EFFECT OF ROOT PRUNING PRIOR TO TRANSPLANTING ON ESTABLISHMENT OF SOUTHERN MAGNOLIA IN THE LANDSCAPE

by Edward F. Gilman

Abstract. Roots of field-grown southern magnolia (*Magnolia grandiflora*) were pruned once during dormancy, following the first shoot growth flush or after the second growth flush, prior to transplanting in the winter. During the first year *after transplanting, root pruned trees grew at a slightly faster* rate than unpruned trees but growth rates were similar for root pruned and unpruned trees the second and third year after transplanting. There was no difference in post-transplant growth among root pruning treatments. Trees required, at most, 1 year per inch of trunk caliper to become established in the landscape.

Root pruning of trees in fruit, forest and landscape tree nurseries is an old and varied practice (11). It has been used as a horticultural tool to produce a sturdier tree, force development of a more compact, fibrous root system, retard top growth and increase transplant survival and post-transplant growth (14). The timing, frequency, severity and location of root pruning are governed more by practical experience and tradition than by scientific studies. Only recently have the effects of root pruning on pre- and post-transplant tree growth been studied. Gilman and Kane (8) suggested that post-transplant tree growth may be related to the distribution of roots among diameter classes within the root ball and that transplanted trees may benefit from treatments encouraging a high fine-root:coarse-root dry-weight ratio. Root pruning may increase fine-root production in the root ball.

According to Kramer and Kozlowski (12), each species has a characteristic shoot:root ratio. When the ratio is changed, as it is in transplanting, plants respond by redirecting assimilates to replace the removed parts. Root pruning, while reducing shoot growth, stimulates root growth as the plant attempts to restore the pre-pruning shoot:root ratio (13, 15). Roots regenerated in response to root pruning originate primarily at or just behind the cut (5, 19). However, a portion of regenerated roots can originate from at least 4 inches (10 cm) behind the cut, depending on species (10). This likely accounts for the increase in fibrous roots within the root ball in response to root pruning reported for a number of species (9,18). Lower shoot:root ratios were induced by root pruning (2,16), and were associated with improved post-transplant tree seedling performance (3). However, others report no benefit to survival and post-transplant growth from pre-transplant root pruning seedling-sized forest species (6,14).

The objective of this experiment was to measure the effects of root pruning prior to transplanting on survival and growth of landscape-sized southern magnolia for three years following transplanting. Previous work only reported on the first year after transplanting (8).

Materials and Methods

Southern magnolia trees from #3 (3 gal. - 10 liter) containers were planted in rows on 8 ft X 13 ft (2.5 m x 4 m) spacing in the fall of 1984 on a Chandler fine sand near Gainesville, Florida. Irrigation (0.8 gal -3 liters/tree) was applied through microspray stakes generally daily except during rainy periods and winter. Nitrogen was applied to a 10 ft^2 (1 m^2) circular area around each tree as ammonium nitrate at 6 lb N/1000 ft^2 (482 kg/ha) / yr divided into 5 equal applications. Glyphosate was periodically applied to control weeds in a 3.2 ft (1 m)-wide strip centered on the tree line down each row.

Thirty-two trees were root pruned in 1987 at each of the following times: 1) mid-dormant season - February, 2) just following the first shoot growth flush, after a terminal bud formed - June,

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and 3) following the second growth flush - October. Root pruning cuts were made with a sharpened hand-spade inserted to a 12-inch (30-cm)-depth at 60° from the horizontal in a circle 14 inches (38 cm) in diameter centered around the trunk. Thirty-seven trees were not root-pruned. Irrigation (2.1 gal. - 8 liters/tree) was applied to all plants, including controls, in the study for 7 days following a root pruning treatment. Treatments were arranged in a randomized complete block design with 4-tree replications/ treatment in each of 8 blocks (rows), totaling 32 trees/treatment.

