Tammy Currey

Plant Propagation Protocol: Ponderosa Pine

ESRM 412 – Native Plant Production Spring 2007

TAXONOMY	
Family Names	
Family Scientific Name:	*Pinaceae*
Family Common Name:	Pine Family
Scientific Names	
Genus:	*Pinus*
Species:	*Ponderosa*
Species Authority:	P. & C. Lawson
Variety:	Ponderosa
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	P. & C. Lawson
Variety:	*Scopulorum*
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	Engelm.
Common Name(s):	Ponderosa pine, Blackjack Pine, bull pine, pinabete, rock pine, western yellow pine (IT IS, 2007) Variety ponderosa: Ponderosa Pine Variety *scopulorum*: Ponderosa Pine, Rocky Mountain Ponderosa Pine, Rocky Mountain Ponderosa Pine.
Species Code (as per USDA Plants database):	PIPO
GENERAL INFORMATION	
General Distribution (geographical range (states it occurs in), ecosystems, etc):	Found in western North America from British Columbia, Idaho and the Cascade mountains, coastal mountains and the Sierra Nevadas to southern California and northern Mexico and east to Nebraska and Oklahoma (Ross, 1975; Rose, 1998; Oliver et. al, 2007). Most often found on loamy sands, loam or gravel, though it grows best in wet, deep, sandy clay and gravel soils (Rose, 1998).
Climate and elevation range	Dry and warm sites with a short growing season and little precipitation annually where most moisture is in the form of snow (Rose, 1998). 100-3300 m elevation range (Farjon, 1984; Rose, 1998). Tolerates fire and

	severe winter storms (Pojar and MacKinnon, 1984).
Local habitat and abundance; may include commonly associated species	In Washington it is a common pine inhabiting primarily dry sites east of the Cascade Mountain crest into Okanagan and in the Blue Mountains (WNPS, 2007). May also found west of the Cascade Range (USDA, 2007).
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	May be seral species primarily at higher elevations or a climax species at the lower elevational limit of Coniferous forests (Oliver et. al, 2007). In the Northwestern US it is often found in association with Lodgepole pine, Rocky Mountain Douglas Fir, Grand Fir and Western Larch (Oliver et. al, 2007).
PROPAGATION DETAILS	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants
Propagation Method (Options: Seed or Vegetative):	Seed
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.)	Bareroot (Field Grown)
Stock Type:	2+0
Time to Grow (from seeding until plants are ready to be outplanted):	7-24 months (Evans et. al, 2001; Steinfeld, 2003; Steinfeld, 2001; Wenney, 2001; Zeidler et. al, 2003)

Target Specifications (size or characteristics of target plants to be produced):	West of the Cascade mountains seedlings with a minimum height of 15 cm (6 inches) and 5mm caliper. No mechanical damage to the main stem. In the Cascade Mountains seedlings with a minimum height of 10 cm (4 inches) and 4 mm caliper. Cranberry girdler damage can be acceptable if it is less than 0.6 cm (1/4 of an inch) long by ¼ the stem circumference (Steinfeld, 2001).
Propagule Collection (how, when, etc):	Seed may be collected in the fall from the wild. Ponderosa pines have a flowering period from April to June and the cones ripen in August and September (Rose, 1998; USDA, 1948). Cones may be collected when they are ripe, but when the seeds have not yet been shed (Rose, 1998). Collection is best September to November (USDA, 1948). Seed dispersal is from Fall to Spring and seed bearing age is 20 years with optimum at 150 years (USDA, 1948). Cones open when they have air-dried for 4 to 12 days or are kiln-dried for 3 hours at 120 degrees Fahrenheit (Dirr et. al, 1987). Seeds may also be obtained through the Bureau of Land Management and Forest Service which is organized by date collected, collection area and elevation and is collected via these or other government agencies (Steinfeld, 2001).
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Immature seeds are yellow-green to green and turn brown to yellow-brown when ripe (Dirr et. al, 1987). Seeds should be dried immediately by spreading them out in an area with good ventilation to avoid mold then when dry stored in well ventilated trays or bags (Rose, 1998). Seed density is approximately 15, 210 to 50, 705 per kilogram or 12,000 cleaned seeds per pound (Dirr et. al, 1987; Rose, 1998). Seed is dried to 5-8% moisture and placed in air tight plastic bags and stored in freezers at -15 degrees Celsius (5 deg. F.). Under these conditions storage life is long (Steinfeld, 2001) and can last 15 years with 70% germinative capacity (Dirr et. al, 1987).
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	The propagation techniques for this species vary widely (Baskin et. al, 2002; Steinfeld, 2001; Wenney, 2001). Seeds can be removed from cones by tumbling or shaking them and cleaned via de-winging and fanning them. Seeds can remain viable in cold storage for 20 years (Rose, 1998). Fresh seed will not require any pre-treatment, but stored seeds may need 1-2 month of cold stratification (Dirr, et. al, 1987; Rose, 1998). They are then sow at a depth of 0.5 cm in the late fall or spring (Rose, 1998). One successful strategy is to place seeds in mesh bags with cold water running over them for 48 hours. Seeds may then be spread 3cm (1 inch) thick on a tray covered with fine mesh screen and cold stratified for 30 to 45 days. Foggers can be set to spray on the naked seeds and keep them moist at all times. The temperature should be 1 degree Celsius (33 degrees F) and monitored daily for mold. If mold is found the seeds should be

