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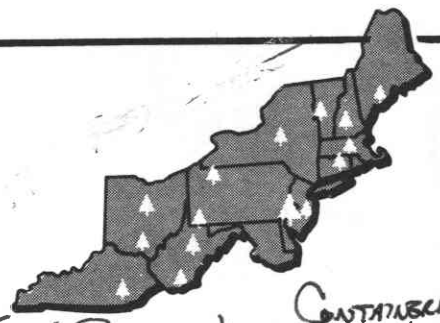

* FILE: REGENERATION - CONTAINERIZED SEEDLINGS

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SUMMER PLANTING OF CONTAINER-GROWN NORTHERN HARDWOODS

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Abstract. Seedlings of paper birch and yellow birch were grown in styrofoam blocks of two cavity sizes, 40 cc and 125 cc, in four different soil mixes. After 16 weeks, the seedlings were outplanted on a cleared forest site in mid July. Seedling survival for all treatments after two growing seasons was very good (98.8 percent). The effects of container size and soil mix were relatively small and statistically significant only at the time of outplanting. Paper birch seedlings grew much more rapidly than the yellow birch. An early August outplanting of red maple seedlings was added to the study. Growth and survival of the red maple was similar to that of the birches.

Planting northern hardwood seedlings presents some very difficult problems to the forest manager. The planting season is short, and the trees must be lifted from the nursery and outplanted while they are still dormant. Planting must be completed while soils are moist and temperatures are moderate. In many years, conditions are suitable for planting for only 3 or 4 weeks in the spring. Such a short season greatly limits the amount of planting that can be done. But even when the planting operations are accomplished, seedling survival is often poor (Bjorkbom 1968). When survival is adequate, the seedlings frequently grow slowly (Bjorkbom 1972) and are overtopped by faster-growing weed species (Rudolph et al. 1964).

One promising solution to this problem is planting container-grown seedlings (Davidson and Sowa 1974, Forbes and Barnett 1974, and White et al. 1970). We have tested this technique in New Hampshire with paper birch (*Betula papyrifera* Marsh.), yellow birch (*Betula alleghaniensis* Brit.), and red maple (*Acer rubrum* L.).

Figure 1.—Each cell in the styrofoam block contained a single seedling.

