PNW 645

Growing Corkbark Fir and Subalpine Fir for Nursery Production

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Figure 1. Subalpine fir with Crystal Lake, Mount Ranier National Park, behind. Photo by Walter Siegmund

Introduction

Conifer production for landscape and Christmas trees is well-established in the Northwest. Much is known and has been written about Colorado spruce, noble fir, grand fir, and other species commonly used for commercial production. In recent years, producers and consumers have shown increased interest in "exotic" species in general and true fir species in particular. This guide addresses the cultivation of corkbark fir (*Abies lasiocarpa* var. *arizonica*) and subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*) (figure 1) for such small, niche markets. Though corkbark firs may be produced for landscapes, commercial production of subalpine firs for landscapes is not recommended because of their vulnerability to foliar blight. However, both varieties have potential for use as specialty Christmas trees and have been used for landscapes and Christmas trees to a limited extent in the Pacific Northwest.

While the varieties have some commercial potential, it is advisable for nursery and Christmas tree farm managers to plant only a small portion of their fields to corkbark and/or subalpine fir while moving through the production learning curve and establishing markets. Certain sites may have too high pressure from diseases, insects, or frost to make either variety a profitable crop or a suitable landscape tree. Corkbark and subalpine firs are likely to remain specialty, niche crops; however, given an appropriate site and high quality seedlings from acceptable seed sources, both varieties are relatively easy to grow.

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Corkbark and Subalpine Firs

Corkbark and subalpine firs are generally considered to be the same species, but they differ enough in their physical characteristics to list them as different taxonomic varieties (figure 2). Refer to The Gymnosperm Database for more information (see further readings). These varieties are part of the true fir group that includes noble (*A. procera*), grand (*A. grandis*), concolor or white (*A. concolor*), balsam (*A. balsamea*), as well as other fir species. They are the smallest of the eight true fir species native to the western United States.

Figure 2. Corkbark fir (A) and subalpine fir (B) growing at the University of Idaho research and extension center in Sandpoint, Idaho. Photos by Jennifer Jensen

Figure 3. New growth in the spring. Photo by Dr. Dan Barney

Desirable characteristics

Desirable characteristics (table 1) for both varieties include soft, fragrant foliage; narrow, conical shapes when mature; and medium- to dark-green, blue-green, or silvery needles. New shoots are light green and make a dramatic contrast to older foliage in the spring (figure 3). Corkbark fir develops whitish, corky bark beginning around 10 years of age and tends to have blue-green to bright, silvery foliage. Limited evaluations indicate both varieties retain their foliage and fragrance well when used as indoor Christmas trees if placed in water immediately after being cut. The tall, narrow, often open trees can look good in landscapes with mountain or alpine meadow themes.

Production problems

Common production problems (table 1) include slow growth and seed source variability in growth rates and tree quality. Spring frost damage is a problem on many sites because these trees break dormancy very early in spring. Foliar diseases have been occasional problems in some locations. Some landscape experts consider *A. lasiocarpa* to be generally unsuitable for the eastern and midwestern United States due to its limited drought tolerance and early, frost-susceptible bud break. Some garden centers in western Washington and Oregon will not warranty the survival of these trees in landscapes. For those reasons, careful selection of production and landscape sites is especially important for these crops.

Range

The native range of *A. lasiocarpa* is widely distributed from Arizona and New Mexico to the Yukon and Alaska. Corkbark fir is native to southern Colorado, New Mexico, and Arizona. Elevations range from sea level in Alaska to more than 12,000 feet in the southern Rockies. In the Pacific Northwest region, subalpine fir is native to the Cascade Range of Washington and Ore-

Table 1. Pros and cons of corkbark fir and subalpine fir production.

Pros	Cons
Soft, fragrant foliage	Slow growth rates
Fragrant even after cutting	Variable in growth rates and tree quality depending on seed source
Narrow, conical shapes when mature	Limited tolerance for drought
Good for mountain or alpine meadow landscape themes	Susceptible to foliar diseases, especially subalpine fir
Appropriate for niche markets	Susceptible to frost damage
	Subalpine fir not recommended for landscapes

gon; the eastern slopes of the Olympic Mountains of Washington; and the high mountains of northeastern Washington, Oregon, and Idaho.

A. lasiocarpa grows in the coolest and wettest forests of the western United States and survives from -50˚F to 100˚F (USDA hardiness zone 2-3a) in its native range where annual precipitation exceeds 24 inches per year, mostly as snow or late summer and fall rains. Average heights in forests range from 45 feet to 100 feet, though both varieties can form stunted shrubs at timberline or grow 100–160 feet tall under ideal conditions. These trees are relatively long-lived and specimens older than 250 years are often found in the wild.

