Influence of Styroblock Container Size on Field Performance of Douglas-fir, Western Hemlock, and Sitka Spruce

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Several Pacific Northwest conifers were grown in BC/CFS Styroblocks of 2- and 8-cubic-inch capacity and then outplanted in coastal British Columbia. The Styroblock-8 seedlings survived no better than the Styroblock-2 seedlings. However, the taller Styroblock-8 seedlings grew faster over the 5-year test period.

Many types and sizes of containers are available in North America for growing tree seedlings (3). Recent trends to design larger containers for correspondingly larger classes of stock have stemmed from the belief among some land managers that large container seedlings, grown in larger containers, guarantee better field survival and growth. This study provides some quantitative data on the subject from trials established in 1972 and 1973 on western Vancouver Island, B.C. The objective of the investigation was to determine what differences in field performance occurred between two sizes of stock grown in two sizes of containers, BC/CFS Styroblocks 2 and 8 (*2*).

Materials and Methods

Seedling production. The seedling species tested were Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), and Sitka spruce (*Picea sitchensis* (Bong.) Carr.). Seedlings were grown in BC/CFS Styroblock containers 2 and 8, with respective volumes of 40 and 125 cubic centimeters, using a growing medium of three parts peat and one part horticultural vermiculite, plus 3 kilograms per cubic meter (12 mesh and finer) dolomitic lime. The medium was loaded wet (about 400% of ovendry weight) to obtain a density of 0.1 gram ovendry weight of growing medium per 1 milliliter of usable container volume. All seeds were soaked in water for 24 hours and then stratified for 2 to 3 weeks at 2° C before sowing in mid-April 1971 in the Styroblocks at the Pacific Forest Research Centre Nursery at Victoria, B.C.

Styroblocks were placed under plastic film in a heated headerhouse for 6 days to initiate seed germination. Thereafter, the Styroblocks with smaller cavities (Styro-2) were kept in an outdoor shadehouse nursery and the Styroblocks with larger cavities (Styro-8) in a heated greenhouse. The rationale for selecting these two different thermal regimes was that seedling growth had to be maintained at a higher level in the Styro-8's for the seedlings to fully use the greater volume of growing medium in the larger containers. The Douglas-fir and Sitka spruce seedlings in the Styro-8's were subsequently moved to the outdoor shadehouse nursery in mid-June, with the western hemlock following in mid-July. All stock was moved into an unheated shelterhouse nursery at the beginning of October. The fiberglass roof in this nursery protected the seedlings from heavy winter rains and the first radiation frosts in mid-October.

All fertilizers, except the dolomitic lime, were supplied through the irrigation system. For the first 16 weeks, biweekly applications of 28-14-14 fertilizer at a rate of 180 to 375 grams per 1,000 liters were applied following secondary needle formation. From September to early November, 15-15-30 fertilizer was applied weekly at 120 to 180 grams per 1,000 liters. Thereafter 15-15-30 fertilizer was applied once a month from November to February at 375 grams per 1,000 liters. Mean monthly winter temperatures at Victoria rarely fall below 4.5° C, the critical level at which root growth ceases, hence the need for a winter fertilization schedule.
The seedlings were fertilized

with 310 grams per 1,000 liters of 28-14-14 fertilizer before planting on March 21, 1972. A representative sample of the three seedling species grown in the two container sizes is shown in figure 1.

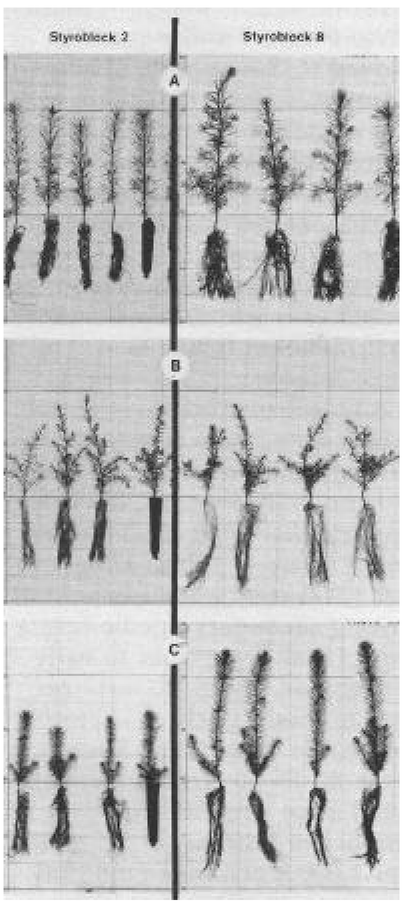

Figure 1.-*Representative seedling sample of Douglas-fir (A), western hemlock (8), and Sitka spruce (C) grown in two container sizes.*