Five trees (1 from each of 5 randomly chosen blocks) from each of the 4 treatments (for a total of 20 trees) were dug on Jan 20, 1988 with a 20-inch (50-cm)-diameter root ball according to American Association of Nurseryman standards (1). Soil was washed immediately from the root ball with a stream of water. Roots were separated into 3 diameter classes: 1) 0-2 mm, 2) >2-5 mm and 3) >5-10 mm, and dried at 70°C to constant weight. These data were reported earlier (8).

Sixteen trees (2 from each of the 8 blocks) from the nonpruned, and pruned February, June and October treatments (total 64 trees) were transplanted on Feb 17, 1988 with a 20-inch (50-cm)-diameter root ball using a 2-blade mechanical tree spade. Trees were lifted into the air about 3.2 ft (1 m) to assure that all roots were severed, then lowered back into the original hole. A 4-inch (10-cm)-high soil ridge was constructed around each tree to retain water. Sixteen nonpruned trees were not transplanted to serve as a second control. Irrigation (0.8 gal - 3 liters/tree) was applied daily, except when it rained, during 1988. Irrigation was applied every other day during 1989 and 1990. Tree height and stem caliper were measured at transplanting and in February 1989, 1990 and 1991. A randomized complete block design analysis of variance with 8 blocks and 4 treatments was performed for each measured variable each year. Mean separation was accomplished with Duncan's multiple-range test at the 5% level. Slopes of regression curves were compared among treatments using the GLM procedure in SAS at the 5% level.

Results and Discussion

All 64 transplanted trees survived transplanting. Root-pruned plants were shorter and had less caliper at transplanting than the nonpruned controls but there was no significant difference in height or stem caliper among pruned and nonpruned transplanted trees one growing season following transplanting (Figures 1 & 2). This showed that root-pruned trees grew at a slightly faster, yet significant, rate than trees which were not root pruned. Growth rate during the first year on all transplanted trees was much slower than on trees that were not transplanted, but there were no differences in growth rate during the second and third year after transplanting (Figures 1 & 2). Since the growth rate in the second and third year on transplanted trees matched that on trees that were not moved, 3 1/4-cm (1 1/4-inch)-caliper southern magnolia were established within one year after transplanting. Establishment period may be shorter further south in USDA hardiness zones 9 through 11 (4), but can be one year (or longer) per inch (2.54 cm) caliper further north (7, 17). Root pruning prior to transplanting had no effect on rate of establishment.

Establishment period has been defined as the time required to completely replace the root system to the same size as it was before transplanting (7) or the time required for shoot growth rate to match that on the tree prior to transplanting (17). Shoot growth rate will probably match pre-transplanting growth rate just as the root system is completely replaced, and further studies are under way to confirm this.

This study was conducted under nearly ideal post-transplanting conditions, with irrigation applied daily the first year following transplanting, and it shows what can be accomplished with adequate irrigation following transplanting. Unfortunately, most trees planted in urban environments do not receive irrigation as frequently as this, and this may significantly increase the time required to establish a tree in the landscape. If resources are directed to deliver frequent irrigation immediately following transplanting, the establishment period in the urban landscape may approach those reported in these studies, and tree survival may increase.

These results question the wisdom of the often discussed, sometimes implemented, practice of root pruning previously unpruned landscape-sized southern magnolia prior to transplanting. Although

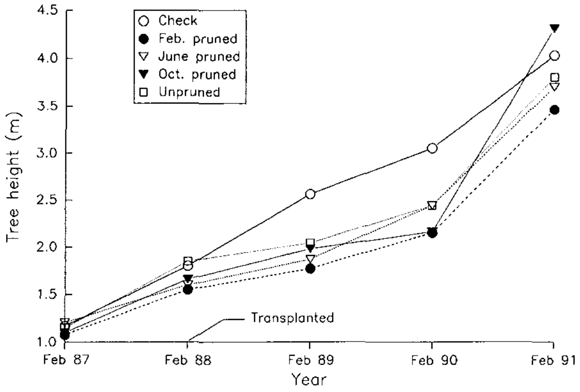

Figure 1. Height of southern magnolia trees one year before transplanting, at transplanting and one, two and three years after transplanting. Check trees were not root pruned in the nursery and they were not transplanted.