Site Selection

Soil

Subalpine and corkbark firs tolerate a range of soil types and grow well on moderately to strongly acidic sandy loams, loams, and silt loams that provide good water drainage without being droughty. Growth is poor on shallow, coarse-textured, and wet soils.

Soil pH for native *A. lasiocarpa* soils ranges from 4.5 to 5.9, although some research suggests the trees will tolerate neutral to slightly alkaline soils. Production on soils with pH values somewhat above and below that range is possible, but production or landscape use on alkaline soil is not recommended.

Frost damage

Subalpine and corkbark firs grow well on cool, moist sites with north or east facing slopes. Because they break dormancy and develop new shoots early in the spring, these crops are susceptible to spring frost damage (figure 4). Avoid planting in low-lying frost pockets or other locations where cold air can be trapped. An ideal site will provide a slope and lower surrounding areas for frosty and humid air to drain away from the planting blocks. Good air drainage helps reduce damage from frosts as well as diseases.

Although the trees can tolerate -50˚F when fully cold hardy during the winter, opening buds and new shoots are killed at around 29˚F. Fortunately, the buds on a particular tree break over a period of several days to a week or more, depending on temperatures. The loss of a few early lateral buds to frost is usually a minor problem because later-developing shoots remain undamaged.

If the frost damage is minor and a tree is otherwise healthy and vigorous, that tree will usually fill in with new foliage and be marketable. More troublesome is damage to the leaders, which can stunt tree growth, create irregular trunks, and require corrective pruning. University of Idaho mathematical models show that some frost damage is virtually certain anywhere the trees are grown in Idaho. During any 5-year period, there is a 50 percent chance of a damaging frost occurring at a time when 90 percent of the trees have broken bud. Both varieties break dormancy at about the same time and are equally at risk of frost damage.

Despite 1 year of severe frost damage to trial trees, researchers were able to produce marketable subalpine and corkbark firs on plots in Sandpoint, Idaho. Production at a nursery 15 miles north of Sandpoint proved more difficult due to chronic spring frost damage. Frost damage was generally minor at a nursery in northeastern Oregon.

Because the risk of frost damage is greater for these crops than for spruce, pine, and some other true fir species, growers must balance risks and rewards in selecting the best mixes of tree species to plant. Corkbark and subalpine firs are best grown on sites that are relatively free of spring frosts.

Elevation

Elevation is important only as it relates to temperature and soil moisture. Subalpine fir, for example, is reported to have poor tolerance for high temperatures. In the Rocky Mountains of Idaho and Montana and associated mountains of eastern Washington and Oregon, subalpine fir can be found in wild stands between 2,000 feet and 11,000 feet elevation. Corkbark fir in its native ranges is found between 8,000 feet and 12,000 feet elevation, usually on north-facing slopes.

In University of Idaho trials, irrigated corkbark and subalpine firs grew well at 2,000 feet elevation in northern Idaho and unirrigated trees grew well at 4,200 feet elevation in northeastern Oregon. Over a 9-year period,

Figure 4. Spring frost damage. Photo by Dr. Dan Barney

irrigated trees in the northern Idaho trials frequently experienced summer temperatures of 85°–95°F, and occasional days as warm as 100°F.

In cultivation or landscapes at elevations lower than the native ranges listed above, irrigation may be required to maintain tree health and vigor. It is therefore advisable for nurseries and Christmas tree growers, particularly at lower elevations, to plant a small trial of these trees to determine if there is an appropriate location for production available.

Seedling Production

Production of subalpine and corkbark fir seedlings can be relatively slow. Plan on 3–4 years from seed to field planting.

Seed collection, handling, and storage

In the Pacific Northwest and Rocky Mountains of Idaho and Montana, *A. lasiocarpa* is a good cone producer. Even when abundant cones are set, however, they may contain 65–90 percent or more of empty seed. Lack of pollination and genetic irregularities are factors in the high percentage of nonviable seed, as are harvesting immature cones and poor seed handling and storage.

Because fir cones disintegrate when ripe, they should be harvested before ripening occurs. Subalpine fir seed typically ripens in August and disperses in September. Corkbark fir seed reportedly ripens in September and is dispersed in October. Latitude, elevation, and weather conditions all influence seed ripening and dispersal.

Once collected, cones are typically stored in porous sacks inside drying sheds under cool, dry conditions for several weeks or months to allow the seed embryos to fully mature (i.e., after-ripening process). Removing the seeds from the cones too quickly reduces seed viability. Standard nursery practices include kiln drying the after-ripened seeds at 86°–100°F for 6–14 hours, or air drying cones for 1–3 weeks or more at 71°–86°F. The goal should be to reduce seed moisture to between 9 percent and 12 percent before extracting seeds.

