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DUTCH ELM DISEASE ERADICATION BY PRUNING

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Abstract

A pruning study was conducted in an Illinois city having a comprehensive sanitation and spraying program to control Dutch elm disease. When pruning was restricted to trees having 5 percent or less of the crown showing wilt symtpoms, about two of three naturally infected elms were saved by prompt removal of infected branches. When pruning was delayed 1 to 4 weeks after wilt symptom detection, only one of three trees was saved. Pruning success was attributed to early detection of infected trees.

Pruning American elm trees to remove the Dutch elm disease fungus, *Ceratocystis ulmi,* has been attempted for the past 40 years by various research agencies. Pruning studies based on the use of small elm trees 10 to 20 feet tall gave results that did not encourage further research on this method of control. Few researchers have published studies that would refute or support the practice of pruning large diseased elms.

For several years arborists have attempted to save infected elms by pruning out the diseased portions. Some have had moderate success and others have indicated that pruning is neither effective nor practical in view of the relatively low percentage of success and the high cost involved in pruning large trees.

In 1944 Dr. Curtis May and W.R. Douglas reported results on artificially inoculated American elms (6). Thirty-nine trees about 20 feet tall were twig-inoculated on June 11. As soon as wilt symptoms were observed, the infected branches were pruned off at the trunk. Of the 39 trees, 24 (62 percent) showed no further wilt symptoms the year of inoculation even though 14 of the surviving trees had discoloration extending to the base of the severed branch.

In 1952 Dr. David Marsden, in Massachusetts, reported that of 24 trees promptly pruned only 15 trees (63 percent) manifested no further symptoms during the season (5). In 1970 Dr. John Hart, in Michigan, reported pruning results on naturally infected small nursery trees and mature street elms (3). Beginning in June and continuing throughout the summer, young trees were pruned immediately after the detection of wilt symptoms. Pruning of the street trees was carried out during August and September on trees that exhibited less than 5 percent wilt. Of 31 small trees, 13 trees (42 percent) were saved, and of 53 mature elms, 6 trees (11 percent) were saved.

In 1975 Dr. R.J. Campana, in Maine, reported a test involving 120 large trees in which diseased branches were removed at their junctures with the main stems (2). Of the 120 trees, 63 percent remained free of disease through the second year following the pruning. He reported that the effectiveness of eliminating infected wood was related to the distance between the visible exylem discoloration in the infected branches and the point of junction with the main trunk, If the length of apparent disease-free wood was greater than 10 feet, 87 percent of the pruned trees survived; 5 to 10 feet, 42 percent; and less than 5 feet, 12 percent.

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MATERIALS AND METHODS

American elm trees, *Ulmus americana,* on both public and private property in Evanston, Illinois, were used in this study during 1972 through 1975. Personnel of the Evanston Forestry Section visually surveyed from the ground the entire city elm population every 2 weeks throughout the growing season. Each tree exhibiting Dutch elm disease symptoms was tagged and twig samples were collected for laboratory confirmation of the presence of the Dutch elm disease fungus. The fungus was isolated from all trees included in this study. Trees selected for pruning were restricted to those exhibiting visible wilt symptoms in 5 percent or less of the crown.

For several years all public elms have received an annual dormant application of methoxychlor. Privately owned elms have not been consistently sprayed by the property owners. Both publicly and privately owned infected trees routinely have been removed before the European elm bark beetles, carriers of the causal fungus, could complete their life cycle and emerge. Infected trees usually were removed within 1 month after laboratory confirmation.

To avoid delays, the pruning operation was carried out by a specially trained city arborist crew before a laboratory confirmation report was obtained for each tree. Those branches showing wilt were pruned back to large main laterals or back to the main trunk. Special attempts were not made to determine how far sapwood discoloration had progressed down the infected branch although such a procedure would appear advantageous. Multiple infections in the crown were infrequent, but where they were observed by the climber, multiple pruning was carried out. Pruning equipment was not sterilized between cuts or between pruning operations.

The majority of early June infections are believed to be carryovers from the previous year or infections through root-graft transmission. Root-graft transmissions accounted for about 28 percent of all Dutch elm disease infections in Evanston. Elms potentially infected through root-graft transmission were not included in the pruning experiment. Trees showing infection symptoms in early June were not pruned but were removed. The pruning operation was started in the third or fourth week of June and continued through mid-September. Pruning and painting of the wound was completed within 1 to 5 days after each infected tree was located. This was not found to be a complicated procedure, as daily work orders were issued to the crew that carried out the regular pruning operation in the city. Because of limited manpower, only a portion of the trees showing early infections were pruned each year.

Infected trees occurring on private property were reported to the property owners, and they were advised that pruning out of infected portions of the crown might be successful. Private-property trees were pruned by commercial tree companies 1 to 4 weeks after disease detection.

RESULTS

The data summarized in Table 1 indicate that 62 percent of the public trees, pruned within 1 to 5 days after wilt symptoms were detected, survived. Thirty-two percent of the trees on private property, pruned 1 to 4 weeks after wilt symptoms were detected, survived. All trees included in the 4-year study were observed several times each year and a final critical examination of all trees was made in the fall of 1975. Occasionally a pruned tree would show further wilt progression that resulted from the failure to remove the fungus completely or from an infection occurring at a later date.

