

OVERLAND SPREAD OF THE OAK WILT FUNGUS IN MINNESOTA

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Abstract. In seven locations involving 158 oaks from 1953-1979, infection occurred only in trees wounded in late May or early June. In plots established between 1953 and 1980 of over 5,000 oaks wounded, infection occurred in trees wounded as early as May (one tree in 1978) and as late as June 15. None of 322 trees wounded and with wounds painted became infected.

Oak trees can be infected by the oak wilt fungus, *Ceratocystis fagacearum*, by way of grafted root systems between infected and healthy trees or by insects carrying spores. The total number of kinds of insect vectors is not known, but the sap-feeding nitidulid beetles (*Colleoptera:Nitidulidae*) are apparently the important group of vectors in Minnesota (3). Research, principally in Iowa, West Virginia and Wisconsin established that nitidulids transmit the fungus when they fly from the sporulating mats produced by the fungus on diseased trees to fresh wounds on healthy trees (1,7,8). This paper presents evidence on the association between wounding and oak wilt in Minnesota, based on observations made during a period of over 25 years, and on experiments involving deliberate wounding of trees in 1952, 1953, 1974, 1975, 1978, 1979 and 1980.

Observations in Minnesota

In the summer of 1953, wilt was noticed in northern pin oaks, *Quercus ellipsoidalis*, near a new power line at White Bear Lake, Ramsey County. Four out of 9 pruned trees were infected and only 1 out of 7 unpruned trees. There was no disease in 13 white (*Q. alba*) and bur (*Q. macrocarpa*) oaks, 5 of which had been pruned. The pruning consisted of the removal of branches (8-30 cm diam) up to a height of 7.5 m. The exact date of the pruning was not established but was

reported by residents to have occurred in late May or early June.

In 1954, wilt occurred in northern pin oaks alongside a new REA distribution line at Carnelian Lake, Washington County. Detailed data were not recorded, but several of the red oaks became infected and pruning was completed prior to June 1. Oak wilt did not occur in any of hundreds of nearby oaks which were not pruned.

On May 29, 1967, 21 northern pin oaks in the front yard of a home in Newport, Washington County were pruned. All 21 trees became infected and died by the end of that summer and the front yard was effectively cleared of trees. Climbing irons had been used by the tree trimmer. A group of red oaks across the driveway a short distance from the pruned oaks were not pruned and all of these trees remained uninfected. The pruned trees ranged in size from 7.8-40.6 cm in diameter and were valued at \$4,450.

On June 3, 1971, a magnificent northern red oak, *Q. rubra*, (102 cm in diameter) was pruned in Orono, Hennepin County. It wilted in August. This tree was a feature of the landscape and the home had been partially built around the tree. The value of the tree was placed at \$9,200.

On or about June 1, 1973, a large number of northern pin oaks were pruned with pruning saws in the city of North Oaks, Ramsey County. Thirty-nine red oaks were wounded by climbing irons used to reach branches which were removed from the trees. Of these, 35 (88%) became diseased. On the same property and at the same time, 5 (24%) of 21 red oaks which were not climbed to remove branches became infected. Two out of 16 white oaks pruned, both of which had been wounded with climbing irons, also became diseased. No value was placed on these trees but most of the trees in the yard were lost to oak wilt and

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the decrease in property value amounted to thousands of dollars.

In late May or early June of 1974, 11 northern pin oaks were pruned in the front yard of a house in New Brighton, Ramsey County. Climbing irons were used during the pruning and all of these trees died of wilt. Several small trees (less than 13 cm in diameter) in the same yard which were pruned but not climbed remained healthy. The 11 trees which died of oak wilt were valued by the court at \$7,500.

In 1979 a tree service pruned approximately 20 pin oaks between May 27 and June 12 near Wyoming, Chisago County. By mid-July, 7 of these trees had wilted. No tree wound dressing was used at the time of pruning, though the wounds were painted 3 days after pruning.

The observations provide considerable evidence that infection can follow the wounding of trees in late spring. The more or less simultaneous appearance of disease in all the trees at each site precludes the possibility that root infection might have played any part in the process. It appears that climbing iron wounds in the trunk may provide a more favorable infection court than wounds resulting from a saw. No tree wound dressings or paints had been applied to any of the trees immediately after wounding. This is probably significant in view of the report by Drake *et al.*, (2) and our own observations that prompt treatment of wounds with wound dressing prevented infection.

Trunk Wounding Experiments

Between March 18 and July 31, 1953, a total of 178 northern pin oaks on a variety of sites were wounded. The trees ranged in size from 5-61 cm dbh and each tree had a series of branches removed with ax or saw from approximately 50 cm above ground to a height of 2.5-3 m. A portion of these trees, 60, were in locations where oak wilt was not present or at least miles away from the wounded trees. None of these became infected. Of the remaining 118 trees located in areas where oak wilt was present the disease developed in only 5 trees. All of these trees were at one site in the city of North Oaks and were wounded on May 27. None of the trees, a total of 61, which were wounded before May 8 or any of the 47 wounded on June 5 and later became infected. None of the

unwounded reference trees became diseased.