Seed moisture is determined by weighing small lots (1–5 grams) of seeds before and after drying in an oven at 214°–221°F for 16 hours, and is calculated using the equation below. This procedure requires a very accurate analytical balance that can measure to 0.0001 grams, such as is used in laboratories.

$$\text{Moisture content (\%)} = \left(\frac{W_2 - W_1}{W_2 - W_3}\right) \times 100$$

Where W_1 = empty weighing container; W_2 = weighing container and seed before drying; W_3 = weighing container and seed after drying.

Tumblers, shakers, and screens are used to separate the seeds from scales and cone debris. The extracted seeds can easily be damaged during removal of the wings, which can be done mechanically or by hand. Hand dewinging is recommended for balsam fir and may be beneficial for the closely related subalpine and corkbark firs. Once they are extracted and dewinged, seeds should be stored inside sealed plastic bags at or near 12°F. Seed handled and stored in this manner should remain viable for 5 years or more.

Seed sources

The location of the seed source for corkbark and subalpine firs affects seedling growth rates, tree shape, disease resistance, and adaptability to commercial cultivation. In addition, subalpine fir heights tend to decrease as the latitude and elevation of the seed source increases.

Location. With native ranges stretching over thousands of miles, from the desert Southwest to the Yukon and Alaska, many seed sources are available for subalpine fir. Although more limited in geographic range, ample sources of corkbark fir are also available.

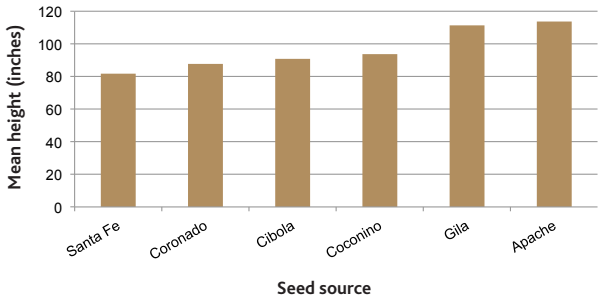

Figure 5. Average heights of corkbark fir trees after nine growing seasons from transplanting plug 2-1 seedlings. Seed sources represent national forests where the seed was collected.

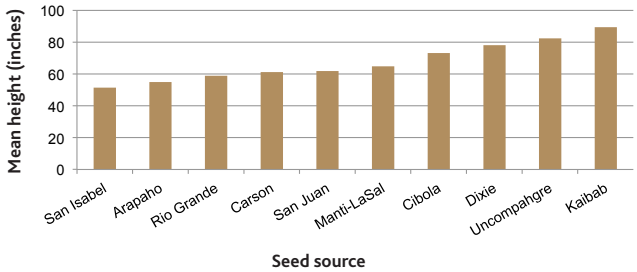

Figure 6. Average heights of subalpine fir trees after nine growing seasons from transplanting plug 2-1 seedlings. Seed sources represent national forests where the seed was collected.

University of Idaho trials tested six seed sources of corkbark fir and 10 seed sources of subalpine fir from national forests in the desert Southwest. Seedlings were grown for 2 years in plastic foam block containers, transferred to transplant beds for 1 year, and transplanted to field plots in 2001. From 2001–2009, the trees were evaluated for growth, disease resistance, and suitability as landscape and Christmas trees. Figures 5 and 6 show the heights of the trees after growing for nine seasons in the field. Even as 2-year-old seedlings, corkbark firs were generally taller than were subalpine firs. That trend continued for the duration of the project. However, within both varieties, some seed sources grew faster and more uniformly than others.

Disease resistance. In 2007, University of Idaho researchers observed a Phoma-type fungal foliar blight that caused minor to severe damage to new shoots of both corkbark fir and subalpine fir (figure 7). Three years of observations confirmed significant differences in resistance to the blight between different seed sources. Of the two varieties, corkbark fir trees were more resistant to the disease and all seed sources tested produced high percentages of marketable trees with or without fungicide treatments. Even so, from a practical standpoint, growers should be prepared to apply fungicides to corkbark fir for blight control during years with high disease pressure and wet or humid weather.

With the exception of a few disease-resistant trees selected as possible cultivars, subalpine fir that produced adequate growth for commercial cultivation also proved too susceptible to foliar blight to be used in landscapes. Four of the five fastest growing seed sources tested proved to be moderately to highly susceptible to the blight and required fungicide treatments to produce marketable trees.

Recommended seed sources. Based on growth and disease evaluations, corkbark fir derived from the Apache, Coconino, and Gila national forests appears most suitable for landscape use and for Christmas trees. With fungicide treatments, subalpine trees from the Kaibab, Uncompahgre, Dixie, and Cibola national forest seed lots proved suitable for commercial Christmas tree production.

