ferences were found between the following three groups: (1) convoluted elms took an average of 5 minutes to girdle (Table 3); (2) the larger nonconvoluted elms took 3.5 minutes; (3) the smaller nonconvoluted elms to an average of 2.5 minutes to girdle. The overall average girdling time was 3.7 minutes.

If the representation of these categories of elms in the street-side trees is known, then an accurate financial estimate could be made based on the girdling time for each category. Because it is not likely that managers would have such information about the elm population of the urban forest at the outset of a control program, we chose to apply our findings to the average situation using the 3.7 minutes average girdling time.

To the time needed to survey a unit a 1,000 trees, we added 3.7 minutes for each tree girdled. If 10 elms were found to be diseased, then 37 minutes were added to the survey time. If the elms were easier to girdle, that is they were in the smaller category dbh, then only 25 minutes need be used. If the elms were convoluted, then 50 minutes would be more appropriate. Although we have used the average of 3.7 minutes per tree throughout for our cost comparisons, the following equation can be used to compute costs for the other two categories of elms:

Adjusted girdling cost = (cost based on 3.7 min/tree) × (k_1 or k_2)

where

k_1 = 0.67 for the smaller easier-to-girdle elms.

k_2 = 1.35 for the convoluted more-difficult-to-girdle elms.

Contributed Abstract

HIGH TEMPERATURE LIMB BREAKAGE

by W. Douglas Hamilton

Richard Harris, Department of Environmental Horticulture, University of California, Davis, has been pursuing information about causes of sudden limb breakage for many years. As more historical records and new information are investigated, we are coming closer to understanding causes and can take measures to prevent hazardous situations.

High temperature limb breakage or *summer branch drop,* as it is called in England where it is fairly common, is also known in South Africa and Australia. In California it was recorded on *Quercus lobata* (white oak) as early as 1882. Since then it has been reported in California on several species of elm, eucalyptus, oak and pine, and on London plane, deodar cedar, silk oak, and Indian laurel.

High-temperature limb breakage occurs out on a limb, not at the crotch. The break may be quite jagged or short and at right angles to the branch length. The wood at the point of the break may appear sound. Limbs that fail are usually mature, large in diameter, horizontal, and healthy in appearance. Also, they are usually branches that have extended considerably. Young and vigorous maturing trees of susceptible species appear less prone to the problem, while over-mature and senescent trees may repeatedly shed branches, at least in England. The time of occurrence in California is usually on a hot, calm afternoon in August or September; in England, it usually occurs on a warm, calm afternoon following a rain that has broken a prolonged dry spell.

Evidence to explain high-temperature limb breakage is lacking. Brashness, where the wood has become brittle, may cause a branch to be more susceptible to breakage. Many limbs that fall, however, do not appear to have brash wood. Another predisposing cause may be small fractures developing when an extended limb twists or when other conditions prevail to cause internal cracking.

Where large branches of mature trees extend over structures and people-use areas, it may be advisable to shorten such branches. In young trees, such limbs should be avoided by removing them while they are small and the tree is vigorous; less decay and rapid wound closure should result.

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