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Identification, Ecology, Use and Culture of Sitka Alder

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Introduction

Sitka alder [*Alnus viridis* (Vill.) Lam. & DC. subsp. *sinuata* (Regel) A.& D. Löve] is a native deciduous shrub or small tree that grows to height of 20 ft, occasionally taller. Although a non-crop species, it has several characteristics useful for reclamation, forestry, and erosion control. The species is known for abundant leaf litter production, the fixation of atmospheric nitrogen in association with *Frankia* bacteria, and a strong fibrous root system. Where locally abundant, it naturally colonizes landslide chutes, areas of stream scour and deposition, soil slumps, and other drastic disturbances resulting in exposed minerals soils. These characteristics make Sitka alder particularly useful for streambank stabilization and soil building on impoverished sites. In addition, its low height and early slowdown in growth rate makes it potentially more desirable than red alder (*Alnus rubra*) to interplant with conifers such as Douglas fir (*Pseudotsuga menzieii*) and lodgepole pine (*Pinus contorta*) where soil fertility is moderate to low. However, high densities can hinder forest regeneration efforts. The species may also be useful as a fast growing shrub row in field windbreaks. Sitka alder is most abundant at mid to subalpine elevations. Low elevation seed sources (below 100 m) are uncommon but probably provide the best material for reclamation and erosion control projects on valley floors and terraces.

Distribution and Identification

Sitka alder (*Alnus viridis* subsp. *sinuata*) is a native deciduous shrub or small tree that grows to a height of 1-6 m (3-19 ft) in the mountains and 6-12 m (19-37ft) at low elevations. Synonyms include *Alnus sinuata*, *A. sitchensis*, and *A. crispa* subsp. *sinuata*. Other common names include green alder, mountain alder, and wavy-leaf alder. Growth habit is freely branching at the base, upright, and multi-stemmed with a rounded crown. The species occurs from southern and western Alaska and the Yukon southward to northern California and eastward to southwestern Alberta, western Montana, and Idaho. It is one of three subspecies of *Alnus viridis* that form a circumpolar group disturbed across northern North America, Asia, and Europe. The other subspecies are *A. viridis* subsp. *crispa and A. viridis* subsp*. fruticosa*. Sitka alder is found from sea level to above timberline, but most commonly occurs above 900 m

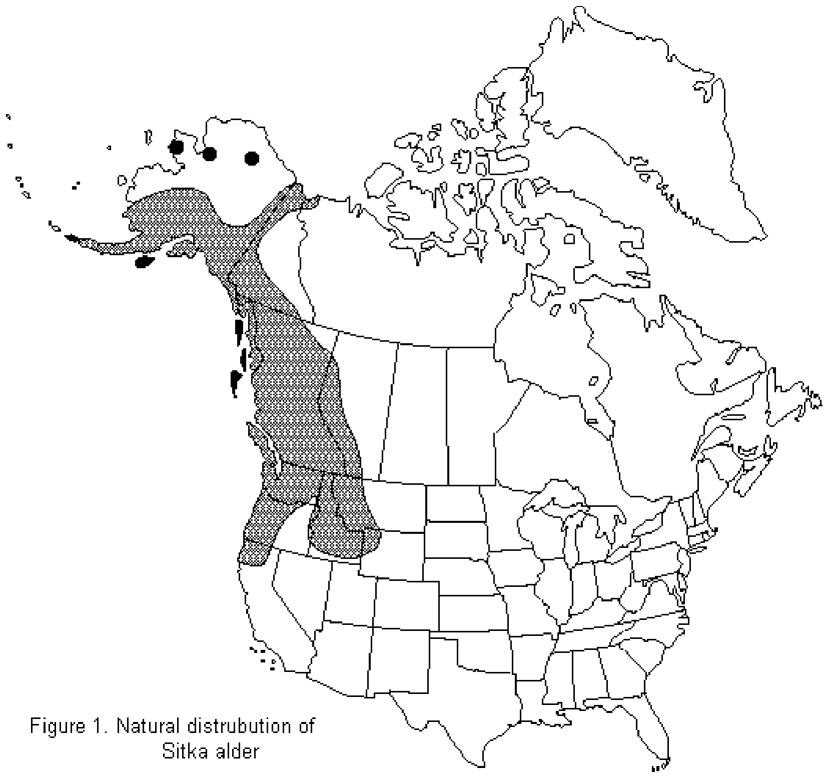

Figure 1. Natural distrubution of Sitka alder

(3000 ft) in the mountains (USDA Forest Service 1988, Elias 1980, Oregon State University 2005, Hickman 1993). It is infrequent to rare below 100 m in Oregon, Washington, and southern British Columbia. [Figure 1 reproduced from the FNA website, 1993+, with permission from the Flora of North America Association.]