These recommendations are based on the best information we have as of 2012. Throughout corkbark and subalpine fir native ranges, there are certainly other good seed sources that can be used for commercial applications. Note, also, that the sources are listed only as national forests. Within any forest you will find individual trees or groups of trees that produce better or poorer seedlings for commercial fir production.

Seed germination

Sow the seed either in containers or directly into nursery beds. Seed can be sown in the fall without prechilling (stratification) or in the spring after prechilling at 37˚–41˚F for 21–28 days. Fall planting outdoors allows the seeds to meet their prechilling requirements. In nursery beds, cover the seeds no more than 1/4 inch deep with soil or mulch. For container production, sow the seeds onto the surface of the potting soil and cover them with about 1/8 inch of white sand to hold the seeds in place.

Both corkbark and subalpine fir seed germination rates tend to be low, often 30 percent or less. Unless you have germination test results that show higher rates, the following guidelines should provide suitable emergence. For direct sowing to nursery beds, sow 500–700 seeds per square yard. For container production, sow 3–4 seeds per container cell and thin to the strongest seedling per cell. Temperatures between 68˚F and 86˚F are recommended for germination. Expect germination in 21–28 days. Seedling growth is slow, particularly for subalpine fir.

Figure 7. Phoma-type fungal foliar blight damage on new shoots of corkbark fir. Photos by Dr. Dan Barney

Containers and media

Cone-shaped containers—either individual containers or planting holes incorporated into plastic foam blocks—work well for corkbark and subalpine firs (figure 8). Because of the seedlings' slow growth rates and the need to overwinter them for one or two winters, foam block containers may be the better option because they provide some insulation for the roots during winter storage. Containers with 3–7 cubic inch capacity are adequate for fir seedlings.

For container culture, use either commercial soilless media mixes or mix your own. The *USDA Forest Service Container Tree Nursery Manual* (volume 2, chapter 2) recommends using sphagnum peat moss–vermiculite mixes with either grade 2 or 3 vermiculite. Including perlite (10–30 percent by volume) increases porosity, aeration, and water drainage. The amount of media porosity needed will depend on your irrigation practices, temperature, and shading. When using commercial mixes, choose those that are specifically formulated for forestry applications.

Irrigation

Irrigate often enough to keep the soil moist but not saturated. Overhead irrigation is commonly used for container-grown trees. Apply sufficient water at each watering to completely saturate the root plugs and rinse out excess fertilizer salts. In all cases, irrigating early in the morning to allow the seedlings to dry quickly can help reduce foliar diseases. Avoid irrigation on cool or rainy days. The quantity of water to apply will depend on the nursery bed soil or container media, temperatures, precipitation, sunlight exposure, and seedling size. Frequent monitoring of the soil or media is the best irrigation management tool.

Fertilization

Fertilization is important for fir seedling production. In nursery beds, you can use a wide variety of dry and/or liquid fertilizers. When using dry fertilizers, slow- or controlled-release fertilizers reduce the likelihood of excessive fertilization and damage to the seedlings. Different formulations are available to suit a wide range of growing conditions.

Figure 8. Foam block and plastic containers used for starting corkbark fir and subalpine fir trees. Photo by Jennifer Jensen

For container-grown trees, the *USDA Forest Service Container Tree Nursery Manual* recommends using liquid fertilizers. Incorporating dry fertilizers into mixes works, but liquid fertilization reduces the likelihood of excessive fertilization, provides a consistent supply of nutrients, and allows rapid adjustments to the fertilizer program. Liquid fertilizers can be included at low rates with every irrigation, or applied every 1–3 weeks at higher rates. Using liquid fertilizers, however, increases the risk of groundwater contamination due to nutrient runoff and leaching. Design your container yards and irrigation and fertilizer programs to reduce and manage wastewater runoff.

Weed control

Their slow growth rates make corkbark and subalpine fir seedlings susceptible to competition from weeds during their first few years, including moss and liverwort in container culture. For conifer seed beds, hand weeding and herbicides are the most common weed control methods. Perhaps the most important weed control strategy for nursery beds is to ensure they are weed-free before planting, particularly of perennial weeds. Form the beds well in advance of planting the conifers, then use translocatable, contact herbicides to kill weeds before sowing fir seeds. After sowing, several different herbicides are available, depending on the age of the seedlings. Hand weeding and herbicides are also used for container culture.

Because pesticide registrations change frequently, specific recommendations are not included in this publication. Refer to the annually updated *Pacific Northwest Weed Management Handbook* (see further readings).

Transplant beds

Plan to keep your seedlings in containers or seedbeds for at least 2 years, followed by 1–2 years in transplant beds. Plug-grown seedlings can frost heave out of the soil during their first year in the field. Leaving plug-grown seedlings in a transplant bed for 2 years allows the roots to grow beyond the original plug and can reduce damage from frost heaving.

