Black Walnut *(Juglans nigra* L.) Establishment: Six-Year Survival and Growth of Containerizec and 1 + 0 Seedlings

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*Outplant survival and growth of containerized black walnut (*Juglans nigra *L.) was compared with that of bareroot 1 +0 seedlings. Survival of containerized seedlings was significantly lower than that of 1 +0 seedlings but the avoidance of outplanting shock produced a significant growth advantage for the surviving containerized seedlings.* (Tree Planters' Notes 37(1):1 1-14; 1986)

Black walnut (*Juglans nigra* L.) has traditionally been planted as 1 +0 bareroot seedlings. However, walnut seedlings are subject to outplanting shock, which limits growth during the first year following outplanting. To determine if planting shock could be avoided and early growth increased by planting containerized seedlings, field performance of black walnut in tarpaper containers was compared with that of bareroot seedlings from the same seed source. This report presents the 6-year results.

Methods

In the autumn of 1978, black walnut seeds from selected sources in Indiana and Michigan were hulled and stratified in moist sand at 0.5 °C. In April 1979, half of the nuts were sown in a nursery and the other half were germinated in a greenhouse and sown into tarpaper containers, one nut per container. The open-ended containers, made of 19 types of commercially available tarpapers ranging in wall thickness from approximately 0.05 to 0.09 millimeter, measured 6.5 by 6.5 by 20 centimeters (fig. 1). Six of the tarpapers were formed into containers that were 6.5 by 6.5 by 30 centimeters. The growing medium was 75 percent peat and 25 percent loam without amendments.

Figure 1—*Containerized seedling at time of outplanting.*

The seedlings were grown in a greenhouse under extended photoperiods of 16 hours and a temperature of approximately 18 °C (night) and 28 °C (day). After 6 weeks the seedlings were transferred to shade frames for 2 weeks of conditioning. In the middle of June the container stock was planted by spade into well-drained loam in a fully cultivated field near Parkhill in southern Ontario. At the time of outplanting the seedlings were 20 centimeters high and actively growing (fig. 1).

In April of the following year, rows of bareroot seedling stock grown in the nursery were planted by spade between rows of containerized seedlings from the same seed sources. Of all the seedlings planted, 204 were in containers 20 centimeters high, 32 were in containers 30 centimeters high, and 271 were 1 +0 nursery-grown stock.

The entire plantation was kept weed-free by annual applications of simazine (5.0 kilograms/hectare) and spot treatments of glyphosate (2.0 kilograms/hectare). The roots of each of three trees planted in containers and of three trees planted as 1 +0 seedlings were excavated in the autumn of 1984, photographed, and examined for possible differences in root development. Survival and height were recorded each autumn for the first 6 years after planting, and the sixth-year survival and height data were analyzed by the Chi-square test and analysis of variance, respectively.

Results

There were no significant differences in either survival or growth of trees grown in tarpaper containers of varying thicknesses or lengths. Therefore, data from the various container treatments were combined. Six-year survival of trees planted in containers and as 1 +0 nursery-grown seedlings was 87 and 94 percent, respectively, with a significant difference at

P<0.05. However, nearly all mortality of the containerized seedlings occurred in the year of planting and was probably related to lack of hardening off.

At the end of the sixth growing season, total heights of containerized and bareroot seedlings were 416 and 385 centimeters, respectively (table 1). The difference was statistically significant (P = 0.05) and was mainly the result of outplanting shock suffered by the 1 +0 seedlings (fig. 2). There were no discernible differences in root development of the containerized and nursery-grown seedlings (fig. 3 and 4).

Table 1—*Height growth of containerized and bareroot seedlings by years from seeding*

Years from seeding	Containerized seedlings (cm)	Bareroot seedlings (cm)
1	27	33
2	54	19
3	88	70
4	67	78
5	33	44
6	147	141
Total height	416	385

Discussion

The biological advantages of containerization are well known, and black walnut seedlings have been grown in a variety of containers with different potting media, soil amendments, length of photoperiods, and other treatments to accelerate growth (1-7). Most experiments have shown that early

