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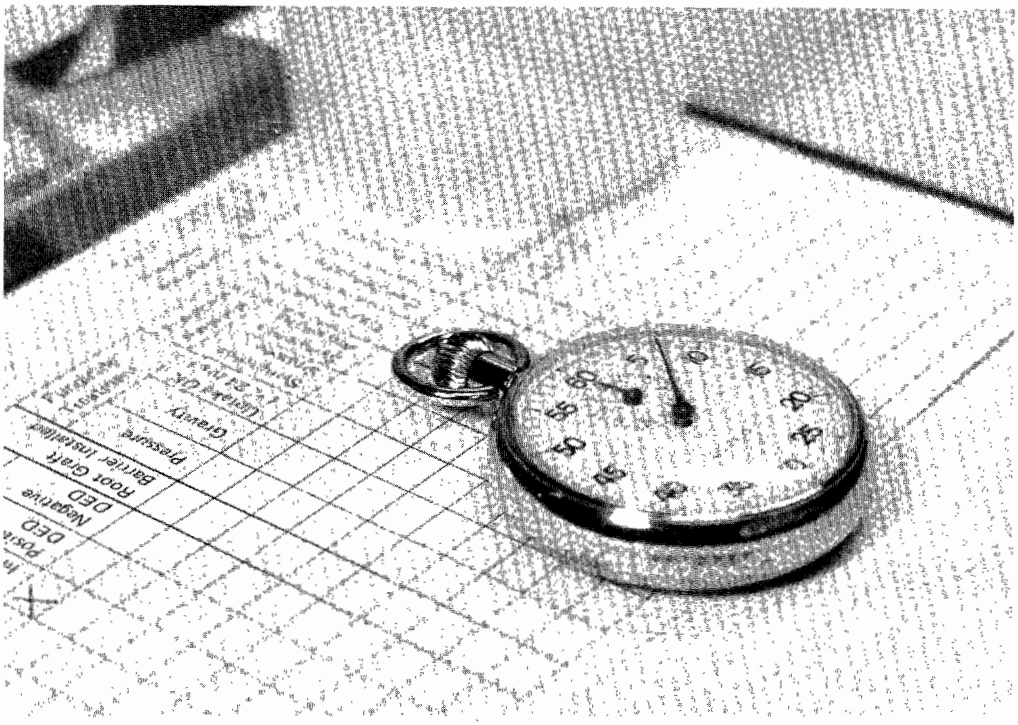
Time and Materials Needed to Survey, Inject Systematic Fungicides, and Install Root-Graft Barriers for Dutch Elm Disease Management

William N. Cannon, Jr.
Jack H. Barger
Charles J. Kostichka



The Authors

William N. Cannon, Jr. is a research entomologist with the Northeastern Forest Experiment Station's Forestry Sciences Laboratory at Delaware, Ohio. He received B.S. and M.S. degrees in agriculture from the University of Delaware, and a Ph.D. degree in entomology from The Ohio State University. Before joining the USDA Forest Service in 1965, he was a research associate in the Department of Entomology at Oregon State University.

Jack H. Barger, a research entomologist, received a B.S. degree in education from Concord College and M.S. and Ph.D. degrees in entomology from The Ohio State University. In 1965 he joined the Northeastern Station's Forestry Sciences Laboratory at Delaware, Ohio.

Charles J. Kostichka, former Dutch elm disease education coordinator for the University of Wisconsin—Extension, received B.S. and M.S. degrees in environmental science from the University of Wisconsin—Green Bay.

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Abstract

Dutch elm disease control practice in 15 communities showed a wide range of time and material required to apply control methods. The median time used for each method was: sanitation survey, 9.8 hours per square mile; symptom survey, 96 hours per thousand elms; systematic fungicide injection, 1.4 hours per elm; and root-graft barrier installation, 2.2 hours per barrier (5.6 min/ft). The median amount of Arbotect 20-S used for disease therapy was 13 ounces per elm. The median amount of Vapam used for soil fumigation for root-graft control was 3 ounces per foot.

Designing cost-effective programs for managing Dutch elm disease (DED) requires that the manager know the time it takes to perform recommended control activities, and the amount and cost of materials needed for each activity. This information would be useful in determining which activities can be funded and accomplished.

A study was made of the time needed for (1) sanitation survey, (2) symptom survey, (3) systemic fungicide injection for DED therapy, and (4) installation of root-graft barriers. The amount of materials used for systemic injection and root-graft barriers was determined for this report.

