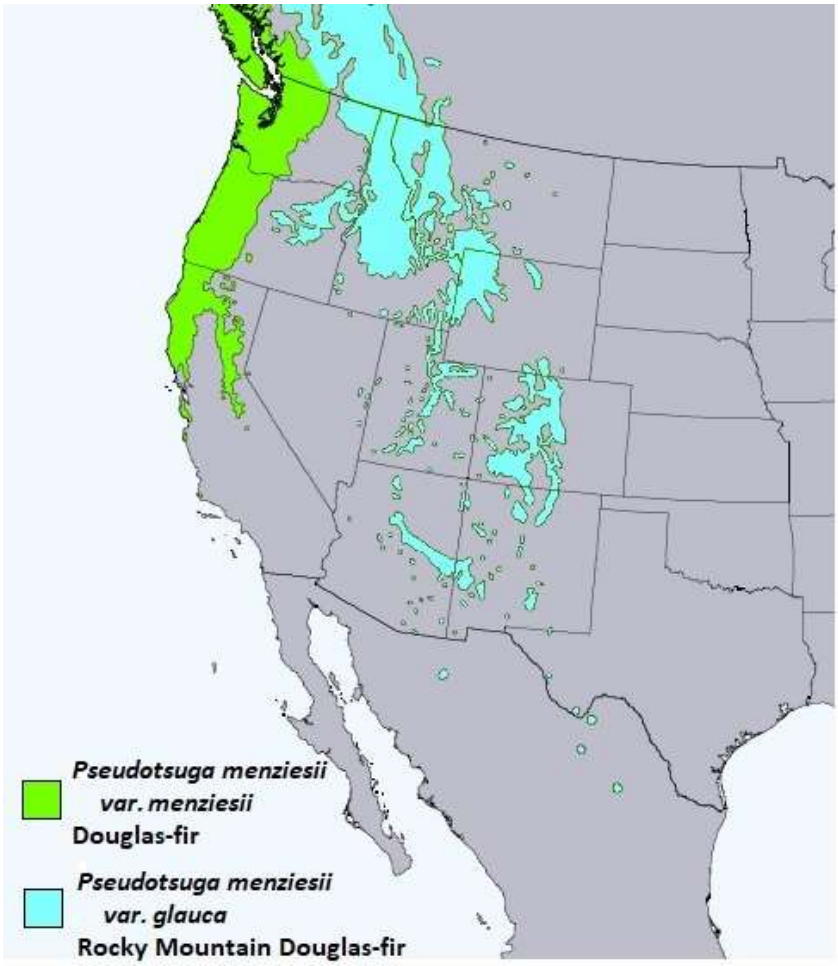
Plant Propagation Protocol for *Pseudotsuga Menziesii*
ESRM 412 – Native Plant Production
URL: https://courses.washington.edu/esrm412/protocols/2021/PSME.pdf

Douglas-fir ovulate cone (Apiolaza 2016)

Stand of Rocky Mountain Douglas-fir (Powell 2002)



Range of *Pseudotsuga menziesii.*
Modified from Thompson (USGS) 1999

TAXONOMY	
Plant Family	
Scientific Name	*Pinaceae*
Common Name	Pine Family
Species Scientific Name	
Scientific Name	*Pseudotsuga menziesii* (Mirbel) Franco
Varieties	*Pseudotsuga menziesii* (Mirbel) Franco var. menziesii *Pseudotsuga menziesii* (Mirbel) Franco var. *glauca* (Beissn.) Franco (USDA 2000)
Sub-species	
Cultivar	
Common Synonym(s)	*Pseudotsuga menziesii var. viridis* (Schwerin) Franco *Pseudotsuga taxifolia* Lamb. (Uchytil 1991)
Common Name(s)	(Coast) Douglas-fir (*var. menziesii*) Rocky Mountain/ Blue Douglas-fir (*var. glauca*) (USDA 2000)
Species Code (as per USDA Plants database)	PSME
GENERAL INFORMATION	
Geographical range	*var. menziesii* is found along the coast from central British Columbia to central California. *var. glauca* is found along the Rocky Mountains south of central British Columbia. Pockets of this variety are found as far south as the mountains of northern Mexico. (Hermann 1990) See map above.
Ecological distribution	Coastal and mountain forests
Climate and elevation range	In Washington and Oregon, Douglas-fir is generally found between sea level and 1520 m, but it occurs as high as 3260 m in southeastern Arizona. Coast Douglas-fir is adapted to a mild maritime climate with wet winters and relatively dry summers. Rocky Mountain Douglas-fir is adapted to longer, colder winters. In some parts of its range, it also experiences very hot, dry summers. (Hermann 1990)
Local habitat and abundance	Douglas fir is the dominant tree species in the Pacific Northwest. (Uchytil 1991) It occurs in extensive, nearly pure stands in coastal areas north of the Umpqua River. In mountainous areas it can be found in nearly pure stands between bands of Ponderosa Pine (drier sites) and Spruce-Fir Zones. It is also found at various proportions within mixed forests in its range. (Hermann 1990)