	rinsed with water (Steinfeld, 2001).
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	Sandy Loam soils are used, and nine months before the seeds are sown in spring 2.5cm (1 inch) of fresh sawdust can be worked into the surface (Young et. al, 1986; Steinfeld, 2001). The field should be irrigated in the summer to encourage weed sprouting. These weeds should then be removed regularly. These treatments as well as sowing them early can minimize weeds and disease so that fumigation will not be necessary. A pre-emergence herbicide may be used (Steinfeld, 2001). Sow in spring at 380 seeds per m^2 at 0.7 cm depth. No mulch needed (Young et. al, 1986).
Establishment Phase (from seeding to germination):	Seeds are sown from late March to early April and are covered with 0.7-1.3 cm of undecayed sawdust and the sawdust is sprayed with agrilock at 15% solution to hold the seed and soils in place during high winds (Young et. al, 1986; Steinfeld, 2001). Goal (oxyfluorfen) may be applied at 2 pints per acre to control reemergence control of weeds. No fertilizer needs to be used during this period and during warm days when the seed appears to be drying out seedbeds should be irrigated (Steinfeld, 2001). Seeds take approximately 21 days to germinate when placed on at 20/30 degrees Celsius when light is provided and they are pre-chilled for 28 days at 3-5 degrees Celsius (Steinfeld, 2001).
Length of Establishment Phase:	Three to Eight weeks (Baskin et. al, 2002; Evans et. al, 2001; Steinfeld, 2001; Wenney, 2001)
Active Growth Phase (from germination until plants are no longer actively growing):	When the soil temperature reaches 33C in June, 35C in July and 38C in early August and 40C in late August small five minute bursts of irrigation should be applied. Fertilizer: Sprinkle granular fertilizer over the seedlings and run irrigation for a half hour to wash it off the foliage. Fertilize in four treatments. 56kg/Ha of Ammonium Nitrate may be applied about six weeks after the seedling emerges and lateral roots have developed. Then again around 8 weeks at 84kg/Ha. At 10 weeks apply 181kg/HA Ammonium Sulfate. At twelve weeks apply 140 kg/Ha Ammonium nitrate and again at 14 weeks at 168 kg/Ha (Steinfeld, 2001).
Length of Active Growth Phase:	3-4 Months (Steinfeld, 2003; Steinfeld, 2001; Baskin, et. al, 2002; Zeidler et. al, 2003).
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):	2-4 months or when dormancy is induced (Baskin et. al, 2002; Wenney, 2001). With treatments above by the third week of August (Steinfeld, 2001).
Length of Hardening	2 months (Steinfeld, 2001; Zeidler et. al, 2003).

