PLANT PROOCOL
Aaron Jorgenson
Thuja plicata

Family Names	
Family Scientific Name:	Cupressaceae
Family Common Name:	Cedar family
Scientific Names	
Genus:	*Thuja*
Species:	*Plicata*
General Information	
Common Name:	Western red cedar
Species Code (as per USDA Plants database):	THUPLI
Ecotype:	Mixed deciduous and conifer park, 50m elevation. Seattle, Ravenna park, University district, WA.
Date Entered or Updated (MM/DD/YY):	5/11/2007
General Distribution (elevation range, ecosystems, etc):	Western red cedar is found along the west coast of north America. It is found in California, Organ, Washington, British Columbia and Alaska. It is also as far east as Montana. It prefers maritime climates with cool summers and mild wet winters. Western red cedar is found in elevations of 610 – 1,798 meters in the northern Rocky Mountains, 0 – 910 meters in Alaska, 0 – 1,190 meters in British Columbia, and 0 – 2,290 meters in Oregon. The tree prefers wet sites such as wet ravines, along streams and rivers, narrow, poorly drained canyons, bottomlands, depressions a forested swamps. It is a very shade tolerant species and is likely to be found under already existing canopies. (Colman 1977)
Propagation Details	
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants
Propagation Method (Options: Seed or Vegetative):	Seeds
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Container (plug)
Stock Type:	172 ml containers
Time to Grow:	10 months
Target Specifications:	Stock Type: Container seedling Height: 17 cm Caliper: 6 mm Root System: Firm plug in container. (Rosa 1998)
Propagule Collection:	Thuja plicata flowers in late May to June and cones ripen from late August to October. Seeds are collected in late October to November when cones are brown, but before scales begin to reflex. Seeds are collected using a pruning pole and canvas tarp. Cone bearing branches are cut and fall on tarp below. Cones are hand pulled off branches and stored in paper bags. (Dirr 1987)
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Seeds are easily extracted from opened cones using a tumbler. Do not dewing the seeds. Seeds are stored at 0C in sealed containers.

	Seed longevity is up to 6 years. Seed dormancy is classified as non dormant. Seeds/Kg:900,000/kg % Purity:100% % Germination:52% (Dirr 1987)
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	Seeds are placed in a 48 hour water soak. Do not bleach treat seed. Seeds are placed into a 45 to 65 day cold moist stratification. Seeds are placed in fine mesh bags and buried in peat moss in ventilated containers under refrigeration at 3C. (Norman 1993)
Growing Area Preparation / Annual Practices for Perennial Crops:	Greenhouse and outdoor nursery growing facility. Sowing Method: Direct Seeding. Seeds are lightly covered with media. Growing media used is 6:1:1 milled spaghnum peat, perlite, and vermiculite with Osmocote controlled release fertilizer (13N:13P2O5:13K2O; 8 to 9 month release rate at 21C) and Micromax fertilizer (12%S, 0.1%B, 0.5%Cu, 12%Fe, 2.5%Mn, 0.05%Mo, 1%Zn) at the rate of 1 gram of Osmocote and 0.20 gram of Micromax per 172 ml conetainer. Conetainers are filled and manually sown. Seed is lightly covered with media. Containers are irrigated thoroughly and greenhouse temperature is maintained at 21 to 23 C day and 15 to 18C night. Plants are grown under greenhouse conditions for 16 weeks and are then moved to the outdoor shafehouse for the remainder of the growing season. Seedlings require shade during the first year of production. (Baskin 1998)
Establishment Phase:	Germination was slow but uniform and is usually complete in 3 weeks. Seedlings are fertilized with Conifer Starter 7-40-17 liquid NPK at 50 ppm for 4 weeks after true leaves emerge. (Baskin 1998)
Length of Establishment Phase:	10 weeks (Coleman 1977)
Active Growth Phase:	Seedlings reach the rapid growth stage 10 weeks after germination. Average height was 14 centimeters 4 months after germination. Growth of seedlings is maximized when air temperatures are maintained at 20 to 21C. Plants attained root-tightness 5 months after germination. Plants were regularly fertilized with 20-7-19 liquid NPK at 200 ppm. (Coleman 1977)
Length of Active Growth Phase:	16 weeks
Hardening Phase:	Plants are fertilized with 10-20-20 liquid NPK at 200 ppm in early fall. Irrigation is gradually reduced through September and October. One final irrigation is applied prior to winterization.
Length of Hardening Phase:	8 weeks
Harvesting, Storage and Shipping:	Total Time To Harvest: 10 months Harvest Date: October to November Storage Conditions: Over winter in outdoor shade house under insulating foam cover and snow. (Agriculture Handbook)
Length of Storage:	Under Optimal conditions (adequate moisture and climate) storage can last up to 7 years.
Guidelines for Outplanting / Performance on Typical Sites:	Outplanting Site: Seattle, Union bay Natural area, WA. Outplanting Date: October (Agriculture Handbook)
Other Comments:	3L (1 gallon) containers can be produced in 1.5 years with the seedlings averaging 23 centimeters in height and 1.0 cm in caliper. 9L (3 gallon) container seedlings can be produced in 2.5 to 3 years. (Dirr 1987) Mineral soil that has been disturbed is the best, but undisturbed

