From Forest Nursery Notes, Winter 2010

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# Fall Planting and Tree Shelters for Reforestation in the East Washington Cascades



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ABSTRACT

Reforestation on harsh, high-elevation sites near the crest of the Cascade Mountains in Washington can be challenging because of persistent snowpack and extreme climatic variation. The use of tree shelters was investigated with two species, Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) and western larch (*Larix occidentalis* Nutt.), on two Yakama Nation sites across three fall planting dates. For both species, seedlings inside tree shelters had increased survival compared with nonsheltered seedlings after one growing season despite increased damage by crushing from snowpack. Volumetric soil moisture content on the western larch site increased from 10% to 17% between the first and second planting dates, resulting in no effect of planting date on western larch survival. On the Douglas-fir site, however, soil moisture content was below 12% for all fall planting dates, resulting in only 2% survival for those seedlings planted on the first planting date. First-season seedling growth was unaffected by planting date or tree shelter treatment for both species. These results indicate the critical importance of soil moisture at time of planting and onset of precipitation after planting. Use of tree shelters may improve seedling survival on a harsh, high-elevation site, but it increases potential seedling damage because of crushing by snowpack.

**Keywords:** Douglas-fir, western larch, fall planting, tree shelters

High-elevation sites in the eastern Cascades of Washington have a short period of favorable spring planting conditions followed by a short growing season. In addition, rapid changes in soil moisture, temperature, relative humidity, and solar radiation make plantation establishment on these sites more challenging than on lower-elevation sites (Arnott 1975, Scagel et al. 1989). Most soil moisture on these sites results from snowmelt with very little additional precipitation from spring through fall. The snowpack insulates the ground and young seedlings from constantly changing and potentially deadly temperatures and winds during the winter months; but once the snowpack melts, the seedling environment changes rapidly from wet and cold to hot and dry. The dry air also increases evaporative losses and decreases soil moisture, the primary causes of plantation failure (Brand 1991).

Higher-elevation sites can be impossible to plant until late spring because the persistent snowpack prevents access. By the time sites become accessible, soil moisture may drop to unacceptably low levels (Scagel et al. 1990). The short window between snowmelt and summer drought results in a narrow margin between plantation success and failure. Fall planting is a potential alternative because roads are clear of snow and sites are accessible for planting (Livingston 2000). However, very few data are available for fall planting on high-elevation sites.

Inherent risks associated with fall planting require careful consideration of local conditions. Cleary (1978) and Krumlik (1984) suggested conditions for summer and fall planting should be as follows: the top 25 cm of the soil profile have a temperature >4°C and water potential >0.1 MPa, air temperature <18°C, and wind speed <30 kph. Furthermore, planning with the nursery is crucial for successful fall planting because there is a short window when both seedling phenology and weather conditions are favorable (Barber 1989).

Tree shelters can increase seedling survival on harsh, high-elevation sites by limiting the intensity of ultraviolet light that may cause damage via desiccation and sun scald (Potter 1988). Engelmann spruce (*Picea engelmanni* Parry ex Engelm.) seedling survival increased from 58% in nonsheltered trees to >95% using shelters that allowed 21–24% of available photosynthetically active radiation (PAR) to reach the seedlings (Jacobs and Steinbeck 2001). In addition, tree shelters may increase $CO_2$, temperature, and relative humidity (Frearson and Weiss 1987, Minter et al. 1992), as well as shielding seedlings from animal browse (Jacobs and Steinbeck 2001, Runde et al. 2008). Management considerations for using tree shelters include the costs of purchase, assembly, and installation, as well as annual maintenance following winter snowpack (Jacobs and Steinbeck 2001). The increased cost may be offset by increased survival, thereby reducing the need to replant at a later date when competing vegetation is established. The objective of this study was to quantify Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) and western larch (*Larix occidentalis* Nutt.) seedling field performance as influenced by planting date, tree shelters, and environmental conditions.

Manuscript received December 1, 2008; accepted February 13, 2009.

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This article uses metric units; the applicable conversion factors are: centimeters (cm): 1 cm = 0.39 in.; cubic centimeter ($cm^3$): 1 $cm^3$ = 0.061 $in^3$; meters (m): 1 m = 3.3 ft; square meters ($m^2$): 1 $m^2$ = 10.8 $ft^2$; kilometers (km): 1 km = 0.6 mi; milliliter (ml): 1 ml = 0.061 cubic inch (dry) or 0.27 fluid dram (liquid).