Effect of Container Type and Watering Regime on Early Growth of Western Larch Seedlings

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*Seedlings of western larch (*Larix occidentalis *Nutt.) were grown in three types of containers (Rootrainer®, Pinecells®, and Styroblocks®) at three different watering regimes (50, 75, or 100% water content). The Rootrainer container combined with a 75% watering regime resulted in the greatest top and root growth. Seedlings grown in Pinecell containers were similar. Styroblock containers resulted in the least growth at all levels of moisture, but the 50% watering regime resulted in the longest roots.*
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Western larch (*Larix occidentalis* Nutt.) is a valuable timber species indigenous to moist, well-drained sites of the Pacific Northwest (2). Because of its extremely rapid growth rates (5), western larch is favored for planting on appropriate sites after logging. However, producing vigorous container seedlings for outplanting has been problematic because of the difficulty in controlling growth and phenology. Previous work in our greenhouses (1,4) suggested that different potting containers might result in substantial differences in growth performance, and that there may be interacting effects of containers with moisture regimes. The following study was undertaken to examine early growth performance of western larch seedlings in three commonly used containers and under three differing moisture regimes.

Methods

Stratified western larch seed were sown into one of three types of containers: Ray Leach Pinecells® (Ray Leach "Conetainer" Nursery, Canby, OR); Sixes Rootrainer® (Spencer-Lemaire Industries Ltd., Edmonton, Alberta, Canada); or Beaverfoam Styroblock® 4 (Beaver Plastics Ltd., Edmonton, Alberta, Canada). Cells of each container were of the same size (140 cm^3; 5.5 in^3).

The growth medium was a 1:1 peat-vermiculite mix (Standard Forestry Mix, W.R. Grace & Co., Santa Ana, CA). Seedlings were grown in a greenhouse maintained at 25 °C day and 20 °C night temperatures. Metal halide lamps extended the photoperiod to 14 h with minimum light intensity of 300 to 500 µmol $m^{-2}s^{-1}$. Three seeds were sown into each cavity in mid-July 1985; seedlings were thinned to one healthy seedling after about 2 weeks.

The medium of each container is maintained at one of three water contents: 50, 75, or 100% of the weight of the container plus potting medium and water. Weight at field capacity was used as the 100% regime. Weights were determined four times daily throughout the experiment and water contents adjusted accordingly.

Seedlings were irrigated at 15-day intervals alternately with one of two liquid fertilizers:

1. $Ca(N0_3)_2 \times 4\ H_20$ (53 ppm N, 75 ppm Ca) with Sequestrene 330 Fe (Ciba-Geigy, Greensboro, NC) at 2 ppm Fe;
2. Agro 5-25-25 (Pacific Agro Company, Renton, WA) at 20 ppm N with $MgS0_4 \times 7H_20$ at 48 ppm Mg.

This formulation also included 44 ppm P, 83 ppm K, 0.12 ppm S, 0.44 ppm Fe, 0.28 ppm Zn, 0.20 ppm Cu, and 0.08 ppm B.

Each container was represented by 12 blocks, each containing 60 cells. These were subdivided to accommodate the three watering regimes. Thus, 80 cells were available for testing each container x water combination. The heights of 20 randomly selected seedlings from each block were measured

on September 3, September 12, and October 15.

Three seedlings per block were destructively harvested on the same dates for determination of total root length and root dry weight. Root lengths were measured using a semiautomated X-Y-plotter-based method (6). Harvested material was dried to constant mass at 50 °C and weighed. Data were analyzed using analysis of variance procedures and treatment means compared using Duncan's multiple range test (2). Differences were declared significant at probability level of P=0.05.

Results and Discussion

Seedlings in the Rootrainer container displayed the greatest height growth. Seedlings grown in the Pinecell and Rootrainer containers both showed greater height growth than seedlings grown in Styroblocks (table 1). The 75% watering regime resulted in the greatest overall height growth. Seedling heights with the other two regimes were similar 90 days after planting; however, the 50% watering regime limited height growth during early establishment (table 1). Root growth, both length and weight, followed a similar pattern (table 2).

There was a significant interaction between container type and water regime. In both the Pinecell and Rootrainer containers, the 75% water regime resulted in the greatest height growth throughout the experiment, but the influence of the other two water regimes changed over time (fig. 1). Within the Styroblocks, the greatest and least height growth resulted from the 100 and 50% watering regimes, respectively, during early establishment. However, these differences were minimal by 90 days after sowing (fig. 1).

Root length and weight behaved similar to height growth in both the Pinecell and Rootrainer containers, but the magnitude of difference caused by the 75% water regime in the Rootrainer was considerably greater (fig. 2). In the Styroblock containers, the 50% water regime resulted in the greatest root length; the 100% watering regime, the least. The 50 and 75% watering regimes had equal effect on root dry weight (fig. 2).

