DETECTION, DESCRIPTION AND TREATMENT OF GIRDLING ROOTS ON URBAN NORWAY MAPLE TREES[1]

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ABSTRACT. --Girdling roots are examined and described on street-side Norway maple trees (Acer platanoides L.) in Ann Arbor, Michigan. Treatments consisting of cutting girdling roots, fertilizing and pruning foliage were evaluated after two years and found to be of no benefit to girdled trees.

From August 1977 to August 1979 this study was made on 410 Norway maple trees (Acer platanoides L.) planted between 1925 and 1928 on the sidewalk extensions in the west-central section of the City of Ann Arbor, Michigan. The objectives of the study were to 1) evaluate the degree to which girdling roots affect Norway maples growing along streets in this area; 2) gain information on the characteristics of girdling roots, such as diameter, number per tree, depth, degree and severity of girdling and relative percentages of surface and subsurface occurrence; 3) identify and evaluate the effects of factors that contribute to the formation of girdling roots; 4) determine if treatments of fertilizing and trimming benefit girdled trees after two growing seasons; 5) determine if removal of girdling roots affect the health and vigor of trees; and 6) confirm the most effective measures for evaluating the effects of treatments.

GIRDLING ROOT CHARACTERISTICS

Thirty-five percent of the girdled trees were girdled by only one root, 46 percent were girdled by 2 to 3 roots and 19 percent were girdled by 4 to 9 roots. The mean diameter of all girdling roots was 2.5 inches (6.4 centimeters). Surface girdling roots have a significantly larger mean diameter than subsurface girdling roots (3.38 vs. 2.22 inches [8.59 vs. 5.64 centimeters]). On the average, 2.4 girdling roots were found on each girdled tree. Seventy-three percent of the girdling roots were subsurface. The mean depth of subsurface girdling roots was 2.5 inches (6.4 centimeters), and 79 percent of them were found within 3 inches (7.6 centimeters) of the ground surface. There was no grafting between girdling roots and trunks.

[1]Metro. Tree Impr. Alliance (METRIA) Proc. 3:83-87, 1980.

FOLIAGE CHARACTERISTICS

Most of the trees, whether girdled or not, displayed dark-green leaves. The percentage of girdled trees with leaves that were lighter in color than normal was nearly twice that of non-girdled trees, but these differences were not significant. Smaller-than-normal leaves were more common on girdled than on normal trees. The differences in leaf sizes between normal and girdled trees were significant. Girdled trees had a considerably greater proportion of deadwood (foliage dieback) in their crowns than normal trees but the difference was not significant. In August 1977 girdled trees and normal trees did not differ significantly in vigor, crown diameter or total height.

BOLE CHARACTERISTICS

Bole characteristics such as the absence of normal trunk flare, a bulge near the ground line and the presence of a slightly flat or concave area of the trunk near the base were measured. Normal trunk flare was found on 66 percent of the non-girdled trees compared to 24 percent of the girdled trees. Twice as many girdled trees exhibited abnormal lower-bole characteristics as did non-girdled trees.

ENVIRONMENTAL CHARACTERISTICS

Extension width and distances between the bole and sidewalk and curb were measured. The proportions of normal and girdled trees were about the same in all extensions encountered regardless of whether the trees were planted in the center of the extension or off-center nearer curb or sidewalk.

Significantly more roots began to deflect along lines perpendicular to the curb or sidewalk than along lines in 6 other positions. Only 4 percent of the roots were deflected by physical contact with the concrete associated with curbs, sidewalks or driveways.

DEGREE OF ROOT GIRDLING

Most of the girdled trees did not appear to be severely girdled. Fifty-three percent had no more than one-quarter of the bole encircled by roots. Only 5 percent of the trees had roots that were overgrown by more than 0.6 of their diameters. Bole overgrowth was not great.

RESPONSE TO TREATMENTS

Measures of foliage characteristics such as leaf color, leaf size and general foliage dieback, tree-vigor rating, growth and tree mortality were taken during August 1979 to determine the benefit, after two

growing seasons, of combinations of treatments to trees with girdling roots.

There was no appreciable difference in the proportion of dark-green and medium-green leaves between girdled trees with roots cut and girdled trees with roots not cut. Fertilizing and pruning girdled trees whose roots had not been cut did not affect the proportion of dark-green and medium-green leaves compared to other individual treatments.

The proportion of smaller-than-normal leaves on girdled trees was not reduced by any combination of cutting girdling roots, fertilizing leaves, or removing live limbs.

The amount of foliage dieback after two years was less on girdled trees with roots cut compared to girdled trees with uncut roots but the difference was not significant. Individual treatments on girdled trees with roots cut did not reduce the amount of foliage dieback. Treatments did not affect the vigor of treated trees as compared to untreated trees.

