TWO-YEAR PERFORMANCE OF BAREROOTED AND CONTAINERIZED TREMBLING AND BIGTOOTH ASPEN SEEDLINGS

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Containerized bigtooth and trembling aspen seedlings showed higher survival than barerooted seedlings following transplanting. After two growing seasons, no difference in height was observed between the two types of planting stock.

The ultimate objective of forest tree improvement is superior long-term performance of test materials in the field. Survival of the outplanted nursery or greenhouse-grown tree in its new plantation environment depends not only on the environmental conditions in the new site, but also on the quality and physiological status of the planting stock.

The condition of the roots and whether seedlings are grown directly in the ground or in containers can greatly affect overall survival in the field, especially in areas with prolonged dry periods during the growing season (*5*). Traditionally, conventional bareroot planting stock has had widespread use because it is relatively inexpensive to produce. But some species are difficult to grow as bareroot stock, or are difficult to keep in good planting condition during handling, transporting, or outplanting. These problems are alleviated by using containers (*7*). There are, however, relatively few studies evaluating the performance of many hardwood species. This may be the result of two factors—the difficulty in raising certain hardwood species and the difficulty in establishing plantation of certain hardwoods. However, one study (*5*) showed that the survival and consequent growth of an outplanted seedling vary not only with the species, but especially with the nature and size of container used. This study evaluates the survival and growth of bareroot and containerized bigtooth and trembling aspen seedlings following transplanting.

Materials And Methods

In spring 1974, seeds and root segments were collected from 93 clones of trembling aspen and 51 clones of bigtooth aspen located throughout the State of Michigan. Seedlings and young cuttings obtained from root segments (*2*), (*10*) were grown in the greenhouse during the fall of 1974 as containerized plants. Adequate levels of moisture and fertility were maintained throughout the growing period. The containers, made out of .05 cm tar-coated roofing paper, were 5 X 5 X 30 cm. They were held in groups of 30 in wooden crates lined with perforated roofing paper to prevent the growing medium from falling through, yet allow air pruning of the roots growing out of the bottom. Plants were preconditioned by lowering the greenhouse temperature gradually over a 6-week period and moved outdoors in January 1975.

In spring 1975, for both species, trees belonging to the same clone were randomly separated into two groups. Seedlings of one group were carefully lifted, shaken free of soil, and packed with moist sphagnum moss according to conventional methods. They were stored in a refrigerated room (4° C) until planting 13 days later. The other group was left outside in the original containers.

Both the barerooted and containerized seedlings were transplanted into blocks in irrigated nursery beds 70 X 1.2 m. Planting was done at a spacing of 18 cm along rows and 30.5 cm between rows. The transplants were watered by a sprinkler irrigation system throughout the growing season, and effective weed control was maintained by hoeing periodically.

In the fall after bud set, the amount of current-year growth was measured for all the surviving trees. Both the current-year height increment and total height were also measured at the end of the second growing season in November, 1976. Height growth differences between the two aspen species and between the two types of planting stock for both years were analyzed by the t-test. Simple correlation analysis was used to determine the relationship between the performance of the two types of planting material.

Results And Discussion

At the end of September 1975, in spite of regular irrigation, only 50 percent of all barerooted trees survived whereas 87 percent of the containerized trees were successfully established. The effect of cold storage on survival could not be determined. Our

Figure 1.–*Block A, September 1975 – One of the blocks planted with barerooted aspen seedlings, toward the end of the first growing season following transplanting. Notice the relatively low survival.*

experience with aspen seedlings, however, shows that they can be lifted and stored under similar conditions for up to 10 months without loss of viability. However, it is likely that some of the new lateral roots which developed during the storage period may have been damaged during planting, and hence hampered the survival of the plants.

Table 1 shows that in both aspen species containerized plants grew twice as fast as barerooted plants in the first growing season following transplanting. However, trembling aspen showed faster height growth than bigtooth aspen irrespective of the planting material used. There was no significant correlation in the clonal performance between the containerized and the barerooted plants. Table 1 also shows height growth measurements in 1976 at the end of the second growing season. For both aspen species there was no significant difference in the second season's growth between the barerooted and containerized plants. In fact, barerooted trembling aspen plants grew slightly faster than the containerized plants of the same species. The difference in total height growth between the two types of planting stock of each species was not significant after two growing seasons.

Barerooted trembling aspen transplants significantly outgrew their barerooted bigtooth aspen counterparts in both the 1975 and 1976 growing seasons. Consequently, the trembling aspen barerooted plants were significantly taller than the bigtooth aspen plants after 2 years' growth. The containerized trembling aspen transplants were also significantly taller than their bigtooth counterparts after two seasons (table 1). However, the containerized bigtooth aspen plants grew as fast as the trembling aspen containerized transplants during the second growing season.

No significant relationship was observed in the current year's height growth of both species between the containerized and barerooted plants of the same clones. Clonal performance in total height between the two types of trembling aspen planting stock was highly correlated (r = .452, 45° of freedom); that is, clones that grew best as barerooted stock also tended to be the tallest among the containerized trees, but bigtooth aspen clones showed no significant relationships.

These results suggest that barerooting aspen seedlings adversely affects their survival after transplanting. Apart from the physical damage to the root system, the failure to recover all the lateral roots during lifting significantly curtails the absorbing root surface needed to keep pace with the rapidly expanding transpiring leaves in early spring. Stone (*8, 9*) observed that the peak period of lateral root initiation in ponderosa pine and Douglas-fir occurs in spring, prior to terminal bud break. Several other woody plants have also been observed to exhibit periods of active root elongation in spring (*3*), (*4*), (*8*), (*9*). If the aspens show similar phenomena, spring lifting of seedlings would seriously hamper not only the root initiation, but also the root elongation potentials of the young trees. Such problems are minimized with container plants.

