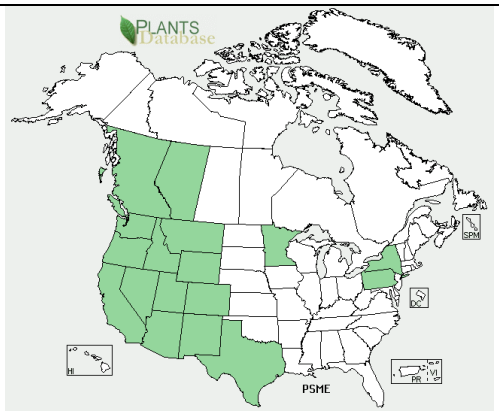
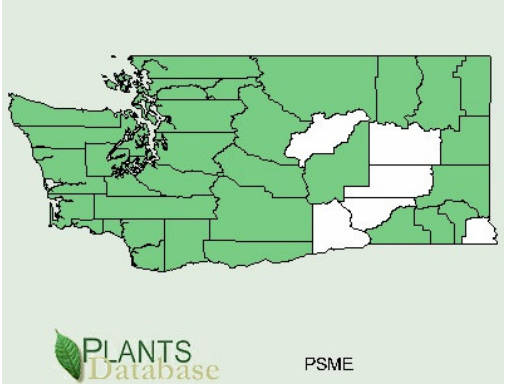
Plant Propagation Protocol for
Pseudotsuga menziesii
ESRM 412 – Native Plant Production
Spring 2008

Pictures acquired from http://biology.burke.washington.edu/herbarium/imagecollection/taxon.php?ID=9044 (6) and http://plants.usda.gov/java/profile?symbol=PSME (1)

TAXONOMY	
Family Names	
Family Scientific Name:	Pinaceae (1)
Family Common Name:	Pine Family (1)
Scientific Names	
Genus:	*Pseudotsuga* (1)
Species:	*menziesii* (1)
Species Authority:	Mirb. (1)
Variety:	*menziesii*
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s):	• *Abies menziesii* Mirb. *Pseudotsuga menziesii* var. *menziesii* • *Abies mucronata* Raf. *Pseudotsuga menziesii* var. *menziesii*

	• *Abies taxifolia* Poir. *Pseudotsuga menziesii* var. *menziesii* • *Pinus douglasii* Sabine ex D. Don *Pseudotsuga menziesii* var. *menziesii* • *Pinus taxifolia* Lamb. *Pseudotsuga menziesii* var. *menziesii* • *Pseudotsuga douglasii* (Sabine ex D. Don) Carrière *Pseudotsuga menziesii* var. *menziesii* • *Pseudotsuga menziesii* var. *caesia* (Schwer.) Franco *Pseudotsuga menziesii* var. *glauca* • *Pseudotsuga mucronata* (Raf.) Sudw. *Pseudotsuga menziesii* var. *menziesii* • *Pseudotsuga taxifolia* Britton *Pseudotsuga menziesii* var. *menziesii* • *Pseudotsuga taxifolia* var. *caesia* (Schwer.) Asch. & Graebn. *Pseudotsuga menziesii* var. *glauca* • *Pseudotsuga taxifolia* var. *glauca* (Beissn.) Sudw. *Pseudotsuga menziesii* var. *glauca* • *Pseudotsuga taxifolia* var. *viridis* ined. *Pseudotsuga menziesii* var. *menziesii* (9)
Common Name(s):	Douglas-fir
Species Code:	PSME
GENERAL INFORMATION	
Geographical range:	  (1)

Ecological distribution:	
Climate and elevation range	Douglas-fir grows under a wide variety of climatic conditions. The coastal region of the Pacific Northwest has a maritime climate characterized by mild, wet winters and cool, relatively dry summers, a long frost-free season, and narrow diurnal fluctuations of temperature (6° to 8° C; 43° to 46° F). Precipitation, mostly as rain, is concentrated in the winter months. Climate in the Cascade Range and Sierra Nevada tends to be more severe. In Washington and Oregon, the species generally occurs from sea level to 1520 m (5,000 ft), although locally it may occur higher. In the southern Oregon Cascades and in the Sierra Nevada, the altitudinal range is between 610 and 1830 m (2,000 and 6,000 ft). In river valleys and canyon bottoms, the species may occasionally occur at elevations of 240 to 270 m (800 to 900 ft). Near the southern limit of its range in the Sierra Nevada, the species grows to elevations of 2300 m (7,500 ft). The inland variety grows at elevations from 550 to 2440 m (1,800 to 8,000 ft) in the northern part of its range. In the central Rocky Mountains, Douglas-fir grows mostly at elevations between 1830 and 2590 m (6,000 and 8,000 ft), and in the southern Rocky Mountains, between 2440 and 2900 m (8,000 and 9,500 ft). In some localities in southern and central Arizona, Douglas-fir may be found as low as 1550 m (5,100 ft) in canyon bottoms. The highest elevation at which Douglas-fir grows in the Rocky Mountains is 3260 m (10,700 ft) on the crest of Mount Graham in southeastern Arizona. (4)
Local habitat and abundance; may include commonly associated species	Douglas-fir grows with many other species, some of which are: Red Alder, Sitka Spruce, Western Hemlock, Western Hemlock-Sitka Spruce, Coastal True Fir-Hemlock, Western Redcedar-Western Hemlock, Western Redcedar, Redwood, Oregon White Oak, Tanoak, and Pacific Madrone. (4)
Plant strategy type / successional stage:	Shade tolerant in dry low-middle elevation forests. It is shade intolerant in wetter forests. It is both a climax and seral species by replacing some species but also being replaced by other species. It is resistant to fire due to its thick, corky bark. Has naturally survived due to changes in fire regime, climate variation, and selective logging.
Plant characteristics:	Tree, *Pseudotsuga menziesii*, Douglas-fir, is one of the world's most important and valuable trees. The needles persist up to 8 years and are scattered singly over the twigs. Needle length ranges from 3/4 to 1 inch and the width is approximately 1/16 inch. The bark on young stands is dark gray-brown with resin blisters. Later the bark becomes thick, reddish-brown, and is divided by deep irregular fissures. The cones are 3 to 4 inches long and are easily identified by the three pointed bracts

