Plant Propagation Protocol for *Tsuga mertensiana*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/TSME..pdf

TAXONOMY	
Plant Family	
Scientific Name	Pinaceae
Common Name	Pine family
Species Scientific Name	
Scientific Name	*Tsuga mertensiana* (Bongard) Carrière
Varieties	None
Sub-species	None
Cultivar	Dwarf Mountain Hemlock/Mountain Hemlock "Elizabeth"
Common Synonym(s)	None
Common Name(s)	Mountain hemlock, Black Hemlock, Alpine Hemlock
Species Code (as per USDA Plants database)	TSME
GENERAL INFORMATION	
Geographical range	Found in Canada in British Columbia Found in America in Alaska, Washington, Idaho, Montana, Oregon, California, and Nevada [1,3,4]
Ecological distribution	Most common in alpine and subalpine forests [2,4,5]
Climate and elevation range	Climate: Trees can survive down to around -30°C and up to around 38°C. Average habitat temperature across full range is 3-4°C. Generally thrives in sites with cold or mild winters, a short warm or cold growing season, and moderate to high precipitation. Often found on mountains, average snowfall of its habitats ranges from 32-50 feet. Elevation: The range is lowest in Alaska, where it can be found at sea level, up to 3,500 feet. In British Columbia, it is most commonly found between 1,000-3,000 feet. Within the continental U.S., it is found from around 4,000 feet all the way up to the tree line at around 10,000 feet. [2,3,5]
Local habitat and abundance	Most abundant in alpine and subalpine forests. Commonly associated with *Abies amabilis*, *Abies lasiocarpa, Cupressus nootkatensis, Picea engelmannii, Pinus albicaulis, Vaccinium membranaceum*, and *Xerophyllum tenax* [2,3,5,11]
Plant strategy type / successional stage	Tolerant of cold, snowy environments. Tolerant of shading. Considered a minor or major climax species in most of its range, meaning it is largely late

	successional. However, along glacial moraines found in Alaska and BC it is considered a pioneer species. [2,5]
Plant characteristics	This is a perennial coniferous tree species that can also grow as a small tree or in a shrub-like manner. Can grow up to 150 feet tall, but given it's cold climate and short growing seasons, it grows very slowly. Can live upwards of 800 years. [3]
PROPAGATION DETAILS	
Ecotype	Alpine/Subalpine
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container/plug or Fabric Pots
Stock Type	Container stock
Time to Grow	Roughly 5-8 years [6,10]
Target Specifications	Plants transplant well when they are just over a foot and a half tall, but transplanting plants at this stage can be harmful for plant growth after transplanting, as well as root health and wind resistance. Therefore plants should ideally be struck when they are around 1-1.5 feet tall. In addition, some signs other than height that the plant is ready for transplanting are well-developed crowns, and when the plant's root + rhizomes fill the soil profile in the container. [6,9,10]
Propagule Collection Instructions	Individual trees do not produce cones until around 20 years old. Cycles of heavy seed production occur every 3 years on average. Seeds generally ripen and disperse in October and November, so collection should take place as close to dispersal as possible, just before the cones open releasing seeds. Heavy seeds germinate more readily, so if possible they should be selected for. [2,5,11]
Propagule Processing/Propagule Characteristics	102,000-207,000 seeds per pound. Seeds exhibit physiological dormancy, and can survive for several years if stored properly, but are not viable for normal long-term storage. [2]
Pre-Planting Propagule Treatments	Cold stratification (most sources say for 90 days around 4°C) [2,6,7,8,10]
Growing Area Preparation / Annual Practices for Perennial Crops	Does best in cool, moist, well-drained soil. Can grow in many soil types, but sandy to loamy is ideal. Can survive very acidic soil conditions, but slightly acidic or neutral soil is ideal for growth. Large containers or burlap bags ideal for growing to avoid issues with constrained root growth. [2,5,6,10]
Establishment Phase Details	After stratification/treatment of seeds, sow seeds at the surface, with 2-3 seeds per plug. Cover seeds with a thin layer of growth medium/vermiculite. Plots

