TREE TRANSPLANTING FEASIBILITY

INTRODUCTION

Many aspects of the Tree Transplanting Practice have refined over the past four thousand years. Modern equipment and tree care techniques have made it feasible to transplant large historically significant trees – affordably, with "soil balls" (though not all are round). Containerized Tree production has grown in popularity for many reasons including the ability to plant in any season. One thing remains the same - plants must quickly establish or reestablish a normal, spreading root system on the new site to minimize susceptibility to stress and assure survival.

PLANTING SITE PREPARATION

Soil conditions on urban planting sites can be very difficult for root growth. Planting site preparation can provide an optimum environment for root growth for only a limited time. Considering that the roots of a tree can normally spread two to three times as far as the branches, the long-term needs of even a small tree cannot be completely provided for at planting time. Long-term survival will depend more on selecting a species that will be able to survive and thrive under the existing site conditions. Planting site preparations should focus on providing the highest quality environment possible for initial root growth during the first year or two after transplanting (possibly longer for trees over 4 in (10 cm) caliper). Even in cool northern climates, tree roots with average growth rates may extend 3 feet (1 m) or more from the root ball after two years. Though it would be desirable to prepare a larger area, in most cases it would be impractical. Not every site requires extensive preparation before planting. Undisturbed sites and landscapes in older neighborhoods often have good quality soil. Site preparation must be more intensive on disturbed sites or sites with naturally poor quality soils.

PLANTING HOLE SIZE and SHAPE

The planting hole should provide adequate quality and quantity of backfill soil suitable for rapid initial root development and, should not restrict root spread beyond the planting hole. Ideally, these objectives should be achieved with a minimum of cost and effort. The root ball must be supported by undisturbed soil underneath to prevent settling. Most new roots will grow horizontally from the sides of the root ball; so compacted soil at the bottom will not substantially affect overall root growth. Since a deeper planting hole is not an option, widening the planting hole is the only way to increase its size. The most vigorous root growth is likely to occur near the surface and planting efforts should be concentrated there. In many disturbed urban soils, root growth from the bottom half of a 12-18 in (30-45 cm) deep root ball will be inhibited by inadequate drainage and aeration. A wide hole for the entire depth of the root ball may not be as efficient as a hole with sloped, or stepped, sides. With this configuration, the majority of the effort is directed towards surface soils where the new roots will grow most vigorously. A hole with sloped sides will not restrict root spread. Deeper roots will grow towards the surface soils and continue to spread if they are unable to grow into the compacted subsoil. A planting hole that is 2 to 3 times the width of the root ball at the surface with sides sloping towards the base of the root ball, is optimum for most situations. If the root ball holds less than 5 percent of the original root system, a hole only 25 percent greater in diameter than the root ball will allow the root system to reach less than 10 percent of its original size before poor quality site soils slow root growth. A hole 3 times the width of the root ball with sloped sides will allow the root system to grow rapidly to 25 percent of its original size before being slowed by the poorer quality site soil. The well-aerated surface soil is increased up to ten-fold by the shallow wide configuration.

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Though far from fully established at the time roots fill all of the backfill soil, the tree planted in a larger hole will be less subject to severe drought stress than the tree in a smaller hole. Trees transplanted with a tree spade also benefit from a larger planting hole (Preaus & Whitcomb 1980). In this situation, cultivation around the root ball after planting may be the only practical method.

BACKFILL SOIL MODIFICATIONS

The interface between backfill soil and undisturbed soil is often blamed for poor root development in the undisturbed site soil. If the backfill soil is amended, the abrupt change in soil texture can affect soil properties such as water movement, but probably not root growth. The inability of roots to cross the interface is often confused with the inability to grow vigorously in the soil material on the other side. When three types of backfill soils were compared, including unamended soil, there was no difference in root development in the any of the backfills (Watson, 1992). Unamended soil is not the same as unaltered soil. Root development in the soils outside of the planting hole was lower than in each of the backfill soils, but this appeared to be due to the overall reduced root growth in the compacted clay site soil, rather than an inability of the roots to grow across the interface between the soils. On moderate sites, amending the soil may be unnecessary, but not necessarily harmful. On extremely poor quality sites, soil amendments may be more important, but still probably not as important as digging a large planting hole.

Drainage. Adequate drainage from the bottom of the planting hole is very important for root regeneration. Gravel in the bottom of the planting hole can make drainage worse. Water will accumulate in the finer textured soil above the layer of coarse gravel until the soil is completely saturated. Drainage tubing may be used to drain water from the bottom of the planting hole if the water can be discharged at a lower level nearby. Planting with the top of the root ball slightly above grade can also increase survival on poorly drained sites. No more than one-third of the root ball should be above grade, and the soil should be gradually sloped between the top of the root ball and the original grade (Fig. 2).

ESTABLISHMENT AFTER TRANSPLANTING

The establishment period can be defined as the period required for plant to grow a normal root system. During this period the plant is quite susceptible to extreme stress. The length of the establishment period is affected by many environmental and cultural factors.

