

Combating the Dutch Elm Disease



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Research Progress on Control Methods

Research has shown that elms can now be protected against Dutch elm disease. An individual or a community can reduce losses of elms considerably by making use of control measures now tested for several years. As a result of research work, the entire outlook for these beautiful shade trees is improved and the point of view underlying a control program has changed.

In 1940 the elms of New England were considered by many to be doomed; in sharp contrast today some towns are once again planting elms, on the basis that elms, particularly small ones, are not impossible to protect, and that if no elms are planted, they are surely doomed as city shade trees. The modern control program emphasizes primarily what can be done to protect valued healthy trees, rather than stressing only the removal and destruction of diseased trees, as was the past approach. This change in thinking has focused attention on the valued elm rather than on the one which is already valueless because it is already diseased.

Biology of the Dutch Elm Disease

Dutch elm disease is caused by a fungus that grows in the water-conducting columns of the tree, plugging them and probably secreting toxins which cause the leaves to wilt. This fungus is spread from one tree to another by an insect, the elm bark beetle, which feeds in twig crotches through the bark. This beetle carries spores of the causal fungus on its body and introduces them into the water-conducting cells of the sapwood.

The primary spread of Dutch elm disease occurs in the early spring, when the elm bark beetle emerges from bark in diseased trees in which it has passed the winter, and flies to the small twigs of healthy trees to feed upon their bark. Following this feeding period, the bark beetle seeks out dead or dying bark, apparently attracted by the fermentation products there. It bores into this bark and lays eggs which then hatch to form a new brood of bark beetles. This later brood also feeds in the twig crotches. Usually there are two broods of bark beetles per year, one emerging in early to mid-May and one emerging in July.

Relation of the Control Program to Biology of Dutch Elm Disease

These facts are intimately related to control programs for Dutch elm disease. Because the disease is carried by an insect, one can prevent its spread

by use of proper insecticidal sprays. To do this, it is necessary to use an insecticide so powerful that a deposit, spread over the bark of the twig, will paralyze or kill the elm bark beetle between the time when it lands on the twig and the time it arrives at a twig crotch, ready to feed on bark. Such insecticides were not available until after World War II, during which DDT was developed. Even DDT must be applied in high concentration and in a special formulation to be effective. For this reason a clear distinction must be drawn between DDT sprays applied for control of ordinary leaf-eating insects and those applied for combating the elm bark beetle and Dutch elm disease.

Leaf-eating insects, such as the canker worm, the elm leaf beetle and the Japanese beetle, are readily controlled by ordinary sprays composed of either lead arsenate or wettable DDT in less than 1 per cent concentration. To control the elm bark beetle, the spray deposit must be so permanent that it is effective over at least a 10-week period despite the washing effects of rains. For such purposes DDT should be applied in an oil emulsion and at concentrations as high as 12 per cent for mist blown applications or 2 per cent for hydraulic sprayers.

Two methods have been developed for applying DDT sprays to elms. One uses the conventional hydraulic sprayer which applies a high number of gallons of spray in low concentration of insecticide. The mist blower uses more concentrated sprays but fewer gallons. The same number of pounds of DDT are applied by either method. The mist blower is more economical when street trees are being treated, but cannot be employed when trees are located in back yards where a truck cannot be driven. Experiments have shown, however, that the same level of control can be expected when the proper spray is applied by either method.

The DDT spray for elm bark beetle must be timed carefully. It must be applied before leaves expand in the spring so that the bark on twigs will not be covered by foliage. If applied too early, however, the deposit will lose its effectiveness too soon. It must remain highly toxic all during the period while the elm bark beetle is active and likely to infect the elm tree. For this reason applications are usually made in late April, just before leaves develop on the tree.

