

**Idaho State Department of Agriculture  
Nursery and Florists Advisory Committee  
2004 Final Project Report**

**Title:** Evaluation of Corkbark and Subalpine Fir for Their Potential as Ornamental Nursery Stock and Christmas Trees - 2003 - Grant No. NAC/ISDA 2004-3

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**Introduction:**

This report covers the fifth year of what is planned as a ten-year study on the growth and development of subalpine and corkbark fir from selected seed sources in the southwestern United States. Seed sources represented in the collection are listed in Tables 1-4. Seeds were planted in styrofoam blocks in 1998 and transferred as plug-2 seedlings into a transplant bed in 2000. In the spring of 2001, the trees were transplanted into nursery plots at three sites in Bonner and Boundary County, Idaho. Trees were also distributed to Paradise Tree Farm in Enterprise, Oregon.

**Results and Discussion:**

Tables 1-4 summarize the results from each site. Results include tree height at the end of 2004, leader growth in 2004, and survival at the end of 2004. In addition, frost damage was measured at the three Idaho sites. Due to the late data collection date in Oregon, frost injury symptoms were ambiguous and estimates of the percentage of trees suffering frost damage in 2004 were not recorded. Dates of bud break, shown in Table 5, were recorded at the University of Idaho Sandpoint Research & Extension Center (SREC).

Survival varied between sites and, in some cases, seed sources. Trees at the SREC were irrigated two to four times annually from 2001-2004, with approximately eight inches of water applied annually during July and August. Precipitation during the summer of 2004 was above average in north Idaho and the trees were irrigated less than during earlier years. SREC-grown trees exhibited the greatest survival, averaging 96% for corkbark and 97% for subalpine fir as of September 2004. Most of the mortality at the SREC occurred during early spring of 2002 when many of the trees were frost heaved from the silt-loam soil and had to be replanted. Unirrigated trees at PossAbilities Tree Farm exhibited somewhat variable results, with survival ranging from a low of 50% for Santa Fe corkbark to 100% for Apache-Sitgreaves and Coronado National Forest corkbark seed sources. It appears probable that the Santa Fe corkbark seedlings suffered preplant damage prior to shipping to the PossAbilities site. Excluding the Santa Fe seedlings, corkbark fir survival at PossAbilities averaged 97%. Subalpine fir survival at the PossAbilities site was lower than for corkbark, ranging from 64% to 96% and averaging 82%. Tree survival was poorest at Birchhaven (unirrigated), with complete loss of trees from four corkbark and one subalpine seed source as of 2003. Due to replanting within rows during 2003-2004, the fate of original trees was difficult to determine and survival statistics are not presented for Birchhaven for 2004. Tree survival at Paradise Tree Farm (unirrigated) was quite variable and appeared heavily dependent on location within the plot. According to the grower, John Sullivan, much of the mortality was due to an unusually severe invasion of pocket gophers. At Paradise Tree Farm, subalpine survival ranged from 21 to 86% (average 62%) and corkbark survival from 25-64% (average 43%). Total precipitation for the three Idaho planting sites during April through September 2004 was approximately 16 inches, with an average for that period being 10.7 inches. Precipitation records were not available for the Oregon site for 2004, but total precipitation for April through September averages approximately 7.5 to 9 inches at two weather stations located about 30 miles from the Paradise Tree Farm.

Frost damage to newly opened buds was widespread at all three Idaho sites during the spring of 2004, but the number of injured buds per tree appeared lower than for 2003 and damage, from a practical standpoint, was minor. Spring temperatures in north Idaho were unusually warm during 2004 with eight mild frost events during mid April through mid May. Frost events were recorded at the SREC as 31°F on April 10 and 11 and May 14; 30°F on April 17, 18, 22, and 25; and 32°F on April 29.