	(modified leaves) which are longer than the cone scales. On the average a heavy seed crop can be expected every 5 to 7 years. During this period, there usually is at least 1 crop failure. (1)
PROPAGATION DETAILS	
Ecotype:	Oregon, Glacier National Park
Propagation Goal:	Plants (2)
Propagation Method:	Seeds (2)
Product Type:	Bareroot (field grown) (2), Container (plug) (3)
Stock Type:	1,2,3,4,and 8 Gallon Container (3)
Time to Grow:	10 months (2)
Target Specifications:	Minimum height is 4 inches and minimum caliper is 3mm. Target height is 7 inches. (2) Seedlings have reached target when roots have fully occupied the container but not to the amount where seedlings are root-bound. (3)
Propagule Collection:	Cones are collected in September when cones turn tan and scales begin to reflex in early fall. Mature seeds are firm and brown in color. Cones from younger trees are reported to produce larger cones with greater seed viability than trees over 100 to 200 years in age. Cones are collected using pruning poles to cut branches from trees. Cones are collected in burlap sacks and spread on a canvas tarp in a well vetiliated drying shed prior to cleaning. (8)
Propagule Processing/Propagule Characteristics:	The seed is dried to between 5 and 8% moisture and placed in air tight plastic bags, then stored in freezers set at -15C (5F). This seed has a long storage life under these conditions. Seeds/Kg: 16,000 to 20,000 seeds/kg (35,000 to 45,000 seeds/lb) (5)
Pre-Planting Propagule Treatments:	Prechilling the seeds and pre soaking increases germination energy. Seeds are placed into a 1:3 (v:v) 3%hydrogen peroxide/ water soak for 10 minutes. Seeds are then placed into a 48 hour running water rinse, followed by a 30 to 45 day cold, moist stratification at 3C. Seeds are placed into fine mesh bags and buried in milled moist sphagnum peat moss in a well ventilated container. (8)
Growing Area Preparation / Annual Practices for Perennial Crops:	Greenhouse and outdoor nursery growing facility. Sowing Method: Direct Seeding. Seeds are covered with medium. Growing medium used is 6:1:1 milled sphagnum peat, perlite, and vermiculite with Osmocote controlled release fertilizer Greenhouse temperatures are maintained at 21 to 25C during the day and 16 to 18C at night. Seedlings are hand watered and remain in greenhouse until mid May. Seedlings are then moved to outdoor nursery for the remainder of the growing season. (8)
Establishment Phase:	Medium is kept evenly moist (but not saturated)during germination. Germination continues for 21 days after sowing. Seedlings are thinned at the birdcage stage. Seedlings shed the seedcoats 7 to 10 days after emergence. After seedlings are well established, they must dry down slightly between irrigations. This practice prevents the incidence of post-emergence damping-off disease and other root diseases. (8)