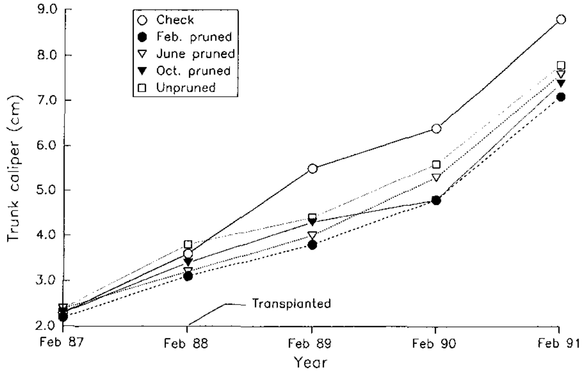

Figure 2. Trunk caliper of southern magnolia trees one year before transplanting, at transplanting and one, two and three years after transplanting. Check trees were not root pruned in the nursery and they were not transplanted.

root pruning increased the ratio of fine roots to coarse roots, trees with higher ratios (more fine roots) grew only slightly more the first year following transplanting (8) compared to trees having a low fine-root:coarse-root ratio which were not pruned. During the second and third year root-pruned trees grew at the same rate as trees that were not root pruned. In addition, there was no difference in tree quality among any treatments during the three years following transplanting (data not shown).

Results from this study may not apply to oaks and other trees with coarse root systems, and they may not apply to trees larger than those used in this study. Root pruning 2-inch (5 -cm)-caliper live oak (*Quercus virginiana*) increased root density within the root ball 6-fold compared to unpruned trees (9), and 4-fold in blue spruce (*Picea pungens*) (18). Unfortunately, trees in these two studies were not transplanted so the effect of increased root density on transplanting was not evaluated. The increase in root density in response to root pruning was nowhere near 4- to 6-fold for the magnolias in the current study (8), and there was little effect on post-transplant growth. Further study needs to be conducted on the effect of increased root density within the root ball on transplant survival and growth in the landscape.

Conclusions

1) Root pruning southern magnolia prior to transplanting corresponded to only slightly better post-transplant growth the first year following transplanting. There was no difference in growth rate between root-pruned and nonpruned trees the second and third year after transplanting.

2) Root pruning prior to transplanting did not enhance the rate of establishment of southern magnolia.

3) Southern magnolia with 1 1/4 inch (3 1/2 cm)-caliper trunks were established within one year after transplanting.

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Resumé. Les racines de magnolias à grandes fleurs (*Magnolia grandiflora*) croissant en plein champ étaient taillées 1) durant la dormance, 2) après la première phase de croissance des pousses ou 3) après la seconde phase de croissance, mais avant la transplantation en hiver. Au cours de la première annèe après la transplantation, les arbres aux racines taillées croissaient à rythme légèrement plus élevé que les arbres sans taille aux racines. Les taux de croissance étaient similaires la seconde et la troisième année après la transplantation pour les arbres aux racines taillées ou non taillés. Les arbres exigeaient, au plus, un an par pouce (2.5 cm) de diamètre de tronc pour s'établir dans leur nouveau milieu.

Zusammenfassung. An Freilandpflanzen der "Southern Magnolia" (*Magnolia grandiflora*) wurden die Wurzeln beschnitten 1) während der Vegetationsruhe, 2) direkt nach dem ersten Wachstumsschub oder 3) nach dem zweiten Wachstumsschub, aber vor der Verpflanzung im Winter. Die Versuchspflanzen wurden alle umgepflanzt. Während des ersten Jahres nach der Umpflanzung wuchsen die an den Wurzeln geschnittenen Pflanzen etwas schneller als die ungeschnittenen Kontrollbäume. Im zweiten und im dritten Jahr waren die Wachstumsraten bei behandelten und unbehandelten Pflanzen ähnlich. Die Bäume benötigen bis zu einem Inch Dickenwachstum pro Jahr, um sich in der Landschaft durchzusetzen.