Plant Propagation Protocol
ESRM 412 – Native Plant Production
JD Bakker
Spring 2007

Family Names	
Family Scientific Name:	*Betulaceae*
Family Common Name:	Alder, Birch
Scientific Names	
Genus:	*Alnus*
Species:	*rubra*
Species Authority:	Bong.
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym	
Genus:	*Alnus*
Species:	*Oregona*
Species Authority:	Nutt. (ITIS, 2007)
Variety:	*Pinnatisecta*
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	Starker (ITIS, 2007)
General Information	
Common Name:	red alder, Oregon alder, Pacific coast alder, alder (AgroForestry Tree Database, 2007)
Species Code (as per USDA Plants database):	ALRU2
Ecotype:	
Date Entered or Updated (MM/DD/YY):	04/10/2007
General Distribution (elevation range, ecosystems, etc):	Occurs along streams and in moist bottoms, and on moist mountain slopes. Ranges from southeastern Alaska southward through western British Colombia, and on the west side of Cascade mountains as far south as southern California. Elevational range: sea level to 3,500 feet. (Jensen et al, 2002)
Propagation Details	
Propagation Goal:	Plants
Propagation Method :	Seed
Product Type :	Bareroot (field grown)
Stock Type:	1 + 0 seedlings
Time to Grow:	A plantable bareroot seedling can be produced at the nursery in one growing season. (Potash and Aubry, 1997)
Target Specifications:	A plantable bareroot seeding which can be planted in the field, or lifted and transplanted into containers or another bed for growing on.
Propagule Collection:	*A. rubra* reaches sexual maturity after 10 years (Young, 1992). The tree is generally monoecious, with separate male and female catkins developing on previous years' growth. Male catkins are thin and 10-15 cm long while female catkins are thicker and shorter, 0.8-1.2 cm long. The seeds are tiny winged nutlets found inside woody cone-like fruits

	called strobiles. The strobiles are 1.3-2.5 cm long, cylindrical shaped, persistent, and turn from green to yellow to brown as they ripen. (Rose et al, 1998) Seed dispersal begins in late September in the middle of the species range, somewhat earlier in Alaska, and several weeks later in California. *A. rubra* is a consistent and prolific producer of seed. (Agroforestry Tree Database, 2007) Handpicking is particularly convenient for *Alnus* sp. (Macdonald, 1986) Seed maturity can be checked by twisting a strobile along the long axis. If it is mature, the strobile will twist easily and scales part slightly. (Rose et al, 1998) Another way to tell when cones are ripe is that the stem below the cluster of cones thins noticeably and you are able to break off clusters at this point. (Potash and Aubry, 1997) To determine whether or not the cones on a certain alder tree are worth collecting take a knife and split a few cones lengthwise. The light colored seeds are located between the cone scales and near their base. A good seed crop is indicated by a count of five or more seeds. (Hibbs and Ager, 1989) Collect from standing or recently felled trees when the bracts start to separate on the earliest strobiles. Collect strobiles by stripping from the branches and blow out any leaf litter with a fan. Strobiles found on the upper third of the tree usually contain the most viable seed. (Rose et al, 1998) Collect seed from a source as geographically and climactically close as possible to the final planting site of seedlings, for greatest seedling growth rates and viability. (Hamann et.al, 2000) While one study found high elevation stands to have significantly higher viable seed production per catkin than low elevation stands, (Markham, 2002) another found this correlation to be negligible. The second study found the best growth performance associated with seed sources from warmer areas with low moisture demands. In general, this combination of climate conditions exists in low-elevation coastal areas; in this study, all seed collection locations fitting this description were in northwestern Washington state. (Hibbs et al, 1994)
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Once picked, dry immediately with good air circulation (on screens or in mesh bags at 16-27º C) to prevent molding. Most strobiles will open after being in above storage treatment for several weeks. They can be opened in a shorter time by kiln drying at 32º C for 24 hours within 4-6 wks of collecting. (Macdonald, 1986, Rose et al, 1998) Most seeds fall out of the strobiles during the drying process. The remainder, if needed, may be extracted by tumbling and shaking. (Young, 1992) Once cleaned, seed can be stored for a short time by refrigeration. For long term storage, dry to less than 10% moisture content and store in moisture proof containers at -12 to -13º C for up to five years. (Rose, et al, 1998) Moderate seed crops are produced annually and large crops occur every 3-5 years. The seeds are very light, numbering 800,000-3,000,000/kg. (Young, 1992) Higher number of seeds per gram may indicate lower quality. (Young, 1992)

Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	*Alnus rubra* seeds have no or little dormancy. (Burns and Honkala, 1990) Seeds germinate easily. Generally, no stratification is required for red alder seed, (Rose et al, 1998) although seed not planted in the same fall it was collected may be cold-stratified for 30 days to break seed dormancy. (Stevens, 1993)
Growing Area Preparation/Annual Practices for Perennial Crops	Will germinate in fall or spring on moist mineral soil in full sunlight. (Baskin, 2002) Sowing smaller seed such as alder is made easier by bulking up the seed with fine peat moss or fine sand to a known volume. (Macdonald, 1986) Sow at less than one pound per acre. (Potash and Aubry, 1997) Seeds germinate at 24/16º C. Due to their size, seeds should not be covered, or they will not germinate. (Rose et al, 1992) If seeds are to be covered depth should be no greater than 1 cm. Seedling growth is stimulated by soil sterilization before sowing seeds. This decreases root nodulation, however, so it is recommended to follow sterilization with inoculation with a cultured strain of the nitrogen fixing bacteria *Frankia*, which greatly increases seedling root nodulation. (Moffat, 1994, Martin and Myrold, 2003) Pre-germination inoculation with cultured strains of *Frankia* has been shown to increase seedling growth more than treatment with standard nursery fertilizers. (Wheeler, et al 1991)
Establishment Phase:	It may be necessary to give 3-4 applications of water each day during dry weather after sowing seed until the radicle has developed sufficiently to function and maintain moisture status. This is critical during the first few days for small seeds such as *Alnus*. (Macdonald, 1986) Results of one study indicate that red alder would benefit in total plant growth from increased ambient CO2 during seed stratification, germination, and establishment. The same study also indicates this increased ambient CO2 would increase the seedlings drought tolerance. (Hibbs et. al, 1995)
Length of Establishment Phase:	Few weeks
Active Growth Phase:	Seedlings are irrigated in the early morning when the wind is at a minimum. Irrigation scheduling is based on the moisture content of the seed bed. Generally, the bed is not allowed to dry down much below field capacity. During periods of maximum summer temperatures, seedlings are irrigated every 2 to 3 days for up to 4.5 hours an irrigation. Seedlings are not cooled in the afternoon with overhead irrigation. Seedlings are monitored for pests but generally insects and diseases do not occur in this species and stocktype. Seedlings must be hand-weeded every 6 weeks. (Steinfeld, 2003)
Length of Active Growth Phase:	3 months
Hardening Phase:	Hardening begins in the late summer with a reduction in the frequency of irrigations. Generally seedlings are hardy to any nighttime low temperatures that are encountered in the fall and winter months. For winter freezes where temperatures reach into the low teens, seedbeds can be covered with poly hoop houses until the event has passed.
Length of Hardening Phase:	3 months
Harvesting, Storage and Shipping:	1 + 0 bare root seedlings are lifted in the fall and can be