Sitka alder is monecious with separate male and female catkins on the same plant. The male catkins form late in the growing season and become exposed during winter. Female flower (catkin) buds form by midsummer, remain enclosed within buds during winter, and bloom the following spring. Unlike other alders, the catkins bloom with the leaves as opposed to beforehand (photo 1). Female catkins (strobili) are cone-like and the seeds are nutlets that mature in late October or November (photo 2). Natural pollination is by wind. This species produces seed primarily through outcrossing, but self pollination is possible as evidenced from controlled pollinations. It freely interbreeds with green alder (*A. viridis* subsp*. fruticosa*) and intermediate types can be found in British Columbia (Hauessler et al. 1990).

The older bark is thin, smooth grey to blue-grey in color. The branches are slender, glabrous, light brown to reddish brown or grey, and slightly zigzagged in appearance. Twigs are reddish to yellow brown, at first pubescent later becoming smooth with conspicuous lenticels. The winter buds are sessile on new growth, 1.2-1.4 cm long (0.5-.06 in), sharply acute, and covered with 3 to 5 (4 to 6) brownish-red to dark purple overlapping scales. The staminate inflorescence is slender, 10-14 cm (4.0-5.5 in) long at pollination, and drooping. The pistillate inflorescences are 0.7-1.0 cm (0.3-0.4 in) long in clusters of 3 to 6 per upright branch, becoming woody, cone-like structures (strobili) comprised of many leathery scales. Mature cones are 1.3-1.9 cm (0.5-0.8 in) long and half as thick, ovate to ovoid-ellipsoid in shape, and born on a slender peduncle. The fruit is a small nutlet (seed) with thin membranous wings that are twice the width of the seed. Leaf blades are thin, sticky and fragrant when young, alternate, narrowly to broadly ovate, 7-14 cm (2.8-5.5 in) long, and 3-10 cm (1.2-4.0 in) wide. They have a fine single or double serrate-denticulate to sinuate margin. The leaf surfaces are glabrous except for hairs along the major vein axils, yellow-green above, and slightly paler and shiny beneath. The base of the leaf is rounded to subcordate while the tip is acute to slightly acuminate. The petiole is glabrous, 1.3-1.9 cm (0.5-0.8 in) long and grooved on the upper surface (Hitchcock et. al. 1969, Hickman 1993, Elias 1980). Life expectancy is 30 to 50 years under typical growing conditions.

Photo 1. Twigs of Sitka alder (April) with male catkins and small female flowers (future cones) in bloom.

Photo 2. Twig of Sitka alder with current year’s male catkins and current and previous year's female cones (strobili).

Ecology and adaptation

Sitka alder is thicket forming, pioneer or early seral species with moderate shade tolerance. It is well recognized as an ecologically important species for natural stabilization and reclamation of landslide chutes, steep slopes, rock slides, streambanks, areas of flood deposition and scour, and exposed mineral soils following glacial retreat, avalanches, massive soil slumping, and other drastic disturbances. Typical habitat for Sitka alder includes moist, montane woods, rocky or sandy coasts (Alaska), streambanks, lakeshores, moist talus slopes, the edges of moist meadows, and the north face of rocky outcrops or other shady aspects. The abundant leaf litter is an important source of organic matter for soil building and nutrient cycling (Uchytil 1989). The roots of Sitka alder form beneficial symbiotic relationships with both ectomychorrhizal fungi and actinobacteria (actinomycetes) in the genus *Frankia*. The latter association results in the formation of root nodules which are active sites for fixation of atmospheric nitrogen. Contributions to soil nitrogen by Sitka alder in the Pacific Northwest have been estimated at 20 to 150 kg N/ha (16-122 lbs/ac) per year (Binkley 1986). It also produces an acidifying effect on the soil (Hauessler et al. 1990). The species highly fibrous root system aids in soil erosion control.