What Is Transplanting Stress? Plant growth is always limited by something, usually a single factor. Common limiting factors are temperature, light, water, nutrients, and plant genetics. If no environmental factors are in short supply, then plant growth will be limited only by the genetic potential of the plant (maximum possible growth rate). Following transplanting, water is usually the most limiting factor. Recently planted trees rely heavily on moisture in the root ball throughout the first growing season. For B&B trees, the moisture contained within the root ball represents only a small fraction of the water that was available to the tree before transplanting, and is small relative to the transpiration demands of the tree. Figure 3 shows that root ball soil moisture can be depleted quickly, while backfill soil just outside the root ball stays moist. The water from the backfill soils is not able to move into the root ball quickly enough to effectively replace what the tree is removing. The root ball soil can reach -500 mbars of soil moisture tension in just two days after watering (Fig. 3). This is dry enough to stop root growth and reduce the capacity of the roots to absorb water because of increased suberization (Bevington and Castle 1985), It took 4-5 months for roots to grow sufficiently dense in the backfill soil just outside the root ball to absorb significant amounts of soil moisture (Watson and Kupkowski 1991). It may take several days for growth to resume after watering. With frequent, repeated soil drying, root growth may be halted continuously for long periods. Calculating the amount of water held in the root zone in relation to usage by the plant is another way to estimate the water needs of new plantings. The moisture supply available to the rapidly expanding root system of a recently planted shrub increases more rapidly than does water use by the slower growing crown. Between 4 and 21 weeks after planting, the water supply increased from 2 to 11 days (Barnett 1986). Growth rate also provides an indication of stress (Fig. 4). Growth rate will slow immediately after transplanting and recover to pre-transplanting levels as the root system regenerates and transplanting stress is reduced (Watson 1987, Gilman and Beeson 1996).

Duration of Transplanting Stress. To be considered fully established after transplanting, the tree must develop a full root system on the new site. The partial root system in the root ball, or the confined root system of the container, must develop into a normal spreading root system that can utilize soil moisture and nutrient resources from a large soil volume. This will take several years.
Root establishment takes longer for large trees than for small trees. When standard specifications are followed, the size of the root ball or container is proportional to the size of the plant. The same small percentage of the root system is transplanted within the root ball, regardless of plant size. Likewise, the root system is confined to a proportionately small soil volume in container plants. Root growth rates are also similar for large and small trees. What is very different is the distance that root must grow to develop the full spreading root system necessary for complete establishment. A smaller tree requires fewer annual root growth increments after transplanting than a large tree, in order to replace the original root system. Since the smaller tree recovers vigor faster, one day it may be nearly the same size as a larger tree transplanted at the same time (Fig. 5). Root growth after transplanting is highly affected by soil temperature. In climates where the soils are warm all year round, roots will grow faster and plants will become established sooner. In the north temperate climate of the upper Midwestern US, twig growth of a four-inch caliper tree is reduced for four years after transplanting. In other words, the establishment period is approximately one year per caliper inch (Watson et al, 1986). In the subtropical climate of northern Florida, roots grow much faster. Trees establish an approximately 3 months per caliper inch (Beeson and Gilman, 1992, Gilman and Beeson, 1996). During the second half of the establishment period, stress may not be as apparent. Growth reduction may not be as obvious, but can still be measured. At this time, monitoring should be continued, but it may be possible to limit supplemental watering to periods of drought. Establishment of traditional field grown trees with conventional root balls has been compared to container grown trees, and trees grown in in-ground fabric containers. Based on water stress data, trees that were transplanted from field soil or from fabric containers establish more quickly than trees planted from plastic containers (Beeson and Gilman, 1992). Container plants were smaller and had very little root loss at transplanting, and yet took longer to establish. The smaller container plants with a more balanced root-crown ratio, might be expected to be less stressed and establish more quickly, but did not. The authors provided no explanation, but it is possible that the relatively large amount of surface area within the root ball and frequent irrigation after transplanting reduced the need for the roots to grow out of the root ball in order to meet the water requirements of the plant. Both periodic and chronic stress can reduce growth of any plant. If a plant receives a high level of care and a consistent environment is maintained above and below ground, the plant will establish faster. Water stress reduces photosynthesis and root growth, and also increases susceptibility to certain disease and insect problems. Adequate site preparation and judicious watering throughout the growing season will do more to assure survival in maximize vigor than anything else, except perhaps for selecting high quality plant material.

SUMMARY

The successful establishment of transplanted trees is dependent primarily on the reestablishment of a normal spreading root system on the new site. Inadequate site preparation, and difficult sites can slow this process. Root growth is naturally slower in colder climates. Relative to small trees, large trees have proportionally larger root systems and thus, given similar root elongation rates after transplanting, large trees take longer to replace the ire root system after transplanting than small trees. Both experience and research make it clear that almost any size tree of any species can be transplanted. Large and small trees transplanted at the same time may eventually be similar in size. The choice whether to transplant a large or small tree depends on size of the plant material budget, the post-transplanting maintenance, and the client's understanding of transplant recovery rates; within a few of transplanting, the smaller tree may be of equal size to the larger trees because of faster establishment

TREE TRANSPLANTING FEASIBILITY

TREE TRANSPLANTING IN ACTION

Courtesy of Little River Tree Farm

90" Triple Pod Trailer

Courtesy of Environmental Design

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