The average dates of bud break (needles from one or more buds on a tree being visible) were remarkably consistent among all of the seed sources and between subalpine and corkbark trees, as they were in 2002 and 2003. Buds broke on all species approximately 12 to 15 days earlier than in 2003 and 20 to 27 days earlier than in 2002, due to warm spring weather. In 2004, the first dates of bud break ranged from

at least April 9 through April 12 for subalpine seed sources. Data collection began on April 9, and some buds had already opened by that date, skewing the data somewhat for the earliest breaking seed sources and producing averages that are one to several days later than probably occurred. All subalpine trees had open buds by April 23. On average, subalpine trees exhibited open buds on April 13, with a range from first to last trees with open buds averaging six days. Results for corkbark fir were similar, with an average opening date of April 12 and an average range of opening dates of six days. Compared with concolor fir (*Abies concolor*, Rio Grande National Forest seed source) and Colorado spruce (*Picea pungens*, San Juan National Forest seed source) trees in nearby blocks, subalpine and corkbark trees broke bud earlier, as they did in 2002 and 2003. Bud break on concolor trees was first observed on April 16. Colorado spruce buds began opening about April 19.

Corkbark fir leaders developed about equally with irrigation (SREC) or without it (PossAbilities Tree Farm) through 2003, with soil conditions and cultural practices being similar. By the end of 2004, however, irrigated trees at the SREC site were both taller and continuing to produce greater leader growth than trees at the other three unirrigated sites (Tables 1-4). The Gila corkbark seed source produced the tallest trees, followed by Apache-Sitgreaves corkbark at the SREC site. At Paradise and PossAbilities sites, Apache-Sitgreaves corkbark were the tallest trees. Of the 30 tallest trees from all sites, 29 were corkbark fir, with one Kaibab subalpine fir. Of the 30 tallest corkbark fir, 29 were grown at the SREC and one at PossAbilities Tree Farm. The tallest corkbark group included eleven Apache-Sitgreaves, three Cibola, two Cocino, one Coronado, eleven Gila, and two Santa Fe. The five tallest corkbark fir were Gila at the SREC. The largest corkbark was 59 inches (151 cm) tall after four growing seasons in the field.

Results were similar for subalpine fir. Trees at the SREC were significantly taller than those at the other sites and continued to produce greater leader growth than trees at the other three sites. Kaibab subalpine fir trees were taller than those from any other seed source at all four sites. Of the 30 tallest trees at all sites, 21 grew at the SREC, five at PossAbilities Tree Farm, and four at Birchhaven. The trees included three Arapaho, one Carson, one Cibola, five Dixie, thirteen Kaibab, one San Juan, and six Uncompahgre. Manti-LaSal, Rio Grande, and San Juan trees were not included in the 30 tallest subalpine fir. The largest subalpine fir was 45 inches (115 cm) tall.

### **Conclusions:**

Corkbark and subalpine fir have been grown in both irrigated and unirrigated nursery plots in northern Idaho and northeastern Oregon. Irrigation appears to provide an advantage for early subalpine fir survival, although results for corkbark fir were inconclusive. Differences in survival and growth on unirrigated plots may relate to weed and pest control. Neither species emerged as a strong competitor with weeds and

pocket gophers caused significant losses on two sites. After one year in a transplant bed and four growing seasons in nursery plots, many subalpine trees were developing leaders eight to fifteen inches in length and corkbark trees were producing leaders eight to nineteen inches long. Susceptibility to spring frost continues to be problematic, particularly when compared with nursery staples, such as Colorado spruce, which breaks dormancy later and over a longer time. While corkbark and subalpine fir offer commercial promise, both present frost risks, require careful site selection, and should not comprise the sole crop(s) at a nursery. Pest and weed control are critical and irrigation may be beneficial.

**Future Plans:**

Provided grant funding continues, survival, frost damage, and growth will be measured annually at the SREC, Paradise, PossAbilities, and Birchhaven plots. Dates of bud break will be measured annually at the SREC and a heat unit model developed to assist in site selection and predict frost damage. As the trees approach harvest size, needle length, color, and retention after cutting for Christmas trees will be characterized, and the trees will be graded according to standards for Christmas trees and nursery stock.

Superior trees in terms of growth rates and form are emerging. Provided funding continues, trees with the best commercial potential will be identified and methods of cloning and commercially propagating them will be developed. Following further evaluation, the best performing trees will be named and released for commercial propagation and sale.