Methods

In 1980, data from community-wide integrated management programs were obtained from 15 Wisconsin communities (Kostichka 1982) which were participants in the Wisconsin DED Control Demonstration Program. They represented a wide range of physical characteristics, elm inventories, and DED situations (Table 1).[1]

Records of job time and materials used for individual control practices were kept by program supervisors in each community. Not every community furnished data for each control practice, but for those that did we determined the median value and range of values for each practice.

Additional data on symptom surveys were obtained from a study in Michigan (Barger 1977). Three surveys were made during the season. Each survey was made by driving along each street twice and visually inspecting elms to the right of the observer. In areas where elms were sparse and their crowns did not overlap, elms on both sides of the street were surveyed during one pass along the street.

Records of gross job time, the number of trees surveyed per hour, and the number of diseased elms found (Worley et al. 1965) were kept for these surveys. The number of elms per mile of street was determined from the records and city maps, and related to the survey times by regression analysis.

[1]Bassett, S. R.; Groth, L. J.; Krawczyk, J.; Schaefer, S.; Kostichka, C. J. Wisconsin Dutch elm disease control demonstration program accomplishment report. Madison, WI: Wisconsin Department of Natural Resources and the University of Wisconsin-Extension; 1980. 141 p.

Results

There is great variation in the times reported for these control practices (Table 2); differences between the shortest and longest times varied sevenfold for systemic injection and up to fifteenfold for symptom surveys. The frequency distributions of time for each practice showed that they were not normally distributed (Fig. 1). We analyzed the data for each practice to see if time was related to size of the community, the annual rate of elm mortality, or the type of DED management program (Table 1). No such relationships were found. Communities with similar characteristics had widely divergent time records. Many unmeasured variables may have influenced the control-practice time.

Sanitation Survey

A lot by lot examination for actual or potential elm bark beetle breeding sites and pathogen reservoirs was made in the spring by control technicians. In most cases they walked because they needed to inspect many backyard elms and piles of firewood. Vehicles were used for transportation to and from survey areas.

Time spent on these surveys ranged from 3.1 to 38.1 hours per square mile of control area (median: 9.8 hours). On a thousand-elm basis, the median time was 8.9 hours (range: 2.5 to 55.4 hours) (Tables 2-3).

Time based on area is more useful for planning sanitation surveys since the entire management area must be canvassed each year despite any decrease in the number of elms. Estimates based on the number of elms are less meaningful as the elm population declines.

Symptom Survey

Every elm in each community was examined by technicians on foot for foliage symptoms of DED once a month in June, July, August, and September. The times to do all four surveys ranged from 23 to 356 hours per thousand elms (median: 96 hours) (Tables 2-3).

We computed the number of elms surveyed per hour in each community. The survey rate ranged from 11 to 178 elms per hour (median: 42 elms). One-half of the communities had survey rates between 22 and 75 elms per hour, and one-fourth had even higher rates.