Grading

Grading the seedlings when they are removed from the transplant bed and discarding culls is an important step in producing faster growing subalpine and corkbark fir trees. Discard seedlings that are deformed, damaged, or substantially smaller than the other trees within a particular lot.

Establishment and Care

Standard conifer nursery and Christmas tree practices generally work well for corkbark and subalpine firs. For trees to be marketed in the 8–14 feet height range, a spacing of about 6 feet by 6 feet produces acceptable growth and few difficulties in establishment and maintenance. Guidance on general farm design, site preparation, and weed control are available in the bulletins, *Developing High Quality True Fir Christmas Trees* and *Growing Christmas Trees* (see further readings).

Irrigation

Corkbark and subalpine firs can be produced successfully with and without irrigation. In University of Idaho trials, however, irrigated trees survived at higher percentages and grew faster than their unirrigated counterparts. In irrigated plots, survival after two growing seasons in the field averaged 96 percent for corkbark fir and 99 percent for subalpine fir, while in unirrigated plots, average survival was 90 percent for corkbark fir and 83 percent for subalpine fir.

In the same trials, irrigated subalpine fir averaged 39 inches in height after six growing seasons and corkbark fir averaged 57 inches. For corresponding trees at two unirrigated commercial nurseries, corkbark fir heights were 24–36 percent less and subalpine fir heights were 24–55 percent less.

The most critical period for irrigation appears to be the first 2–3 years from planting while the tree root systems become established. Spring and summer drought, particularly when combined with high temperatures, can cause significant losses in young fir trees. In the UI trials, researchers applied a total of 8 inches of irrigation water each year from planting through the sixth growing season in the field. The water was applied twice during July and twice during August, with about 2 inches of water applied by overhead sprinklers during each irrigation. These trials were performed on moderately drained silt loam soil.

Any irrigation should wet the entire root zone. As with seedlings, overhead irrigation should be applied early in the day to allow the foliage to dry before nightfall. Avoid irrigating on cool or rainy days. Overhead irrigation with trees infected with foliar blight or other fungal diseases can increase the spread of pathogens to uninfected foliage and trees.

Fertilization

The amount of fertilizer to apply, if any, depends on many factors. Start with preplant soil analyses for pH, phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), boron (B), and SMP buffer (lime requirement). If deficiencies or problems are indicated, incorporate the needed materials before planting, following guidelines from the testing laboratory or your extension office. During mid-rotation, tissue sampling and analysis or color chip readings can be used to determine nutrient deficiencies. Although specific recommendations are not available for these species, the information regarding nutrient deficiencies in Christmas trees in the *Christmas Tree Nutrient Management Guide, Western Oregon and Washington* (see further readings) can be used as a guide.

If you choose to fertilize, applications to individual trees are more effective for trees under 3 feet in height than are broadcast applications. If the soils have been properly prepared, no fertilization is generally required during the planting year. Apply about 1/2 ounce of actual nitrogen (N) per tree (38 pounds of N per acre) beginning in the second growing season in the field. As the trees grow taller, gradually increase the rates to a maximum of 0.8–1.2 ounces of actual N per tree (60–90 pounds per acre). A good option is to apply slow-release forms of N fertilizers in late fall. The fall applications and slow-release fertilizers help provide for adequate growth and foliage color without causing excessive leader growth.

The goal in fertilizing is to produce trees with optimal growth and color. If your trees show acceptable growth (at least 6 inches per year) and the needle color is satisfactory, no fertilization may be required.

Shaping your trees

Subalpine and corkbark fir trees require shaping for landscape or Christmas tree applications.

Training leaders. Both crops (especially corkbark fir) tend to set multiple leaders due to failure of the terminal bud to grow, particularly trees from certain seed sources. The reasons for the terminal bud aborting or otherwise failing to grow in spring are unclear. When a terminal bud fails to form a leader, the whorl of buds immediately below it and individual buds on the trunk just below the terminal usually develop, creating a cluster of leaders. In other cases, several leaders form even when the terminal bud breaks to form a leader. Beginning the year of planting, use hand pruners to remove all but one vigorous leader that produces the straightest trunk (figure 9). Although the unwanted leaders can be removed at any time, removing them in late spring or early summer each year reduces scarring of the trunk and produces a straighter trunk than if pruning is delayed.

When no leaders form or a leader is lost, you can tie up one or two lateral (side) shoots near the terminal to form a new leader. This process can be accomplished by tying a bamboo stake to the trunk and a lateral branch to that stake. When two or more lateral shoots

are available, simply tie them together in an upright position using flagging tape. Prune off other laterals arising at the same location, leaving several inches of bare trunk below the new leaders. Either later in the season or early in the following season, retain the best leader and remove the other upright branches.