	should be kept partially to mostly shaded. [7,10]
Length of Establishment Phase	Germination (given proper treatment) normally occurs at around 30 days after sowing [8]
Active Growth Phase	Keep soil moist and relatively shaded, as small saplings are particularly vulnerable to damage from overexposure to sunlight. Weeds should be monitored and removed. [2,7]
Length of Active Growth Phase	The active growth phase of these plants, after they've germinated, is annually from the onset of spring through the summer. As noted above, it takes several (3-8) years of these annual growth cycles to reach a point where transplanting is feasible. [2,10,11]
Hardening Phase	Keep seedlings moist and cool. Allowing several years for proper growth is crucial. At a certain size, plants should be individually potted/planted in preparation for the hardening phase. Fabric pots may be used to prevent root circling. [7,10,12]
Length of Hardening Phase	Hardening, as with active growth, seems to occur annually for this plant. After active growth finishes in the summer, from the summer through to the onset of winter the tree is in the hardening phase. This means hardening is usually occurring 3-4 months out of the year. [11]
Harvesting, Storage and Shipping	As discussed above, seedlings that transplant the best are not the ideal transplants for several reasons. Rather, slightly younger, smaller plants around 1-1.5 feet tall should be harvested for striking. Store at 4-7°C for transportation to out planting site. [6,10]
Length of Storage	As fast as possible
Guidelines for Outplanting / Performance on Typical Sites	After striking the seedlings in a shaded/partially shaded area, water regularly and monitor plant. Young plants are relatively unappealing to common herbivores, so fencing should be unnecessary. Growth will be slower for the first few years , but after a few growing seasons growth rate should be increased. If sapling is 5 years old at transplanting, it would take 15-25 years for the tree to reach sexual maturity and begin producing cones. [2,5,6,10]
Other Comments	Trees in this genus are particularly resistant to honey fungus. Susceptible to high wind, root rot, and overexposure to the sun. Named after German botanist Karl Heinrich Mertens, who discovered *Tsuga mertensiana* in 1827. Vegetative propagation via layering possible but infrequently used. [2,3,6]
INFORMATION SOURCES	
References	Plants profile for tsuga mertensiana (mountain hemlock). Retrieved from https://plants.usda.gov/core/profile?symbol=TSME [1]

	Tesky, Julie L. 1992. Tsuga mertensiana. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Retrieved May 1, 2019 from https://www.fs.fed.us/database/feis/plants/tree/ts umer/all.html [2] Tsuga mertensiana (mountain hemlock) description. Retrieved May 1, 2019 from https://www.conifers.org/pi/Tsuga_mertensiana.php [3] Tsuga mertensiana in flora of north america @ efloras.org. Retrieved May 1, 2019 from http://www.efloras.org/florataxon.aspx?flora_id=1& taxon_id=233501323 [4] Means, Joseph E. 1990. Tsuga mertensiana (Bong.) Carr.: mountain hemlock. In: Burns, Russell M.; Honkala, Barbara H., tech. coords. Silvics of North America: Volume 1, conifers. Agric. Handb. 654. Washington, DC: Forest Service, U.S. Department of Agriculture: 623-634. [5] Tsuga mertensiana - (Bong.)Carrière. Retrieved May 1, 2019 from https://pfaf.org/user/Plant.aspx?LatinName=Tsuga mertensiana. [6] Mountain hemlock, (tsuga mertensiana). (n.d.). Retrieved May 1, 2019 from https://www.treeseedonline.com/store/p297/Mountain _Hemlock,_(tsuga_mertensiana).html. [7] Baskin, Jerry M.; Baskin, Carol C.. 2002. Propagation protocol for production of Container (plug) *Tsuga mertensiana* (Bongard) Carriere plants University of Kentucky Lexington, Kentucky. In: Native Plant Network. URL: http://NativePlantNetwork.org (accessed 2019/04/30). US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources. [8] 2015. Propagation protocol for production of Container (plug) *Tsuga mertensiana* plants USDA NRCS - Corvallis Plant Materials Center Corvallis, Oregon. In: Native Plant Network. URL: http://NativePlantNetwork.org (accessed 2019/04/30). US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources. [9] Huxley, A. (1992) The New RHS Dictionary of Gardening. MacMillan Press, London. [10] Ze'ev Gedalof, & Dan J. Smith. (1984). Dendroclimatic response of mountain hemlock (Tsuga mertensiana) in Pacific North America. *Canadian Journal of Forest Research. 31*(2), 322-332. [11] Tsuga mertensiana - Mountain Hemlock. Retrieved May 1, 2019 from https://lebeaubamboo.com/Tsuga-mertensiana-Mountai n-Hemlock.php. [12]
Other Sources Consulted	None
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Date Protocol Created or Updated	5/1/19