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DUTCH ELM DISEASE AND COMMUNITY DECISIONS

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Elms are one of the most common shade trees in Iowa. They beautify many Iowa communities, provide shade and lower the temperature on hot, sunny days. The presence of these beautiful trees increases property values, whether in cities, suburbs, towns or villages. But unless communities take action to protect their elms, populations of these trees may be seriously depleted or even wiped out entirely by Dutch elm disease.

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THE FACTS

Dutch elm disease invaded Iowa in 1957. By November 1964, presence of the disease had been confirmed in 60 counties in Iowa. Spread has been rapid. Counties found infested each year are: 1957—2, 1958—1, 1959—3, 1960—6, 1961—10, 1962—11, 1963—15, 1964—12.

Every Iowa community with elm trees either has Dutch elm disease or can count on it appearing within a few years. Experiences in states to the east of Iowa indicate that it is not possible to escape an invasion of this disease.

Dutch elm disease was first recognized in Omaha, Nebraska in 1960. Five years later, the disease has been found in 27 counties in Nebraska. Confirmed reports of the disease occurring in counties each year are: 1960—1, 1961—0, 1962—3, 1963—5, 1964—5, 1965—13.

THE CHOICES

With Dutch elm disease on the way, the valuable elm trees which beautify a community represent a liability as well as an asset. It will cost money if no protective measures are taken and elm trees are allowed to die. It will also cost money to fight Dutch elm disease with a sanitation and chemical protection program. Such a program, however, will protect our elms and maintain the value of real estate.

Based on the experiences of some midwestern cities, it has been shown that over a 10-year period, a sanitation and chemical protection program need cost but little more than doing nothing except removing diseased trees as they die. Such a program can save up to 80 percent of the elms. And the community can budget this program at a steady rate. The cost of tree removal is small at the beginning when the disease is just starting, and at the end when only a few elms are left. During the middle 5 of the 10 years, costs are very high (table 8).

At the end of 10 years, it is believed that all unprotected elms surrounding the community will be dead. Therefore, the principal source of disease inoculum would be nonexistent. When this occurs, chemical protection can be discontinued and only sanitation practiced. The possibility does exist that continued chemical protection and sanitation may be the only way to maintain protection after this period. There is also a possibility that a much lower cost type of control may be developed during this period of time.

In View of the Problem, City Governments Have These Alternatives:

1) Remove the dead elms and replant to a variety of species.

2) Control the disease by sanitation and chemical protection.

FIRST, each community concerned should make a thorough, accurate tree survey to determine the number of elms and other trees, their condition and value.

Prepared by Departments of Botany and Plant Pathology, and Entomology and Wildlife.

UNIVERSITY OF NEBRASKA COLLEGE OF AGRICULTURE AND HOME ECONOMICS
THE AGRICULTURAL EXPERIMENT STATION
E. F. FROLIK, DEAN J. L. ADAMS, DIRECTOR

THEN,

If You Simply Remove Dead Elms and Replant

Virtually all elms will die in communities which take no action. Losses of about 15 percent per year can be expected after Dutch elm disease becomes well established. Experience indicates that nearly all elms will probably be dead within 10 years. Data shown below are figures compiled from surveys taken in one Illinois community without a control program in which records of its losses were maintained.

Table 1. Percent of elms killed by Dutch elm disease.

Year	Percent loss	
1951	.01	Champaign-Urbana, Ill.
1952	.10	14,768 elms—89 remain.
1953	1.10	78.09 percent or 11,243
1954	4.90	trees killed by Dutch elm
1955	12.70	disease. 3,436 killed by
1956	13.00	other factors.
1957	15.00	
1958	12.50	
1959	12.80	
1960	4.90	
1961	.80	
1962	.22	
1963	.06	

Elms in this community also suffered from another disease, phloem necrosis. The trees dead from phloem necrosis may have increased the momentum of Dutch elm disease. However, losses in other communities without phloem necrosis have occurred at virtually the same rate.