Why the different containers should contribute to such differences in growth performance is not clear, but it may be related to the thermal characteristics of the fabrication material. The Rootrainer is made from a thin polystryrene sheet plastic that provides little insulation and allows rapid heat transfer. By contrast, the Styroblock containers are formed from expanded bead polystyrene and provide good insulation and much slower heat transfer characteristics. The polyethylene material used in Pinecells would probably fall somewhere in between. Thus, potting medium in the Rootrainers may heat more rapidly

Table 1—*Effects of container type (over all watering regimes) and water regime (over all container types) on height of western larch seeds sown July 13*

	Seedling height (cm)	
Category	Sept. 3	Oct. 15
Container type		
Pinecell	1.69 ± 0.03 b	2.14 ± 0.03 b
Rootrainer	1.77 ± 0.02 a	2.25 ± 0.04 a
Styroblock	1.45 ± 0.02 c	1.91 ± 0.03 c
Water regime		
50%	1.39 ± 0.02 c	1.98 ± 0.03 b
75%	1.83 ± 0.03 a	2.38 ± 0.04 a
100%	1.69 ± 0.02 b	1.93 ± 0.03 b

Values shown are means (± standard error) of 240 samples. Those values followed by the same letter within a category are not significantly different (P ≤ 0.05) for that date, Duncan's multiple range test.

Table 2—*Effects of container type (over all watering regimes) and water regime (over all container types) on root length and dry weight of western larch*

Category	Root length (cm)	Root weight (g)
Container type		
Pinecell	153.5 ± 10.7 b	0.05 ± 0.003 a
Rootrainer	171.5 ± 14.7 a	0.05 ± 0.007 a
Styroblock	104.6 ± 5.4 c	0.03 ± 0.001 b
Water regime		
50%	150.0 ± 8.49 b	0.04 ± 0.002 b
75%	186.1 ± 14.0 a	0.06 ± 0.007 a
100%	93.5 ± 6.0 c	0.03 ± 0.002 c

Values shown are means (± standard error) of 36 samples. Those values followed by the same letter within a category are not significantly different (P ≤ 0.05), Duncan's multiple range test.

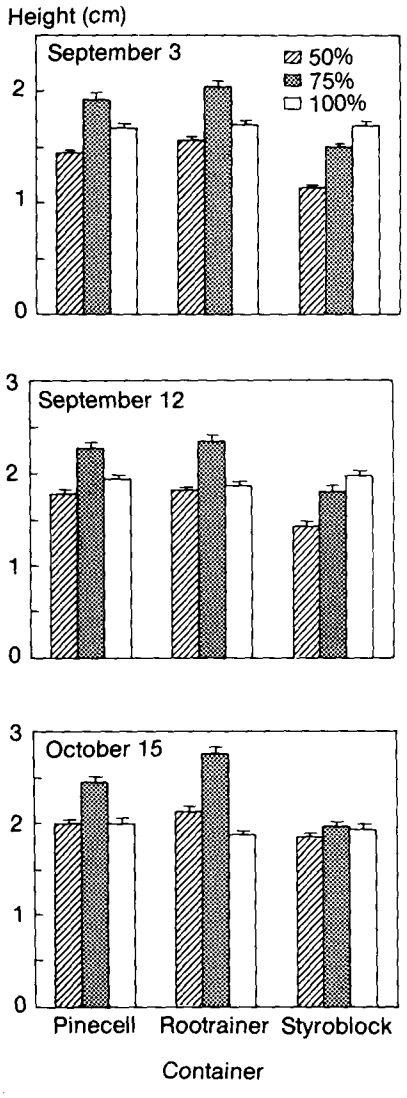

Figure 1—*Height growth of western larch seedlings in relation to combinations of container type and watering regime. Seeds were sown July 13 and measurements made September 3, September 12, and October 15. Each vertical bar is the mean of 80 samples. Error bars represent one standard error of the mean.*

during the day and stay warmer for more of the day than medium in Styroblocks. This, in turn, would contribute to greater root development, consistent with our observations.

In summary, of the three containers and three moisture regimes tested, the Rootrainer container combined with a 75% watering regime resulted in the best top and root growth in young western larch seedlings. Seedlings grown in Pinecell containers were similar. Styroblock containers resulted in the least growth at all levels of moisture. The 50% watering regime resulted in the greatest root length.

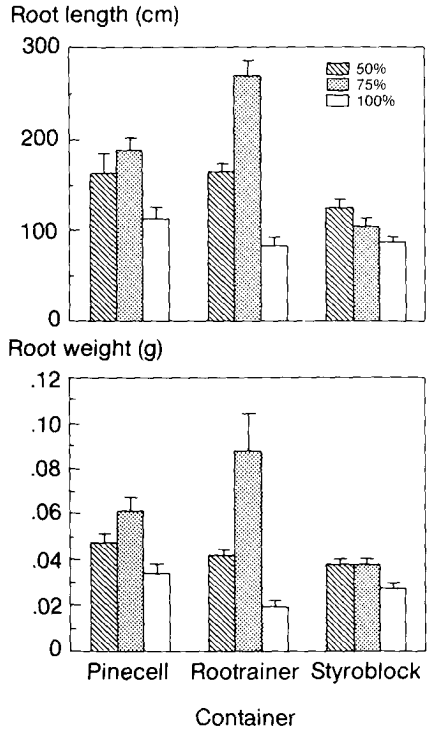

Figure 2—*Root growth of western larch seedlings in relation to combinations of container type and watering regime. Seeds were sown July 13 and measurements made October 15. Each vertical bar is the mean of 36 samples. Error bars represent one standard error of the mean.*

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