Landscape Performance of Shade Trees Initially Grown in Above-ground Wire Basket Containers

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Trees of green ash [*Fraxinus pennsylvanica* var. *subintegerrima* (syn. *F. pennsylvanica* var. *lanceolata*)] grew equally well after 2 years in above-ground wire basket containers lined inside with tar paper, vinyl, or geotextile fabric. After an additional 7 years in the landscape, trees grown with both the basket and liner removed, or with the basket removed and the liner slashed, grew similarly and better than those with both the basket and liner intact. When the root ball was removed from the containers before planting in the landscape, trees initially grown in the tar-paper-lined containers grew the best. Trees initially grown in the fabric-lined containers grew the least.

INTRODUCTION

The introduction of the in-ground fabric container method of growing shade trees in the 1980s heightened interest in container tree culture (Reiger and Whitcomb, 1983). As an alternative tree culture system, the Ornamental Nursery Research Program at the Horticultural Research Institute of Ontario has been examining the use of inexpensive containers, custom-fabricated from wire baskets lined inside with various types of materials.

ABOVE-GROUND IN CONTAINERS

Through two growing seasons and two winters between May 1988 and June 1990, we evaluated and compared the production of green ash [*Fraxinus pennsylvanica* var. *subintegerrima* (syn. *F. pennsylvanica* var. *lanceolata*)] in three types of above-ground wire basket containers, fabricated by Braun Nurseries Ltd., Mount Hope, Ontario. The wire baskets (50 cm wide × 30 cm deep, normally used in conjunction with the burlapping of trees) were lined with: tar paper (similar in composition to roofing shingles); vinyl (grey on the outside and black on the inside); or geotextile fabric (the same material used in the construction of below-ground fabric containers). The linings fitted snugly inside the wire basket, and were composed of two parts (Fig. 1), either stitched together (vinyl and fabric) or unstitched (tar paper). Holes were punched in the bottom of the vinyl liner to allow drainage of water. Two specially-designed capes (Polyfoam or THERMAT) were also tested for their efficacy in moderating container soil temperatures during the winter and also during the growing season.

The trees survived without any winter injury and grew equally well in all the above-ground container treatments. A detailed report of this part of the trial was published (Chong et al., 1990). Further information about the subsequent performance of these trees in the landscape is provided below.

Fig. 1. The container liner, composed of two parts (circular bottom and sidewall), was designed to fit snuggly inside the wire basket.

LANDSCAPE PERFORMANCE

In early June 1990, the same trees (48-mm mean caliper) were planted into a silty clay loam soil to simulate a permanent landscape setting. Before planting, trees from each container type (tar paper, vinyl, and fabric) were treated (pre-plant treatments) as follows: (a) both wire basket and liner removed; (b) wire basket removed and vertical slashes made in the liner 15 to 20 cm apart around the root ball; or (c) both wire basket and liner left intact. There was a total of 45 trees (3 container types × 3 pre-plant treatments × 5 single-tree replications) planted at random in two rows 3 m apart and 2 m within rows.

Before planting and each spring thereafter, 112 kg N ha^{-1} was broadcast applied to the soil in the form of ammonium nitrate. The soil contained adequate quantities of P and K. Each year, mid-season leaf samples from each tree were analysed for N, P, K, Ca, Mg, Fe, Mn, and Zn, and end-of-season caliper and height were recorded. The trial was terminated at the end of the 1996 season, when trees began to crowd each other. At this time, the root ball of selected trees from each container type and pre-plant treatments were dug with a tree spade, loose soil was washed away, and the roots were inspected.

Growth Measurements. As illustrated by caliper and height data recorded in 1996 after 7 years in the landscape (Table 1), trees which had been planted with basket and liner intact grew less than those which had the basket removed and with liners either slashed or removed before planting. The same data showed that the types of liners used also influenced growth. Trees from the tar paper treatment grew best followed in order by those from the vinyl and the fabric containers (Table 1).

Table 1. Effects of container type and pre-plant treatments on performance of green ash (*Fraxinus pennsylvanica* var. *subintegerrima*) trees after 7 years in the landscape.

Container type	Pre-plant treatments: Basket and liner intact	Basket removed liner slashed	Basket and liner removed	Mean pre-plant effects
		Caliper (mm)		
Fabric	78	94	89	87 C
Vinyl	88	92	99	93 AB
Tar paper	96	101	105	101 A
Mean container type effects	87 b[Z]	96 a	98 a	
Height (cm)				
Fabric	545	604	610	586 C
Vinyl	588	618	623	610 AB
Tar paper	643	674	640	652 A
Mean container type effects	592 c	632 a	624 ab	

[Z]Means within columns (pre-plant treatment effects) or rows (container type effects) followed by the same letter are not significantly different according to LSD at 5% level of probability. There was no significant container type × pre-plant treatment interaction.

Root Ball Observations. Roots growing out of the intact containers invariably did so through the container side-walls, or through the stitches. Trees grown in tar paper liner only during the above-ground phase, showed no apparent restriction upon their root system (see basket and liner removed, Table 1). This result was observed also for trees which were planted in the landscape with the tar paper liner slashed (see basket removed, liner slashed, Table 1). In the two pre-plant treatments with tar paper liner intact or slashed, the tar paper had apparently been disintegrating during the landscape phase. When roots were dug, only remnants of the tar paper were visible in these treatments.

With the vinyl contained root ball, only a few larger roots emerged from the intact vinyl liner. Swellings at the points of root emergence were evidence of girdling (Chong et al., 1987; 1989; Remphrey et al., 1990). The fabric-contained root ball had numerous fibrous roots confined within the container (Reiger and Whitcomb, 1983). Many small, outer feeding or "nurse" roots, with knob-like swellings at the points of emergence indicated severe girdling. The nurse roots were loosely attached and easily broken off, as previously described (Chong et al., 1987; 1989).

Data from earlier years indicated that growth constraints by the intact fabric liner began to be manifested after the 2nd year in the landscape, and to a lesser extent and somewhat later by the vinyl liner. These differences were quite accentuated at the end of the landscape phase. Within the vinyl liner, there was substantial circling of medium-sized (1 to 2 cm diameter) or larger roots. This observation is consistent with description of "pot-bound" roots in regular nursery containers (Appleton, 1989). Within the fabric liner, many larger roots appeared to be abnormally swollen or deformed as previously described in "smaller-than-normal" experimental in-ground fabric containers (Chong et al., 1989). The occurrence also of less growth each year in landscape-grown trees with the fabric or vinyl liner removed or slashed was indicative of delayed manifestation or "latent effects" due solely to prior confinement (2 years) in these containers above-ground.

Chong et al. (1989) reported decreased foliar N and P contents in poplar trees grown in in-ground fabric containers. Throughout the landscape phase, we observed no differences in foliar nutrients due to container type or pre-plant treatments. Also the wire basket had little or no visible effect on the root system. Roots were not large enough for them to be restricted or girdled by the openings of the wire basket (Lumis and Struger, 1988).

CONCLUSIONS

The results of this study provide information about tree performance in various lined, wire basket containers and restrictions on the root system by these containers during nursery production above-ground and, subsequently, in the landscape. Reduction in tree growth varied with the type of container liner material and the extent of root ball confinement by the container. Slashing of the container liners was just as effective as complete removal (Fig. 2).

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Fig. 2. Slashing of the container liner did not restrict root growth and was just as effective as complete removal of the liner.

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