	mineral soil also works. Cuttings should be dipped in 3000ppm solution for 1 minute. (Chang 2000) Type of Cutting: Fall semi hardwood tip cuttings, treated with 3000 ppm IBA talc; taken in early October, under mist with sand:peat rooting media and bottom heat have yielded 91% rooting in 8 weeks. In closed canopies, western redcedar reproduces naturally from layering, and rooting of live branches which have fallen on wet soil. (Univ. of Washington 1990) Deer and elk browse the foliage and bears feed on the sapwood. Univ. of Washington 1990)
References:	Flora of the Pacific Northwest, Hitchcock and Cronquist, Univ. of Washington Press, 7th printing, 1990. S. X. Chang, L. L. Handley (2000) Site history affects soil and plant 15N natural abundance's (δ15N) in forests of northern Vancouver Island, British Columbia Functional Ecology 14 (3), 273–280. Coleman, W K. Thorpe, T. (1977). In vitro Culture of Western Redcedar (Thuja plicata Donn). I. Plantlet Formation. Botanical Gazette, Vol. 138, No. 3 (Sep., 1977), pp. 298-304 Seed Germination Theory and Practice, Second Edition, Deno, Norman, published 1993. Glacier Park Native Plant Nursery Propagation Records, unpublished. The Reference Manual of Woody Plant Propagation, Dirr and Heuser, Varsity Press, Inc., 1987. Seeds of the Woody Plants of the U.S., Agriculture Handbook #450, U.S.F.S., Washington DC. Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination, Baskin and Baskin, Academic Press, 1998. Propagation of Pacific Northwest Native Plants, Rose,R., Chachulski, C., and Haase, D. Oregon State University Press,1998.
Propagator (Author) That Developed This Protocol	
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Thuja plicata (Western Red Cedar)

Range

Thuja plicata is found along the west coast of North America. It ranges from northern California to southern Alaska, through Oregon, Washington, and British Columbia. East to Montana.

Climate, elevation

Prefers maritime climates with cool summers, and mild but wet winters. It can be found at elevations from 610 – 1,798 meters in the northern Rocky Mountains, 0 – 910 meters in Alaska, 0 – 1,190 meters in British Columbia, and 0 – 2,290 meters in Oregon.

Local occurrence (where, how common)

Wet sites such as wet ravines, along streams and rivers, narrow, poorly drained canyons, bottomlands, and depressions, and forested swamps.

Habitat preferences

Moist to wet soils, shaded forests, bogs.

Plant strategy type/successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)

Very shade tolerant species. Usually considered a climax species, but is prevalent in all stages of succession.

Associated species

(Trees) *Populus trichocarpa*, *Acer macrophyllum*, *Tsuga heterophylla*, *Tsuga mertensiana*, *Picea sitchensis*, *Pinus monticola, Pinus contorta, Chamaecyparis lawsoniana, Chamaecyparis nootkatensis, Libocedrus decurrens, Pseudotsuga menziesii*, *Abies grandis*, *Abies amabilis, Alnus rubra, Arbutus menziesii, Taxus brevifolia, Abies lasiocarpa, Larix occidentalis, Picea engelmannii, Picea glauca*, and *Pinus ponderosa.*

(Shrubs) *Amelanchier alnifolia, Menziesia ferruginea, Rubus parviflora, Holodiscus discolor, Oploponax horridum, Symphoricarpos albus, Berberis nervosa*, *Vaccinium ovatum*, *Rhododendron macrophyllum*, *Gaultheria shallon*, and *Rubus spectabilis.*

May be collected as: (seed, layered, divisions, etc.)
Seeds are the most common type of collection. Rooting of cuttings also works.

Collection restrictions or guidelines
Collection of seeds should be done in October and November.

Seed germination (needs dormancy breaking?)
Germination is accomplished without stratification. Seeds sown on a mineral soil with adequate moisture and shade will germinate in autumn, winter, and spring. No or little dormancy.

Seed life (can be stored, short shelf-life, long shelf-life)
Retain viability for approximately 7 years when stored at adequate moisture and climate conditions.

Recommended seed storage conditions
5-8% moisture content, 0^{o}F (-18^{o}C)

Propagation recommendations (plant seeds, vegetative parts, cuttings, etc.)
Sow seeds into medium, being aware of the high mortality rate of seedlings. Plant large quantities of seeds.

Soil or medium requirements (inoculum necessary?)
Mineral soil that has been disturbed is the best, but undisturbed mineral soil also works. Cuttings should be dipped in 3000ppm solution for 1 minute.

Installation form (form, potential for successful outcomes, cost)
Sown from seeds, containerized seedlings from nurseries, bare root, cuttings. Containerized seedlings are the most successful, but bare root are cheaper. Seed mortality is very high.

Recommended planting density
Dense planting with light thinning until approximately age 25.

Care requirements after installed (water weekly, water once etc.)
Is very important to keep the soil moist, to keep the roots watered. The roots are very slow to establish.

Normal rate of growth or spread; lifespan
Very slow growing tree. Can reach 130 feet tall. Trunk tapers out but the diameter can reach 6+ feet. They can be as old as 800-1000 years old.

Sources cited
1.) http://www.or.blm.gov/Medford/Wa_rest/rip_plants_gallery/pages/thpl2.htm

2.) http://www.fs.fed.us/database/feis/plants/tree/thupli/all.html
3.) http://www.na.fs.fed.us/spfo/pubs/silvics_manual/Volume_1/thuja/plicata.htm
4.) Pojar, Jim, Mackinnon, Andy. Plants of the Pacific Northwest Coast. Canada: Lone Pine, 1994.

Data compiled by:
Kevin Klein; April 10, 2003