In 1974 and 1975, wounding experiments were established in a disease-free stand of northern red oak (*Q. borealis*) in Hay Creek Recreation Area south of Red Wing in southeast Minnesota (5).

Four plots were established in the spring of 1974, 15 m, 30 m, 60 m and 150 m from a source of inoculum consisting of sections of logs bearing sporulating mats of *C. fagacearum*. Within each plot 5 trees were wounded at weekly intervals from May 5 to June 16. Each tree received five trunk wounds to the heartwood with either climbing irons or an ax (Fig. 1). The treatment was applied, at random, to one of the four cardinal directions, N, E, S, or W. The wounds on one of each group of 5 trees were covered with tree paint (Leonard's Tree Compound, A.M. Leonard and Sons, Inc., Piqua, Ohio). Of the 112 trees



Figure 1. Northern pin oak (*Quercus ellipsoidalis*) with 4 wounds made with an ax.

(not including those trees on which the wounds were painted), 19 wilted and died by the end of the summer (Tables 1 and 2). All of these 19 trees were wounded between May 19 and June 9. Considering only the trees wounded during the time when infection occurred, 29% of those 64 trees became infected. None of the 28 wounded and painted trees died, nor did any unwounded trees. An average of 40 days was required from the time of wounding until evidence of wilting. The shortest time required for symptoms was 21 days and the longest 63 days. There was no effect of distance from inoculum source, type of wound, or the direction of the wound (Table 2).

Plots established in the fall of 1974 were near trees with mats but not so close that transmission of the fungus through roots would occur. If trees with fungus mats were not nearby, logs with mats were brought into the plots and placed against some of the experimental trees. At least 10 mats were present on the infected trees. Ten or more trees were wounded at weekly intervals from September 15 to November 15 using the same treatments as in the earlier experiment. No trees became diseased.

Each week from May 1 to November 1 in 1975 plots were established near trees producing mats and 10 trees were wounded using the same methods as in 1974. Two of the trees were immediately treated with a bituminous paint (Cabots Tree Healing Paint, Samuel Cabot Mfg., Inc., Boston, MS). A total of 6 out of 220 trees became infected, all among the 30 which were wounded between May 26 and June 9. Six of these 30 trees had the wounds covered with paint and none of these became infected. There was no effect of wounding method or wound aspect. None of the 44 trees with painted wounds nor any unwounded trees became diseased.

In 1978 in the cities of North Oaks (Ramsey County), East Bethel (Anoka County) and Stacy (Chisago County), northern pin oaks were wounded each week between April 4 and June 19. At North Oaks and Stacy, an equal number of wounded trees received the wound dressings for the period May 15 through June 12. Nonwounded trees were included at all three sites. The four wounds on each tree were made with a metal punch 1/2 in. in diameter driven 1-1.5 in. into the

tree. The wounds for each tree were on one side and equally spaced from .6 m above the ground to 1.8 m. Equal numbers of trees had wounds in each of the four cardinal facings.

None of the 700 wounded trees at Stacy became infected. Of the 315 oaks wounded in East Bethel between April 25 and June 20 only 2 (6%) of those wounded May 23 became infected and 1 (3%) of those wounded June 13. Of the 450 trees wounded in North Oaks from April 24 through June 19 and not protected by tree wound dressing, 23 (5%) became infected, 1 on May 1, 1 on May 15, 20 on May 22 and 1 on June 5. None of the 250 trees with wounds covered with tree wound dressing became infected. The paint used was "Treekote" a product of Walter C. Clark and Son, Orange, CT. Facing of the wounds had

Table 1. The number of red oaks which became infected and the time for symptoms to appear in relation to when they were wounded. A total of 19 (16%) of 112 wounded trees became infected.

Date of wounding	Trees wounded number	Trees wilted number	Time between wounding and symptoms days*/
May 5	16	0	-
12	16	0	-
19	16	2	46.5 (42-49)
26	16	2	38.5 (35-42)
June 2	16	5	44.8 (28-56)
9	16	10	35.7 (21-63)
16	16	0	-

* /Average number of days between wounding and appearance of symptoms; range of days in parentheses.

Table 2. Numbers of red oaks which became infected in relation to type of wound, facing of wound, and distance from source of inoculum. A total of 19 of 112 wounded trees became infected. Numbers of trees in each category are in parentheses.

Type of wound	Number	Infecting Facing of wounds	Infecting trees	Distance from inoculum m	Infecting trees
Climbing iron Ax	9	North (28)	3	15 (28)	5
		South (28)	6	30 (28)	3
		East (28)	5	60 (28)	6
		West (28)	5	150 (28)	5

no significant effect on incidence of infection. None of the 270 reference trees, which were not wounded, became infected.

