ZELKOVA: A 20-YEAR HISTORY IN SOUTHERN MICHIGAN[1]

by John H. Hart

Abstract. In 1955, 102 *Zelkova serrata* trees were planted on the grounds of the Agricultural Experiment Station at Michigan State University at East Lansing. During the next 10 years, 23 trees died of unknown causes. Beginning in 1966, the condition of each tree was determined annually. By 1975 an additional 38 trees had died, primarily from nectria canker (*Nectria cinnabarina*) or mouse injury. Death from canker could not be correlated with the frequent injury the trees received from lawnmowers but once a tree became colonized by canker, it usually died. Of the 41 trees alive in 1975, 25 had good or satisfactory crown shape while 16 had distinctly lopsided crowns. None of the 41 trees had active trunk cankers but 6 trees had at least one active canker on a main branch. Eight trees had severe V-crotches where the trunk divided into the crown. The trees had an average diameter one meter above ground line of 16 cm; the largest being 27 cm. In spite of the rather high mortality of these trees, Zelkova appears to be a suitable shade tree if care is taken in site selection and maintenance.

The Japanese Keaki (*Zelkova serrata* (Thumb.) Mak.) has been suggested as a possible replacement for the elm as the former is resistant to Dutch elm disease. However, few accounts of its adaptability to eastern North American environments have been published.

Zelkova is native to Japan where it is one of the most commonly planted deciduous trees. It was introduced into the United States in 1862. Several trees established at that time in Rhode Island are now 25 meters high and with trunks 2 meters in circumference. Ten years after planting, *Zelkova* in New Haven, Connecticut, were 8 meters tall with a trunk diameter of 18 cm.

Perkins (1964) described the tree's characteristics, stating that it had "impressive credentials" as a low maintenance shade tree. The tree normally has a globose crown and the trunk is without flare. The bark is an attractive mottle of gray and brown while the leaves are dark green in summer but turn russet red in autumn. Perkins stated that Zelkova is usually free of leaf insects and that its branches are resilient and similar in strength to oak. The only weakness he mentioned is the tendency of the species to form double crotches.

When the planting in Michigan first came to the attention of the author in 1966, the trees were in poor condition, many with obvious cankers. The purpose of this study was to determine the cause of the cankers, the cause of tree mortality, and the long-term performance of *Zelkova* in southern Michigan.

Methods

In 1955, 51 *Zelkova* were planted along each side a north-south road on the grounds of the Michigan Agricultural Experiment Station (Figure 1). The soil is basically a clay which is well drained. The area is open farm land with no protection from the prevailing westerly winds.

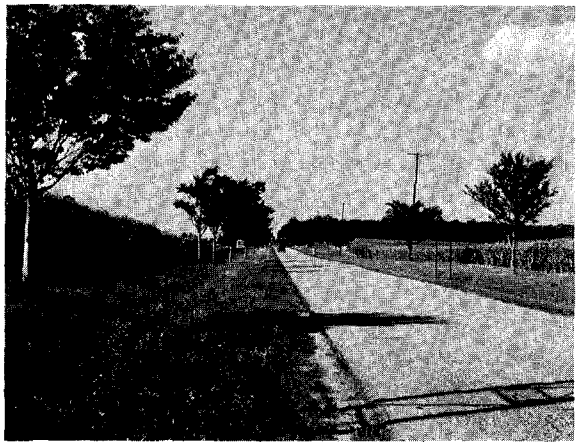

Figure 1. Zelkova planting on the Michigan Agricultural Experiment Station.

Although details of the planting are no longer available, the trees are believed to have been approximately 2-3 meters tall with a caliper of 2-3 cm. Spacing between trees was 4 meters. Other than mowing around the trees with a tractor-drawn

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mower several times each summer, the trees received no special care.

The number and size of cankers, insect attack, condition of bark and foliage, crown shape and trunk diameter were recorded annually beginning in 1966. Cause of mortality was determined for each tree that died and for injuries that were noted. Fungal fruiting bodies were collected from the margins of active cankers and identification determined. Small pieces of infected wood surrounding the cankers were placed on potato-dextrose agar. Pure cultures of two commonly isolated fungi were tested for pathogenicity by placing small quantities of the cultures into wounds on branches 1 cm in diameter on trees growing in the field.