Plant strategy type / successional stage	Douglas-fir is more fire tolerant than many associated species due to its thick, corky bark. Its winged, wind-dispersed seeds often colonize recently burned areas. Because it is relatively shade intolerant in coastal areas, without major disturbances such as fire or windthrow, it will gradually be replaced by more shade-tolerant species such as Western hemlock and Western redcedar. In drier inland areas, it is sometimes the dominant climax species. (Uchytil 1991)
Plant characteristics	Douglas-fir is an evergreen coniferous tree. In coastal old-growth areas, it typically lives more than 500 years and grows to about 76 m tall and 1.8 m in diameter. (Uchytil 1991) Douglas-fir has spirally arranged needles, approximately 2.5 cm in length. Younger trees have grayish brown bark with resin blisters. Mature trees have deeply fissured, reddish brown bark. Cones are 7-10 cm long with distinctive 3-pointed bracts. (USDA 2000)
PROPAGATION DETAILS Propagation techniques compiled from Loveall (2008), Luna (2008), and Wenny (2009), using additional sources as indicated.	
Ecotype	
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	66-172 mL “Conetainer”
Time to Grow	8-12 months
Target Specifications	Height: 15-20cm Caliper: 2-3mm Root system: firm root plug
Propagule Collection Instructions	Cones are harvested when they turn brown and before the scales open. This generally occurs in August at lower elevations and as late as October at higher elevations. Cones are generally ripe for collection 2-3 weeks before they begin opening. Cones should be collected from trees about 20-100 years of age. Older trees may produce seeds with lower germination percentage. Cones from trees growing in dense stands of mature Douglas-fir in favorable habitat conditions are more likely to produce viable seed (Dorofeeva 2019). Cones can be collected by climbing trees or using ladders or pruning poles to cut branches out of the tree.
Propagule Processing/Propagule Characteristics	Cones should be kept cool, dried promptly, and stored in locations with good air circulation. They can be stored for 2-4 months if kept cool, dry, and well-ventilated. If needed, cones can be opened by heating to 38-42C for 2-10 hours. Open cones can be tumbled to extract and de-wing the seed. Seeds are stored in sealed containers. They can be stored up to a year at 2-4C, but should be frozen (approximately -9 to -12C) for longer-term storage. Properly stored seeds may retain some viability for up to 20 years, but this will decrease over time. Seeds vary in size. In the northern part of Douglas-fir’s range, 132,000 seeds/kg is typical; farther south, about 51,000 seeds/kg is common. (Hermann 1990)
Pre-Planting Propagule Treatments	Seeds are placed in mesh bags under running water for 48 hours. The mesh bags are then placed into plastic bags and stratified at about 3C. Stratification for 28-45 days is typical and effective. However, optimal germination percentage and timing has been obtained with a 25-48 week stratification at 30-35% moisture content. If moisture content can be carefully controlled, long stratification can occur without premature germination. Long stratification leads to increased germination percentage, and faster,

	more synchronous germination. (Gosling 2003) After stratification, seeds should be soaked in running water for 24 hours before sowing. (Dorofeeva 2019)
Growing Area Preparation / Annual Practices for Perennial Crops	In late March to early April, seeds are sown in media containing 2-6:1:1 (v:v:v) *Sphagnum* peat moss, vermiculite, and perlite. Controlled release fertilizers may be added to the media or fertilizer can be applied through the irrigation system. An NPK fertilizer and a micronutrient fertilizer should be used, such as commercially available conifer-specific fertilizers and Micromax. After sowing, the medium is immediately saturated. Seedlings are grown in a greenhouse with a controlled daily temperature range of about 18-24C.
Establishment Phase Details	The ideal temperature to promote germination is 15C, but after longer stratification periods (>25 weeks), germination shows decreased temperature sensitivity. (Gosling 2003) Approximately 2 weeks after sowing, seedlings are thinned to 1 per conetainer. Seedlings are kept moist by misting.
Length of Establishment Phase	28 days
Active Growth Phase	Fertilizers are applied regularly. Irrigation occurs in the morning, allowing foliage to dry during the day. The medium is allowed to mostly dry between waterings, decreasing the likelihood of disease. When plants reach target height, containers are leached with pure water to remove excess salts.
Length of Active Growth Phase	18 weeks
Hardening Phase	This phase begins when plants reach their target height, typically in August. Fertilizer application continues in August and September. Irrigation frequency is gradually decreased. Plants experience lower ambient temperatures.
Length of Hardening Phase	9 weeks
Harvesting, Storage and Shipping	Seedlings are kept at cool temperatures but protected from freezing. Seedlings are typically shipped in late February/ early March.
Length of Storage	4-5 months
Guidelines for Outplanting / Performance on Typical Sites	Seedling success can vary greatly depending on the quality of the outplanting site and competition. Some data suggest an expected survival rate of 70-98% after three years. At this time, the approximate average tree height is 1.2-2.0 m and average trunk diameter (15cm above the ground) about 19-44 mm (Rose 1999).
Other Comments	
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Protocol Author	Frances Reno
Date Protocol Created or Updated	05/05/21