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Survival, Frost Susceptibility, Growth, and Disease Resistance of Corkbark and Subalpine Fir Grown for Landscape and Christmas Trees

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Summary. **Trees from six corkbark fir (*Abies lasiocarpa* var. *arizonica*) and 10 subalpine fir (*A. lasiocarpa* var. *lasiocarpa*) seed sources were grown at the University of Idaho Sandpoint Research and Extension Center (SREC), Sandpoint, ID, and two commercial nurseries in Idaho and Oregon. Posttransplant mortality was highest during the first two years. After six growing seasons, survival averaged 76% and 80% for corkbark and subalpine fir, respectively. In SREC irrigated plots, survival averaged 96% and 99% for corkbark and subalpine fir, respectively. Spring frost damage occurred annually on 66% to 100% of trees during 2002–06. In SREC plots, damage was minor and did not adversely affect appearance. Tree heights and growth rates varied significantly between seed sources. In general, corkbark fir grew faster than subalpine fir. After nine years in the field, mean heights of SREC-grown corkbark trees ranged from 2.1 to 2.9 m and that of subalpine trees ranged from 1.3 to 2.3 m, depending on seed source. Corkbark fir proved moderately resistant to resistant to a phoma-type fungal blight. Three corkbark seed sources appeared suitable for Christmas tree production. Subalpine trees were more susceptible to the blight. Some trees within both botanical varieties proved resistant to or highly tolerant of the blight, but the use of seedlings for landscapes may be unacceptably risky because of disease potential. Two fungicide programs (three applications of pyraclostrobin plus boscalid or one application of pyraclostrobin plus boscalid followed by one application of chlorothalonil) controlled the blight. Eight subalpine fir and 23 corkbark fir at SREC were selected for further testing as possible cultivars. Neither crop is recommended for sites with frequent or severe spring frosts.**

Corkbark fir and subalpine fir have potential as landscape and Christmas trees. Desirable characteristics include soft, fragrant, green or blue-green foliage with narrow, conical habits and good winterhardiness. Subalpine fir is distributed from Arizona and New Mexico to the Yukon and Alaska, from sea level to more than 12,000-ft elevation, and grows in the coolest and wettest forests of the western United States. Corkbark fir is distinguished by its peculiar, whitish, corky bark and blue-green foliage and is found mixed with subalpine fir on scattered mountains in southwestern Colorado; northern, western, and southwestern New Mexico; and in the high mountains of Arizona(Alexander et al., 1990). In the wild, corkbark and subalpine fir form stunted shrubs at timberline and average heights in closed forest conditions range from 45 to 100 ft (Sudworth, 1916). Corkbark and subalpine fir characteristically break dormancy early in spring, and buds and new shoots can be injured by frosts. Subalpine fir adapts to a range of soil types, although growth is reported to be poor on shallow and coarse-textured soils.

Jones and Cregg (2006) hypothesized that subalpine fir is more adaptable to higher pH soils (≥6.0) and drought conditions than previously thought, but considered subalpine and corkbark fir risky choices for midwestern U.S. landscapes because of limited drought tolerance and early-emerging, frost-susceptible shoots in spring. Dirr (1998) mentions subalpine fir's limited adaptability.

Previous work at the University of Idaho suggested that subalpine fir provenances differed in growth rate, tree shape, and adaptability to cultivation (D.L. Barney, unpublished data). Corkbark fir, subalpine fir, or both from North American seed sources have been tested for Christmas tree production in Norway, Iceland, and Denmark. In Danish provenance trials, Nielsen et al. (2012) observed significant differences in tree performance between provenances and reported the best overall source was from the White River area of British Columbia, Canada. Corkbark fir from Arizona and New Mexico seed sources showed good potential but proved highly susceptible to dieback, possibly due to a *Neonectria* pathogen. The trees exhibited slow growth rates and the trials produced a low percentage of marketable Christmas trees after 10 years.

Our objectives were to compare survival, frost susceptibility, growth rates, total growth, tree shapes, disease resistance, and suitability for landscape and Christmas tree production for a range of subalpine and corkbark fir provenances, and to select promising genotypes for testing as possible cultivars for clonally propagated nursery stock.

Materials and methods

Seeds collected from the wild in 15 national forests of the southwestern

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.3048	ft	m	3.2808
2.54	inch(es)	cm	0.3937
16.3871	$inch^3$	cm^3	0.0610
1.1209	lb/acre	$kg \cdot ha^{-1}$	0.8922
1.6093	mile(s)	km	0.6214
70.0532	oz/acre	$g \cdot ha^{-1}$	0.0143
(°F – 32) ÷ 1.8	°F	°C	(°C × 1.8) + 32