Sitka alder grows on soils that vary from mineral to rich, humus covered substrates, acid to neutral pH (3.8 to 7.5), and course to medium texture (rocky, gravelly, loamy sands, sandy loams, silts, loams). It also does well in heavier clay loam soils that are nutritionally poor and moist (Plants for a Future 2005). This species volunteers readily from seed on avalanche sites or other disturbances created by soil slumps, stream flow, logging, road building, fire, or retreating glaciers. In some regions, Sitka alder can be sympatric with red alder (*Alnus rubra*). However, Sitka alder is more likely to be found on steep sites and those with well drained, rocky or coarse textured substrates while red alder occurs on swampy areas, moist floodplains, and poorly drained soils. While listed as a facultative wetland plant (FACW) (Reed 1988) and purportedly indicative of high water tables (Uchytil 1989), Sitka alder appears more maladapted to flooding compared to red alder. Unlike red alder, Sitka alder lost substantial root and shoot biomass and did not restore growth during flooding (20 days) or recovery (10 days) (Batzli and Dawson 1997). Because of nitrogen fixation within the root nodules, sites with Sitka alder colonies generally have higher available soil nitrogen than adjacent plant communities (Haeussler and Coates 1986). This species will be found in full sun but has intermediate shade tolerance and will persist under a forest canopy (DeLong and Sanborn 2000).

The palatability of Sitka alder is considered poor and forage value low for most ungulates (Uchytil 1989), but others report that it is one of most palatable of the native alders, being rated fair to good as browse for sheep in some areas (USDA Forest Service 1988). Selective browsing of this species by moose occurs in Idaho during summer months as leaves remain green (Pierce 1984). It is also considered high-quality moose browse in British Columbia. Elk will browse the tender young shoots, while white-tailed and mule deer feed on leaves and twigs (Haeussler et al.

1990). Alder twigs and leaves are consumed by muskrats, rabbits, snowshoe hares, and squirrels, while the seeds, buds, or catkins are an important source of food in winter for numerous song and game birds (Healy and Gill 1974, Haeussler et al. 1990, Martin et al. 1951). Beavers eat the bark and use the stems to build lodges and dams (USDA Forest Service 1988). Thickets provide thermal and hiding cover for big game and other wildlife, as well as nesting habitat for many small birds (Uchytil 1989).

Uses

Sitka alder has several potential uses. Benefits to soil productivity along with the ability to tolerate low nutrients, high acidity, and high exchangeable aluminum make it a good candidate for vegetating copper mine tailings (Kramer et al. 1996-1997) as well as reclaiming coal mine spoils. It is a valuable species for streambank stabilization, erosion control on nutrient poor sites, and other land rehabilitation efforts where an easy to establish, deciduous shrub is desired. Sitka alder may also be useful in improving forest site productivity as a companion or nurse shrub in conifer reforestation plantations (Hauessler et al. 1990). Compared to red alder, Sitka alder is considered potentially less competitive with young conifers because of its smaller stature and slower growth (Harrington and Deal 1982). Species like Douglas fir and Ponderosa pine should be planted several years in advance of Sitka alder. Ideal planting densities are unknown and will vary by precipitation zone, soil type, timber species, and other site factors. Under some circumstances Sitka alder is considered a minor to major competitor with tree seedlings and an obstacle for plantation establishment (Hauessler et al. 1990). The species can also be used as a fast growing shrub row in field windbreaks or for wildlife habitat and species diversity. While not preferred browse for some ungulates, it provides good food and cover for rabbits, squirrels, and birds.