In 1979 in the Carlos Avery Wildlife Management Area (Anoka County), northern pin oaks 13-38 cm in diameter were wounded bi-weekly from April 24 to November 1 (6). The wounds were made with a metal punch 11 mm in dia to a depth of 8 cm into the wood. The wounded trees (750 total) were along radiating lines E. to SSW of the known source of inoculum (sporulating mats on infected trees) or in three blocks (total of 330 trees) N and NW of inoculum source.

Of 1080 oaks wounded, only 6 wilted, all of which had been wounded June 15. None of the nonwounded oaks became infected. Of 84 wilted oaks in the infection center which served as a source of inoculum, 29 had mats present during the wounding experiment. Peak mat formation occurred June 11 on which day 128 new mats were detected, an average of 5.8 per tree. Totals of new mats on other dates were April 26 - 0, May 11 - 5, May 24 - 44, June 28 - 64, and July 12 - 8.

In 1980 in the same general area as in 1979, four circular plots 0.04 ha were established where 20 northern pin oaks in each plot had been inoculated in July 1979 (6). These trees served as the source of inoculum for trees wounded in 1980. On the first of these four sites, 200 were wounded May 21 and 200 on June 4. On the second site, 200 trees were wounded May 29 and 200 on June 13. On site three, 256 trees were wounded May 30 and 256 on June 13. On the fourth site 112 oaks were wounded each week for five consecutive weeks on May 22, May 29, June 5, June 12, and June 19. Wounds were made with a hatchet exposing the xylem tissues.

Of the 1872 trees wounded at the four sites, 11 wilted, all of which had been wounded May 22 through June 12. The distances to the nearest source of inoculum for these 11 trees ranged from 18 - 119 m. Although trees were wounded at a range of heights from 0.3 - 1.8 m there were no patterns to suggest that height of wound influenced amount of infection. Facing of wounds had no effect on incidence of infection.

Discussion and Conclusions

Based on these studies and on an accumulation of observations in Minnesota, we are reasonably certain that overland spread of the oak wilt fungus by insects occurs only in May and June. Probably a combination of factors are involved, including availability of inoculum, insect vectors, and fresh wounds on the oak trees. During the summer there are few mats. During the winter, the insect vectors, especially the nitidulid beetles, are not active. There is no obvious explanation for the lack of infection during the fall when the insects are present and ample amounts of inoculum are available. It might be assumed that the tissues in the wounds are not suitable for establishment of the fungus. In the fall the wounds rarely bleed. These same wounds will bleed in the spring when insects are present, but no infection results. Also in the spring, these wounds, which were produced the preceding fall, are usually colonized by fungi other than *C. fagacearum* (4). Although the nitidulid beetles are present in the fall, their numbers are less than in the spring and they are far less active.

A distance of 150 m does not appreciably limit the ability of the vectors to find fresh wounds. Also the facing and type of wound had little if any influence on the amount of infection. Wounds made with a saw are apparently less susceptible to infection than wounds made with climbing irons or an ax.

Red oaks infected as a result of insect activity in May and June wilt during the same season, approximately 6 weeks after wounding. All three commercial tree wound dressings used in this study prevented infection. No non-wounded trees wilted during the study.

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ARBORIST CERTIFICATION VS. LICENSING¹

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If we carefully examine the history of man and nature, we discover all things are governed by laws; Nature's processes are governed by natural laws; the function of governments by legislative laws; and the behavior of individuals by ethics and morals.

I suspect most of us would agree that our legislative laws are as ineffective in dealing with our morals and ethics as they most certainly are in dealing with the laws of nature.

Those of us committed to arboriculture have accepted responsibilities such as the preservation of trees and the hopeful perpetuation of our environment. We should also accept the responsibility to establish laws or certification processes that are effective and give our profession more credibility. We must be aware when establishing these systems that they must be designed to work with imperfect components, as man himself is not perfect — nor has he shown any inclination towards perfection.

Our discussion is to deal with arborist licensing versus certification. Let's take these two systems and briefly define and discuss each one.

Licensing. The term license implies a formal permission or authorization by law. The reasons stated by most governing bodies for the formation of a license is for consumer protection. In today's world, many consumers or, if you will, taxpayers, look at the politicians reasons with a jaundiced eye. That is to say, are they really looking out for the man in the street or are they trying to establish another bureau or office to put more people on the payroll as a further burden to the taxpayer. Most states that have, or have had, such laws will admit that they do not sustain themselves through monies derived from the licensee. I do not mean to imply that this could not be a self-sustaining system. I am sure it could be if handled efficiently.

The fact that it would be a law would probably mean that any arborist within the realm of this law must obtain a license. The process would logically

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