The same seedlots were sown again in mid-April 1972 and grown under similar regimes to those of 1971 for a further replication of outplanting trials on April 3, 1973. The only difference in the cultural schedule was the biweekly application of 10-52-10 fertilizer at 625 grams per 1,000 liters for 2 weeks immediately following formation of the secondary needles, again in the fall, and once monthly throughout the winter. This high-phosphorus fertilizer had been introduced as a standard feature in cultural regimes for British Columbia container nurseries in 1972 following research by Van Eerden (*4*). The nutritional change did not make any substantial difference in seedling morphology between the stock grown in the 2 consecutive years. Average seedling size of the stock outplanted in the field trials is shown in table 1.

Test site. The outplanting site was at Braden Creek near Port Renfrew, B. C. (lat. 48°45' N., long. 124°25' W.). Situated at 300 meters above sea level on the west coast of Southern Vancouver Island with 260 frost-free days and an annual precipitation exceeding 3,000 millimeters, the local growing conditions are ideal for all three test species. The area was logged and burned in the autumn of the year before planting. The area had formerly supported a decadent stand of western red cedar *(Thuja plicata* Donn), western hemlock, and amabilis fir (*Abies amabilis* (Dougl.) Forbes), with a site index (base 100) of 42 meters. The topography sloped gently to the north and soils consisted of well-drained gravelly outwash sands over coast intrusive bedrock. The area falls within the CWHb1,2 (wetter maritime coastal western hemlock biogeoclimatic subzone (*1*)).

The experimental layout in the field comprised a randomized complete block with split plot design. Three blocks were established each year with seedling species being randomly assigned to the three split plots within which the two stock types were located. A total of 50 seedlings per species per stock type was planted in each of the three blocks in each year. As one experimental block was accidentally destroyed, the final analysis of variance was conducted on a total of five blocks.

Results and Discussion

Seedling size differences in the nursery. The larger volume Styro-8 container produced larger and sturdier seedlings than those grown in the Styro-2 (table 1, fig. 1). Shoot and root dry weight were substantially greater, but height differences never exceeded 5 centimeters. Western hemlock showed the

Table 1.—*Morphological characteristics of Douglas-fir, western hemlock, and Sitka spruce grown in small (Styro-2) and large (Styro-8) containers*

Seedling species	Container type	Shoot		Root	
		Length	Ovendry weight	Ovendry, weight	Collar diameter
		Cm	*Mg*	*Mg*	*Mm*
Douglas-fir	Styro-2	17[1]	962	527	2.6
	Styro-8	22	1,791	1,304	3.5
Western hemlock	Styro-2	14	764	397	2.1
	Styro-8	17	1,052	506	2.2
Sitka spruce	Styro-2	15	979	439	2.3
	Styro-8	19	1,710	901	3.0

[1]Values are means of 20 seedlings per container type per seedling species.

Table 2.—*Percentage of survival of three species of Styro-2 and Styro-8 seedlings 5 years after planting*

Seedling species	Container type	Survival by growing season 1	2	3	5
		%	%	%	%
Douglas-fir	Styro-2	94a[1]	89a	88a	87a
	Styro-8	97a	92a	90a	89a
Western hemlock	Styro-2	86b	79b	75b	73b
	Styro-8	84b	76b	70b	65b
Sitka spruce	Styro-2	97a	91a	90a	90a
	Styro-8	98a	96a	96a	96a

[1]Within each growing season, means followed by the same letter are not significantly different (p = 0.01).

least amount of stock size difference between the two container types, because the cultural and environmental regimes used to grow this species in 1971 and 1972 were inadequate to fully use the growing medium volume of the large Styro-8 containers. This could have been corrected by using an earlier sowing date, coupled with more time in the heated greenhouse.

Field performance. There were no significant differences in seedling survival between the two sizes of stock for all three species (table 2). However, the Styro-8 seedlings were significantly ($p = 0.01$) taller after the first growing season in the field and that difference has remained throughout the first 5 years of this investigation (fig. 2).