	transported immediately to a planting site, to another nursery, potted up or put in another bare root bed to grow on another year.
Length of Storage:	NA
Guidelines for Outplanting / Performance on Typical Sites:	Seedlings are typically planted in the early spring when snow has left the site and soils are no longer frozen or in early fall. Seedlings are placed in holes so that the top of the plug is several inches below the surface of the soil. Soil is placed back over the planting hole so that no media is exposed. The resulting depression around the seedling will store rain or irrigation water. Competitive grasses and forbs are often removed from around the seedling and the site then mulched. Seedlings are protected from animal damage with deer repellent or netting. Seedlings that are planted in the early fall are usually watered after planting. (Steinfeld, 2003) Underplanting in thinned stands of Douglas fir, which is done for various reasons, has good success, and plants may not need to be protected from deer or elk browse. (Maas-Hebner et al, 2005) One study suggests that rectangular planting of red alder at dense spacing enhance stand differentiation, accelerate competition-related mortality, and thus lead to improved growth of surviving trees. (Debell, 2002)
Other Comments:	
References:	AgroForestry Tree Database. URL: http://www.worldagroforestrycentre.org. (accessed 8 April 2007). Baskin, Carol J.; Baskin, Jerry M. 2002. Propagation protocol for production of container *Alnus rubra* plants; University of Kentucky, Lexington, Kentucky. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 8 April 2007). Burns, R. and B. Honkala 1990. Silvics of North America, Volume 2, Hardwoods. Agricultural Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, D. C. 877 p. DeBell DS, Harrington CA. "Density and rectangularity of planting influence 20-year growth and development of red alder." Canadian Journal od Forest Research 32 (7): 1244-1253 Jul 2002 . Hamann A, Koshy MP, Namkoong G, Ying CC. "Genotype x environment interactions in *Alnus rubra*: developing seed zones and seed-transfer guidelines with spatial statistics and GIS." Forest Ecology and Management 136 (1-3): 107-119 Oct 1 2000. Hibbs DE, Bouvarel L, Ducros ET. "Performance of Red Alder seed sources in France." Canadian Journal of Forest Research 24 (5): 1008-1014 May 1994

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Propagator (Author) That Developed This Protocol	
First Name:	Katie
Last Name:	Pencke

Plant Data SheetPlant Data Sheet

Red alder, Alnus rubra

Range
Pacific Northwest coastal areas into SE Alaska (Silvics of N.A. 1990)

Climate, Elevation
Low winter temperatures and lack of precipitation limit red alder. Locally, elevations below 450 m (Silvics of N.A. 1990)

Local occurrence (where, how common)
Forest understory, disturbed sites, riparian, wetlands

Habitat preferences
Moist soils, sunny sites, disturbances (Silvics of N.A. 1990)

Plant strategy type/successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)
Weedy, colonizer and seral. Nitrogen-fixer

Associated species
Big-leaf maple, Douglas fir, willow, western red cedar, western hemlock, grand fir, black cottonwood (Silvics of N.A. 1990)

May be collected as: (seed, layered, divisions, etc.)
Seed, stump-sprouts, greenwood cuttings, mound layering (Silvics of N.A. 1990)

Collection restrictions or guidelines
Seeds shed in September (Alaska) through December (California) (Silvics of N.A. 1990)

Seed germination (needs dormancy breaking?)
Will germinate in fall or spring on moist mineral soil in full sunlight. No or little dormancy. (Silvics of N.A. 1990)

Seed life (can be stored, short shelf-life, long shelf-life)
Short; very small seeds. Store no more than two seasons.

Recommended seed storage conditions
Store in paper sacks in cool, dry environment

Propagation recommendations (plant seeds, vegetative parts, cuttings, etc.)
Collect cones, separate seeds, plant seeds. Pull-ups also convenient and plentiful. (Rose et al. 1996)

Soil or medium requirements (inoculum necessary?)
Will grow in non-soil medium, but requires inoculum for nitrogen-fixing actinobacteria Frankia in nodules.

Installation form (form, potential for successful outcomes, cost)
Seeds, container-plants grown from seeds, green cuttings, bare root (Silvics of N.A. 1990)

Recommended planting density
6’ centers (Stevens and Vanbianchi 1994)

Care requirements after installed (water weekly, water once, never water, etc.)
Requires moist soil (Stevens and Vanbianchi 1994)

Normal rate of growth or spread; lifespan
Fast growth: 30’ at 5 yrs., 50’ at 10 yrs. 80 ft. at 20 yrs. Mature at 60-70 yrs. Maximum age 100 yrs. (Silvics of N.A. 1990)

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Data compiled by: Kern Ewing, 14 Mar 2003