Results

By 1966, 23 of the original 102 trees were missing and died of unknown causes. The remaining 79 trees were in generally poor condition, many trees exhibiting trunk and/or branch cankers (Figures 2 and 3). Trees girdled by the canker frequently sprouted from below the injured area (Figure 4). East Lansing received subnormal rainfall from 1960 to 1966, and cankers were prevalent on a number of tree species by 1966. The trees had been and were being repeatedly damaged by the mowers (Figure 5), usually within 30 cm of the ground.

Fungal fruiting bodies collected in 1966 from canker margins were identified as sporodochia of *Tubercularia vulgaris* (imperfect stage of *Nectria cinnabarina*) or as pycnidia of *Cytospora* sp. Similar collections in 1967 and 1973 yielded sporodochia of *T. vulgaris*. No previous records of *T. vulgaris* causing a canker of *Zelkova* were located in the literature (Booth, 1977). When placed in artificial branch wounds, *T. vulgaris* consistently produced cankers while *Cytospora* sp. never caused cankering.

Mortality during 1966-1975 is recorded in Table 1. Additional observations were made on a yearly basis.

In 1966, cankers were abundant and actively enlarging; mower wounds were common and feeding by *Scolytus multistriatus*, the smaller European elm bark beetle, was noticed.

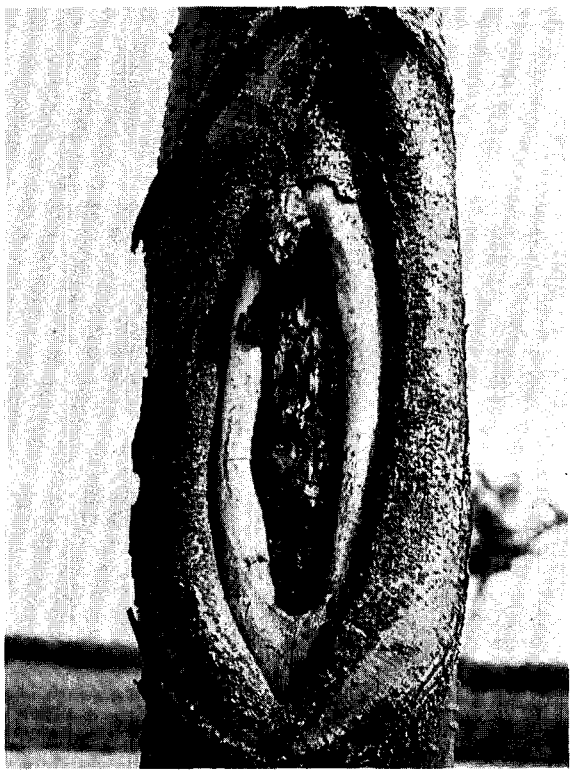


Figure 2. Canker caused by *Nectria cinnaborina* on the trunk of a Zelkova.

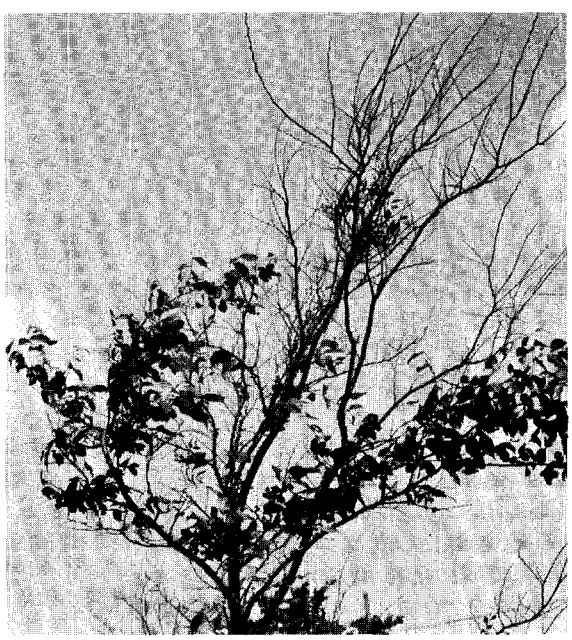


Figure 3. Branch mortality caused by numerous Nectria cankers on a Zelkova.