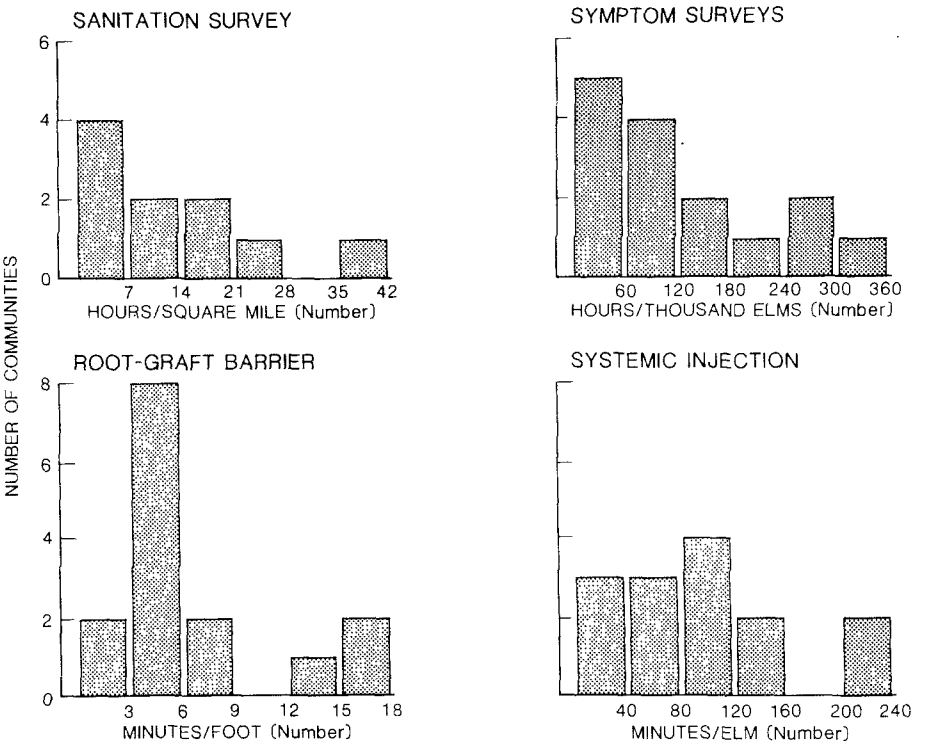

Figure 1.—Frequency distributions of time used to apply DED control practices in Wisconsin communities, 1980.

Table 1.—Physical characteristics of Dutch elm disease situation in Wisconsin demonstration program communities

Community	Control zone area[a]	No. of elms in 1980 inventory	Year when first case of DED reported	Elm mortality rate (%)[b]		
				1978	1979	1980
	Miles			-------- *Percent* --------		
			LOW DISEASE RATE (<5%)[c]			
A	27.0	35,334	1967	2.6	1.9	1.6
B	2.4	4,808	1956	1.8	2.6	1.8
C	2.1	1,445	1970	1.8	10.4	3.1
D	3.3	8,267	1957	3.1	3.0	3.1
			MEDIUM DISEASE RATE (5–10%)			
E	2.5	3,702	1963	5.3	4.6	1.9
F	2.8	4,050	1956	5.7	12.3	4.5
G	2.2	3,938	1958	6.9	7.6	4.7
H	2.3	2,148	1956	8.7	4.8	5.2
I	3.2	2,052	1969	5.6	10.9	5.3
J	2.4	5,277	1970	8.2	9.8	6.4
K	13.1	7,036	1956	9.0	6.7	7.9
			HIGH DISEASE RATE (>10%)			
L	3.8	1,438	1972	16.9	14.2	7.7
M	10.9	6,048	1963	12.7	16.7	15.0
N	4.7	1,012	1964	21.6	28.8	17.5
O	3.8	920	1966	31.3	44.0	18.6

[a]Designated intensive control zone within community.
[b]Based on residual elm population at beginning of each year.
[c]Communities classified by initial elm mortality rate.

The use of a vehicle to survey requires two people and should allow the crew to survey more elms per hour than can be surveyed on foot. This technique was used in a sanitation study in Detroit (Cannon et al. 1977). Since then, additional job time records have provided new information on survey time. These results along with earlier survey data are shown in Figure 2.

The first survey of the season took more time than subsequent surveys. As the number of trees per mile increased from 20 to 60, the number of hours per thousand trees decreased from 9.8 to 6.5 in 1976 and from 7 to 3.4 in 1978. By 1978, survey speed increased by about 28 percent; at the higher tree densities, survey speed increased at a more rapid rate than in 1976 (Fig. 2).

Table 2.—Median and range of time used to apply Dutch elm disease control measures in Wisconsin communities, 1980

Item	Number of communities	Time spent on control measures	
		Median	Range
Sanitation survey			
(hr/1,000 elms)	9	8.9	2.5–55.4
(hr/mi^2)	9	9.8	3.1–38.1
Symptom survey[a]			
(hr/1,000 elms)	15	96.0	23.0–356.0
Systemic injection			
(min/elm)	12	86.0	36.0–216.0
Root-graft barrier			
(hr/barrier)	15	2.2	0.2–5.5
(min/ft)	15	5.6	1.5–17.1

[a]Data for a total of four surveys per season.

Table 3.—Time[a] (per thousand elms) spent on control measures in Wisconsin demonstration program communities, 1980

Community	Total time	Sanitation survey		Symptom survey[b]		Root graft barrier		Fungicide injection	
		Hours	% of total time	Hours	% of total time	Hours	% of total time	Hours	% of total time
	Hours								
				LOW DISEASE RATE (<5%)[c]					
A	43.5	9.5	22	31.5	72	3.0	6	0	0
B	72.5	2.5	3	27.5	38	11.0	16	31.0	43
C	389.5	55.5	14	195.0	50	75.5	20	63.5	16
D	116.5	2.5	3	108.5	92	3.0	3	2.5	2
				MEDIUM DISEASE RATE (5–10%)					
E	165.5	0	0	153.0	92	3.0	2	10.0	6
F	66.5	3.5	5	22.5	34	3.0	5	37.0	56
G	81.5	10.5	13	50.5	62	6.0	7	14.5	18
H	237.0	8.5	4	96.5	40	104.0	44	28.0	12
I	306.0	0	0	254.5	83	16.0	5	35.5	12
J	90.0	12.0	13	67.0	74	11.0	13	0	0
K	141.0	5.5	4	56.5	40	56.5	40	22.0	16
				HIGH DISEASE RATE (>10%)					
L	296.5	0	0	251.0	85	3.0	1	42.5	14
M	126.5	0	0	80.5	64	37.0	29	9.0	7
N	285.0	0	0	176.0	62	11.0	4	98.0	34
O	614.5	0	0	353.0	57	118.0	20	143.5	23