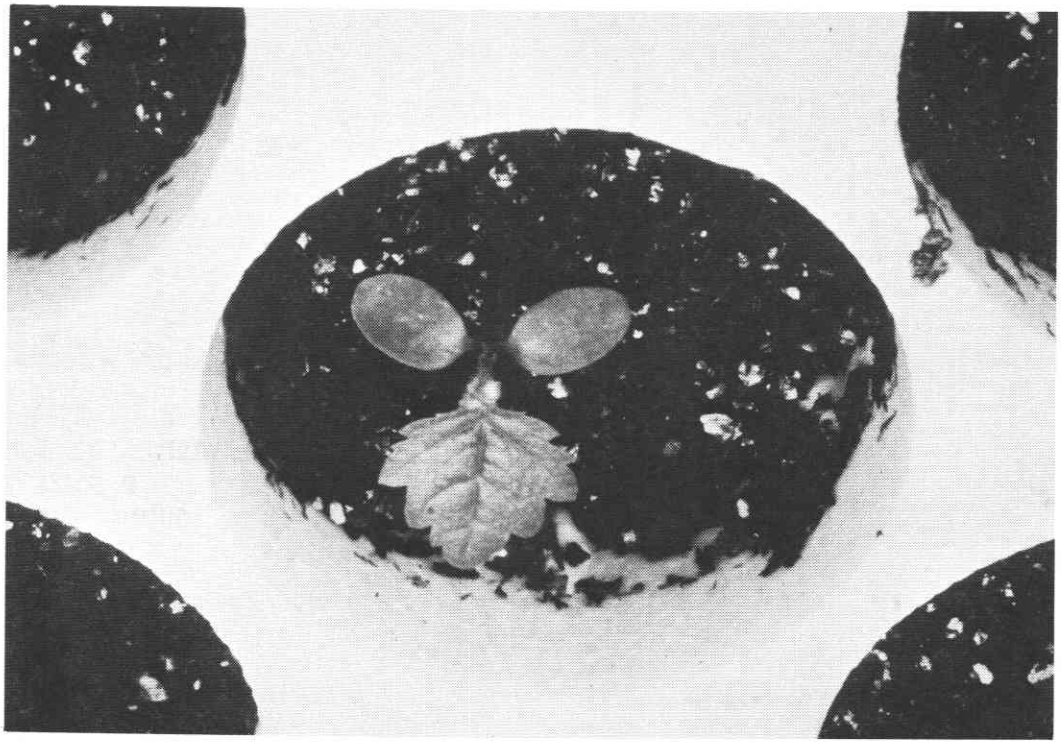
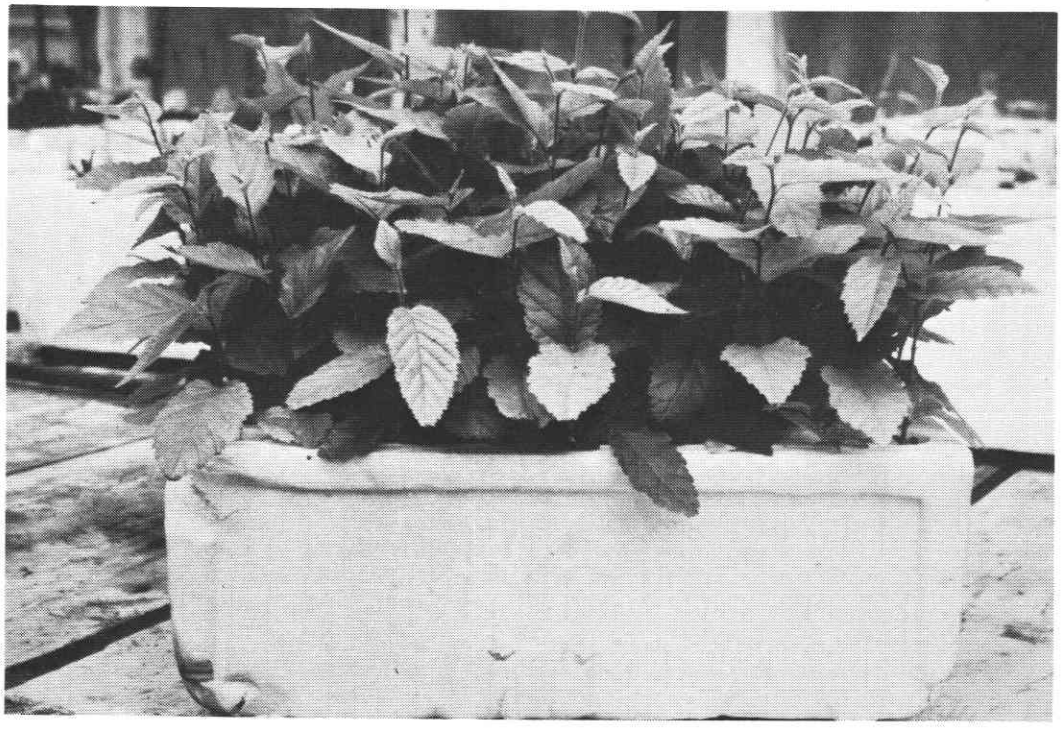


Figure 2.—After 16 weeks' growth, these yellow birch seedlings are ready for outplanting.



METHODS AND MATERIALS

The seedlings were grown in styrofoam blocks with planting cavities of two sizes: 40 and 125 cubic centimeters (2.45 and 7.63 cubic inches, respectively). The styrofoam blocks were filled with four different soil mixes as follows: Soil A: 50 percent shredded forest humus, 25 percent Jiffy-mix,[1] and 25 percent sandy loam; Soil B: 50 percent shredded forest humus and 50 percent sandy loam; Soil C: 50 percent Jiffy-mix and 50 percent sandy loam; Soil D: 100 percent Jiffy-mix.

In late March, a single germinated seed of yellow or paper birch was planted in each cell of the styrofoam blocks (Fig. 1). The plants were grown in a greenhouse, irrigated daily with an automatic misting system, and fertilized with a complete nutrient solution every 2 weeks.