Table 1. Average height, growth, survival, and frost damage for six-year-old corkbark and subalpine fir seedlings at Birchhaven Nursery.

Seed source (National Forest)	Variety	2004 Height <sup>1</sup> (cm)	2004 Leader Growth <sup>2</sup> (cm)	Survival <sup>3</sup> (%)	2004 Frost damage <sup>4</sup> (%)
Arapaho	Subalpine	23.2	6.2		58.3
Carson	Subalpine	40.2	11.2		100
Cibola	Subalpine	29.7	8.9		78.6
Dixie	Subalpine	52.0	14.6		52.0
Kaibab	Subalpine	52.2	14.7		63.3
Manti-LaSal	Subalpine	37.5	11.0		72.7
Rio Grande	Subalpine	Trees removed from planting due to poor survival			
San Isabel	Subalpine	30.8	8.3		88.9
San Juan	Subalpine	28.3	8.7		83.3
Uncompahgre	Subalpine	39.8	10.1		53.3
<b>Subalpine average</b>		<b>37.1</b>	<b>11.8</b>		<b>72.3</b>
Apache-Sitgreaves	Corkbark	Trees removed from planting due to poor survival			
Cibola	Corkbark	32.0	8.3		80.0
Cocino	Corkbark	Trees removed from planting due to poor survival			
Coronado	Corkbark	Trees removed from planting due to poor survival			
Gila	Corkbark	Trees removed from planting due to poor survival			
Santa Fe	Corkbark	41.5	10.5		87.0
<b>Corkbark average</b>		<b>36.8</b>	<b>9.4</b>		<b>83.5</b>
1. Height = average height from the ground to the topmost tip of the leader at the end of 2004					
2. 2002 leader = average length of leader formed during 2004					
3. Due to replanting and the difficulty in determining the fate of individual trees, survival data was not calculated for Birchhaven in 2004.					
4. Frost damage = percentage of trees exhibiting one or more frost-damaged buds in April-May 2004					

Table 2. Average height, growth, survival, and frost damage for six-year-old corkbark and subalpine fir seedlings at the Paradise Tree Farm.

Seed source (National Forest)	Variety	2004 Height <sup>1</sup> (cm)	2004 Leader Growth <sup>2</sup> (cm)	Survival <sup>3</sup> (%)	Frost damage <sup>4</sup> (%)
Arapaho	Subalpine	24.7	5.1	71.1	
Carson	Subalpine	41.7	12.0	57.6	
Cibola	Subalpine	42.3	12.3	21.1	
Dixie	Subalpine	38.8	11.1	86.2	
Kaibab	Subalpine	48.3	13.8	75.0	
Manti-LaSal	Subalpine	37.4	8.8	85.7	
Rio Grande	Subalpine	39.8	9.7	33.3	
San Isabel	Subalpine	Not planted at this site			
San Juan	Subalpine	36.4	9.0	55.0	
Uncompahgre	Subalpine	46.9	13.6	74.1	
<b>Subalpine average</b>		<b>39.6</b>	<b>10.6</b>	<b>62.1</b>	
Apache-Sitgreaves	Corkbark	70.6	19.8	27.8	
Cibola	Corkbark	47.8	14.0	55.0	
Cocino	Corkbark	57.0	17.4	46.9	
Coronado	Corkbark	53.2	13.7	64.0	
Gila	Corkbark	63.0	16.8	25.0	
Santa Fe	Corkbark	50.3	13.4	40.4	
<b>Corkbark average</b>		<b>57.0</b>	<b>15.9</b>	<b>43.2</b>	
<p>1. Height = average height from the ground to the topmost tip of the leader at the end of 2004  2. 2002 leader = average length of leader formed during 2004  3. Survival = percentage of trees alive in September 2004  4. Frost damage was not estimated at Paradise Tree Farm in 2004 due to lateness of data collection</p>					

Table 3. Average height, growth, survival, and frost damage for six-year-old corkbark and subalpine fir seedlings at PossAbilities Tree Farm.