The differences in amounts of annual twig growth which might be attributable to the treatments were small. In general, all study trees grew more in 1979 because the 1979 growing season was wetter than normal. Girdled trees with roots cut grew slightly more than non-girdled normal trees. During the two-year period of study, girdled trees with roots cut grew slightly more than non-girdled normal trees and girdled trees without cut roots.

Tree mortality was noted during August 1979. During the study, 7 girdled trees and none of the normal (non-girdled) trees died.

CONCLUSIONS

This study has shown that the magnitude of abnormal foliage characteristics and dieback is greater on girdled trees than on non-girdled trees. The degree of magnitude, though not significant, is large enough to be marginally attributable to the effects of root girdling. Measures of abnormal foliage characteristics and dieback are useful as diagnostic indicators only when girdling is so severe that irreversible damage to the tree has occurred. The predictive value of these characteristics is small and unreliable.

Even though it is not known how long the 50-year-old study trees have been girdled, their long-term growth does not appear to have been affected by girdling roots. Comparison of the total heights, crown diameters and diameters at breast height shows no significant difference in accumulated growth over the 50-year life span of girdled and non-girdled trees.

Other conclusions are as follows: Ratings of tree vigor are of no predictive value in determining whether trees are girdled by subsurface roots. Abnormal trunk-types are extremely valuable and highly significant as a diagnostic tool to predict the presence of subsurface girdling roots. Narrow extension widths do not appear to influence root girdling. The percentage of girdled trees as compared to non-girdled trees did not increase as the widths of extensions decreased. Most of the girdled trees are girdled by more than one small, shallow subsurface girdling root and are not girdled deeply. Because most of the girdling roots are found below the soil surface, the cost of excavating and treating is large.

There is no clear indication that treatments of fertilizing or pruning, or both, benefit girdled trees whether or not their roots are cut. No single measure or combination of measures was found that indicated a response to treatment. Removal of girdling roots did not affect the overall condition of girdled trees when other treatments were withheld. Root pruning, leaf fertilization and crown pruning did not appear to benefit girdled trees during the first two years following treatment. However, the short length of time between treatments and evaluation probably influenced the ability to judge the effectiveness of individual measures of treatment and overall tree response.

From the standpoint of cost and time spent on excavating and treating girdled trees, treatment of girdling roots is probably not appropriate on trees similar to those observed in this study. The dollars expended treating each tree probably should be invested in services such as tree planting, fertilization and insect and disease control.

MANAGEMENT IMPLICATIONS

The purpose of this section is to discuss the implications based on the results of this study with respect to management of urban street trees.

The chief problem in a study similar to this is the large number of unknown and uncontrolled variables that may influence results. For example, the environment in which street trees grow is highly complex and not properly understood. From city to city, planting practices vary and tree maintenance techniques are not uniform. From tree to tree there is a lack of visible uniform symptoms of stress. Moreover, the literature on the subject of girdling roots of street and landscape trees is sparse.

Only one tree species was examined in this study, so general conclusions about all girdled street and landscape trees cannot be made. Although the Norway maple is a popular and widely planted street-tree species, other species of trees need to be studied. Additionally, the time

period of two years used to evaluate treatments and their response needs to be extended several more years. I intend to conduct a follow-up study to further evaluate treatment over a longer period.

Even though there was no single reliable indicator of subsurface girdling roots except abnormal trunk-type, additional study needs to be initiated to identify other characteristics which may predict subsurface girdling roots.

This study suggests that there is little biological and aesthetic value in removing girdling roots and subsequently fertilizing and pruning the tree. Perhaps additional treatments not identified here, such as bole injection of trace elements, root-growth stimulants and inarching grafting techniques to bypass the root-girdle, should be examined to evaluate their worth in promoting overall tree vigor and longevity. Also, additional measures of treatment response should be identified and evaluated.

Extension width and soil texture did not appear to influence root girdling; few roots were deflected by physical contact with curbs, sidewalks and driveways. Nearly two-thirds of the girdled trees were girdled by more than one root; improper planting technique probably contributed to the abnormal growth of roots on these study trees. Urban foresters should make certain, through training and supervision, that tree planting is done properly.

Since girdling roots do not appear to have affected the long-term growth of the study trees, treatment is probably unnecessary in light of its high cost ($43.00 average cost per tree) if a reasonable life expectancy of Norway maple street trees does not extend much beyond 50-60 years.

Because most urban foresters purchase a large amount of bare-rooted trees for street planting from commercial nurseries, efforts should be made to make certain that potential girdling roots are removed at the nursery prior to delivery.

Since this study dealt with older trees, future studies should examine younger trees of various ages to determine if and when symptoms begin to occur and if treatment is beneficial.