Although there are two broods of the elm bark beetle per year, recent experiments have shown that it is efficient to apply only one DDT spray each season for controlling this insect. One reason is that

the second brood of the elm bark beetle is unimportant in spreading Dutch elm disease, because elms become more resistant to infection as the season advances. In the second place, a spray applied during July to control the second brood must be less concentrated to avoid injury to the foliage. At the same time the fully expanded foliage tends to prevent adequate coverage of the bark by DDT to inactivate the insect. Finally, the beneficial effect of DDT sprays which control the elm bark beetle are offset when more than one such spray is applied. Everyone has seen the bronzed foliage on elms in late August when these trees are treated with two or more bark beetle sprays. This bronzing is caused by the red spider which feeds on foliage. Normally, the red spider is kept under control by insect enemies which feed upon it. When these enemies are killed by DDT sprays, the red spider multiplies rapidly, causing conspicuous bronzing of foliage in late summer. The best compromise between controlling the elm bark beetle, on the one hand, and the red spider, on the other, appears to consist of a single DDT spray for the bark beetle.

A second combative procedure is directed against the fungus which causes the disease. This involves soil treatment with a compound such as oxyquinoline benzoate. This compound is absorbed by the roots of the healthy tree and becomes distributed through the tree, making infection less likely. It inactivates the fungus spores left by the bark beetle which might otherwise cause infection. This treatment, like DDT, does not always prevent infection but treated trees are less likely to become diseased than untreated ones. Because of the high cost of this treatment, it is usually reserved for trees that are especially highly valued and for which an extra measure of protection is desired, in addition to DDT sprays. Experiments have demonstrated the value of such treatment when used to prevent infection of healthy trees; diseased trees usually die of Dutch elm disease despite treatment.

In addition, experiments have shown that a tree which receives good general care is less apt to contract the disease and suffers less if it does become infected. Such care would include watering when dry, fertilizing when needed, and spraying for control of elm leaf spot and leaf-eating insects.

At one time prime emphasis in a control program was on removal of dead and dying elms and on pruning out unhealthy branches in an effort to remove bark which might harbor the elm bark beetle. These practices have proven to be of almost no

value in controlling the disease. In such a removal program some diseased material is always missed in swamps and in inconspicuous places in the community. These sources are usually more than adequate to maintain an abundant source of infection in the community. In any case, experiments have shown that an elm tree dead for a year is no longer likely to be a source of infection, and that an infectious elm more than 600 feet from healthy trees is unlikely to be dangerous to them. Moreover, elms can now be protected reasonably well by insecticidal sprays and chemotherapy treatments as described above, so that sanitation is not mandatory to a control program if, for one reason or another, removal of infected trees close by is not feasible. While dead and dying elms must eventually be removed in the interest of public safety and might as well be removed and rendered innocuous promptly, this is no longer considered essential to the success of a control program for Dutch elm disease.

A Control Program for Dutch Elm Disease

Below are given procedures which may be followed by those wishing to protect trees now healthy or treat those showing disease symptoms. Some may be carried out by the individual himself; others require the services of a tree expert.

I. Protection of Healthy Trees

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| <i>Watering,
Fertilization</i> | <ol style="list-style-type: none">1. Trees which are periodically watered and fertilized die less rapidly from Dutch elm disease if they contract it.2. Elms protected against leaf-eating insects (cankercworm, elm leaf beetle, and Japanese beetle) and defoliation diseases (elm leaf spot) are less apt to contract Dutch elm disease and die less rapidly if they do become infected. |
| <i>Control of
Leaf-Eating
Insects and
Foliage Dis-
eases</i> | <p>The cankerworm attacks trees in June and is controlled by the elm bark beetle spray, the formulation and timing of which is given under step 3, just below. For control of the elm leaf beetle and the Japanese beetle, however, a second foliage spray is required in mid-June, consisting of 6 pounds lead arsenate in 100 gallons of water or 2 pounds 50 per cent wettable DDT powder in 100 gallons of water. Elm leaf spot can be controlled by applying two sprays of Bordeaux</p> |

mixture (2-2-50), the first just after the leaves are fully expanded and the second two weeks later.

- DDT sprays for preventing crotch feeding by the elm bark beetle involve the following formulations and spray schedules. Thorough spraying cannot be done when high winds are blowing. Be sure emulsification is complete.