How will the loss of elms affect wildlife?

Where elms are allowed to die from Dutch elm disease, we can speculate that the relative effect on birds will be as follows:

Percent of trees dead that are standing elms	Effects
25	No measurable effect.
50	Some apparent increase in woodpeckers attracted by dead elms still standing, and starlings attracted by nesting sites. Little or no measurable effect on other birds or squirrels.
75	Some apparent increase in woodpeckers. A decrease in tree-nesting species, such as robins, Baltimore orioles and mourning doves. No effect on squirrels.

In 10 years, as dead trees fall, woodpecker populations return to normal (an apparent decrease); populations of tree-nesting birds are reduced, and there is an apparent reduction in squirrel populations.

Actually, no community can forever follow a policy of doing nothing about Dutch elm disease. Dead elms will litter the streets and parks with falling branches, threatening life and property until they are removed. Property values will be reduced even further.

REMOVING DISEASED TREES IS A MINIMUM COMMUNITY PLAN

This is not a control program. Losses will occur at nearly the same rate as in those communities where the dead trees are left standing. However, this plan has two advantages: Property values will not decline to the same degree, and hazards to life and property will not persist. A city can require removal of diseased elms from private property.

Tree losses in a community will likely reach a peak during the fourth through the eighth year following attack. In order to meet the high cost of removal during these years, some infested cities have passed special forestry taxes through referendums voted upon by the people. Another approach is to issue bonds which provide money immediately for tree removal but postpone the cost to later years.

Wildlife is involved, too.

There are no data available, but we may assume that there would be a sharp decrease in woodpecker and starling numbers. There would be a gradual decrease in populations of robins, mourning doves, orioles, migrating warblers, bluejays and titmice as tree numbers, nesting sites and food supplies decline. Fox squirrels will also decrease as nesting sites are reduced and hazards of travel across open areas increase.

REPLANTING A VARIETY OF TREES WILL HELP

A community with Dutch elm disease and no positive control program should visualize its appearance after the elms are gone. Unless the citizens want a nearly treeless community, desirable species of trees should be planted according to a well-thought-out plan. Trees planted now may develop several years' growth before all elms are lost, thus cushioning the shock of their removal. For descriptions of other recommended tree species, see FS-890, "Shade Trees for Iowa."

It would be wise to use a variety of trees and landscaping plans to minimize the likelihood of some future malady wiping out a large percentage of a community's trees.

Obviously, tree removal and planting programs can be carried out simultaneously. Indeed, this is desirable as a phase of any plan of operation.

The effect on wildlife

If elms are few in number, there will be no obvious change in bird or wildlife populations. If elms are dominant, birds and squirrels will decrease at first, then return as the replacement trees reach 20 to 25 feet high.

Control Programs Available to the City

The only control program which has proved successful in the Midwest requires a thorough and persistent community effort in the removal and burning of dead and dying elm wood, supplemented by dormant applications of residual insecticides or spring treatment with systemic insecticides as soon as the disease is found. Trees in close proximity to each other may be infected through root grafts. Either trenching or soil fumigants may be used to sever these connections. Questions frequently arise concerning the effectiveness of either the sanitation program or the spray program when used alone, and why their chances for success are minimal at best.

IF SANITATION-ONLY IS PRACTICED

In areas where the elms are well scattered and do not exceed 30 percent of the total tree population, it is probable that a rigidly enforced routine of elm sanitation could substantially reduce the impact of Dutch elm disease. Some New England reports indicate success under these conditions. Sanitation is also being used effectively by some eastern cities after sanitation-chemical protection programs have protected the trees for several years while surrounding wild elms were destroyed. In effect, such communities are isolated from reinfection by diseased wild elms because elm bark beetles will not breed and the disease organism cannot live in dead trees which have lost their bark. This happens in 1 to 3 years.