Measuring taper. Taper is a measure of tree shape and is determined by dividing the width of a tree by its height (figure 10). For landscape use, the amount of taper desired depends on grower and customer preferences, and planting site limitations. For Christmas tree production, percent tapers between 40 percent and 60 percent are preferred. Narrower trees facilitate cutting, baling, and shipping. Wider trees can be suitable for choose-and-cut operations. After 9 years in the field, corkbark fir trees grown from the desert Southwest seed sources described in this bulletin had an average height of 96 inches and an average percent taper of 53 percent. Corresponding subalpine trees averaged 68 inches in height with an average percent taper of 63 percent. No side pruning or shearing was used on these trees. For a 7-foot tree, these tapers produce tree widths of 3.7 and 4.4 feet wide, respectively.

Hand shearing. Corkbark and subalpine firs destined for a Christmas tree lot or landscape are usually shaped with hand shears annually during late July through early September. On well-managed trees, pruning involves removing multiple leaders and shortening laterals that are too long. Most cuts should be made on wood that formed during the current growing season. Removing multiple leaders soon after they form and shortening leaders to correct twists and other defects are important with these crops.

Because true firs form buds all along the length of the leader, cutting back the leaders to prevent gaps in the foliage is not as critical as it is for pines. Depending on the species, age of the tree, and desired foliage density, leaders on subalpine and corkbark fir Christmas trees may be shortened during the summer after the terminal buds have set. When tall, narrow, open trees are desired, shortening the leaders may not be necessary. When it is necessary to shorten a leader, make a sloping cut about 1/4 inch above a well-formed lateral bud.

Because of the many variables involved, making firm recommendations on how much leader to leave on a corkbark or subalpine fir Christmas tree is difficult.

Figure 9. Corkbark fir with unwanted leaders removed. Photo by Dr. Dan Barney

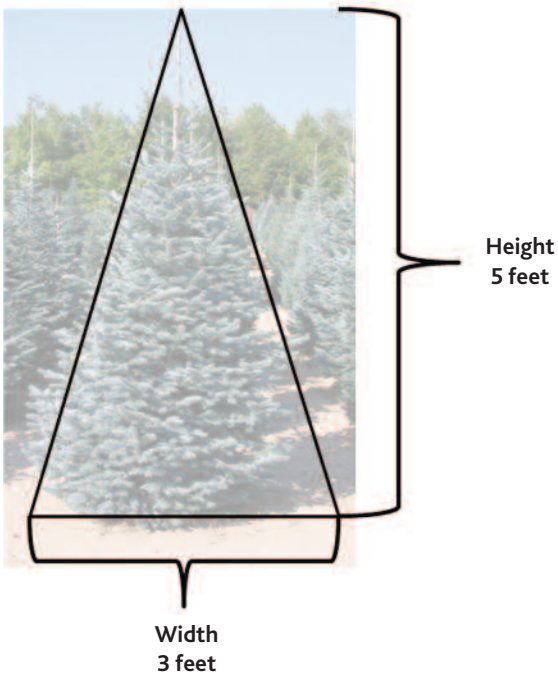

Figure 10. Taper is a measure of tree shape and is determined by dividing the width of a tree by its height, then multiplying by 100 to obtain the percent value. For a tree with a width equal to 3 feet and a height equal to 5 feet, the percent taper would be 60 percent. For Christmas tree production, tapers between 40 percent and 60 percent are preferred.

The goal is to produce trees with uniformly dense branches and foliage along the entire trunk. Trees that grow slowly when young and then produce long leaders during the last few years before harvest can appear bottom heavy. A common practice is to leave no more than about 10–14 inches of leader each year. To produce taller and more open trees, leave the leaders longer.

Leaders on trees intended for landscape use are generally longer than leaders on Christmas trees. With good seed source selection, irrigation, and nutrient management, you should have little need to shorten leaders for landscape nursery trees, other than to remove damaged or distorted wood.

Fork pruning. If side shoots (laterals) require shortening, a method called "fork pruning" is typically used (figure 11). Fork pruning allows growers to control side growth while maintaining a natural shape without the sharp profile created with a shearing knife. Fork pruning also helps prevent prominent stubs and birds-nest-like clusters of new shoots that can develop when lateral shoots are cut back but not completely removed. New lateral shoots consist of one or two central shoots that form in line with the axis of the branch, extending its length. At the base of those central shoots, two side shoots develop, forming a "Y" or fork in which the central shoot(s) are centered. For fork pruning, remove the center shoots at their junction with the side shoots. Where more severe side pruning is needed, cut back branches to the junction with a previous season's side shoots.

