REGENERATION OF GIRDLING ROOTS AFTER REMOVAL[1]

by Gary W. Watson and Sandra Clark[2]

Abstract. Removal of girdling roots as an early corrective treatment on young Norway maple (*Acer platanoides*) trees was not effective. Roots reformed from the wound site. There were often multiple roots where a single girdling root had been removed, creating potential for even more extensive girdling. The best hope for eliminating girdling root problems may be to develop root stock from trees without girdling roots.

Girdling roots are a significant problem on Norway maples (*Acer platanoides*) in the urban landscape (6). Their formation is associated with root growth patterns after transplanting field-grown nursery stock (7). After the main (terminal) root is cut during the digging process, the growth rate of existing, but normally slow-growing, lateral roots near the base of the trunk increases. These roots are naturally positioned to become girdling roots as the trunk, the primary roots forming the root flare, and these lateral roots all continue to increase in diameter.

Mechanical removal of girdling roots has been suggested as a treatment (1,2,6), though the effectiveness of this practice has not been fully studied. When girdling roots are removed, a wound is created. Many new roots are regenerated from similar wounds to terminal roots resulting from transplanting. It is not known whether roots also regenerate from the wounds created by removing girdling roots.

Methods

In a previous study of girdling root formation (7), girdling roots were removed from Norway maples for both study and treatment. Some of these same trees were used in this study to investigate the potential for root regeneration from the wound site. Fifteen of the 60 Norway maples included in the original study were selected. From notes and photographs of the previous work, trees were chosen which had more than one girdling root at least 5 mm diameter removed during the previous study, 4-5 years earlier. Root flare areas were re-excavated in a similar manner. Using the photos, the wound sites were relocated and inspected for regeneration of new roots.

Results and Discussion

As the root systems were excavated, it soon became clear that one or more roots had consistently regenerated from each wound site (Fig. 1). The new roots were usually nearly perpendicular to the radially oriented main root. This orientation of lateral roots is consistent with the literature. Horsley (3) reported that lateral roots produced away from the growing root tip were perpendicular to the main root, but was unable to explain why.

On trees of reduced vigor, there was little or no root regeneration from the wound sites. All of the trees had been vigorous during the previous study. The reduction of vigor in the interim was usually attributed to trunk wounds or other problems clearly unrelated to the root removal treatment. This observation led to the examination of some more mature, less vigorous trees that also had some girdling roots removed at least 5 years earlier. These trees also did not regenerate new roots from the wound sites, indicating that vigor may be an important factor.

It was also interesting to note that abrasion wounds from excavation tools did not result in the formation of new roots. The abrasion wounds on roots resulting from the previous excavation healed over completely without the production of new roots. Perhaps where the vascular system was completely severed by root removal, there was an

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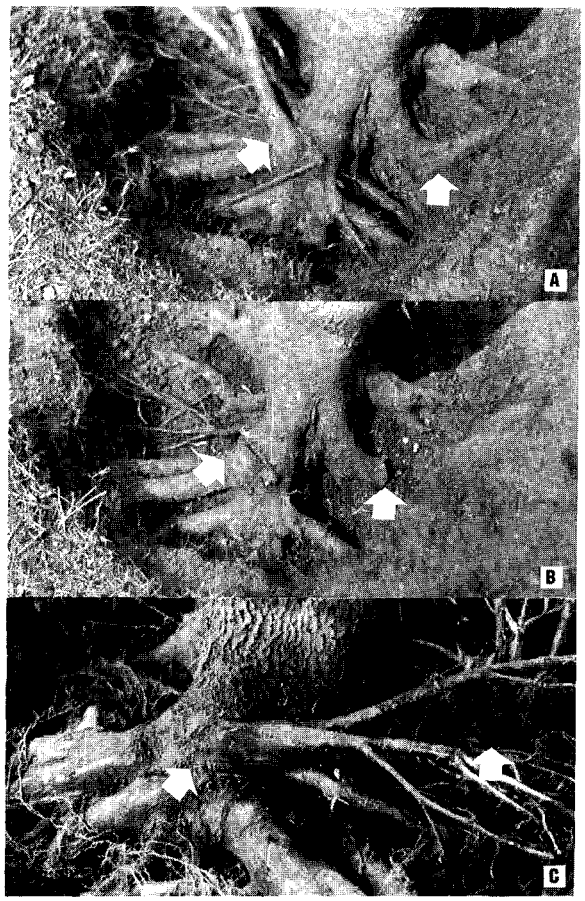

Figure 1. Photos of the girdling roots of a Norway maple before (a) and after (b) corrective treatment, and then again four years later (c). Arrows indicate the same location in all photos.

accumulation of carbohydrates, hormones or other stimuli for root regeneration which was missing from the abrasion wounds.

