IMPROVED SANITATION PRACTICE FOR CONTROL OF DUTCH ELM DISEASE

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ABSTRACT

In Detroit, Michigan, 12 plots, each containing about 600 American elm trees, *Ulmus americana* L., were subjected for 3 years to intensive and conventional sanitation treatments to control Dutch elm disease. In the intensive treatment, three disease surveys were conducted each year; each followed by tree removal within 20 working days. In the conventional treatment, one survey was conducted each year, and diseased trees were removed in late fall and winter. Results showed that the intensive sanitation treatment was significantly better than the conventional treatment each year. Arborists should consider the advantage of detecting and removing diseased elms promptly.

SINCE DUTCH ELM DISEASE, caused by the pathogen *Ceratocystis ulmi* (Buism.) C. Moreau, was first observed (in the Netherlands and later in the United States), sanitation has always been recommended as the major control procedure. Sanitation—the removal and disposal of diseased elm trees—not only reduces populations of both vectors, *Scolytus multistriatus* (Marsham) and *Hylurgopinus rufipes* (Eichhoff), the European and the native elm bark beetles respectively, but also the pathogen reservoir.

Miller et al. *(1969)* reported that when sanitation was used to limit the spread of Dutch elm disease where the European beetle was the primary vector, it was possible to hold elm losses to 2 percent or less per year. But when sanitation was discontinued, losses soared to an annual rate of 15 percent. In a sanitation study where the native beetle was the only known vector, Van Sickle and Sterner *(1976)* found that annual losses averaged 0.4 percent of the initial elm population. In both studies, sanitation was practiced from the onset of the disease.

In most large municipalities where there are heavy concentrations of elms, surveys for finding diseased elms are made in mid and late summer. Removal of these elms begins in the fall and often continues until late spring of the following year. This type of disease detection and tree removal is considered their conventional sanitation practice.

In my study, I wanted to use intensive sanitation: frequent surveys followed by removal of diseased trees within 20 working days after detection. I wanted to find what effect intensive sanitation would have on the disease incidence in a municipality where conventional sanitation was practiced, where the disease was well established, and where the European beetle was the primary vector.

Methods and Procedures

Tree and plot selection.—About 7,500 street-lawn American elms, *Ulmus americana* L., were selected from one contiguous area in Detroit, Michigan. The mean diameter at breast height was 22 inches (56 cm), and the mean height was 65 feet (20 m). Each spring, all trees were sprayed by mist blower with 12.5-percent methoxychlor emulsion at about 0.5 gallon (1.9 liter) per tree.

The area was divided into 12 plots, each having from 550 to 700 elm trees. Because the disease rate can be influenced by tree density, the plots were classified according to elm stocking: four plots had dense stocking, 2.7 to 3.1 stems per acre (0.4 ha); four had medium stocking 2.1 to 2.5 stems per acre; and four had sparse stocking 0.9 to 1.4 stems per acre. Six plots, two from each stocking, were selected randomly for a disease survey in June, July, and August of 1974, 1975, and 1976; each survey was followed by the prompt removal of diseased trees. The remaining six plots received the conventional sanitation treatment. The density strata of plots were considered in the selection process so that neither treatment would be applied to too many plots of similar elm density.

Disease surveys and tree removals.—During June, July, and August of each year, elm trees in the intensive sanitation plots were inspected for symptoms of Dutch elm disease. Trees in the conventional sanitation plots were inspected

only during the August survey. The surveys were conducted by driving along each street twice, and visually examining trees to the right of the observer. Each diseased tree was tagged for removal and recorded. Diseased trees in the intensive sanitation plots were removed within 20 working days. Those in the conventional plots were removed during the fall and winter months. Trees removed for reasons other than Dutch elm disease were dropped from the study. The percentage of infected trees found each year in each plot was the incidence of the disease. The average of the incidence for all plots under each treatment was the average incidence.

Results and Discussion

Though the disease incidence fluctuated from one year to the next within and between sanitation treatments, consistently fewer elms were lost under the intensive treatment. By 1976, nearly twice as many elms were lost under the conventional treatment as under the intensive treatment (Table 1).