Seed source (National Forest)	Variety	2004 Height <sup>1</sup> (cm)	2004 Leader Growth <sup>2</sup> (cm)	Survival <sup>3</sup> (%)	Frost damage <sup>4</sup> (%)
Arapaho	Subalpine	35.3	10.8	76.3	97.6
Carson	Subalpine	38.7	12.4	77.4	97.6
Cibola	Subalpine	29.4	9.2	63.9	95.7
Dixie	Subalpine	25.2	7.6	75.9	100
Kaibab	Subalpine	43.8	15.4	87.8	100
Manti-LaSal	Subalpine	27.8	8.0	92.9	96.2
Rio Grande	Subalpine	17.1	4.1	83.3	100
San Isabel	Subalpine	Not planted at this site			
San Juan	Subalpine	18.6	4.9	*	94.4
Uncompahgre	Subalpine	30.8	8.5	96.0	95.8
<b>Subalpine average</b>		<b>29.6</b>	<b>9.4</b>	<b>72.6</b>	<b>97.5</b>
Apache-Sitgreaves	Corkbark	77.3	19.7	100	100
Cibola	Corkbark	59.8	18.9	95.0	100
Cocino	Corkbark	45.6	13.9	96.9	100
Coronado	Corkbark	60.3	20.0	100	100
Gila	Corkbark	57.1	18.3	94.4	90.6
Santa Fe	Corkbark	42.4	12.8	50.0	89.3
<b>Corkbark average</b>		<b>57.1</b>	<b>17.3</b>	<b>89.4</b>	<b>96.7</b>
<p>1. Height = average height from the ground to the topmost tip of the leader at the end of 2004  2. 2002 leader = average length of leader formed during 2004  3. Survival = percentage of trees alive in September 2004  4. Frost damage = percentage of trees exhibiting one or more frost-damaged buds in April-May 2004  * survival data for subalpine San Juan missing for 2004</p>					

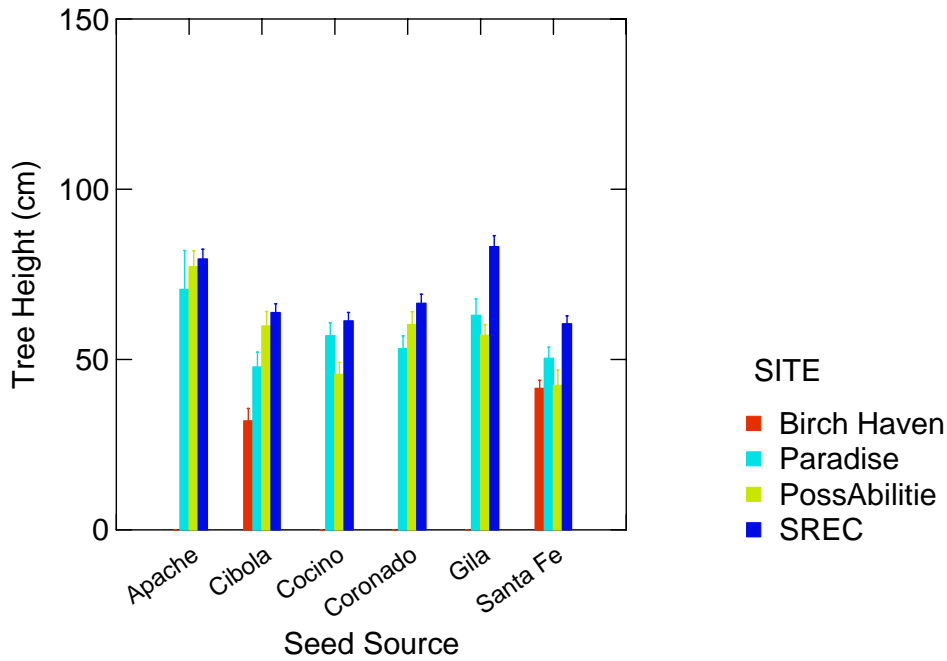
Table 4. Average height, growth, survival, and frost damage for six-year-old corkbark and subalpine fir seedlings at the University of Idaho Sandpoint R&amp;E Center.

