# EFFECTS OF PROPAGATION CONTAINER SIZE AND TRANSPLANTING DATE ON THE GROWTH OF TREE SEEDLINGS

Bonnie Lee Appleton and Carl E. Whitcomb[1/]

Abstract. -- Superior growth was made by deciduous and coniferous trees started in the largest volume container (41 cu.in.). This effect remained evident through the second growing season for all species. Earlier transplant dates were in some cases better, but planting date was much less important than container size.

Additional keywords: Cedrus deodara, Pinus taeda, P. thunbergi, P. resinosa, P. sylvestris, P. eldarica, Pistacia chinesis, Quercus shumardi, tree seedlings, container volume.

Previous studies of container grown tree seedlings have shown that the size of the propagation container can significantly influence subsequent tree growth and development. Davis and Whitcomb (1975) showed that greater root growth could be obtained in 2 1/2 inch square bottomless milk cartons as opposed to 1 1/2 and 2 inch square containers. Hathaway and Whitcomb (1977) showed that size and volume are important, with half pint milk cartons (2 3/4 inch square) producing seedlings equal to larger containers. Similar effects of volume upon tree seedling growth have been shown by Tinus and McDonald (1979), and by Wall and Whitcomb (1980) and are cited by Carlson (1979).

Whitcomb, Storjohann and Gibson (1977) reported that early summer transplant dates were preferrable for container grown deciduous tree seedlings, but that for slow growing conifers transplant date had little effect on subsequent growth. The various components of an integrated tree seedling production system, including container design and the use of bottomless containers, are discussed by Whitcomb (1981).

The following study was designed to further evaluate the effects of propagation container size and transplant date on subsequent tree growth and to determine whether or not a container size-transplant date interaction might exist.

## METHODS

### 1981 - Year one.

Seeds of six conifers, deodar cedar, Cedrus deodara; loblolly pine, Pinus taeda; Japanese black pine, P. thunbergi; red pine, P. resinosa; Scotch pine, P. sylvestris; and Afghan pine, P. eldarica, and one deciduous tree, Chinese pistache, Pistacia chinesis, were direct seeded into four different container sizes on March 12, 1981. Seeds of a second deciduous tree, Shumard oak, Quercus shumardi, were first pregerminated in moist peat moss and subsequently transplanted to the containers on March 24.

The four containers consisted of a) half pint milk cartons measuring 2 3/4" x 2 3/4" x 5 1/2" deep holding 41 cu.in., b) 3" square nu-pots holding 22 cu.in., c) 2 1/4" square nu-pots holding 12 cu.in. and d) paper pots holding

[1/]Graduate Research Assistant and Professor, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078.

9 cu.in. All containers were bottomless. A propagating medium of peat and perlite (1:1 by volume) containing 6 lbs./cu.yd. 18-6-12 Osmocote and 1 lb./cu.yd. Micromax was used. Seedlings were produced in an unheated greenhouse designed to provide good air circulation and air root pruning.

The two deciduous trees were transplanted into larger containers on May 12, May 26, June 9 and June 23, and the six conifers were transplanted on the three later dates. The deciduous trees were transplanted into three gallon white poly bags, the conifers into one gallon white poly bags using a medium of bark, peat and sand (3:1:1 by volume) containing 14 lbs./cu.yd. 17-7-12 Osmocote, 8 lbs./cu.yd. dolomite and 1 1/2 lbs./cu.yd. Micromax. The plants were placed on a container bed in full sun in a completely randomized block design by species with six uniform seedlings per container design as replications for each transplant date.

The trees were evaluated in mid-August with height and caliper taken for the deciduous trees and height and number of branches for the conifers. Height and caliper were taken again for the deciduous trees in mid-November.

Plants from one transplanting date of Shumard oak, Chinese pistache, deodar cedar and Afghan pine were transplanted to the field on December 4. Plants from the remaining two transplant dates for the deodar cedar and the Afghan pine along with all of the plants of the five remaining pines were overwintered in an unheated single poly greenhouse.