HYDRAULIC SPRAYER

Apply
April 15 to
May 15

DDT (Tech. grade)	16 lbs.
Xylene (Indus. grade)	4 gals.
Triton X-100	1 pint
Water—to make	100 gals.

Xylene is highly inflammable and should be handled with caution. To control the elm bark beetle, the above 2 per cent DDT emulsion is applied with tree-spraying equipment, covering the tree thoroughly, especially the top. A large (30-inch diameter) tree may require 30 gallons of spray.

Solvents such as Xylene are injurious to rubber spray hose and rubber gaskets. Spraying equipment should be washed out thoroughly immediately after using. Alternatively, the following 12 per cent DDT emulsion may be used if trees are so situated that a mist blower can be employed.

MIST BLOWER

Apply
April 15 to
May 15

DDT (Tech. grade)	10.0 lbs.
Xylene (Indus. grade)	2.8 gals.
Triton X-100	1.0 pint
Water—to make	10.0 gals.

Precise dosage data cannot be given as the crown volumes of the trees will vary greatly with diameter. Approximate dosages for representative diameters are: For a 10-inch tree, 1 gallon; 20 inches, 3 gallons; 30 inches, 5 gallons. Since this is a concentrated formula, the danger of injuring plants may be great, under some circumstances.

- The application of oxyquinoline benzoate improves the chances that a

Control
of the
Elm Bark
Beetle

healthy tree will resist infection. Trees may become diseased despite treatment, however.

Control of
the Fungus

Oxyquinoline benzoate is applied in solution to the soil around the feeding roots of the tree between May 1 and 15. This may be done by dissolving 13 ounces of the chemical in 100 gallons of water, and injecting this solution under 100 to 300 pounds pressure around the feeding roots at the rate of 5 gallons per inch diameter of the trunk. At this rate, a 24-inch tree receives a pound of chemical.

- Trees seriously affected by Dutch elm disease (an entire main branch or more dead) may be removed and made harmless (see Treatment of Diseased Trees, Steps C, 2-3 below) if they stand nearer than 600 feet from trees to be protected.

Removal of
Diseased
Trees

II. Treatment of Diseased Trees

A. Recognition of Dutch elm disease.

- Early symptoms may appear at any time during the growing season.
 - The leaves on a twig or branch may suddenly turn yellow or brown, or may suddenly wilt.
 - The sapwood, just under the bark, is always discolored in an affected twig or branch. This discoloration may be either a solid or discontinuous ring in cross section; the surface of the wood under the bark is brown. *Discolored sapwood is the most reliable indication of the presence of the disease.*

- Later symptoms on affected branches occur during the growing season. These consist of:
 - Discolored sapwood.
 - Thin foliage.
 - Production of leaves directly from large branches and along the trunk of the tree.
 - Dead branches.

B. Treatment of trees showing early symptoms of disease.

- Trees can sometimes be saved by pruning out infected wood, but only

Pruning

when infections are caught very early. If an amount of clear wood is removed which is equal in length to that already discolored, the chances of pruning out the infection are worth taking.

- Trees protected against leaf-eating insects and defoliation diseases (see Protection of Healthy Trees, Step 2) suffer less from Dutch elm disease.
- Treatment of trees showing advanced symptoms of Dutch elm disease. Such trees will eventually die.

- A diseased or dead tree must eventually be removed for public safety. Prompt removal may reduce the chances of infection in nearby trees (less than 600 feet away) if no other diseased trees are close by. Trees dead for more than a year will not spread Dutch elm disease.

- Spraying the bark of felled trees completely with a 1 per cent solution of DDT in fuel oil will kill any bark beetles present as they emerge. This should be done before May 15, if the tree is felled before that date, and before July 15, if felled after May 15. This spray is inflammable and injures grass and other plants. It also attacks rubber spray hose.

Destruction
of Felled
Trees

- As an alternative to such spraying, all bark, except that on branches an inch or less in diameter, may be peeled off and destroyed by burning; or the wood and bark may be burned. Such burning should be done before May 15, if the tree is felled before that date, or before July 15, if felled after May 15.