No data are available concerning communities in the Midwest which have successfully defended their elms using sanitation alone. Some have tried and failed. Some indication of the protection given by insecticides can be seen from the figures in tables 2 and 3, taken from five Illinois communities which dropped the spraying operation from their control program while dying trees still prevailed in unprotected areas.

Table 2. Percent of unsprayed elms killed in five selected cities with incomplete programs in 1960.

City	Percent of original population
H	6.88
I	9.76
J	11.65
K	16.18
L	29.20

Table 3. Percent of original elm population killed in two Illinois cities which discontinued spraying, but maintained a sanitation program.

City		Percent of original population				
		1956	1957	1958*	1959	1960
F	(street)	.07	.83	.97	.59	1.41
F	(private property)	.07	1.05	1.03	1.88	6.88
G	(street)		.53	.72	1.32	4.43
G	(private property)		.98	1.87	1.81	9.76

*1958 was last year sprayed. Some carryover effect was likely in 1959.

A 1962 report (table 4) of Illinois cities grouped according to disease losses gives further indication of the failure of sanitation only.

Table 4. Illinois cities grouped according to disease loss classes in 1962.

Level of losses	Number of cities: Spraying and sanitation	Number of cities: Spraying discontinued
Below 1 percent	20	1
1 to 2 percent	11	0
2 to 3 percent	4	0
3 to 4 percent	2	1
Above 4 percent	3	3
Average loss in 1962	1.48 percent	8.98 percent

Losses above 2 percent, where both chemical protection and sanitation procedures are followed, indicate the possibility that natural root grafts exist between trees. Root grafting may occur where trees are located within 50 feet of each other. There is a 30 percent chance of root grafts between trees 30 feet apart. The closer trees are together, the higher the incidence of root grafts. Trenching between trees or the injection of sodium N-methyl dithiocarbamate (SMDC)* to break the grafts is the only control.

To prepare SMDC, mix one part chemical with four parts water. Punch or drill holes 3/4 inch in diameter 3 feet deep at 6- to 9-inch intervals in a line between the diseased and adjacent healthy elms. Apply 1 cup of mixture to each hole and immediately tamp shut with your heel to prevent loss of fumes.

This barrier should extend well beyond the drip lines of adjoining trees and around walks, shrubs or other plants. Treatment should not be made within 3 feet of these plantings.

A series of barriers may be necessary. SMDC will kill the lawn about 1 foot wide along the barrier. This area can be repaired after 2 weeks.

The sudden surge of losses occurring in 1960 (table 3), in addition to data shown in table 4, and other observations in the Midwest leave very much in doubt the possibility that sanitation alone can control Dutch elm disease.

* Sold under the trade names Vapam and VPM.

How will sanitation affect wildlife?

The effects on bird and other wildlife populations would be the same as for "removal only," since trees will continue to die.

CHEMICAL PROTECTION ONLY

No successful control program is known to be in operation any place in the United States in which chemical protection is practiced without adequate sanitation procedures. Many cities, realizing too late the overpowering nature of Dutch elm disease, have resorted to "last-ditch" attempts to save their elms from destruction with a chemical protection program. One of the communities attempted to turn the tide by spraying, after the disease losses began to mount, but did so without success.

Efforts to control Dutch elm disease by using only chemical protection practices do not take into account the fact that the disease-carrying beetles develop in tremendous hordes in dead elm wood. Satisfactory control would require 100 percent coverage of every elm twig, which is an impossibility. Spray-only practices cannot be recommended.

SANITATION-CHEMICAL PROTECTION PROGRAM

By removing the beetle-breeding trees and the source of the disease fungus (dead and dying elm wood), the number of carriers and the chances for disease spread are substantially reduced. Good applications of insecticide will protect about 95 percent of the tree surface. This is sufficient to keep losses at a very low level when good sanitation is also followed.