Figure 4. Zelkova girdled by Nectria canker commonly sprout the following year.

Figure 5. Lawnmower wound on the base of a Zelkova.

TABLE 1. Mortality and history of a *Zelkova* planting (102 trees) in southern Michigan, 1955-1976.

Year	*No. of trees dying*	*Cause of death*	*Comments*
1955-65	23	Unknown	
1966	3	Probably canker	Mower injury abundant, cankers common
1967	4	Canker	"
1968	4	Canker	Mower injury rare
1969	16	Mouse injury canker	Many trees severely injured by mice during winter
1970	1	Canker	Mower injury rare Few active cankers
1971	1	Canker	
1972	5	Ice damage, Canker	Severe ice storm March caused extensive injury
1973	2	Canker, decay following mouse injury	
1974	1	Canker	
1975	1	Canker	

In 1967, 15 trees had trunk cankers and 9 trees had branch cankers (Figure 6). Mower injury was frequent. Heavy feeding by *S. multistriatus* was observed. During the period 1966-1968, several branches with wilting foliage were cultured for the presence of *Ceratocystis ulmi,* the causal agent of Dutch elm disease carried by *S. multistriatus.* All cultures were negative and *Zelkova* appears to have very high resistance to Dutch elm disease under field conditions even when subjected to heavy inoculation pressure. One of the four trees which died in 1967 was killed by a support wire which girdled the trunk.

Mower injury was rare in 1968 but common again in 1969. Most of the trees on the west side of the road (adjacent to pasture land) were extensively injured in early 1969 by mice feeding on bark within 10 cm of ground line. High mortality followed in the summer of 1969 but no mouse in-

jury has occurred since then.

By 1970, trunk and branch cankers had become uncommon and remained so for the remainder of the study period. Only in 1974 did the cankers appear to be actively enlarging. Elm scurfy scale, *Chionaspis americana,* was noticed in 1970 on four trees. It has been found in varying amounts yearly since then on both small and large trees but does not appear to be causing significant injury.

Figure 6. One-year-old Nectria canker on Zelkova, small pustules indicated by arrow are sporodochia of *Tubercularia vulgaris* the asexual stage of *Nectria cinnaborina.*

On March 13-14, 1972, an ice storm caused extensive damage to the trees in southcentral Michigan, particularly willow, maple and *Zelkova.* Eighty percent of the *Zelkova* had at least one major branch broken and some had split trunks (Figures 7 and 8) usually starting at a V-crotch. Injury to the *Zelkova* was considerably greater than to the American elm.

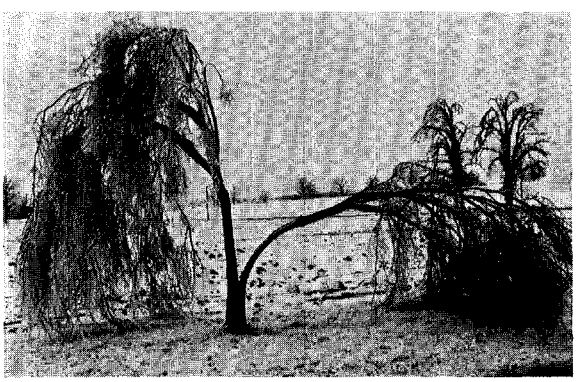


Figure 7 & 8. Damage to Zelkova caused by an ice storm.

From 1970 to 1975, nectria canker killed only seven trees and, with the advent of adequate rainfall, the incidence of new cankers declined. By 1975 none of the trees had active trunk cankers while six had at least one canker on a major branch. Once a tree became severely infected with *T. vulgaris,* it usually died. In 1967, 15 trees had active trunk cankers; 12 were dead by 1975. Nine trees had active branch cankers in 1967; eight were dead by 1975.

While mower wounds may have lowered the general vigor of the tree, their occurrence could not be correlated with death by canker at any time during the study period. Mower wounds rarely became infected with *T. vulgaris* nor did trees with extensive and repeated mower wounds die. Two trees received mower wounds in 3 years and 14 trees were wounded twice during this six-year period but none was dead by 1975. On the other hand, of the six trees that died from canker from 1971 to 1975, four had not been injured by mowers between 1970 and 1975. Overall, prevalence of canker appears to have been caused by the combination of drought (low tree vigor) and winter injury (wound for fungal entry).