1982 - Year two.

All plants overwintered in the poly greenhouse were kept on the container bed for a second growing season. The Scotch and red pines remained in the one gallon bags while the Japanese black pines were transplanted into two gallon plastic pots and the loblolly and Afghan pines and deodar cedar into three gallon poly bags. A growing medium of bark, peat and sand (3:1:1 by volume) containing 14 lbs./cu.yd. of an 18-6-12/17-6-12 Osmocote blend, 6 lbs./cu.yd. dolomite and 1 1/2 lbs. Micromax micronutrients was used.

In early August height, caliper and number of branches was taken for the deodar cedar and loblolly and Japanese black pines and height and number of branches for the Scotch pine. The red and Afghan pines will be evaluated in the fall of 1982.

## RESULTS

1981 - Year one.

All tree species produced superior seedlings when grown in the milk cartons as compared to the three smaller containers. Seedlings were taller, had thicker stems, and the conifers exhibited increased branching (Table 1).

A much less dramatic result was noted with regard to transplant date although earlier transplanting was generally preferred (Table 2).

Very little container size-transplanting date interaction was observed.

Considerable winter kill occurred in the field transplanted trees so no further evaluations were made of their growth.

Table 1. Effect of container size on plant height and caliper or height and number of branches[z]

| Species | Container: Milk Carton | 3" nu-pot | 2¼" nu-pot | Paper pot |
|---|---|---|---|---|
| Chinese pistache | | | | |
| height[y] | 87.7b[x] | 67.9a | 68.3a | 59.0a |
| caliper | 1.10b | 0.71a | 0.68a | 0.60a |
| Shumard oak | | | | |
| height | 71.8b | 61.2a | 49.0a | 55.8a |
| caliper | 1.00b | 0.70a | 0.59a | 0.65a |
| Deodar cedar | | | | |
| height | 20.3b | 15.7a | 16.1a | 16.1a |
| #branches | 21.1b | 6.9a | 6.8a | 6.8a |
| Loblolly pine | | | | |
| height | 36.2b | 24.4a | 25.4a | 22.2a |
| #branches | 8.1b | 5.3a | 6.3a | 4.6a |
| Japanese black pine | | | | |
| height | 16.2b | 11.2a | 10.9a | 11.9a |
| #branches | 3.3b | 1.4a | 2.3a | 2.2a |
| Red pine | | | | |
| height | 7.9b | 5.7a | 5.1a | 5.4a |
| #branches | 2.8b | 1.7a | 1.1a | 1.6a |
| Scotch pine | | | | |
| height | 10.3b | 9.3a | 8.3a | 9.8a |
| #branches | 3.9b | 3.2a | 2.9a | 3.3a |
| Afghan pine | | | | |
| height | 22.0b | 17.1a | 16.6a | 19.6a |
| #branches | 22.1b | 8.9a | 10.1a | 11.4a |

[z]means of six plants for each of the 3 or 4 planting dates
[y]all heights and calipers in centimeters (cm)
[x]all milk carton means significantly better than the other 3 containers at the 0.01 level or higher (protected LSD test)

Table 2. Effect of transplanting date on plant height and caliper or height and number of branches[z]

