

ically rather than mechanically and has great potential for both pistillate and staminate flower production. The use of chemical inducers of lateral branching of pecan has already shown potential (5) and should be investigated further with 'Desirable'.

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Root and Shoot Growth of Field- and Container-grown Pecan Nursery Trees Five Years After Transplanting

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Abstract. Field- and container-grown trees of pecan [*Carya illinoensis* (Wang) K. Koch] were evaluated 5 years after transplanting to the field. Tree survival was 100% with 2-year field-grown and 2-year and 1-year container-grown trees. Trunk height, caliper, and the number of roots were not significantly different for nursery-grown vs. container-grown trees, but roots of field-grown trees grew to a greater soil depth. Container-grown plants had circular and kinked roots, but growth of trees 5 years after transplanting were not affected adversely. Root pruning at transplanting did not influence trunk height and weight, root depth, number of roots, and root weight.

Failure to transplant nursery, bare-root pecan trees successfully may be due to the lack of adequate lateral root formation. Pecan trees produced in containers may be more costly than field-grown trees (1) and often have kinking and circling roots that may be detrimental to establishment and subsequent growth of trees (9). Root girdling apparently causes tree decline by reducing stem conductivity and radial communication between tissues (4). Root pruning of seedling trees shortly after germination did not reduce tree growth in the nursery, but also did not increase growth after transplanting (5). Root pruning of 4 tree species during transplanting to peat pots and 3.8-liter (gallon) containers more than doubled the number of plants with acceptable root systems, but survival and

growth were not affected adversely after one season's growth (3). Tree growth from the bare-root, barrel-grown pecan seedlings was less than that from container-grown seedlings after 2 years (6).

In a 2-year study, pecan trees with taproots pruned to 25 or 50 cm length rerooted better and with a greater survival rate than trees pruned to a 76-cm-long taproot, but root length did not influence shoot length or the number of shoots per tree (7).

The objectives of this study were to evaluate the survival and subsequent growth of transplanted pecan trees. There were 3 comparisons: 1) trees were produced from seed germinated in the field or in containers; 2) trees were root-pruned or unpruned when transplanted; and 3) trees were budded just prior to transplanting or budded one year earlier with one-year-old scions at the time of transplanting.

Pecan seed were planted in the nursery in late February 1975 and 1976 and in containers 28 cm in diameter and 28 cm deep only in 1976 and seedlings were patch-budded with 'Cherokee' the following August. Field-grown trees planted in 1975 (and budded in August 1975) were transplanted to containers in February 1976. One-half of the plants from each

growing regime were root-pruned before planting to permanent location on March 2, 1977. This resulted in a 2 × 2 × 2 factorial (field-grown vs. container-grown; 1- vs. 2-year-old rootstocks; and unroot-pruned vs. root-pruned) replicated 6 times using a randomized complete block design. A least-squares statistical analysis procedure (2) was applied because of missing data. Mean dimensions of the root system of unpruned nursery plants were 40 cm wide and 60 cm deep; those for pruned nursery trees were 40 cm wide and 30 cm deep. The root ball of container-grown plants was 28 cm in diameter and 28 cm deep. Container-grown plants were root-pruned by removing about half of each circling root. The trunk length of the budded field and container trees on 2-year rootstocks averaged 175 cm and 102 cm, respectively. The trunks of one-year rootstocks of field and container trees consisted of dormant buds ready for forcing.

The planting holes dug for orchard establishment were 60 cm wide for all treatments and 76 cm deep for field-grown, unroot-pruned trees and 46 cm deep for the remaining treatments. A slow-release fertilizer 18N-3P-10K at the rate of 198 g per tree was mixed with the backfill soil at planting. The trees were irrigated when planted and no additional water was applied. The trees were fertilized with 13N-6P-11K each spring at the rate of 454

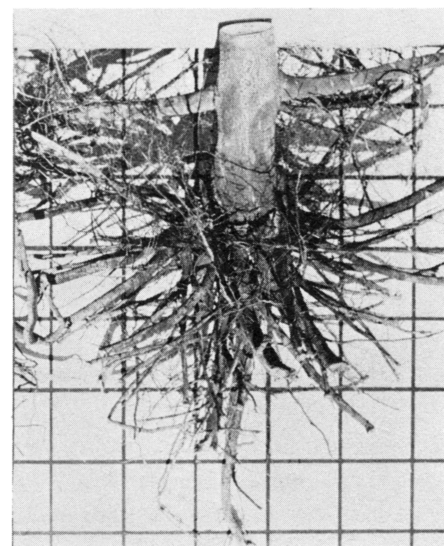


Fig. 1. Roots of a 2-year field-grown, pecan tree; roots were not pruned prior to transplanting.