Knife shearing. Shearing with long knives is a common practice in shaping pine, Douglas-fir, and some fir species for Christmas trees. Because of their naturally narrow shapes and dense foliage, however, corkbark and subalpine firs are best shaped using hand shears and fork pruning, as described above. If you shear the trees, do so only until one or two seasons before harvest. During the final one or two seasons, use fork pruning to soften the outline of the trees. If you shear a tree, you will need to continue shearing or heavily fork pruning it. Trees that are sheared for several years and then left unsheared develop dense, narrow bottoms and rangy, overgrown tops, making them unmarketable.

Basal pruning. For Christmas trees, an additional pruning step called basal pruning is needed. Basal pruning leaves a clear section (handle) at the bottom of the trunk that can be inserted into a Christmas tree stand. To meet U.S. Department of Agriculture standards for Christmas trees, the handle must be no less than 6 inches long and no more than 1.5 inches per foot of tree height. Make basal pruning cuts close to the trunk to prevent resprouting and stubs that could die back and become infected. Wait to begin basal pruning until the trees are at least 3 feet tall. Remove no more than one-third of the total foliage on any tree. The basal prunings can be used to make wreaths.

Insect, Mite, and Vertebrate Pests

Subalpine and corkbark firs are attacked by about eight insect and mite pests in the Northwest. Conifer aphid is the most common. Of the other common pests, balsam twig aphid (figure 12), balsam wooly adelgid (figure 13), and white grubs may be the most serious. Subalpine firs are particularly susceptible to balsam wooly adelgid, both in their native range and in nurseries or landscapes. Corkbark fir has been reported to also be highly susceptible to balsam wooly adelgid when planted in a landscape setting. Other true fir pests in the Northwest include coneworm, eriophyid needle mites, spruce spider mite, and spruce budworm. Descriptions of pests and management strategies, including pesticide recommendations, can be found in the annually updated *Pacific Northwest Insect Management Handbook* (see further readings).

By far the most important pest control tool is frequent scouting throughout your fields. Pay particular atten-

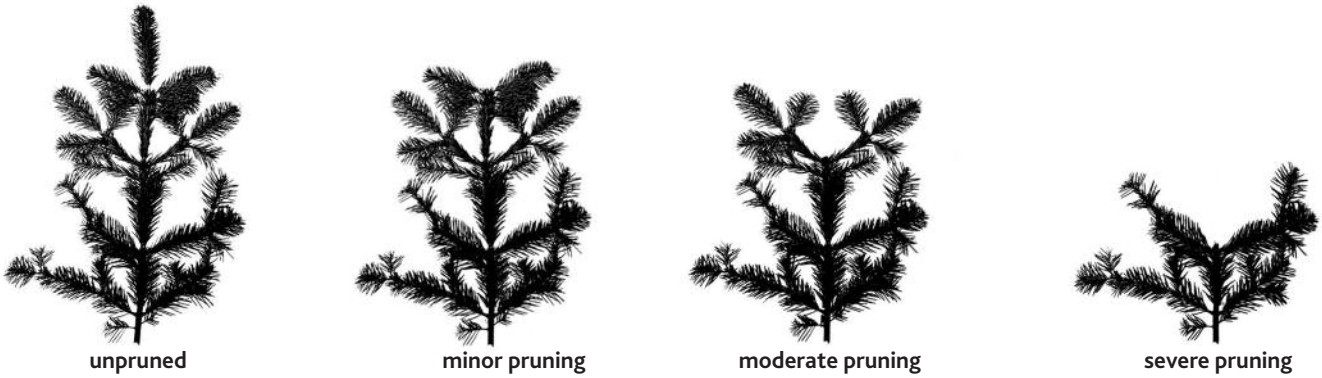

Figure 11. Examples of minor, moderate, and severe fork pruning. Image by Jennifer Jensen

tion to the edges of fields to identify new pests moving in from adjoining areas. If your fields are close to wild stands of true fir, the likelihood of pest infestations is higher than for more isolated locations. In many cases, native predatory insects and mites provide a measure of control for pests. Plan and make pesticide applications carefully to avoid killing beneficial organisms.

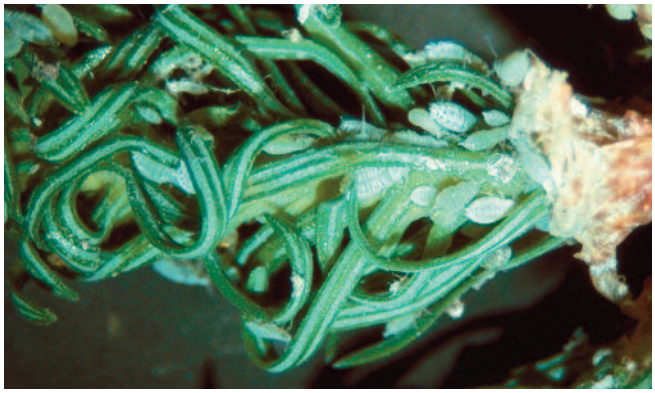

Figure 12. Balsam twig aphid. Photo by E. Bradford Walker, Vermont Department of Forests, Parks and Recreation, Bugwood.org

