

# Cultural Practices Can Influence Root Development for Better Transplanting Success

Gary W. Watson

## INTRODUCTION

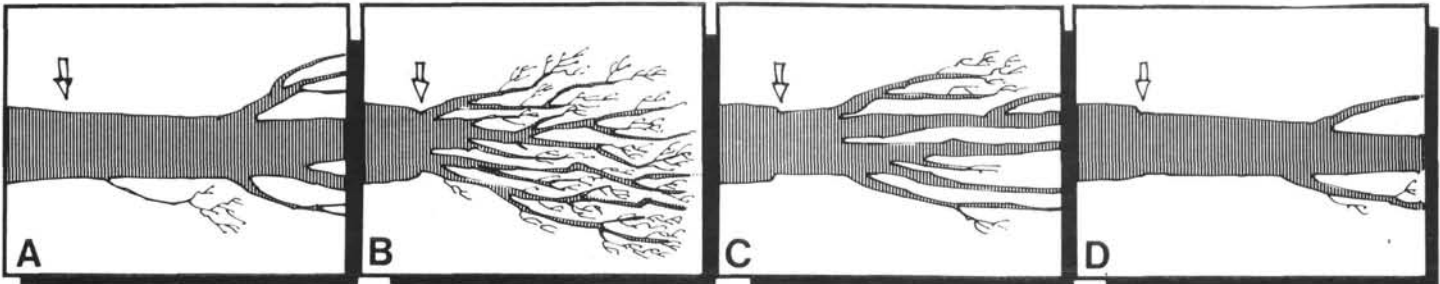
Transplanting results in a great deal of stress on landscape plants and is a difficult procedure, even under the best conditions. When accepted nursery practices are followed, less than 5% of the root system may be moved with the tree (1). The extreme state of imbalance between the root system and the crown results in an extended period of stress and slow growth, often described as transplanting shock. Cultural practices used in both the nursery and landscape can have a significant influence on root growth and development, thus helping to reduce the severity and duration of this period of post-transplanting stress.

## ROOT PRUNING IN THE NURSERY

If the proper technique is used, root pruning can produce a root ball with several times the amount of fine roots compared to an unpruned plant (unpublished data, G.W. Watson). This would no doubt aid in survival and establishment at the new site. The timing and location of the pruning is critical.

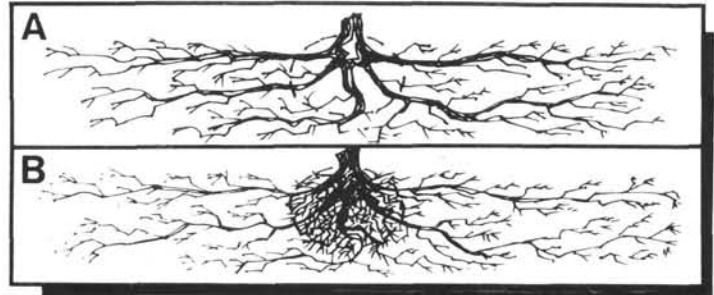
In order to root prune properly, it is important to understand how and where root regeneration takes place. When a root is severed, nearly all of the replacement roots are regenerated from the callus formed at or near the wounded surface (2,3)

**Fig. 1** Stages in replacement of a severed root. A. Root is severed at the arrow. B. Initially, many small roots are regenerated from the callus collar at the severed end. C. Within 12–24 months, one root becomes dominant and continues to elongate, while the other remain stagnant or begin to die. D. Eventually, only a single root remains in place of the original root.



(cont'd. page 9)

**Fig. 2.**



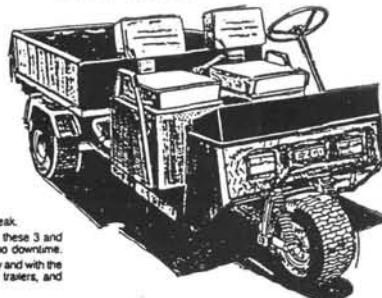
and like most roots, these new roots grow in a nearly horizontal orientation. Usually, many roots are produced from each severed root end and these replacement roots can average 45 cm (18 in) of growth per year. Recent evidence (unpublished data, G.W. Watson) indicates that one (or at most, a few) of these roots become dominant within a year or two and the remainder of the small roots eventually die (Fig. 1). Thus, after several years, the root system again begins to resemble the original root system in both structure and distribution.