Zelkova appears to have the ability to close wounds, even large wounds, rapidly. Injury caused by an automobile in April, 1972 (Figure 9) was almost completely closed by the summer of 1977 (Figure 10).

Of the 38 trees which died between 1966 and 1975, 13 died from canker, nine from mouse injury, three from ice damage, one from a mechanical girdle and 12 from unknown causes but most likely from canker or mouse damage.

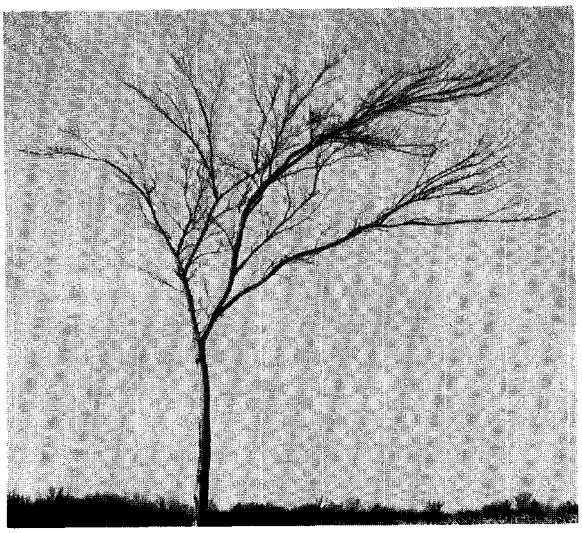
At the end of the study in 1975, two additional problems were apparent. One was the distinctly lopsided form of the crowns (Figures 11 and 12) due to the prevailing westerly winds. Sixteen of the remaining 41 trees suffered from this deformity. The other problem which became very apparent following the 1972 ice storm was the high frequency of V-crotches (Figure 13). Such a branching habit is known to cause a weak union and to be subject to splitting by wind or ice. Eight of the 41 trees were judged to have a potential problem in the future due to V-crotches.

In spite of all these problems, *Zelkova* appears to be a reasonably good shade tree for southern Michigan and other areas with a similar climate if care is taken in site selection and maintenance. It does have many of the desirable qualities listed by Perkins (1964), but it will require some maintenance and, from my experience, the strength of its branches appears much lower than stated by Perkins. Two *Zelkova* planted in a protected location in East Lansing in about 1950 have performed very well. If crown shape is important, it is obvious the trees must not be planted in wind-swept areas. Protected sites also will reduce winter injury and subsequent canker development. Protection from rodents and mowers is important but should not present a major obstacle under normal growing conditions. Early pruning to

Figure 9. Injury caused by an automobile to the base of a Zelkova during April 1972.

Figure 10. Injury (see Fig. 9) five years later.

encourage strong branch crotches will reduce but not prevent injury from ice. With the exception of canker, which was most likely site-induced, no other injurious insects or diseases were noticed. This study does reveal that many hazards await *Zelkova* if attention is not given to the above-mentioned factors.



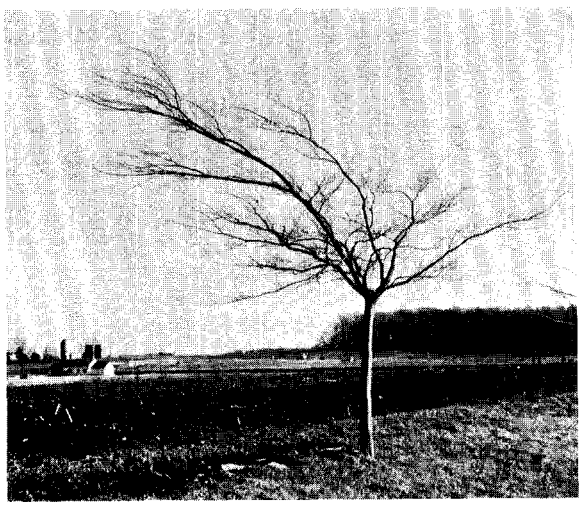


Figure 11 & 12. Crown distortion of Zelkova caused by the prevailing westerly wind.

Figure 13. V-crotch in Zelkova which results in a weak union between the branches.

References

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