There was no external evidence of decay resulting from girdling root removal, but no internal examination was performed. In a previous study, when roots were cut during transplanting, extensive decay was not observed upon dissection (8). Our observations agree with those of Shigo (4) who contends that compartmentalizaton is highly effective in roots.

Watson et al. (7) found that girdling roots on trees that had been planted in the landscape for 10 years or more were often impossible to remove because they were so intertwined with other roots. Holmes (2) also recommended treating trees within a decade of planting. Though it is discouraging to find that attempting to remove girdling roots on older trees is often too difficult, and removing them on younger trees is often followed by their redevelopment, it was encouraging to find that there is a diversity in the growth habit of Norway maple root systems (Fig. 2). Root systems with many large girdling roots at the time of the first excavation also showed many large regenerated girdling roots 4 years later. Root systems with fewer and smaller girdling roots initially, showed the same character in the regenerated roots. Of the 60 Norway maples examined in the original study, girdling or potentially girdling roots were completely absent on 2 trees. There may be enough genetic diversity to select and produce root stock that will reduce or eliminate girdling root problems.

For now, we can only 1) avoid over-planting with this or any other single species, 2) remove girdling roots on some mature trees when they are not overly intertwined, and 3) accept substantial losses as trees reach maturity. These losses, based on Tate's (6) number of girdling roots and

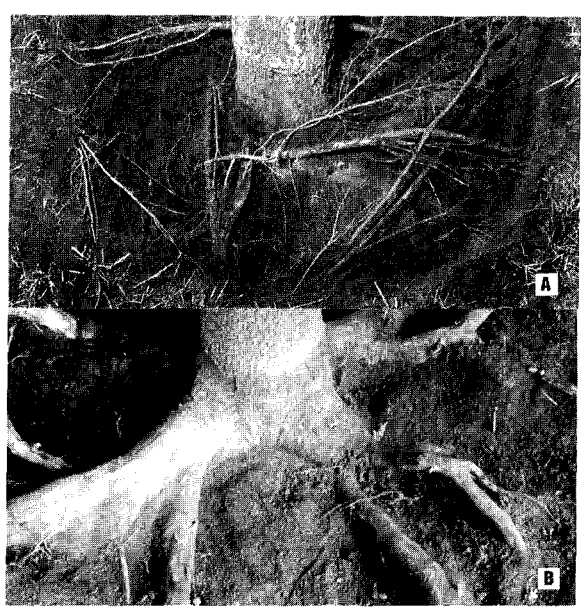

Figure 2. Examples of the diverse character of Norway maple root development. Selection of root stock like that below (b) may be the best way to eliminate most girdling root problems in the future.

percent of encirclement, as well as data and experience from our own work, can be estimated only imprecisely at between 10 and 40 percent. Given that the average life span of an urban tree on a residential site is only 37 years (5), girdling roots may only be shortening the life span of these trees by a few years on the average. However, the loss of even a single tree may be devastating to the individuals receiving benefits from that tree and thus, the decision to plant a species with an increased risk of a shortened life span should not be taken lightly.

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Résumé. L'enlèvement des racines strangulantes à titre de traitement correctif préventif sur les jeunes érables de Norvège (*Acer platanoides*) ne fut pas efficace, les racines se reformant autour de ces mêmes zones. Il y avait souvent présence de racines multiples là où une racine strangulante avait été retirée, créant ainsi une zone potentielle de strangulation plus importante. Le meilleur espoir pour éliminer les problèmes de racines strangulantes pourrait être le développement de lignées d'arbres dont les racines ne tendent pas à produire ce genre de défauts.

Zusammenfassung. Das Entfernen von strangulierenden Wurzeln als eine frühe korrektive Behandlung an jungen Spitzahörnern war nicht effektiv. Es kam zu erneuter Wurzelbildung an der Wundstelle. Oftmals entwickeiten sich viele Wurzeln an der Stelle, wo eine strangulierende Wurzel entfernt wurde, und verursachten weitaus größere Strangulation. Die größte Hoffung auf Elimination von Strangulierungsproblemen an Wurzeln besteht darin, Wurzelstöcke von Bäumen zu entwickeln, die keine strangulierenden Wurzeln haben.