The average incidence of disease for both sanitation treatments for each year is shown in Figure 1. Data for each year were subjected to chi-square analysis. In 1974, intensive sanita-

Table 1.—Annual status of American elm trees treated by conventional and intensive sanitation, Detroit, Michigan, 1974-1976

Year	Conventional sanitation		Intensive sanitation	
	Number of trees	Number of diseased trees	Number of trees	Number of diseased trees
1974	3,585	226	3,856	198*
1975	3,347 [a]	214	3,642	141**
1976	3,132	400	3,489	212**

[a] Some trees were lost to other causes.
*Significant at 5 percent level.
**Significant at 0.1 percent level.

Figure 1.—Average incidence of Dutch elm disease in experimental plots, Detroit, Michigan, 1974-1976.

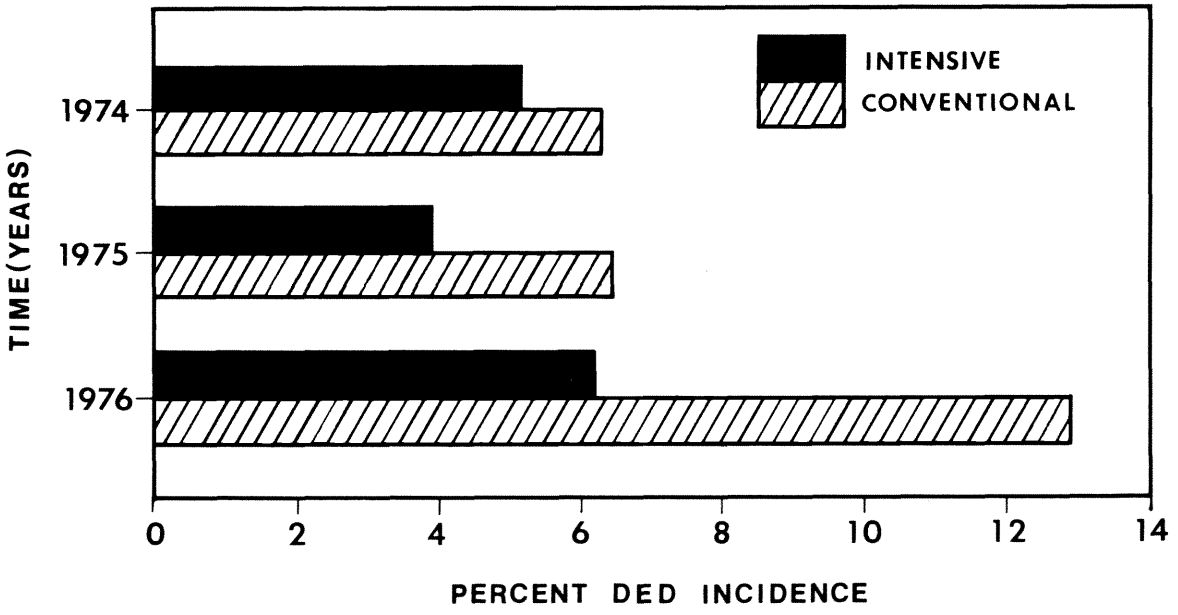
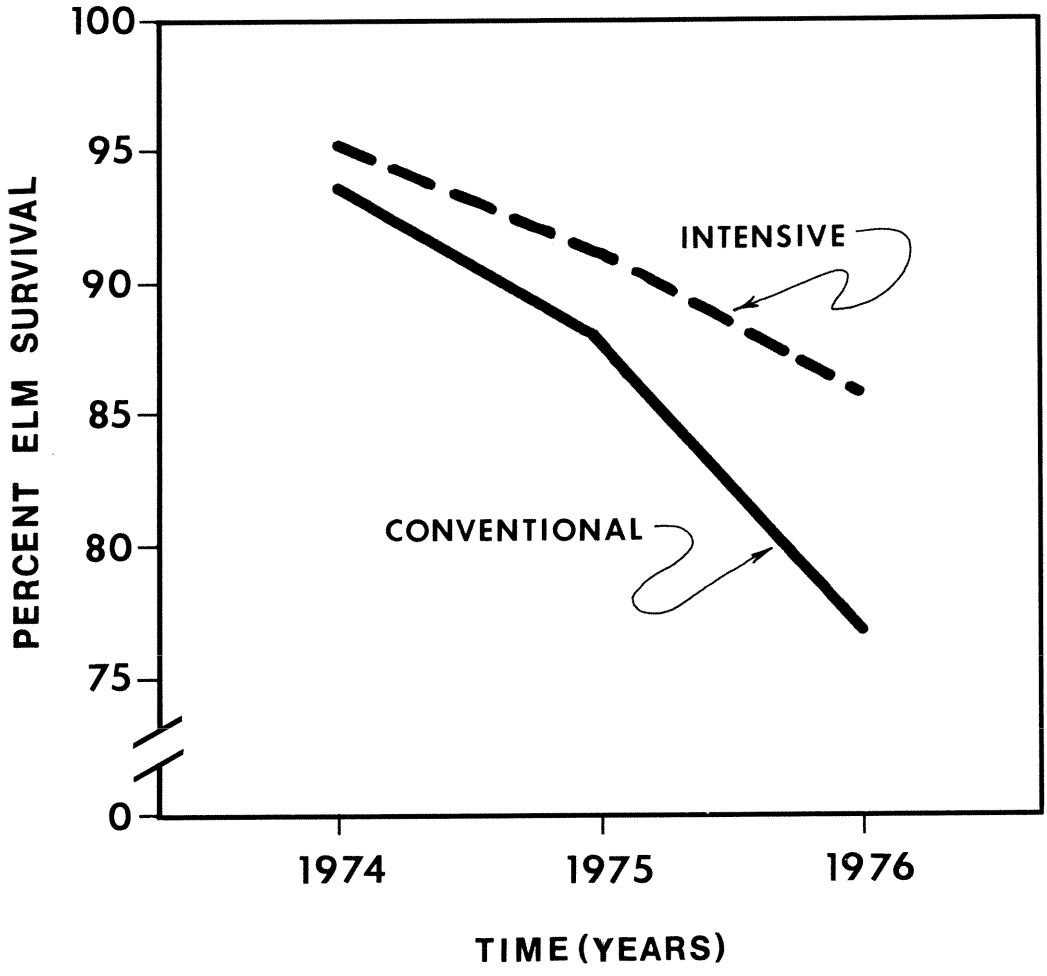