Seed source (National Forest)	Variety	2004 Height <sup>1</sup> (cm)	2004 Leader Growth <sup>2</sup> (cm)	Survival <sup>5</sup> (%)	Frost damage <sup>6</sup> (%)
Arapaho	Subalpine	40.0	13.3	98.3	81.0
Carson	Subalpine	45.1	14.7	100	83.3
Cibola	Subalpine	50.2	18.3	96.7	98.3
Dixie	Subalpine	56.0	20.1	98.3	57.6
Kaibab	Subalpine	65.4	22.1	95.0	64.9
Manti-LaSal	Subalpine	48.2	16.7	96.7	60.3
Rio Grande	Subalpine	44.0	13.3	100	93.3
San Isabel	Subalpine	36.1	10.4	89.8	98.1
San Juan	Subalpine	46.5	14.7	100	95.0
Uncompahgre	Subalpine	56.3	19.6	100	82.3
<b>Subalpine average</b>		<b>48.8</b>	<b>16.3</b>	<b>97.5</b>	<b>81.4</b>
Apache-Sitgreaves	Corkbark	79.5	28.2	98.3	96.6
Cibola	Corkbark	63.8	22.3	98.3	81.4
Cocino	Corkbark	61.4	23.7	96.7	91.4
Coronado	Corkbark	66.5	22.6	96.7	94.8
Gila	Corkbark	84.4	28.6	91.7	100
Santa Fe	Corkbark	60.5	19.6	95.0	89.5
<b>Corkbark average</b>		<b>69.4</b>	<b>25.5</b>	<b>96.1</b>	<b>92.3</b>
<p>1. Height = average height from the ground to the topmost tip of the leader at the end of 2004  2. 2002 leader = average length of leader formed during 2004  3. Survival = percentage of trees alive in September 2004  4. Frost damage = percentage of trees exhibiting one or more frost-damaged buds in April-May 2004</p>					

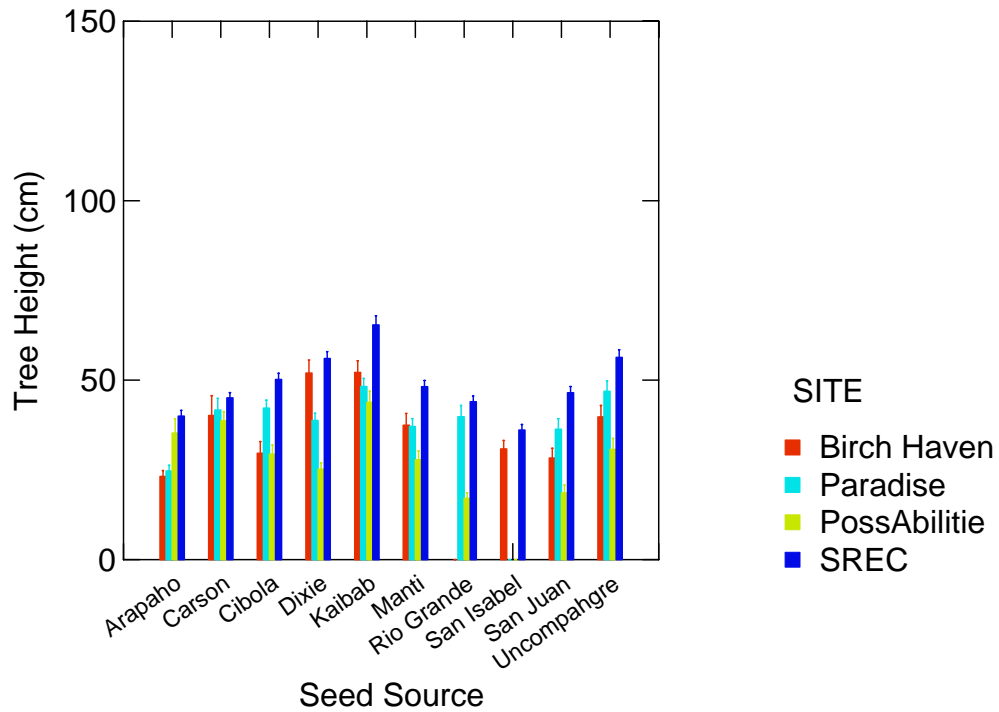
Table 5. 2002-2004 bud break dates at the University of Idaho Sandpoint R&amp;E Center.