Root pruning practices can be designed to take full advantage of natural root regeneration. Figure 2A illustrates a root system which has never been pruned with that portion included in a typical root ball outlined. Note the evenly distributed, but diffuse, fine root system. Figure 2B illustrates how root pruning could be used to produce a dense root system. A greater portion of the root system can be moved along with the tree without altering the ball size. The pruning should be performed between the 2nd and 5th years before the tree will be harvested. The final root ball cut should be made at least 10–15 cm (4–6 in) away from the pruning cut. Preliminary studies have shown this method to be effective in producing a root ball with several times the root surface area (unpublished data, G.W. Watson). This should help to alleviate post-transplanting stress and aid in holding the root ball together during handling. Additional research is needed to refine the root pruning techniques to optimize the horticultural and economic benefits of root pruning.

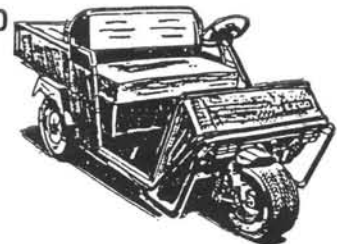
## SOME WORKERS DON'T KNOW WHEN TO QUIT.



GXT-800



GXT-1500



GXT-300

Meet the E-Z-GO work force. Tough guys who work down to dusk and never take a break. Built to E-Z-GO's demanding standards, you can expect years of durable performance from these 3 and 4-wheel gas or electric-powered turf vehicles. Plus lower maintenance costs and little to no downtime. For every job you've got, there's an E-Z-GO designed specifically to handle it—quietly, efficiently and with the least amount of labor. With carrying capacities up to 1,500 pounds, a complete range of trailers, and adaptability to virtually any accessory, they're a team of superbly versatile workers. E-Z-GO. Nobody builds them better.

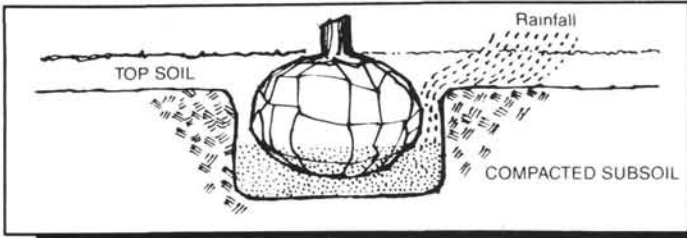
**EZGO TEXTRON**

E-Z-Go Chicago Branch  
P.O. Box 548  
24404 N. Highway 12  
Lake Zurich, Illinois 60047  
312/438-5511

## PLANTING SITE MODIFICATIONS

Urban planting sites are often characterized by artificial soil horizons with dense, compacted subsoils and very thin topsoil layers. On this type of site, water is often in excess and oxygen is unavailable in sufficient quantities to support root growth or even for roots to survive (4,5). Water cannot easily infiltrate into the subsoil and eventually flows to the lowest

**Fig. 3.** Water cannot penetrate subsoils and flows laterally to the lowest point. Planting holes fill up with water and suffocate the root systems.



point, the planting hole, where it can remain for weeks, suffocating the root systems (Fig. 3). Some of these planting holes never dry out. Above ground symptoms (chlorosis, leaf scorch and twig dieback) resemble drought stress (4) and the trees are often watered, compounding the problem.

When trees are planted on this type of site, the fine root system must develop near the surface where oxygen is most available. There are few roots at the bottom of the hole where soil conditions are the most waterlogged, most oxygen starved and least conducive to root growth. A more effective method of promoting root regeneration might be to redesign a better planting hole. Figure 4 illustrates that as the top of the hole is enlarged, with the sides sloping towards the base of the root ball at a progressively more oblique angle, the amount of backfill soil with favorable growing conditions (near the surface) increases rapidly. Since the diameter of the hole decreases with depth, effort is concentrated in the upper soil layers which are most favorable for root growth.

If the planting hole is only 25 percent larger in diameter than the root ball, with vertical sides (Fig. 4A), the backfill material volume is equivalent to only 67 percent of the root ball volume. Up to two-thirds of the soil available for root growth is often waterlogged. If roots are unable to penetrate the compacted site soil, the root system may never be able to regenerate

to even 10 percent of its original size within this planting hole. The abrupt impenetrable vertical interface with the compacted site could act to promote circling roots, just as in container grown plants.