Ethnobotany

Alder species including Sitka alder have numerous ethnobotanical uses. The bark was used by several tribes to make a red or brown colored dye. The dye was used to color fish nets and cedar bark. The aged bark was also used as a medicinal cure for diarrhea, constipation, and other internal ailments. The inner bark and ointments made from it were used to treat skin problems such as wounds, skin ulcers, and swelling. The Quileute eat raw cones to stop dysentery and the Klallam chew catkins as a cure for diarrhea. Fresh scraped bark juice relieves itching from skin rash and an infusion treats poison ivy. Leaf decoctions were used to treat burns and swollen wounds. Alder roots are high in tannins and the Menomini boiled and drank it as an astringent (Gunther 1973, Ellis et al. 1995). A decoction of stems was apparently also drunk as a remedy for colds or dried stems were placed in the nose or chewed for the same reason. Indications that alder was used as a fragrance or scent may have referred to Sitka alder which is known for being sticky and sweet smelling (Turner et al. 1990). Alder wood was used as firewood and was preferred for smoking salmon. Next to cedar, it was the most widely used wood for woodworking (Gunther 1973). The species was considered a sign of water and the hard wood was used for making snowshoes and bows (Turner et al. 1990).

Seed Transfers and Sources

General guidelines for the transfer or movement of tree seed from one area or “seed zone” to another have been written for some states and offer good advice (Randall and Berrang 2002, Randall 1996). Local populations are typically well adapted to local environments and are usually the safest choice, if available. Generally, the harsher the planting site and the higher the elevation, the smaller the seed zone should be. That is, seed should be kept closer to its origin in harsher climates because of the greater risk for maladaptation. Seed zones have been developed for red alder in Oregon and Washington but not Sitka alder. The genecology of the two species may differ substantially and rules for one should not be applied to the other. Nevertheless, seed origin appears to be important for Sitka alder, so precautions apply to the movement of seed and propagules. A study in British Columbia with 28 populations of Sitka alder showed clear geographic patterns in frost hardiness, dry weight, growth, and germination parameters that related to latitude and distance from the coast (Benowicz 2000). The differences are probably adaptive (Centre for Forest Gene Conservation 2002). Anecdotal information indicates local seed sources perform better in central interior British Columbia compared to those imported from the coast. Coastal material never grew above snow depth and only reached knee high after a decade (Sanborn, personal communication).

Sitka alder seedlings are produced by a number of nurseries in the western US and Canada. Particular attention should be paid to the natural origin of material, especially the differences in longitude, latitude, and elevation between the seed source and the planting site. Seed or seedlings should be certified by the seed certification agency within the state to help insure genetic integrity of the planting stock.

Skamania germplasm

Skamania germplasm is native population of Sitka alder from Skamania County, Washington, near the north shore of the Columbia River, elevation 200 ft. This pre-varietal, selected class release is relatively unique because it represents a low elevation, high quality seed source originating from a region where the species is uncommon at low altitude. It was chosen by the Natural Resources Conservation Service from a common garden study of Sitka alder conducted at the Plant Materials Center, Corvallis, Oregon, from 1983 to1990. A total of 64 populations were included, most originating from western Oregon and Western Washington. Based on this study, Skamania germplasm grew more vigorously, taller, and faster (after the first year) than over 90% of the populations (accessions) tested. It also ranked near the top in seed production and foliage appearance (fewer insect and disease signs and symptoms) (Darris et al. 1994). Its earlier bud break and later leaf fall compared to most high elevation seed sources are consistent with expectations for a low elevation seed source from a milder growing clime. Skamania germplasm Sitka alder is valuable for streambank stabilization, riparian buffers, mine spoil reclamation, soil building, and erosion control following logging, mud slides, fire, or other drastic disturbances.

Following general guidelines for seed transfer, the movement of a seed source such as Skamania germplasm to other low elevation sites with a similar, mild environment can be less restrictive than higher elevation material. While further testing is needed, Skamania germplasm is predicted to be adapted to climates typical of the western interior valleys and lowlands of Oregon and Washington below 1500 ft (457 m) with the possible exception of the Rogue River Valley. The entire area is dominated by cool, mild winters with high rainfall, and warm, dry summers where the mean annual precipitation exceeds 35 inches. Given its origin, it should be particularly well suited to watersheds of the lower Columbia River and associated tributaries, including the lower Columbia Gorge west of Hood River, Oregon.

