

The Effect of Chilling and Seed Source on the Growth of Containerized Fraser Fir (*Abies fraseri* (Pursh) Poir.) Seedlings

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*Artificial and natural chilling of containerized Fraser fir (*Abies fraseri* (Pursh) Poir.) seedlings were compared in seed from two sources. Seedlings from both sources showed superior elongation when chilled outdoors through November 13 than when chilled artificially in a cold room at 2 °C. Height growth of 15-month-old containerized seedlings exceeded that of 4-year-old conventionally grown seedlings. Tree Planters' Notes 38(2):19-21; 1987.*

Fraser fir (*Abies fraseri* (Pursh) Poir.) is an important Christmas tree species throughout North Carolina, Tennessee, and Virginia. Commercial plantations are generally established with 5-year-old (3 + 2) transplants (1). As a result of this long production period, demand for seedlings exceeds their supply in most years. This has prompted considerable interest in accelerating growth and increasing the production of plantable Fraser fir seedlings.

Growing containerized seedlings in a greenhouse can significantly reduce seedling production time (3) and may be a feasible method for increasing and accelerating the production of Fraser fir seedlings. However, information dealing with the pro-

duction of containerized Fraser fir seedlings is limited.

Even under optimum growing conditions and continuous long photoperiods, growth of Fraser fir seedlings is limited because seedlings become dormant after only three to four growth flushes (2). Further exposure to long days results in limited new bud break, and seedlings that do break bud often exhibit stunted, abnormal elongation and loss of apical dominance. A chilling period of 4 to 6 weeks has been found to induce bud break and maximize shoot elongation in Fraser fir seedlings (2).

This study was conducted to evaluate the effects of short periods of cold storage on accelerating and maintaining normal growth of containerized Fraser fir seedlings.

Materials and Methods

Wild seed from two sources (Mt. Rogers, VA, and Roan Mountain, NC) were planted in "Cone-tainer" super cell containers filled with ProMix BX. Seedlings were grown in a greenhouse maintained at a minimum temperature of 15 °C and a maximum of 27 °C. Photoperiod was maintained at 16 hours through the use of incandescent lights. Seedlings were fertilized

twice weekly with half-strength Hoagland's solution.

After about 5 months of growth, high greenhouse temperatures in June required moving the seedlings to a slat-house (50 percent shade). No further growth was detected after the seedlings were moved, and they all exhibited well-developed terminal buds. In August, about half of the seedlings were moved into a conventional, dark cold storage facility maintained at 2 °C for 4 weeks, after which they were placed back in a greenhouse. The remaining seedlings were kept outside through November 13, subjecting them to a natural chilling, after which they were placed back in a greenhouse.

Minimum and maximum temperatures from November 1 through November 13 averaged 4.8 °C and 12.7 °C, respectively, with 5 nights below 5 °C. The lowest temperature for this period was 1 °C and the highest 20 °C.

Total seedling height and length of the newest flush was measured after an additional 3 months of growth in a greenhouse. Sample sizes measured varied from 327 seedlings for the artificially chilled seedlings to 463 seedlings for the naturally chilled seedlings. Heights of con-

tainerized seedlings were compared against a random sample of conventionally grown seedlings obtained from a commercial nursery.

Results and Discussion

Total height growth of seedlings varied significantly by seed source (table 1). Growth of Mt. Rogers seedlings averaged 13.2 centimeters; Roan Mountain seedlings averaged 11.7 centimeters. Elongation of seedlings following cold storage did not differ between seed sources; both averaged 6.6 centimeters of new growth (table 1). Therefore differences in total height were due to initial growth differences that occurred before chilling. No significant interaction between seed source and chilling treatment was found.

The natural chilling through November 13 resulted in significantly better growth than the artificial chilling at a constant 2 °C in the dark cold room. Growth of naturally chilled seedlings averaged 14.1 centimeters, whereas that of artificially chilled seedlings averaged only 10.1 centimeters (table 1). This difference in total height was due to better elongation in the naturally chilled seedlings, which averaged 8.3 centimeters. Artificially chilled seedlings averaged only 4.1 centimeters in elongation (table 1).

Many of the artificially chilled seedlings exhibited stunted

Table 1—Total height and elongation after chilling of 15-month-old Fraser fir seedlings as affected by seed source and chilling technique

	Height (cm)	Elongation after chilling (cm)
Seed source*		
Mt. Rogers	13.2 a	6.6 a
Roan Mountain	11.7 b	6.6 a
Chilling treatment		
Cold room	10.1 a	4.1 a
Natural	14.1 b	8.3 b

Means followed by the same letter within a row and treatment do not differ significantly.
 *All seedlings in this test were chilled in a cold room at 2°C for 4 weeks.

Table 2—Height growth of Fraser fir seedlings

Age	Height growth (cm)
Conventional seedlings	
1 + 0	2.3
3 + 0	7.6
3 + 1	11.5
Container-grown seedlings	
6 months	3.0
9 months	8.8
15 months	14.1

elongation and loss of apical dominance similar to that reported by Hinesley (2). Hinesley (2) found that 4 weeks of chilling at 4 °C was sufficient to overcome abnormal elongation; whereas, in this study 4 weeks at 2 °C failed to provide sufficient chilling for normal elongation.

A comparison of conventionally grown seedlings from one North Carolina nursery and containerized seedlings is presented in table 2. Heights of 6-month-old and 9-month-old containerized seedlings are averages from an additional unpublished study. Average height of 6-month-old containerized seedlings exceeds that of a 1 + 0 conventionally grown seedling. At 9 months, containerized seedlings averaged 8.8 centimeters, taller than a 3 + 0 conventionally grown seedling. Naturally chilled 15-month-old containerized seedlings averaged 14.1 centimeters, compared to only 11.5 centimeters for a 3 + 1 conventionally grown seedling, a 23-percent increase (table 2).

Conclusions

Growing Fraser fir seedlings in containers appears to be a feasible method for accelerating their production. Short periods of chilling to break dormancy, followed by further growth in a greenhouse, can produce a seedling in 15 months that is taller than a 4-year-old conventionally grown seedling. For promoting normal elongation, natural chilling outdoors with fluctuating temperatures and natural photoperiod appears to be superior to artificial chilling at a constant temperature in the dark.

Literature Cited

1. Hinesley, L.E. Cold storage of Fraser fir seedlings. *Forest Science* 28:772-776; 1982.
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