	2002			2003			2004		
Seed source (National Forest)	First	Last	Average date	First	Last	Average date	First <sup>1</sup>	Last	Average date
Subalpine Fir									
Arapaho	5 / 1	5 / 6	5 / 2	4 / 21	4 / 30	4 / 25	4 / 9	4 / 16	4 / 12
Carson	4 / 29	5 / 3	4 / 30	4 / 21	4 / 28	4 / 23	4 / 9	4 / 12	4 / 11
Cibola	4 / 29	5 / 3	5 / 1	4 / 21	4 / 30	4 / 25	4 / 9	4 / 14	4 / 12
Dixie	5 / 1	5 / 3	5 / 1	4 / 21	5 / 2	4 / 27	4 / 12	4 / 23	4 / 15
Kaibab	5 / 1	5 / 13	5 / 4	4 / 25	5 / 2	4 / 29	4 / 12	4 / 23	4 / 15
Manti-LaSal	4 / 29	5 / 3	5 / 1	4 / 21	4 / 28	4 / 25	4 / 9	4 / 16	4 / 13
Rio Grande	4 / 29	5 / 3	5 / 1	4 / 21	4 / 28	4 / 24	4 / 9	4 / 14	4 / 12
San Isabel	4 / 29	5 / 1	4 / 30	4 / 21	4 / 28	4 / 24	4 / 9	4 / 14	4 / 12
San Juan	5 / 1	5 / 3	5 / 1	4 / 21	4 / 28	4 / 23	4 / 9	4 / 14	4 / 11
Uncompahgre	5 / 1	5 / 6	5 / 2	4 / 21	4 / 30	4 / 27	4 / 9	4 / 16	4 / 12
<b>Subalpine average</b>	<b>4 / 30</b>	<b>5 / 4</b>	<b>5 / 1</b>	<b>4 / 21</b>	<b>4 / 29</b>	<b>4 / 25</b>	<b>4 / 10</b>	<b>4 / 16</b>	<b>4 / 13</b>
Corkbark Fir									
Apache- Sitgreaves	5 / 1	5 / 8	5 / 3	4 / 23	5 / 2	4 / 28	4/9	4/14	4/11
Cibola	5 / 1	5 / 8	5 / 2	4 / 23	5 / 5	4 / 28	4/9	4/16	4/12
Cocino	5 / 1	5 / 13	5 / 4	4 / 23	5 / 2	4 / 28	4/9	4/16	4/13
Coronado	5 / 1	5 / 6	5 / 2	4 / 21	4 / 28	4 / 25	4/9	4/14	4/11
Gila	5 / 1	5 / 3	5 / 1	4 / 23	4 / 30	4 / 28	4/9	4/14	4/12
Santa Fe	5 / 1	5 / 6	5 / 2	4 / 21	5 / 2	4 / 27	4/9	4/14	4/13
<b>Corkbark average</b>	<b>5 / 1</b>	<b>5 / 7</b>	<b>5 / 2</b>	<b>4 / 22</b>	<b>5 / 2</b>	<b>4 / 27</b>	<b>4/9</b>	<b>4/15</b>	<b>4/12</b>

<sup>1</sup> Data collection in 2004 began on April 9. At that time, buds on some trees had already opened, creating averages that are somewhat later than probably occurred in the field.



**Figure 1. Average heights of Corkbark Fir as of September 2004.**



**Figure 2. Average heights of subalpine fir as of September 2004.**



**Figure 3. Corkbark and subalpine fir plots at the University of Idaho Sandpoint Research & Extension Center, August 2004.**



**Figure 4. Apache-Sitgreaves corkbark fir at Paradise Tree Farm near Enterprise, Oregon, September 2004.**