Seed collection, germination and storage

Sitka alder is monecious with male and female catkins forming on the same individual. Plants can commence flowering and producing seed at an age of four to seven years (Uchytil 1989). Populations grown at Corvallis, Oregon, flowered as early as age three. The seeds or nutlets are borne within small cone-like catkins called strobili that mature in fall. They are winged and can travel long distances by wind or water (Uchytil 1989). Methods for collection, extraction, and storage of red alder seed are generally applicable to Sitka alder. The seed is collected in late October or November when the cone-like catkins turn brown and scales begin to open. Seed may also be sufficiently mature if the “cones” are turning brown in color and their scales easily separate by twisting the cone at the top and bottom (Hibbs and Ager 1989). They may be hand harvested or the branches flailed over a tarp. The cones are thoroughly dried at ambient temperatures by suspending them in fine mesh bags or placing them on elevated screens. The seed is removed by tumbling or shaking. Cones can also be kiln dried at 27-38°C (80-100°F) (Schopmeyer 1974). More recent recommendations are for kiln drying red alder cones at 16-27°C (60-80°F) (Hibbs and Ager 1989). At the Corvallis PMC, 95 cones yielded 27 g (~1 oz.) of clean seed in 1991. For Sitka alder there are approximately 771,000 seeds/kg (1,700,000 seeds/lb) (+/- 10%). When stored in paper envelopes and refrigerated at 3-5C (37-41F), seed has maintained a germination rate of over 50 percent after three years. Red alder seed has been stored for longer periods (10-20 years) without substantial loss in viability when dried to less than 10 percent moisture and frozen in moisture proof containers at -12º C (10°F) (Hibbs and Ager 1989). Appropriate conditions for long term preservation of Sitka alder seed are likely to be similar.

Seed dormancy can vary by provenance, population, moisture content, or age. Dry seed may germinate at higher rates or more uniformly if it undergoes cold moist stratification for one to three months at 1-3ºC (34-38ºF) (Emery 1988). Some report using stratification periods of 14 days for *Alnus viridis* (Farmer et. al. 1985) or one month for *Alnus sinuata* (McLean 1967). Others state that no chilling or treatment is required (Coates et. al. 1990, Hudson and Carlson 1998). Fresh seed often lacks dormancy and will germinate readily without treatment if sown immediately, on the surface or only with very shallow coverage. The NRCS pre-varietal release, Skamania germination, germinates better with two months (nine weeks) of cold moist stratification of dry seed at 1-3º C (34-38°F). Certain fungicide treatments like Captan may reduce germination (Darris et al. 1994).

Seed production

Wild populations of healthy Sitka alder can be located, documented, and the stand and its seed certified as G0 “source identified” through the appropriate state seed certifying agency. However, locating natural stands can be difficult at lower elevations where the species is uncommon or inaccessible. An alternative is to establish seed orchards for maintaining a dependable source of high quality G1 seed. Orchards of Sitka alder are best planted in full sun on well drained, coarse to medium textured soils with acid to neutral pH. Young shrubs can begin flowering and producing seed as early as the fourth growing season. Selections should be properly isolated from other subspecies and populations of both *Alnus viridis* and *Alnus crispa*. Summer irrigation beyond the establishment year is desirable but not required, especially if plants are mulched for weed control and soil moisture retention. Insect and disease pests should be monitored and treated with approved integrated pest management (IPM) methods as required, according to label instructions. At Corvallis, Oregon, oyster shell scale (*Lepidosaphes ulmi*) and poplar-willow borer (*Cryptorhynchus lapathi*) were two pests noted in the mature specimens. Scales can be treated with a dormant oil spray. Borers are controlled by cutting and destroying infested limbs. Others common pests of Sitka alder can include alder leaf beetle (*Altica ambiens*) and the western tent caterpillar (*Malacosoma californicum*) (Hauessler et al. 1990). Fertility management can include use of a balanced fertilizer or one lower in nitrogen and higher in phosphorus (P) and potassium (K) applied at or prior to bud break each spring.