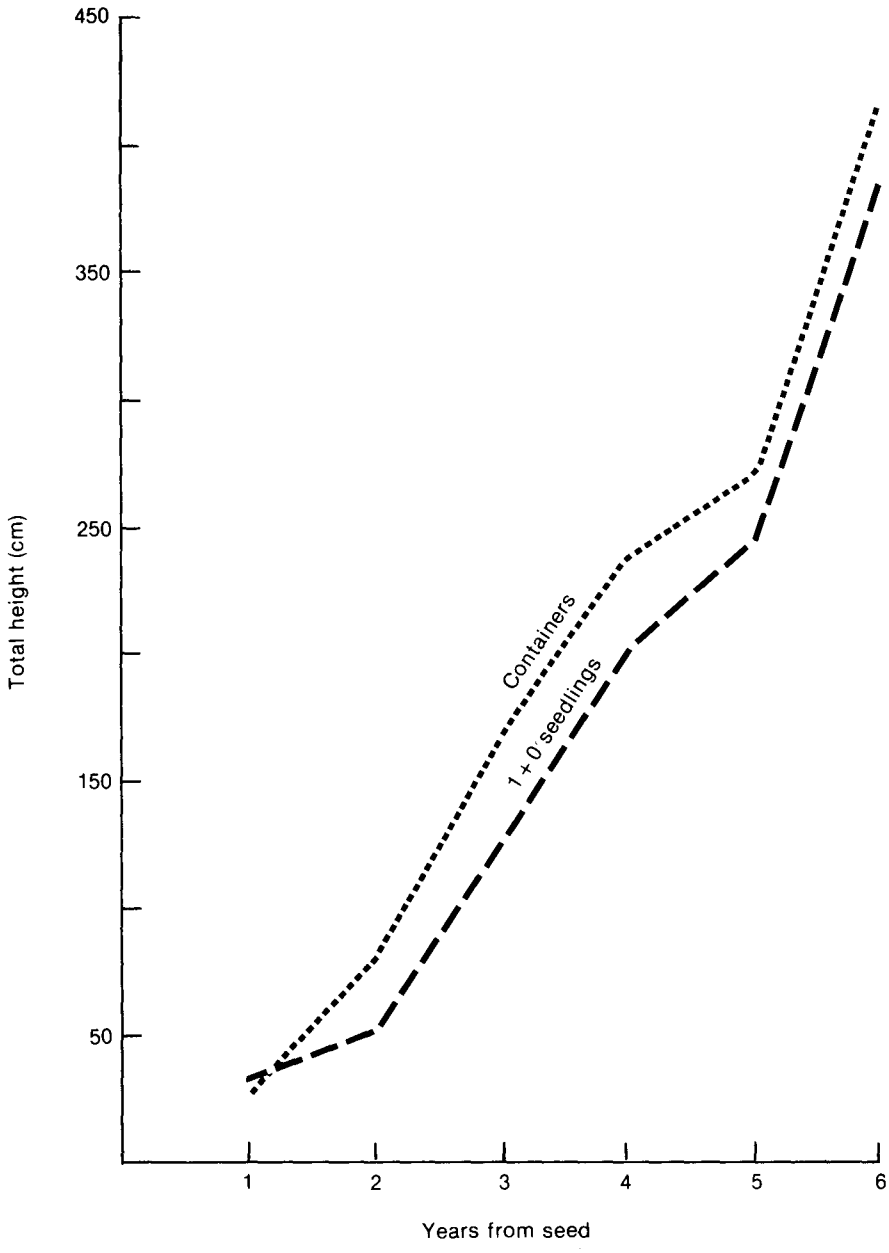

Figure 2—*Height of black walnut seedlings planted either in containers or as 1 + 0 nursery-grown seedlings.*

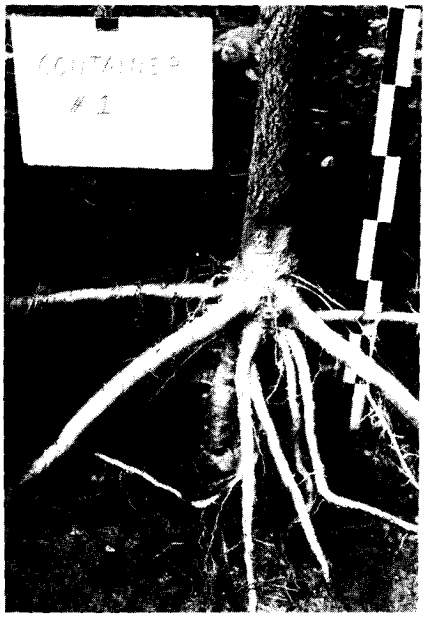

Figure 3—*Root form of containerized seedling.*

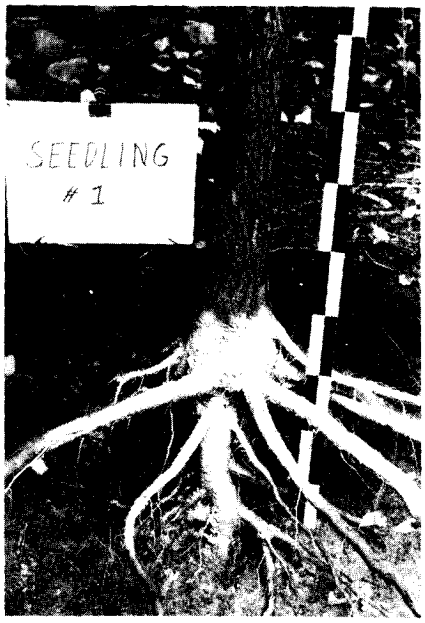

Figure 4—*Root form of nursery-grown seedling.*

growth can be increased by containerization, but little information is available on the field performance and extended growth of these seedlings in comparison with those of bareroot seedlings.

Black walnut seedlings require large containers to accommodate the nut, the pronounced tap root, and the large fibrous root system that develops before the fragile shoot is sufficiently hardened off to withstand injury during transport and outplanting. Wet tarpaper presented no barrier to root penetration (fig. 5). However, all root egress during the greenhouse phase was restricted to the lower half of the tarpaper cubes, which were kept wet by contact with the other cubes in the holding trays. Figure 6 shows that the roots near the soil surface have grown downward along the side of the container wall, either because they were unable to penetrate the dry tarpaper or because the root tips were air pruned.

Figure 5—*Root egress through tarpaper wal at time of outplanting.*

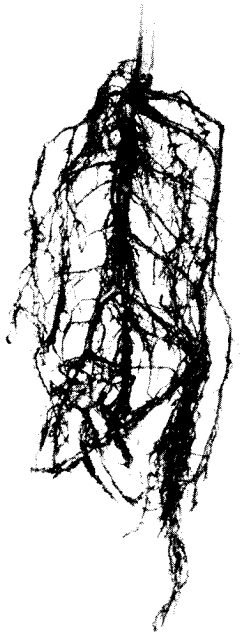

Figure 6—*Root system of containerized walnut seedling at time of outplanting, exposed by removal of container and washed to show root system form.*

Conclusions

Planting black walnut seedlings in containers can be a means of avoiding outplanting shock, and growth can thereby be increased during the early years after outplanting. However, the high cost of

production, transportation, and outplanting will probably restrict containerization to growing high-value seed or for use in reforestation when rapid early height growth is important to the success of the plantation.

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