companies manufacture this type of product. 3. Emulsions containing acetone spot some kinds of paint. Therefore, use them carefully around buildings and cars.

Bidrin Implantation

Bidrin is a systemic insecticide which, upon injection into the trunk by the appropriate method, moves through the tree and accumulates in the leaves and bark of branches in the peripheral crown

†**DILUTE SPRAYS:** If a mist-blower is not available for the dormant treatment, use 8 gallons of 25 percent DDT or methoxychlor emulsion to 100 gallons of water. Apply any time between leaf-drop in the fall and bud-swelling in the spring when the temperature is 40° F, or higher.

Note: Dilute sprays applied with hydraulic equipment are generally more poisonous to wildlife than mist-blower applications of the same material.

of the tree. If administered in the proper dosage, enough Bidrin will accumulate to kill beetles which feed in the twig crotches. Bidrin remains effective for a period of about 30 days.

Research results are inconclusive regarding effectiveness and phytotoxicity of Bidrin under Michigan conditions. Therefore, Bidrin is not recommended for general use in Dutch elm disease control. However, should research reveal important advances in the use of this method for elm bark beetle control, appropriate recommendations will be transmitted to all county agricultural agents.

Mite Control

If damaging mite numbers develop on the elm tree, use Kelthane (2 lbs. of 18½ percent wettable powder or 1 qt. of 18½ percent emulsion to 100 gals. of water), or 1 pound of 50 percent wettable ovex powder or 1 quart of 50 percent malathion emulsion to 100 gallons of dilute spray. When applying mist (concentrate spray) increase the amount used accordingly. Other suitable miticides are available; follow the label for instructions about their use.

Protecting Wildlife

General instructions to reduce wildlife losses are:

a. Apply the treatment during the tree's dormant period. This occurs after leaf drop in the fall and before bud swelling in the spring. **NOTE:** Heavy migration of birds begins about the time leaves appear on the elm trees.

b. Use a mist-blower to apply the DDT or methoxychlor insecticide. Avoid spray drift, puddling and other conditions that concentrate the DDT on the surface of the soil or in it, especially when using a hydraulic sprayer.

CAUTIONS

1. When spraying for control of Dutch elm disease, use hose and gaskets of only **NEOPRENE** or comparable materials. Formulations containing xylene and similar solvents will rot ordinary spray hose.

2. Spray operators and others working with diel-drin, kelthane, methoxychlor, or DDT and their formulations should protect themselves at all times from these materials. Wash skin surfaces with soap and water after exposure.

Other methods and materials for Dutch elm disease control: The suggestions given in this folder are the only reliable means of controlling the disease at this time. All other reported methods are inadequate or are in the experimental stage of development. Research is still in progress on the control of Dutch elm disease.