Table 4 contains data which show that losses can be kept well below the 2 percent level. Table 5 shows further detailed information concerning the percentage of elms affected annually by Dutch elm disease in Illinois communities with comprehensive disease control programs. These cities are located near communities which have not accepted control programs and which have lost their trees.

These data should be compared with those in table 1. Such communities as these in Illinois and in other midwestern states, where the disease has been serious for several years, have demonstrated conclusively that the disease can be controlled.

Is it necessary to protect chemically all the trees in a community?

It would be unusual if every desirable elm was protected. All public elms (streets, parks and cemeteries) should be included in a chemical protection program, and private citizens should be encouraged to have their elms treated to the extent possible. Unprotected trees in communities with comprehensive programs will be more susceptible to infestation than protected trees, as table 6 indicates. But losses will likely be far less than those experienced in localities without complete programs.

Table 6. A comparison of the value of sanitation alone and sanitation with spraying in five Illinois cities.

	Percent of original population killed	
City	Sanitation without spraying (private trees)	Sanitation and spraying (public trees)
A	1.16	.64
B	1.80	.50
C	4.13	.43
D	.80	.54
E	2.30	.70

The trees belonging to private citizens benefit from the public control programs. However, individuals should be strongly encouraged to cooperate to make the coverage as complete as possible.

Systemic insecticides: An organophosphorus insecticide called Bidrin has been injected into elms to control bark beetles feeding in the twig crotches. The chemical travels in the sap stream and is deposited in leaves and bark. It has an effective life of 30 days after injection, then breaks down to nontoxic materials. Bidrin is quite toxic and must be applied only by trained workers wearing approved protective equipment. Use of Bidrin eliminates the residue problem and minimizes the hazard to wildlife. Properly applied, it gives about the same degree of protection as DDT and methoxychlor.

Table 5. Percent of original elm populations affected annually by Dutch elm disease in northern Illinois communities with comprehensive disease control programs.

City	1956	1957	1958*	1959	1960	1961	1962	1963
Glencoe	.55	.49	.45	.33	.27	.51	.47	**.29**
Glenview		.35	.34	.26	.94	.94	.72	**1.16**
Kenilworth	.14	.18	.36	.24	.20	.34	.30	**.20**
Mt. Prospect	.05	.09	.11	.18	1.46	.74	.37	**.48**
Oak Park		.01	.06	.14	.31	.32	.24	**.34**
Riverside		.15	.27	.15	1.33	.58	.55	**.65**
Western Springs*	.11	.27	.28	.33	.95	2.16	.54	**.67**
Winnetka	.31	.32	.31	.20	.39	.95	.88	**.83**

* Street tree data

Wildlife effects

When DDT is properly applied as a dormant spray, some of the chemical does not remain on the bark but falls back to the ground, where it settles on dead leaves and grass. Whether spraying is done in the fall or spring, DDT will still be present in the spring when earthworms emerge out of dormancy, come to the surface and eat the dead vegetation and the DDT. The DDT is stored in their bodies. Before the earthworms die, they may be picked up and eaten by robins. If the robins have just arrived in migration and are thin, Michigan State University studies show that up to 95 percent of the returning robins may die. However, if the robins are in good condition, University of Wisconsin studies indicate that DDT-loaded earthworms can be eaten by robins with no apparent effect. DDT-loaded earthworms will be lethal if fed to nesting young of robins, grackles, starlings, sparrows of all kinds, and brown thrashers.

Birds poisoned by DDT lose coordination and are unable to fly. They suffer violent tremors and attempt to hide in shrubbery. The average citizen observing these symptoms in a number of birds is apt to react strongly against the use of DDT. Birds may show similar symptoms, however, as a result of parasites or disease.

DDT, as used in Dutch elm disease control programs, has no effect on the squirrel population. If spraying is careless and DDT drifts into lakes, ponds or streams, there can be nearly complete fish kill.