[a]Rounded to nearest half hour.
[b]Data for a total of four surveys per season.
[c]Communities classified by initial elm mortality rate.

Subsequent surveys in mid-July and late August were completed more quickly than the initial survey, possibly because fewer diseased elms were found (0 to 2 percent). The number of diseased elms observed and the number of trees per mile of street surveyed affected survey speed (Fig. 2). Finding as few as 2 percent of the trees with symptoms of DED increased survey time in 1976 from 56 percent at 60 trees per mile to 94 percent at 20 trees per mile. In 1978, survey time was reduced to 23 and 39 percent, respectively.

Overall, the time spent in 1978 on the initial survey of the season and subsequent surveys was significantly less than in 1976. We attribute this improved performance to the increased proficiency of the survey crew.

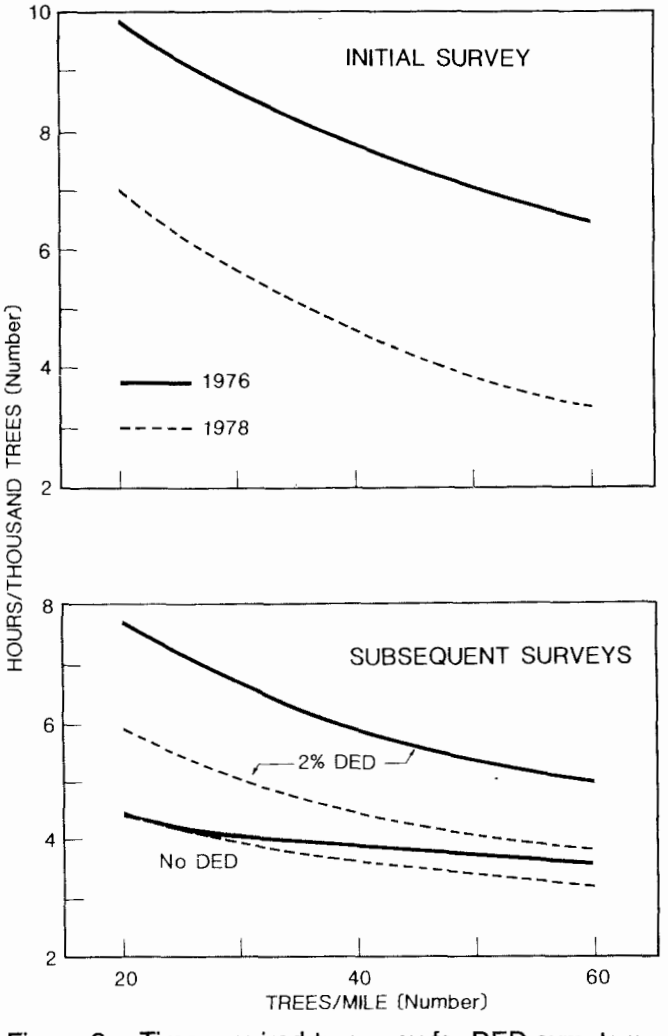

Figure 2.—Time required to survey for DED symptoms as a function of the number of trees per mile of street surveyed.

Systemic Fungicide Injection

Elms were injected with the systemic fungicide Arbotect 20-S[2] for DED therapy. This chemical was injected into trees at a rate of 4 ounces per 5 inches diameter at breast height (d.b.h.). Various types of injection equipment were used (Sinclair and Campana 1978, p. 34; Kostichka et al. 1979). Injected elms ranged in d.b.h. from 5 to 49 inches (median: 19 inches).

It took about 1 hour and 26 minutes on the average to inject each elm (range: 34 minutes to 3 hours and 58 minutes) (Tables 2, 4). The amounts of Arbotect 20-S used ranged from 4 to 38 ounces per elm (median: 13 ounces).