DISCUSSION

Much has been learned in the last few years concerning the rate of fungus distribution in the tree once it gains entrance into the vascular system of an elm (1, 4, 7, 8, 9, 10). When the fungus enters the root system by means of root grafts, it is translocated upward through the sap stream and is able to spread rapidly to large portions of the crown. After the fungus starts to grow in the xylem vessels, spores are produced that can be translocated to all branches and the trunk in a few days.

The vessels colonized by the fungus are rapidly walled off by tyloses and the typical brown discoloration develops in the sapwood. When the discoloration develops in the outer

xylem cells, the cambium dies, and no surgery or chemotherapeutant can save that portion of the tree. Portions of the outer growth rings not already infected and walled off by tyloses may continue to translocate sap to the leaves for several days or weeks before terminal leaves will exhibit wilt symptoms.

Fungus infection and colonization is a slower process when the fungus is transmitted by the elm bark beetle to feeding wounds on twigs. It has been demonstrated that vascular discoloration in elm may occur within 2 days after inoculation with the DED fungus and the fungus can be consistently isolated from discolored tissues. Vascular discoloration and foliar disease symptoms are closely associated and progress at about the same rate. The progress of vascular discoloration downward occurs most rapidly in June and July and averages about 3 inches (7 cm) per day (9).

The probability of multiple infections in any portion of the crown may be dependent upon several variables, but the thoroughness of the annual insecticide spray coverage and the total beetle population in the area may be the most important. Variables such as soil moisture, temperature, virulence of the fungus, and growth stage and susceptibility of the tree affect the rapidity of the early developmental stages of the Dutch elm disease.

The basic concept of pruning as a therapeutic measure is dependent upon all of the fungus growth being surgically removed from the tree. A pruning cut must be made far enough below the point of fungus invasion in a branch so thtat the invasion of other branches and the trunk will be prevented. Preferably an infected branch should be pruned back a minimum of 10 to 15 feet from all sapwood discoloration.

The results reported in this paper and those reported by May and Douglas (6), Marsden (5), and Campana (2) indicate that 62 to 63 percent of the diseased elms can be saved if promptly pruned. These findings support the recommendation to prune elms as soon as possible after wilt symptoms are visible. Such a procedure will save two of three trees if the infected branches are removed before 5 percent of the crown shows wilt symptoms, providing the trees were not infected through root-graft transmission or were not rapidly colonized by the fungus in the previous year.

The cost of pruning out diseased branches in this study averaged $57 per tree. Evanston's cost to remove diseased elms on public property was $190 per tree. In addition to removal costs,

Table 1. Effectiveness of pruning infected elms in Evanston, Illinois.

Year pruned	Total public trees infected	No. trees pruned	No. trees surviving in fall of 1975	Percent pruned trees surviving
		Elms pruned on public property		
1972	395	6	4	66
1973	321	11	7	64
1974	646	55	33	60
1975	235	2	2	100
Total		74	46	Avg. 62
	Total private trees infected			
		Elms pruned on private property		
1972	370	17	2	12
1973	248	4	1	25
1974	495	8	5	63
1975	184	2	2	100
Total		31	10	Avg. 32

$30 was incurred for stump removal and $125 for replacement and maintenance of a new tree, bringing the total average cost of $345 per diseased elm. If approximately 62 percent of the pruned elms can be saved, a saving in maintenance costs will be realized which will more than justify the recommendation of an intensive scouting and pruning program. The saving in aesthetic value of a large tree versus that of a small replacement tree must also be considered.

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ABSTRACTS

Roberts, B.R. and A.M. Townsend. 1975. **What roles do trees play in cleansing the air?** Weeds, Trees and Turf 14(7):38-39.

One detrimental side-effect of the increasing energy demand in this country is the possibility of higher levels of air pollution. With more and more industries converting to coal as an alternative source of energy, the concentration of certain atmospheric pollutants, particularly sulfur dioxide (SO_2), will increase proportionately. Thus, despite our efforts now and in the future, a certain degree of air pollution is inevitable. The problem then becomes one of maintaining pollution at some acceptable level. This can be accomplished in two ways: (1) by controlling the source of pollution through proper legislation and surveillance; and (2) by maintaining an adequate and effective reservoir for existing pollutants.

Furniss, M.M. and W.F. Barr. 1975. **Insects affecting important native shrubs of the northwestern United States.** Forest Service General Technical Report INT-19. Intermountain Forest and Range Experiment Station, Ogden, Utah. 64p.

Information is presented on insects and mites associated with important shrubs native to the Pacific Northwest. Forty-three insect species or insect groups and one mite species are discussed with emphasis placed on their geographic range, hosts, type of damage, appearance and habits, life cycle, and natural control. The orders of insects and mites represented are Coleoptera (beetles), Diptera (flies), Hemiptera (true bugs), Hymenoptera (ants), Lepidoptera (moths and butterflies), Thysanoptera (thrips), and Acarina (mites). A host plant index to the following genera is provided: *Acer, Alnus, Amelanchier, Arctostaphylos, Artemisia, Atriplex, Betula, Ceanothus, Cercocarpus, Chrysothamnus, Populus, Prunus, Purshia tridentata, Quercus, Ribes, Rosa, Salix, Sambucus, Symphoricarpus, Ulmus.*