Figure 13. Balsam wooly adelgid. Photo by Robert L. Anderson, USDA Forest Service, Bugwood.org

Figure 14. Rust disease on true fir. Photo by Oscar Dooling, USDA Forest Service, Bugwood.org

Vertebrate pests are also common problems in subalpine and corkbark fir plantings. Deer damage the trees by rubbing their antlers on the trunks and leaders, especially on young trees. Trees that are rubbed are generally rendered unmarketable. Even worse, the bucks target young trees with long, stout leaders—often the better trees in a young planting.

Bird damage to leaders is common in subalpine and corkbark fir plantations. Robins and other birds perch on still succulent, newly-developed leaders, sometimes snapping off the leaders at their bases. The only cure is corrective pruning and sometimes tying up new leaders. Installing raptor perches in a fir plantation may help discourage smaller birds from entering the plantation.

Diseases

As of 2012, the annually updated *Pacific Northwest Plant Disease Management Handbook* (see further readings) listed 11 diseases on true firs in the Northwest, some of which infect corkbark and subalpine firs. Proper site selection, preparation, and maintenance are important strategies for minimizing disease problems. Seed source and variety selection are also important for disease management. As with insect pest management, frequent scouting of your plantation is the most important disease management tool. The handbook describes cultural and/or chemical controls for these diseases.

Rust diseases also affect true fir species in the Northwest (figure 14). These fungal diseases damage needles and young stems, and alternate between different hosts. Common alternate hosts for fir rusts in this region include native huckleberries and ferns. Whenever possible, eradicate huckleberries and ferns in and around your fir plantings. If rust problems develop, fungicides are available to control the diseases.

A Phoma-type fungal blight can cause serious problems for subalpine and corkbark fir growers in some parts of Idaho. The blight is easily controlled with fungicides, and some desert Southwest corkbark fir seed sources appear to be at least moderately resistant to the disease, requiring little if any fungicide to produce marketable trees. Some desert Southwest subalpine fir seed sources are also relatively resistant to the blight, but of the 10 seed sources tested at the University of Idaho, four of the five best seed sources in terms of growth rates and tree form proved highly susceptible. For that reason, we recommend subalpine fir seedlings only for use as Christmas trees, where the blight can be controlled in the fields.

Further Reading

Christmas Tree Diseases, Insects, and Disorders in the Pacific Northwest: Identification and Management. Misc 0186. Washington State University. 1997.

Christmas Tree Marketing. CIS 896. University of Idaho. 1992.

Christmas Tree Nutrient Management Guide for Western Oregon and Washington. EM 8856-E. Oregon State University. 2009.

Christmas Tree Production: Is This Crop for You? CIS 1021. University of Idaho. 1995.

Developing High Quality True Fir Christmas Trees. PNW 226. Oregon State University. 1993.

Fertilizer Guide: Fertilizer and Lime Materials. FG 52-E. Oregon State University. Reprinted 1998.

Growing Christmas Trees in the Pacific Northwest. PNW 6. Oregon State University. 2003 (revised).

Gymnosperm Database. 2012. http://www.conifers.org/pi/Abies_lasiocarpa.php

Managing Weeds and Vegetation in Christmas Trees. PNW 219. Oregon State University. 1995 (revised).

Pacific Northwest Insect Management Handbook. Current year. http://uspest.org/pnw/insects

Pacific Northwest Plant Disease Management Handbook. Current year. http://pnwhandbooks.org/plantdisease

Pacific Northwest Weed Management Handbook. Current year. http://pnwhandbooks.org/weed

Pest Management Strategic Plan for Christmas Trees in Oregon, Washington, and Idaho. Oregon State University. 2009. http://www.ipmcenters.org/pmsp/pdf/or-wa-idchristmastreespmsp.pdf

Seedling Care and Handling. EC 1095. Oregon State University. 1996 (revised).

Selecting and Buying Quality Seedlings. Oregon State University. EC 1196. 1993 (revised).

Silvics of North America. Agricultural Handbook 654, Vol. 1. USDA Forest Service. 1990.

The Container Tree Nursery Manual. Agriculture Handbook 674, Vol. 2. USDA Forest Service. 1990. http://www.rngr.net/publications/ctnm

USDA, NRCS PLANTS Profiles: Corkbark Fir. 2013. National Plant Data Team. http://plants.usda.gov/java/profile?symbol=ABLAA

USDA, NRCS PLANTS Profile: Subalpine Fir. 2013. National Plant Data Team. http://plants.usda.gov/java/profile?symbol=ABLAL

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