Length of Establishment Phase:	3 Weeks (8)
Active Growth Phase:	Seedlings should be inoculated with mycorrhizae (*Rhizopogon vinicolor*) at the accelerated growth stage, which is usually reached by week 8. Plants are normally fully root tight 25 weeks after germination and average 10 cm in height. (8)
Length of Active Growth Phase:	About 3 months (8)
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, seedlings are either brought into unheated greenhouses or tree storage facilities until the event has passed. (3)
Length of Hardening Phase:	About 3 months (3)
Harvesting, Storage and Shipping:	Total Time To Harvest: 9 months Harvest Date: October Storage Conditions: Overwinter in outdoor nursery under insulating foam cover and snow. (8)
Length of Storage:	5 Months
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. Seedling plugs are placed in holes so that the top of the plug is several inches below the surface of the soil. Soil is place back over the plug 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. (3)
Other Comments:	The Douglas-fir tree is an excellent tree for lumber use and for Christmas trees.
INFORMATION SOURCES	
References (full citations):	(1) http://plants.usda.gov/java/profile?symbol=PSME (2) Steinfeld, David E. 2004. Propagation protocol for production of field-grown *Pseudotsuga menziesii* var. *menziesii* plants (1+0); J. Herbert Stone Nursery, Central Point, Oregon. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 25 April 2008). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery. (3) Steinfeld, David E. 2006. Propagation protocol for production of container *Pseudotsuga menziesii* var. *menziesii* plants (1,2,3,4,and 8 Gallon Container); J. Herbert Stone Nursery, Central Point, Oregon. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 25 April 2008).

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Other Sources Consulted (but that contained no pertinent information) (full citations):	(10)http://www.fs.fed.us/database/feis/plants/tree/psemeng/botanical_and_ecological_characteristics.html. (11)http://www.na.fs.fed.us/spfo/pubs/silvics_manual/Volume_1/pseudotsuga/menziesii.htm. (12) Pojar, Jim, Mackinnon, Andy. Plants of the Pacific Northwest Coast. Canada: Lone Pine, 1994. (13) http://my.execpc.com/~mcphoto/smgal/34.html.
Protocol Author:	Dylan Holm
Date Protocol Created or Updated (MM/DD/YY):	04/28/08

Pseudotsuga menziesii (Douglas –Fir)

Picture from: http://my.execpc.com/~mcphoto/smgal/34.html

Range

North from central British Columbia, all the way south to central Mexico. East to western Montana and Wyoming.

Climate, elevation

A well precipitated winter with dry months of July and August. Mostly a mild, continental climate. Elevation is generally between 550-2,440 m. The highest altitude it has been found growing is at Mount Graham in southeastern Arizona where it is 3260 m.

Local occurrence (where, how common)

Big variety of occurrences. Dry lower elevation sites to moist mountainous sites. Bunchgrass communities to sub alpine forests. Most commonly found on low-middle elevation forests on all types of slopes, aspects, landforms, and soils.

Habitat preferences

Well-aerated and deep soils.

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

Shade tolerant in dry low-middle elevation forests. It is shade intolerant in wetter forests. It is both a climax and seral species by replacing some species but also being replaced by other species. It is resistant to fire due to its thick, corky bark. Has naturally survived due to changes in fire regime, climate variation, and selective logging.

Associated species

Alnus rubra, Pinus ponderosa, Pinus strobiformis, Abies lasiocarpa var. *arizonica, Abies concolor, Picea pungens, Populus* spp., *Acer circinatum, Gaultheria shallon, Rhododendron macrophyllum, Berberis nervosa, Vaccinium parvifolium, Rubus spectabilis, Symphoricarpos albus, Spirea betulifolia, Physocarpus malvaceus, Pachistima myrsinites*

May be collected as: (seed, layered, divisions, etc.)

Seeds

Collection restrictions or guidelines

Seeds dispersal begins around mid August and two-thirds of the seed crop will be dropped by October.

Seed germination (needs dormancy breaking?)

Light exposure and stratification will affect seed germination. The seeds will germinate naturally on the ground after falling from the tree.

Seed life (can be stored, short shelf-life, long shelf-life)

Germination generally occurs 150 days after seed fall, but will remain viable for 1-2 years.

Recommended seed storage conditions

Low temperature and moisture conditions, approximately 5-8% moisture and 7-10^{o} C.

Propagation recommendations (plant seeds, vegetative parts, cuttings, etc.)

Planting seeds and growing them in a nursery is the most common and successful way of propagation. Cuttings have been tried, but have been unsuccessful. Tissue culture is emerging and that propagation method is being research at this time.

Soil or medium requirements (inoculum necessary?)

A moist mineral soil with a little (~1 inch) organic material.

Installation form (form, potential for successful outcomes, cost)

Seeds, seedlings grown in a nursery.

Recommended planting density

In nature, they start with about 2500 trees per hectare.

Care requirements after installed (water weekly, water once etc.)

Water enough to keep the soil from drying out and continue until the root system of the tree has been established.

Normal rate of growth or spread; lifespan

Slow growing for the first year due to dormancy from late summer to the following spring. Very slow growing past 200 years old. The oldest known tree was located in Mt. Vernon at 1400 years old, until it was cut down.

Sources cited

1.)
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2.)
http://www.na.fs.fed.us/spfo/pubs/silvics_manual/Volume_1/pseudotsuga/menziesii.htm.

3.) http://my.execpc.com/~mcphoto/smgal/34.html.

4.) Pojar, Jim, Mackinnon, Andy. Plants of the Pacific Northwest Coast. Canada: Lone Pine, 1994.

Data compiled by

Kevin Klein 17 April 2003.