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Fig. 2. Severe root circling and kinking of a one-year field-grown, one-year container-grown pecan tree; roots were not pruned prior to transplanting.

g/tree beginning in 1978, with the rate increasing 227 g/year. Standard pecan-orchard maintenance practices were used to control weeds, insects, and diseases.

All trees were dug on January 20, 1982; the root mass was cone-shaped with a 112-cm surface diameter and a 112-cm depth. Data for analysis were taken on January 27, 1982 after the soil was removed from the roots. Trunk caliper was taken 60 cm above the soil surface. The trunks of the trees were cut at the soil surface to obtain root and trunk weights.

Roots were divided in sizes larger and smaller than 2.5 cm at the perimeter of the root ball. Visual ratings on a scale of 0 (severe) to 5 (normal) of root circling and kinking were made by a consensus of 3 people. Only 3 trees—all field-grown on one-year rootstocks—of the 48 planted did not survive.

The roots of field-grown trees grew to a mean depth of 97 cm and weighed 9.5 kg, significantly higher than the 85 cm and 11.1 kg for container-grown trees. Field-grown trees had good root distribution (Fig. 1) and container-grown trees had a denser root mass and circling, thicker roots (Fig. 2). Roots arising from the dense mass of circling and kinking roots appeared normal and healthy. Root pruning container-grown rootstocks had a deleterious effect as more circling and kinking was obtained with root-pruned than unpruned plants. Root numbers and trunk height, caliper, and weight of container-grown trees were not significantly different from those of field-grown trees. Trunks of 2-year container-grown trees were substantially shorter than those of 2-year field-grown trees when the trees were planted 5 years earlier. Root pruning field-grown trees was not detrimental to stem or root growth, suggesting that

special equipment designed to dig and transplant nursery-grown trees with long taproots may be unnecessary.

Trunks of trees with a 2-year rootstock were longer and heavier than those of trees with a one-year-old rootstock (Table 1). Trees with 2-year rootstocks produced more roots and had less circling and kinking roots than trees with one-year rootstocks. Age of rootstocks did not influence the depth and weight of roots. A root pruning \times age interaction was obtained; pruning slightly increased trunk caliper of trees with 2-year rootstocks, but not with one-year rootstocks.

Trunk-height differences of trees with 2-year rootstocks and one-year trunks, 175 cm (field-grown) and 102 cm (container-grown), to one-year rootstocks with dormant buds ready for forcing, persisted 5 years later. Root pruning did not influence trunk height and weight, root depth, number of roots, and root weight.

Tate (8) found that growth of 50-year old Norway Maple (*Acer platanoides*) trees was unaffected by girdling roots. Abnormal trunk types were a highly significant indicator of the presence of girdled roots. We also found that root circling and kinking was not detrimental to the growth of pecan trees 5 years after transplanting. However, the effects of root circling and kinking on growth and yield of mature pecan trees is unknown.

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Table 1. Effects of rootstock age on tree growth after 5 years in the orchard.

| Rootstock age (years) | Trunk | | Root | | Visual ² rating |
|-----------------------|-------------|-------------|--------------|--------------|----------------------------|
| | Height (cm) | Weight (kg) | No. > 2.5 cm | No. < 2.5 cm | |
| 1 | 420 | 14.0 | 14.1 | 14.6 | 3.9 |
| 2 | 453* | 19.3* | 17.2* | 19.9* | 4.3* |

²0 (severe circling and kinking of the root system) to 5 (no circling or kinking).

*Significantly higher than one-year-old rootstock at 5% level by Fisher's protected LSD.