| Species | Date: May 12 | May 26 | June 9 | June 23 |
|---|---|---|---|---|
| Chinese pistache | | | | |
| height[y] | $73.4_a$[x] | $68.5_a$ | $77.8_b$ | $63.1_a$ |
| caliper | $0.80_a$ | $0.75_a$ | $0.85_a$ | $0.69_a$ |
| Shumard oak | | | | |
| height | $71.8_b$ | $64.3_a$ | $56.6_a$ | $45.1_a$ |
| caliper | $0.81_b$ | $0.78_a$ | $0.72_a$ | $0.62_a$ |
| Deodar cedar | | | | |
| height | - | $19.6_b$ | $16.4_a$ | $15.1_a$ |
| #branches | - | $10.9_a$ | $10.5_a$ | $9.8_a$ |
| Loblolly pine | | | | |
| height | - | $28.0_a$ | $28.1_a$ | $25.1_a$ |
| #branches | - | $5.6_a$ | $6.7_a$ | $6.0_a$ |
| Japanese black pine | | | | |
| height | - | $14.3_a$ | $10.6_a$ | $12.8_a$ |
| #branches | - | $2.6_a$ | $2.1_a$ | $2.2_a$ |
| Red pine | | | | |
| height | - | $5.6_a$ | $6.4_a$ | $6.1_a$ |
| #branches | - | $1.7_a$ | $2.1_a$ | $1.6_a$ |
| Scotch pine | | | | |
| height | - | $9.8_a$ | $9.8_a$ | $8.7_a$ |
| #branches | - | $4.0_a$ | $3.3_a$ | $2.8_a$ |
| Afghan pine | | | | |
| height | - | $18.6_a$ | $20.9_a$ | $16.9_a$ |
| #branches | - | $14.6_a$ | $13.5_a$ | $11.3_a$ |

[z]mean of six plants for each of the four containers
[y]all heights and calipers in centimeters (cm)
[x]dates significant at the 0.05 level or higher (protected LSD test)

1982 - Year two.

With one exception (height of Scotch pine) the trees grown from the milk carton seedlings were still superior after the second growing season (Table 3).

Table 3. Effect of tree seedling container size on subsequent (second year) tree growth[z]

| Species | Container: Milk carton | 3" nu-pot | 2¼" nu-pot | Paper pot |
|---|---|---|---|---|
| Deodar cedar | | | | |
| height[y] | 72.0b[x] | 62.8a | 61.7a | 61.8a |
| caliper | 1.50b | 1.26a | 1.26a | 1.20a |
| #branches[s] | 266.6b | 171.3a | 169.2a | 166.0a |
| Loblolly pine | | | | |
| height | 128.7b | 114.7a | 115.7a | 115.7a |
| caliper | 2.5b | 1.8a | 2.0a | 1.8a |
| #branches[s] | 47.7b | 33.2a | 36.3a | 29.1a |
| Japanese black pine | | | | |
| height | 70.8b | 59.8a | 62.8a | 58.6a |
| caliper | 1.6b | 1.2a | 1.3a | 1.3a |
| #branches[s] | 23.0b | 12.8a | 13.0a | 15.6a |
| Scotch pine | | | | |
| height | 37.0a | 36.0a | 33.0a | 37.1a |
| #branches[q] | 47.5b | 35.8ab | 30.3a | 38.5ab |

[x]all milk carton means significantly better than the other 3 containers at the 0.01 level (with noted exception) (protected LSD test)
[z]means of six plants for each container size for two or three planting dates (excludes field planted trees)
[y]all heights and calipers in centimeters (cm)
[q]buds or branches 1/2" or longer
[s]branches 1" or longer

As with the previous year's data, transplanting date had a minor effect on tree growth and no appreciable container size-transplanting date interaction was observed.

Frequently the improved growth that is obtained from various experimental factors during the first year of plant growth is diminished in subsequent years. That was not the case to date in this study although whether this benefit will continue in the future has yet to be determined.

The fact that earlier transplant dates had little effect on plant growth during either the first or second year suggests that, given an adequate volume of medium and nutrients during propagation, a healthy and vigorous tree seedling will transplant relatively well even under less than optimum temperature conditions.

Since no significant container size-transplant date interaction occurred it appears that the restricted growth incurred by tree seedlings propagated in small containers cannot be overcome even by early transplanting.

Based on these and the previous studies that have been cited, tree seedling growth can be expected to increase as container volume increases up to a volume of approximately 41 cu.in.

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