Methoxychlor is less toxic to earthworm-eating birds, but it is about three times more expensive than DDT and has less residual properties on elm bark. There is no guarantee that robins or other birds will be completely safe in methoxychlor-treated areas, but losses will probably be reduced. As with careless application of DDT, contamination of water with methoxychlor will also kill fish.

COST CONSIDERATIONS

Dutch elm disease costs money. This is true whether the trees are allowed to die or are protected with a control program. Table 7 provides some basis for

Table 7. Estimates of cost of Dutch elm disease alternatives for 10 years, per 1,000 trees.

		Type of program		
Cost item	**Cost per tree**	**Removal only**	**Removal & replacement**	**Complete program (Sanitation & spray)**
Pruning	$12/4 years			$27,000*
Dormant spraying				
DDT	1.75			17,500
Methoxychlor	3.75			(37,500)
Bidrin	3.75			(37,500)
Removal	70.00	$63,000	$63,000	14,000
Replacement	7.50		6,750	1,500
Total after 10 years		$63,000	$69,750	$60,000
				($80,000)
Effects upon elm population				
Initial population		1,000	1,000	1,000
Elms lost		900	900	200
Elms remaining		100	100	800

Assumptions

Pruning and maintenance	Involves only removal of dead and weak wood and low-hanging branches; trees pruned every 4 years. Some cities have a 5-year system.
Dormant spraying	Spraying with DDT costs $1.75 per tree. Spraying with methoxychlor costs $3.75 per tree. Both figures include $15 per hour machine operation.
Spring application of Bidrin	This insecticide should be injected in the spring, beginning when the **first** pupa of the smaller European elm bark beetle is seen. On the average, this date is about April 25 in southern Iowa, May 5 in central Iowa, and May 15 in northern Iowa. Each town should make its own observations on pupation and emergence. Injection should stop when the **first** adult beetles emerge. Cost is about $3.75 per tree.
Removal	Costs range from $40 to $100 or more, depending on size and location of tree, and help available.
Replacement	Includes wholesale cost of trees, planting, staking, fertilizing and watering for the first 2 years, with 20 percent death loss.

*The sanitation-chemical protection program includes some pruning costs which are required regardless of Dutch elm disease. The spray program can possibly be dropped 10 years after the first diseased tree is found.

Table 8. Cost figures applied to Champaign-Urbana data in table 1 (original number of elms was 14,768).

	Removal of Dutch elm diseased trees only ($70/tree)		Cost of complete control program (Table 7)
1951	$ 140		$ 88,608
1952	1,050		88,608
1953	11,340		88,608
1954	50,610		88,608
1955	131,320		88,608
1956	134,400		88,608
1957	155,050		88,608
1958	129,220		88,608
1959	132,300		88,608
1960	50,610		88,608
1961	8,260		50,213
1962	2,240		50,213
1963	630		50,213
13-year total removal costs for Dutch elm disease.	$807,170	13-yr. total costs to be budgeted	$1,036,719
Removal cost of trees dead from other causes (3,436)	$240,520		$ 240,520
Total removal costs for all causes	$1,047,690	Total costs to be budgeted	$1,277,239
Number of trees left	**89**		**7,787**

anticipating costs. The information has been provided by cities in Iowa with control programs now in operation and cities without control programs where the disease has caused major losses.

These figures should not be considered absolute, however, for costs vary considerably, depending upon the availability of labor, number of trees involved, their size and location, and other factors. Furthermore, these are costs to municipalities only. Expenses of private tree owners will likely be about twice as high for each item. *No figure* is included for the esthetic value or real estate value of trees which are lost.

These figures show that a control program using DDT is slightly less expensive than tree removal alone and that a program using methoxychlor or Bidrin is more expensive, but the cost is distributed rather uniformly each year (see table 8). Removals are expensive over just a short period and leave nothing for the community after the money is expended. Locally prepared brochures, service organizations, Boy and Girl Scouts and other agencies can be used to inform the people about the choices available to them and the results to be expected

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