Vegetative propagation

Sitka alder can be vegetatively propagated. Hardwood cuttings do not work (Java and Everett 1992), but some rooting success has been reported with green stem cuttings (Carpenter, et. al. 1984). Cuttings were dipped in a solution of 2000 ppm IBA and dusted with a mixture of Rootone 10 rooting compound and Benomyl fungicide. The rooting medium was sterile perlite and vermiculite (1:1). They were then misted intermittently for 10 weeks and fertilized weekly with a liquid fertilizer during the last month. Results improved by applying bottom heat of 21°C (70°F). Others report some success rooting cuttings that are taken just after the leaves fall and planted outdoors in a sandy soil (Plants for a future 1997-2000). At the Corvallis PMC, summer wood cuttings made in July and treated with hormones were unsuccessful. Field grafting has been reported for certain cultivars of alder, but the process is generally difficult for this genera. The PMC experimented with a device for hot-callusing graft unions of dormant stock but was unsuccessful (Darris et. al. 1992). The species has been propagated successfully using tissue culture (Tremblay and Lalonde 1984). In the wild, Sitka alder reproduces vegetatively by sprouting from damaged root collars or stumps. Shoots can also form where roots are exposed in streams (Hauessler et al. 1990).

Seedling inoculation

Sitka alder is readily adapted to container nursery production (Hudson and Carlson 1998, Wick et al. 2004). For optimal growth and improved root nodulation, young seedlings should be inoculated with the appropriate *Frankia* actinobacteria using cultured isolates or a dilute slurry created from water and macerated nodules (Ahrens 1994, Subramaniam et al. 1991). Superior cultures are raised on a special medium, harvested by centrifugation, homogenized, suspended in distilled water and applied to four week old seedlings as a soil drench (Subramaniam et al. 1991). Others suggest the inoculum be mixed with a carrier like peat and incorporated in the potting media or nursery beds (Martin et al. 1985). If cultured inocula of *Frankia* are unavailable, fresh nodules can be obtained from the roots of donor plants. They are rinsed thoroughly with tap water, then crushed, ground, or macerated, homogenized in a blender, and stored as a slurry in a refrigerator for a short period until used. The homogenate may be filtered through muslin, diluted with water, and then applied with a watering can to containerized seedlings at four weeks or a seedbed prior to sowing (Wheeler et al. 1991, Ahrens et al. 1992). Soil obtained beneath the canopy of existing Sitka alder stands or from a makeshift inoculum bed of older, nodulated seedlings is a third source of inocula. Work at the Corvallis PMC confirmed that a thin band of this soil placed in the container prior to sowing, coupled with periodic application of a balanced liquid fertilizer or incorporation of a slow-release fertilizer, can produce the most vigorous seedlings (Darris et al 1994). Finally, maintained outdoors, a percentage of non-inoculated seedlings will still form N-fixing nodules by the end of growing season due to chance infection. However, nodule abundance is less and the quality of inoculum is unknown.

Besides *Frankia*, Sitka alder can respond to inoculation with certain species of ectomychorrhizal fungi. The benefits of this symbiotic association between the fungi and the roots of alder and other woody species are well known. Apparently, the ectomychorrhizal fungi do not survive the grinding and slurry treatment used to make the *Frankia* inoculum from fresh nodules. Procedures for fungal inoculation are described elsewhere (Castellano and Molina 1989).

Containerized production

For container production, the use of standard growing media that are 75 to 100 percent peat, moderate to well drained, and amended with micronutrients and slow release fertilizer are suggested. Protocol for tubeling production at the Corvallis PMC included the use of a soil free mix that was 1 part Sunshine Mix #1 (70-80% sphagnum peat moss, plus perlite, gypsum, low concentration starter fertilizer), 1 part Black Gold (screened earthworm castings, sphagnum peat, pumice, oyster shell lime, balanced pH), 1 oz. Osmocote (14-14-14 slow release fertilizer), and 0.5 oz. Micromax (micronutrients-Fe, Zn, Cu, B, Mo) per bushel of media. Stratified seed may be surface sown or covered with a very thin layer of silica sand. Germination usually occurs within three weeks. Depending on the original container size, seedlings may be re-potted into 1 gallon or larger pots within a period of 12 to 18

Photo 3. Two year old container seeding of Sitka alder with abundant fibrous roots. Lines point to root nodules.

weeks (photo 3). Container plants should be maintained in a shadehouse with periodic liquid fertilization and irrigation. The Corvallis PMC applied soluble fertilizer (Peter's 20-20-20 @ 1 tbsp./gal. of water) one or more times in the spring and early summer. In August, fertilization was discontinued and the withdrawal of water began. Sitka alder seedlings are hardened off for eight weeks or more by fall. Pruning, if needed, is done one or more times on soft tissue before mid-August (Hudson and Carlson 1998).