At the end of the 16-week growth period in mid-July, the seedlings were outplanted in the White Mountain National Forest in New Hampshire (Fig. 2). The planting site had previously been forested with old growth beech, yellow birch and sugar maple. After logging, the site was prepared for planting by stump removal and scarification. Most of the litter and humus was removed during site preparation and the ground was bare or nearly so at the time of planting. The soil, a well-drained sandy loam podzol, was moist from a recent rain at the time of planting. The seedlings were planted by forcing a dibble into the ground; then removing the seedling from the container complete with soil and placing the root-bound soil cone into the hole. The soil was tamped around the newly planted seedling. First summer rainfall was normal with 30.94 cm (12.18 in) evenly distributed through the critical July-to-September growing period.

A randomized block design with sampling of plots was used in this study of two container sizes, two tree species and four soil combinations. Ten seedlings were randomly selected from each of the 16 treatment combinations. Total seedling height and diameter at the root collar were measured for each of these seedlings. The measured seedlings were marked so that they could be remeasured at the end of the first and second growing seasons. The treatment effects were tested for significance at the 1 percent level by analysis of variance.

An abbreviated planting test was made with red maple. Only the D soil, consisting of 100 percent Jiffy mix, was used for this species. The seed was collected from the current seed crop in early June and immediately sown in the 40 and 125 cubic-centimeter blocks. In early August, after 8 weeks of growth, the red maple seedlings were outplanted at the same location as the birches. Ten red maple seedlings from each container size were randomly selected and measured before planting. They were marked in the field so they could be remeasured at the end of the first and second growing season.

RESULTS AND DISCUSSION

Growth of the container seedlings was good. At the time of planting, the 16-week-old birches averaged 1.6 mm (.06 in) in diameter at the root collar and 12.5 cm (4.92 in) in height. After one growing season, average diameter was 2.9 mm (0.11 in) and average height was 14.5 cm (5.71 in). At the end of the second growing season, average diameter was 8.2 mm (.32 in) and the average height was 53.8 cm (21.18 in). The rapid growth represents a successful adaptation of the seedlings to the planting site.

At the end of the greenhouse growth period, the effect of the four soil mixtures on diameter and height growth was significant: soil mix D had the best growth, followed by C, then A, and finally B (Table 1). However, growth differences at the end of the first and second growing seasons in the field were not significant.

The 125-cubic-centimeter containers produced a larger seedling with height growth 31 percent greater and diameter growth 22 percent greater than those in the 40-cubic-centimeter containers (Table 2). This advantage in size diminished during the first and second growing seasons, being statistically significant only when first measured at the time of outplanting.

Paper birch grew faster than yellow birch. The differences between species were statistically significant in all measurements. At the end of the second growing season, the paper birch seedlings

[1] Trade name for a commercial product containing equal amounts of finely shredded sphagnum peat moss and horticultural vermiculite, plus nutrients. The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

Table 1.—Effect of soil mix on height and diameter growth of paper and yellow birch seedlings

Growth observation	Soil Mix							
	A		B		C		D	
	Height	Diameter	Height	Diameter	Height	Diameter	Height	Diameter
	cm	*mm*	*cm*	*mm*	*cm*	*mm*	*cm*	*mm*
Container—16 weeks	12.2	1.6	10.8	1.5	13.4	1.7	13.8	1.7
Field—1st year	16.0	3.1	12.5	2.7	14.7	3.1	14.8	2.8
Field—2nd year	56.6	8.7	57.9	8.9	51.3	8.5	49.5	7.1

Table 2.—Effect of container size on height and diameter growth of paper and yellow birch

Growth observation	Container Size			
	40 cm^3		125 cm^3	
	Height	Diameter	Height	Diameter
	cm	*mm*	*cm*	*mm*
Container—16 weeks	10.8	1.5	14.2	1.8
Field—1st year	13.0	2.9	16.0	3.0
Field—2nd year	51.4	8.0	56.2	8.5

Table 3.—Effect of species on height and diameter growth

Growth observation	Species			
	Paper birch		Yellow birch	
	Height	Diameter	Height	Diameter
	cm	*mm*	*cm*	*mm*
Container—16 weeks	13.2	1.7	11.8	1.6
Field—1st year	16.7	3.2	12.3	2.6
Field—2nd year	64.8	9.6	42.8	7.0

were 50 percent taller than the yellow birch. This rapid growth reflects the superior juvenile growth of paper birch and its better adaptation to the exposed planting site (Table 3).