The relative growth performances of the different planting stocks in 1975 suggest the transplant shock effect is greater for barerooted aspens than for containerized stock. However, this effect seems to last longer on bigtooth aspen, since barerooted bigtooth aspen plants still grew significantly less than the containerized plants during the second year, unlike trembling aspen. The quicker adjustment of trembling compared with bigtooth aspen barerooted transplants to their new environment might be due in part to their inherent faster

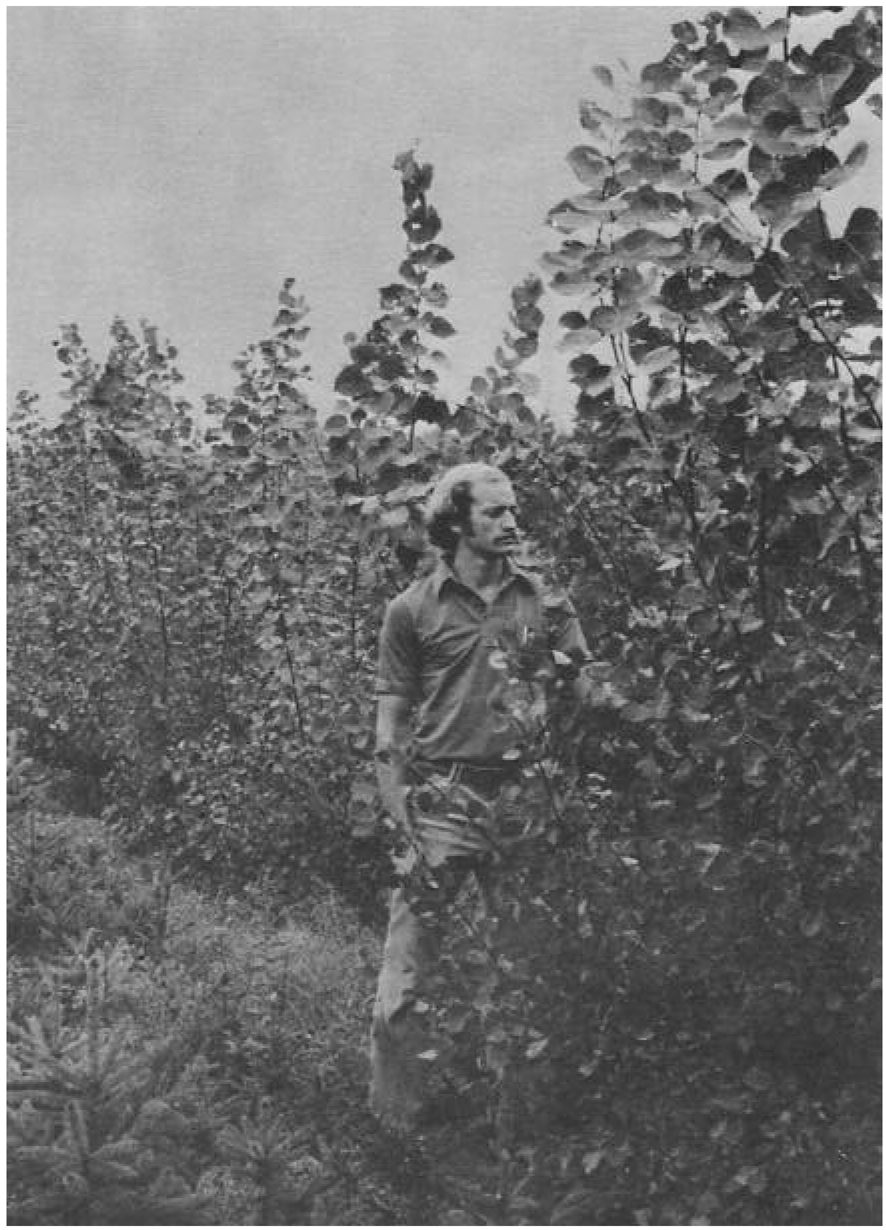

Figure 2.—*Block A, September 1977 – Barerooted aspen seedlings after three growing seasons.*

height growth rate. In the relatively slow-growing conifers, height differences observed in the nursery have been known to persist for several years in the field (*1*). It would seem that these adverse effects of barerooting aspen seedlings will be more drastic under field conditions where the regular irrigation employed in this study would normally be absent.

It should be noted, however, that height growth in this study cannot be equated with growth in terms of dry matter production. Most of the young aspen trees by the end of the second year had produced several lateral branches. In some instances, it was necessary to measure the top of two or three branches to determine the true leader height growth. Rapid early height growth is probably important for aspen in overcoming competition.

From the results of this study, it is recommended that containers be used in raising aspen seedlings to be used in plantation establishment. Both seedling survival and initial height growth should be increased by growing in containers.

Figure 3.–*Block C, September 1975 – A block planted with containerized aspen seedlings, first growing season following transplanting.*

Table 1.—*Relative height growth of barerooted and containerized bigtooth and trembling aspen transplants in 1975 and 1976*

	Height growth (cm)		
	Trembling Aspen (50 clones)	Bigtooth Aspen (42 clones)	Significance between species
1976 season			
Containerized	49	23	**
Barerooted	30	13	**
Significance of difference	**	**	
1976 season			
Containerized	62	58	ns
Barerooted	70	54	**
Significance of difference	ns	ns	
Total height growth			
Contained	112	96	**
Barerooted	108	75	**
Significance of difference	ns	ns	

**Means significant at 1 percent level.

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Figure 4.–*Block C, September 1977 – Containerized aspen seedlings after three growing seasons.*

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