If the surface diameter of the planting hole is expanded to twice (Fig. 4B) or three times (Fig. 4C) the diameter of the root ball, with sloping sides, the backfill volume increases to 150 and 400 percent of the root ball volume, respectively. The well-aerated surface soil increases up to 10 fold in volume. The majority of this good backfill soil is in the well-aerated upper layers and a large interface is created with the compacted soil, giving greater opportunity for roots to penetrate cracks and crevices in the otherwise impenetrable, poorly aerated soil. The sloped walls also serve to direct growing root tips up to the surface rather than in a circling direction.

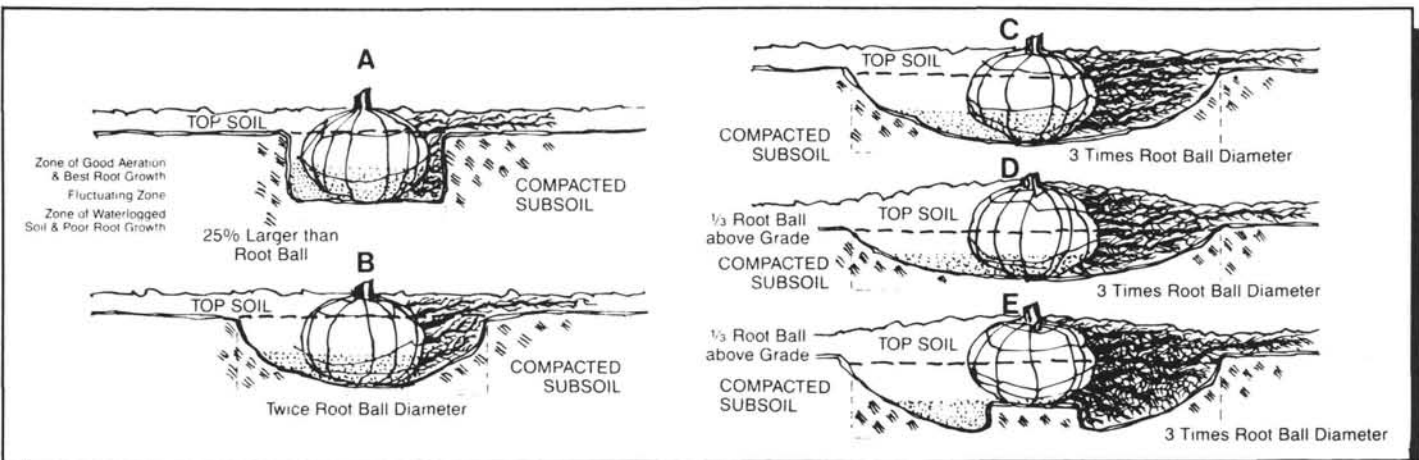
On very wet sites, the root ball can be planted so that at least one third is above grade (Fig. 4D). This will keep the majority of the root system out of saturated soil even during very wet periods. Paterson (4) has recommended placing the root ball on a pedestal of compacted soil to avoid settling. This would also elevate the root ball out of the wet soil at the bottom of the hole (Fig. 4E).

## SIGNIFICANCE TO THE NURSERY INDUSTRY

Trees are subject to tremendous stress when transplanted because of the extremely small amount of root system typically moved with the plant. Reducing the severity and duration of this stress can be achieved by either root pruning to produce a more dense, concentrated fine root system which can be included within the root ball, and/or modifying the planting hole to encourage fine root development in the shallow, well-aerated backfill soil. While it is recognized that these practices will increase the cost of planting, it is very likely that increased survival rates will offset these costs. The improved professional image resulting from higher quality plantings cannot be measured in dollars and cents.

## LITERATURE CITED

1. Watson, G.W. and E.B. Hemilick, 1982. Root distribution of nursery trees and its relationship to transplanting success. *J. Arboriculture* 8:225-229.
2. Watson, G.W. and E.B. Hemilick, 1982. Root regeneration of transplanted trees. *J. Arboriculture* 8:305-310.
3. Watson, G.W. and E.B. Hemilick, 1983. Root regeneration of shade trees following transplanting. *J. Environ. Hort.* 1:52-54.
4. Berrang, P., D.F. Karnowski and B.J. Stanton. 1985. Environmental Factors affecting tree health in New York City. *J. Arboriculture* 11:185-189.
5. Hammerschlag, S.B. and J.C. Patterson. 1978. Constitution Gardens: The making of an urban park. In: *The Manual of Site Management*, pp 1-10. Environmental Design Press, P.O. Box 2187, Reston, VA 22090.



Credit: OGA Notes, Fall '87