The Douglas-fir seedlings were heavily browsed by deer, which accounted for their significantly smaller size (fig. 2). Frequency of browsing on the smaller Styro-2 seedlings was twice that found on the larger Styro-8 stock. Western hemlock seedling survival was significantly ($p = 0.01$) lower than fir or spruce, and the Styro-8 seedlings suffered greater (but not statistically significant) mortality than the Styro-2 seedlings, a reversal of the trend in the other two species (table 2). Root

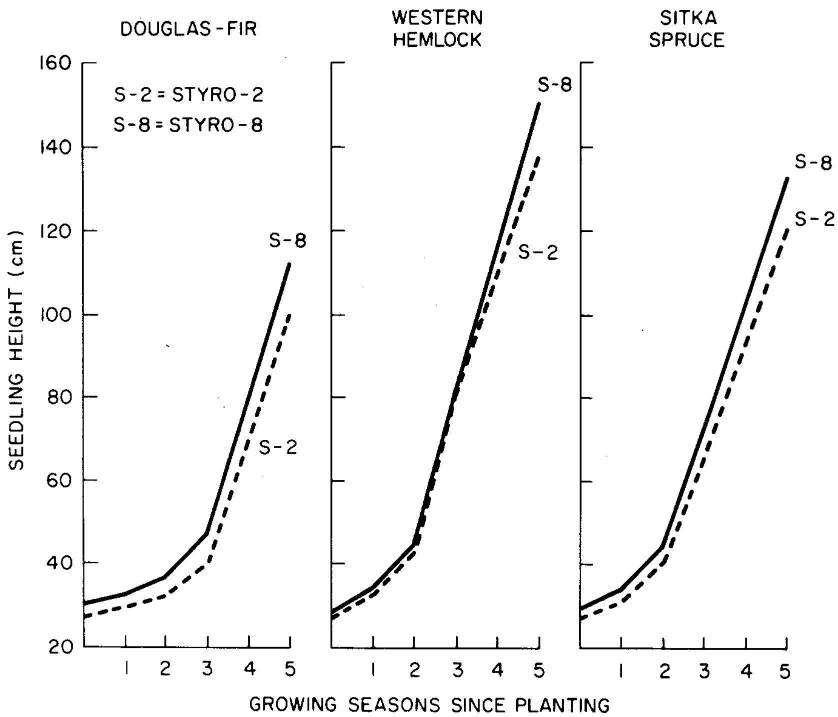

Figure 2.—*Height growth of Styro-2 and Styro-8 Douglas-fir, western hemlock, and Sitka spruce seedlings.*

pathogens were the cause of the hemlock failures.

In summary, the larger container stock did not significantly improve field survival, but the larger Styro-8 seedlings were significantly taller than the Styro-2 seedlings. Although the height differences between the two stock sizes after 5 years did not exceed 25 centimeters, the growth rates of the two seedling types indicate an increasing height difference with time since planting (fig. 2). This was apparent even when the western hemlock seedlings had not grown enough to fully fill the Styro-8 container with roots. Depending on the length of the rotation, this may be a significant consideration. Conversely, the height growth advantages of the Styro-8 seedling must be weighed against the higher costs of growing them in the nursery (approximately 2.5 times greater) and the slower planting productivity with the bulkier and heavier Styro-8 seedlings. On this cost-effective basis, the Styro-2 seedlings appeared to be a better choice of stock type for this site, which had no serious brush competition.

Literature Cited

1. Klinka, K.; Nuszdorfer, F. C.; Skoda, L. Biogeoclimatic units of central and southern Vancouver Island. Misc. Publ. Victoria, BC: British Columbia Ministry of Forests; 1979. 120 P.
2. Sjoberg, N. E. The Styroblock container system. In: Tinus, R. W., and others, eds. Proceedings of the North American containerized forest tree seedling symposium; 1974 Au-. gust 26-29; Denver, CO. Great Plains Agricultural Council Publication 68; 1974: 217-228.
3. Tinus, R. W.; Stein, W. 1.; Balmer, W. E., eds. Proceedings of the North American containerized forest tree seedling symposium; 1974 August 26-29; Denver, CO. Great Plains Agricultural Council Publication 68; 1974. 458 p.
4. Van Eerden, E. Growing season production of western conifers. In: Tinus, R. W., and others, eds. Proceedings of the North American containerized forest tree seedling symposium; 26-29 August 1974; Denver, CO. Great Plains Agricultural Council Publication 68; 1974: 93-103.