Figure 2.—Survival of American elms under intensive and conventional sanitation treatments. Percentage based on initial population, Detroit, Michigan, 1974-1976.



tion was significantly better than conventional sanitation at the 5 percent level (X^2 =4.7, 1 df). And in 1975 and 1976, intensive sanitation was significantly better at the 0.1 percent level (X^2 =23.0, 1 df; X^2 = 88.2, 1 df). The difference in the percentage of disease incidence between the intensive and conventional treatments increased each year. In 1974, the difference was only 1.17 percent, but it increased to 2.42 percent for 1975 and 6.69 percent for 1976.

Survival of elms under the intensive treatment was significantly superior to that under the conventional treatment over all 3 years (Fig. 2). The patterns of elm survival resulting from each treatment were compared in their entirety by a chi-square procedure proposed by Mantel *(1966)*. This analysis showed a highly significant difference between the survival-time patterns of the two treatments (X^2 =95.7, $P < 0.001$).

Conclusions

The results of this study have clearly demonstrated the efficacy of frequent disease surveys followed by the prompt removal of diseased trees in limiting the spread of Dutch elm disease. In municipalities where conventional sanitation is now practiced, immediate consideration should be given to rescheduling survey and removal crews to detect and remove diseased trees promptly.

Literature Cited

Mantel, N.
1966. **Evaluation of survival data and two new rank order statistics arising in its consideration.** Cancer Chemother. Rep. 50: 163-170.
Miller, H. C., S. B. Silverborg, and R. J. Campana.
1969. **Dutch elm disease: Relation of spread and intensification to control by sanitation in Syracuse, New York.**
Plant Dis. Rep. 53(7): 551-555.
Van Sickle, G. A., and T. E. Sterner.
1976. **Sanitation: A practical protection against Dutch elm disease in Fredericton, New Brunswick.** Plant Dis. Rep. 60(4): 336-338.

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