Table 4.—Amount of time and fungicide (Arbotect 20-S) used for therapeutic systemic fungicide injection in Wisconsin communities, 1980

Community	Elms injected	Average d.b.h.	Fungicide per elm	Injection time/elm
	Number	*Inches*	*Ounces*	*Hours*
B	79	22	17.7	1.4
C	92	16	12.8	1.0
D	10	49	38.4	2.3
E	61	5	4.0	0.6
F	251	14	11.2	0.6
H	101	12	9.4	0.6
I	28	16	12.3	2.6
K	87	22	17.4	1.8
L	17	45	10.5	3.6
M	47	21	16.3	1.2
N	71	22	17.7	1.4

Root-Graft Barriers

Soil fumigation with Vapam was used in 15 communities to prevent transmission of the DED fungus through root grafts between adjacent elms. This required two to four barriers per diseased elm. The median length of the barriers was 20 feet. The median

[2]The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture, the Forest Service, or University of Wisconsin-Extension of any product or service to the exclusion of others that may be suitable.

time spent installing the barriers was 2.2 hours per barrier (5.6 min/ft). The median time required to install a 20-foot barrier was 2 hours and 12 minutes. The rates of barrier installation ranged from 3.5 to 39.8 feet per hour (median: 10.8 feet) (Table 5). The amount of Vapam used ranged from 1.8 to 7.6 ounces per foot (median: 3 ounces) (Table 5). About 3.75 pints of Vapam would be required for a 20-foot barrier.

Control Activities

The total time required per thousand elms to apply the control activities by each community was highly variable (Table 3). For communities with low rates of DED, Community A spent the least amount of time while Community C spent as much or more time than communities with medium or high rates. Total time for communities in the low-rate category ranged from 43.5 to 389.5 hours; in the medium category the range was 66.5 to 306 hours, and in the high category the range was 126.5 to 614.5 hours (Table 3). Even though communities with high DED rates tended to spend more time per thousand elms on control activities, some communities were maintaining lower DED rates with much less effort.

When the four control activities were considered simultaneously, the percentage of time devoted to each did not depend on the severity of DED (Table 3). None of the high-rate communities made sanitation surveys, but all of them spent more than 50 percent of their time on symptom surveys. Of the medium and low-DED communities, only 6 of the 11 communities spent as much time for symptom surveys. Communities D and E spent most of their time (92 percent) doing symptom surveys and little time (2 and 6 percent) injecting elms, whereas Community F spent much time injecting elms (56 percent) and the least time of any community doing symptom surveys (34 percent). Community H spent the majority of its time (56 percent) doing root-graft control. Community A spent more of its time (22 percent) on sanitation surveys than any other community.

Discussion

These data reinforce the conclusion of Cannon and Worley (1980) in a survey of 39 midwestern communities that performance in terms of elm mortality was not related to DED control strategies. Good performers with a low incidence of DED did a better job no matter what strategy they followed so long as that strategy was appropriate for their local situation.

The information developed in this study should help managers better plan DED management programs. A knowledge of the median time and material required for a control practice can be used to plan the initial control program; the range indicates the extreme values that might be expected. After the program is oper-

Table 5.—Amount of time and soil fumigant (Vapam) used for root-graft control in Wisconsin communities, 1980

Community	No. of barriers installed	Average barrier length	Fungicide used		Barrier installation	
			Amount/ barrier	Rate	Time/ barrier	Rate
		Feet	*Gallons*	*Ounces/ft*	*Hours*	*Feet/hr*
A	128	7.6	0.1	2.0	0.8	10.0
B	17	22.1	1.0	5.5	3.2	6.9
C	23	20.0	0.7	4.5	4.7	4.2
D	6	40.8	2.4	7.6	4.0	10.2
E	6	5.8	0.2	3.7	1.7	3.5
F	6	51.2	0.7	1.8	2.2	23.6
G	121	8.2	0.2	3.0	0.2	39.8
H	124	20.0	0.5	3.4	1.8	11.1
I	11	11.5	0.6	6.6	3.0	3.8
J	23	28.3	0.7	3.2	2.6	10.8
K	189	20.3	0.3	2.2	2.1	9.6
L	14	3.9	0.1	2.4	0.3	13.5
M	203	19.8	0.4	2.5	1.1	18.2
N	2	90.0	1.3	1.8	5.5	16.4
O	35	51.7	0.8	2.0	3.1	16.6

ating, the actual time and material used under local conditions would become the basis for subsequent plans.

The wide range of times spent by Wisconsin communities for the control practices suggests that there is room for improved efficiency in some operations. By comparing the time spent on a control practice with our estimates, a manager can determine if his or her operation can be improved.

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Keywords: Dutch elm disease; pest management; job time analysis

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