Bareroot production

Sitka alder has also been successfully produced as 1-0 and plug+1 bareroot stock in outdoor nursery beds (photo 4). Seedlings grown in fumigated beds have benefited from inoculation with Frankia just prior to seeding. While the species can be successfully spring seeded, better germination requires fall sowing or the use of pre-treated (stratified) seed. Open bed seedling densities of 60-180 seedlings/m2 (5-15/ft2) recommended for other alders are suggested here. Management of top growth, timing (sowing, lifting, etc.) and grading of seedlings will differ by alder species, climate, and nursery. However, general guidelines for nursery culture including inoculation, sowing, fertilization, irrigation, pest management, storage, and outplanting developed for the production red alder (Ahrens 1994, Ahrens et al. 1992, Bonner and Nisley 2005) are applicable to Sitka alder.

Pest management in the nursery

Sitka alder can be susceptible to several fungal pathogens, including those causing leaf spots and powdery mildew. The diseases may show up in seedling stock. In red alder, top-kill caused by *Bortrytis* spp. and stem cankers caused by *Septoria alnifolia* can cause significant loss in nursery yields, requiring multiple applications of fungicide during the growing season (Ahrens et al. 1992). Sitka alder is susceptible to many of the same pathogens as red alder (Hepting 1971), so control practices may be needed on it as well. While alders can be host to a number of insect pests including aphids, scales, borers, sawflies, and leaf miners (Furniss and Carolin 1980, Johnson and Lyon 1991), only the black vine root weevil (*Otiorhynchus sulcatus*) has been troublesome during containerized nursery production at the Corvallis PMC. The grub-like larvae feed on roots while adult beetles create a notched appearance on the margin of the leaves. Insecticidal soil drenches or parasitic nematodes are useful in managing root weevil larvae, while approved foliar applied insecticides may be necessary for adult weevil control. Timing is critical in order to match treatment with the insect's life cycle (DeAngelis and Garth 1993, McGrath 1999). For larval control the PMC applied Biosafe or Exhibit (insect parasitic nematodes) to the potting media at least once in spring and again in late summer. Orthene (acephate) was also applied according to label instructions once in the spring and once in early fall for control of adult weevils.

Photo 4. Bareroot production of Sitka alder at the Washington DNR Nursery, Bow, WA (now the WACD Plant Materials Center).

Outplanting, monitoring, and maintenance

For revegetation techniques, principles of seedling selection, care, and handling, site preparation, planting techniques, vegetation management, and animal damage control measures, refer to information described for reforestation and other tree and shrub plantings (Rose and Morgan 2000, Elefritz et al. 1998, Nolte and Otto 1996, Hallman 1993, Darris 2001). The best time to plant Sitka alder seedlings varies somewhat by region. In western Oregon and western Washington, fall and winter are preferred. Bareroot material is usually planted in late winter or early spring when stock is most available.

Recommended within row spacing for windbreaks of Sitka alder is 4 feet for single rows and 6 feet for multiple rows. Stock type is typically container, but bareroot material in the range of 18 to 24 inch tall may be used as well. However, seedling quality, root to shoot ratio, and stem caliper are more important than height. Guidelines for windbreak installation and maintenance are described elsewhere (USDA Soil Conservation Service 1991). For riparian buffer plantings or streambank stabilization along low velocity streams, a suggested overall spacing of 4 feet spacing is common (Voss 1997). Plantings are done in either a grid fashion or clumps of three to five seedlings each. Ideal spacing for using Sitka alder as a nurse or companion species along with conifers grown for timber is unknown.

Like all tree and shrub plantings, a monitoring and maintenance program is often critical for successful establishment and growth. The survival and condition of outplanted stock should be surveyed annually for at least the first three to five years. Corrective measures may include replanting, vegetation management, weed control, and animal damage prevention.

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