At the end of the first season, the red maple seedlings averaged 2.2 mm (.09 in) in diameter at the root collar and 16 cm (6.30 in) in height. The seedlings which had been grown in the 125-cubic-centimeter containers were 22 percent larger in diameter and 25 percent taller than the seedlings grown in the small containers. After the second growing season, the red maple seedlings averaged 6.0 mm (.24 in) in diameter and 27 cm (10.63 in) in height.

The effects of container size (40 cm^3 vs. 125 cm^3) on diameter and height growth were relatively small, and by the end of the first growing season were not significant. The use of large containers for the birches and red maple does not seem justified under the conditions of this study. The large

containers require more greenhouse space, and the resulting seedlings are heavier and more difficult to plant in the field. Larger seedlings might be desirable where intense plant competition is anticipated or on difficult sites.

Survival for the three species was extremely good. None of the marked seedlings died the first growing season. One paper birch and one yellow birch died during the second growing season.

It is unlikely that seedling mortality would be this low (1.2 percent) in a large-scale planting. But this result is an indication of the good survival that may be expected from container-grown seedlings. The seedlings were planted in July (the birches) and August (red maple), a time when conventional bare-root nursery stock could simply not be expected to survive. The implication of this excellent survival is that container-grown seedlings can greatly extend the planting season, allowing greater flexibility and more efficient scheduling of planting operations.

Neither seedling growth nor survival was strongly influenced by the choice of soil mix. At the time of outplanting, the soils with 50 percent or 100 percent Jiffy mix (soils C and D) produced the larger seedlings, but this effect was soon lost. By the end of the second year, seedlings grown in the A and B soil mixes with 50 and 25 percent forest humus, respectively, were slightly larger. With regular applications of a balanced nutrient solution and careful irrigation during the greenhouse growing period, any reasonable soil mix may be adequate. An ideal soil mix should be porous enough to ensure good aeration and drainage and yet hold an adequate moisture and nutrient supply. The addition of at least a small percentage of forest humus might be desirable to ensure inoculation with mycorrhizae (Zak 1975).

Paper birch, yellow birch, and red maple seem equally well adapted to the container method, and seedlings of these species have a good potential for survival and growth even when outplanted in midsummer.

LITERATURE CITED

Bjorkbom, J.C.
1968. **Planting paper birch in old fields in Maine.** U.S. Dep. Agric. For. Serv. Res. Pap. NE-103, 12 p.

Bjorkbom, J.C.
1972. **Ten-year growth of planted paper birch in old fields in Maine.** U.S. Dep. Agric. For. Serv. Res. Pap. NE-246, 6 p.

Davidson, W.H., and E.A. Sowa.
1974. **Container-grown seedlings show potential for afforestation of Pennsylvania coal-mine spoils.** Tree Planters' Notes 25(4):6-9.

Forbes, D.C., and P. E. Barnett.
1974. **Containerized hardwoods: A partial summary of current work in production, establishment, and cultural needs.** P. 129-132. *In:* North Am. Containerized For. Tree Seedling Symp. Proc. Great Plains Agric. Publ. 68. Edited by R. W. Tinus, W. I. Stein and W. E. Balmer.

Rudolph, V.J., A.K. Quinkert, and J.N. Bright.
1964. **Analysis of growth and stem quality in mixed hardwood plantings.** Q. Bull. Mich. Agric. Exp. Stn. 47:94-112.

White, D.P., G. Schneider, and W. Lemmien.
1970. **Hardwood plantation establishment using container grown stock.** Tree Planters' Notes 21(2):20-25.

Zak, B.
1975. **Mycorrhizae and container seedlings. P. 21-23.** *In:* 23rd Western Int. For. Dis. Work Conf. Proc. U.S. Dep. Agric. For. Serv.

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