Plant Propagation Protocol for Tsuga heterophylla
ESRM 412 – Native Plant Production
Spring 2008

TAXONOMY	
Family Names	
Family Scientific Name:	Pinaceae
Family Common Name:	Pine
Scientific Names	
Genus:	Tsuga
Species:	T. heterophylla
Species Authority:	(Raf.) Sarg
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (may repeat this section multiple times as needed)	Coast hemlock, Pacific Hemlock, West coast hemlock (Tesky, 1992.)
Species Code (as per USDA Plants database):	TSHE, also found TSUHET (Luna, Evans, Wick, 2008)
GENERAL INFORMATION	
General Distribution (geographical range (states it occurs in), ecosystems, etc):	Found along Pacific coast from Alaska to northern California, and inland to British Columbia, Idaho and Montana (Luna, Evans, Wick, 2008) Also in wet ranges of the Rocky mountains (Govt of BC.)
Climate and elevation range	Sea level to 1550 m, in mesic to wet coastal and montane forests (Luna, Evans, Wick)
Local habitat and abundance; may include commonly associated species	Usually grows among other species. It has shallow roots which make the tree susceptible to windstorms. It is shade tolerant but not fire tolerant. Provides food for local deer and elk (Govt of BC.)
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	Climax species is easily regenerated after long periods of suppression and disturbance. Shade tolerant
PROPAGATION DETAILS	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	Avalanche, Glacier National Park, MT 1100 meters elevation (Luna, Evans, Wick, 2008.)
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants (Luna, Evans, Wick, 2008.)

Propagation Method (Options: Seed or Vegetative):	Seeds and Vegetative (Packee, E.C.)
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Container (plug), Propagules (seeds, grafts, and cuttings), (Luna, Evans, Wick, 2008.)
Stock Type:	Sources vary in size from, 172 ml containers (Luna, Evans, Wick, 2008) to 1, 2, 3, and 4 gallon containers, as well
Time to Grow (from seeding until plants are ready to be outplanted):	19 months (Luna, Evans, Wick, 2008.)
Target Specifications (size or characteristics of target plants to be produced):	Roots should be firm and fill the container. Some sources specifically require seedlings to grow to 7cm tall, with a 7mm caliper, too (Luna, Evans, Wick, 2008.)
Propagule Collection (how, when, etc):	Collect cones before scales start to reflex with pruning poles during late September and keep them dry (Luna, Evans, Wick, 2008.)
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Seeds extracted from tumbler and wings are removed in a fanning mill. 572,000 seeds/kg. Seed longevity is up to 5 years at 0c in sealed containers (Luna, Evans, Wick, 2008.) Tissues are taken from 2-5 week old seedlings cotyledons and placed in medium with high concentration cytokinin and a lower concentration of auxin hormones to promote growth of roots and shoots (Cheng 1976.) Slightly less than half of the seeds collected are viable (Packee, CE.)
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	Seeds rinsed for 48 hours, then undergo approx 45 day cold moist stratification and germination occurs at 20c (Baskin 2002.) Seeds can also be germinated in 6 to 9 months in temperature just above freezing (Zasoski, R.J. 1976.) Seeds then placed in mesh bags and buried in moist peat moss in ventilated containers at 3c (Luna, Evans, Wick, 2008.)
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	Seeds are grown in greenhouse and outdoor facilities. First seeds are planted on top of fertilized soil for direct sunlight in a greenhouse. Water by hand and control temperatures 21-25c during the day and 16-18c at night (Luna, Evans, Wick, 2008.)
Establishment Phase (from seeding to germination):	Germination takes 20 days and must be shaded for controlled light to avoid seed damage (Luna, Evans, Wick, 2008.)
Length of Establishment Phase:	Approx 1 month (Steinfeld, 2003.)
Active Growth Phase (from germination until plants are no	Seedlings irrigated often to ensure the appropriate moisture content for the soil. Also monitored for pests

longer actively growing):	and weeded regularly (Steinfeld, 2003.)
Length of Active Growth Phase:	Approx 3 months (Steinfeld, 2003) to 20 weeks (Luna, Evans, Wick, 2008.)
Hardening Phase (from end of active growth phase to end of growing season; primarily related to the development of cold-hardiness and preparation for winter):	Seedlings transplanted in containers and irrigation is gradually reduced through September and October (Luna, Evans, Wick, 2008.) Seedlings should also be taken to an unheated greenhouse when temperatures drop below freezing (Steinfeld, 2003.)
Length of Hardening Phase:	Sources information varies, 4 weeks (Luna, Evans, Wick), 3 months (Steinfeld, 2003.)
Harvesting, Storage and Shipping (of seedlings):	Harvest time takes 1.7 years, harvest plants in September of 2nd year. Storage in outdoor shadehouse under insulating cover (Luna, Evans, Wick 2008.)
Length of Storage (of seedlings, between nursery and outplanting):	5 months (Luna, Evans, Wick, 2008.)
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	Seedlings can be planted during early fall or spring, but are typically planted in the spring. The seedling should be planted with the top of its roots lower than the soil level to create a depression for water to collect. Weeds and grasses should be removed from the area to reduce competition (Steinfeld, 2003.)
Other Comments (including collection restrictions or guidelines, if available):	
INFORMATION SOURCES	
References (full citations):	-Luna, Tara; Evans, Jeff; Wick, Dale. 2008. Propagation protocol for production of container *Tsuga heterophylla* (Raf.) Sarg. plants (172 ml conetainers); USDI NPS - Glacier National Park, West Glacier, Montana. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 14 April 2008). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery. -Steinfeld, David. 2003. Propagation protocol for production of container *Tsuga heterophylla* plants (1,2,3 and 4 gallon container); J. Herbert Stone Nursery, Central Point, Oregon. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 14 April 2008). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery. -Baskin, Carol C.; Baskin, Jerry M. 2002. Propagation protocol for production of container *Tsuga heterophylla* (Raf.) Sarg. plants; University of Kentucky, Lexington, Kentucky. In: Native Plant Network. URL: http://www.nativeplantnetwork.org

	(accessed 14 April 2008). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery. -Government of British Columbia. Minstry of Forests and Range. Western Hemlock. URL: http://www.for.gov.bc.ca/. (accessed 14 April 2008). -Cheng, T-Y. 1976. Vegetative Propagation of Western Hemlock Tsuga-Hetrophylla through Tissue Culture. Plant and Cell Physiology. Iss 6 V 17. Pages 1347-1350. -Edwards, D. G. W. 1976. Seed physiology and germination in western hemlock. *In* Proceedings, Western Hemlock Management Conference. p. 87-102. W. A. Atkinson and R. J. Zasoski, eds. University of Washington, College of Forest Resources, Seattle. -Packee, E. C. Western Hemlock. URL: http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_1/tsuga/heterophylla.htm (accessed April 16, 2008.) -Tesky, Julie L. 1992. Tsuga heterophylla. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2008, April 19].
Other Sources Consulted (but that contained no pertinent information) (full citations):	Wikipedia
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