Phase:	
Harvesting, Storage and Shipping (of seedlings):	Seedlings should be hand lifted in January for Stocks from east of the Cascade mountains and December for stock west of the cascades. The soil should not be saturated when lifting and the temperature should be above -2.7 degrees Celsius (Steinfeld, 2001).
Length of Storage (of seedlings, between nursery and outplanting):	Maximum storage is 5 months at 1.7 degrees Celsius and at 1 degree Celsius for storage less than 2 months (Steinfeld, 2001; Baskin et. al, 2002).
Guidelines for Outplanting / Performance on Typical Sites (eg. percent survival, height or diameter growth, elapsed time before flowering):	Outplanting survival can be 90% (Wenney, 2001).
Other Comments:	*P. ponderosa var. scopulorum* has quicker germinating and smaller seeds than *P. ponderosa var. ponderosa*. Origin of seeds can have a huge effect on cone and seed size, length and number of needles, disease resistance and germination time and growth (USDA, 1948). Mature trees are fire-resistant (WNPS, 2007). Several protocols exist for this plant. Please see reference section.
INFORMATION SOURCES	
References:	Baskin, Carol C.; Baskin, Jerry M. 2002. Propagation protocol for production of container *Pinus ponderosa* Dougl. plants; University of Kentucky, Lexington, Kentucky. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 8 May 2007). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery. Dirr, M. and Heuser, C. 1987.The reference Manual of Woody Plant Propagation: From Seed to Culture. Varsity Press. Athens, GA. Integrated Taxonomic Information System (ITIS) Report: *Pinus ponderosa*. http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=183365. Accessed May 6, 2007. Oliver, W. and Ryker, R. Forest Service Silvicuture Manual Volume One: *Pinus ponderosa* Dougl. ex Laws. Ponderosa Pine. http://www.na.fs.fed.us/pubs/silvics_manual/Volume_1/pinus/ponderosa.htm. Accessed May 4. 2007. Pojar and Mackinnon. 1994. Plants of the Pacific Northwest Coast.

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Other Sources Consulted (but that contained no pertinent information):	Arbury, J., Bird, R., Honour, M., Innes, C and Salmon, M. 1997. The Complete Book of Plant Propagation. Taunton Press. Newtown, CT. Bailey, L. 1925. The Cultivated Evergreens. MacMillan Company. New York, NY. Bailey, L. 1933. The Cultivated Conifers in North America: Comprising the Pine family and the Taxads. MacMillan Company. New York, NY. Dreesen, Dave. 2003. Propagation protocol for production of container *Pinus ponderosa* plants (One-Gallon Tree Pot, 4”x4”x14”); Los Lunas

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Plant Data Sheet

Pinus ponderosa, ponderosa pine

Range
Western North America. British Columbia to Mexico, east to South Dakota and Texas.

Climate, elevation
Sea level - 3050 meters. Average annual temperature: 5-10 C. Average July/ August temperature: 17-21 C. Annual extremes: -40 to 43 C. Average annual precipitation in dryer parts of range: 355-760 mm, much as snow. Average annual precipitation in wettest parts of range: 1750 mm.

Local occurrence
In Washington, found east of the Cascade Mountains. Some found in Western Washington in the Tacoma/Olympia area.

Habitat preferences
Warm sunny places that are dry in the summer. Although sites are dry, there is available soil moisture. Can tolerate severe winters and can tolerate wet soil in the winter.

Plant strategy type/successional stage
Can be climax species or serial species. Climax species at the lower limits of coniferous forests. Serial species at higher elevation more mesic forests. Fire kills seedlings but not older trees. Fire suppression is creating an understory of Doug-fir and true fir.

Associated species
In the NW: Doug-fir, lodgepole pine, grand fir, western larch, *Arctostaphylos*, *Ceanothus*, *Spirea*, snowberry, Oregon grape, *Poa* spp., *Festuca* spp.
May be collected as: (seed, layered, divisions, etc.)
Seed. Doesn't naturally reproduce vegetatively. Difficult to propagate from cuttings. Can be propagated by rooting and grafting but success decreases when scions taken from trees more than 5 years old.
Collection restrictions or guidelines
Collect cones as soon as they are ripe. This is when the color changes from yellow-green to russet brown, September and October. Widely spaced dominant trees have the most seeds per cone. Begins to produce seed at 7 years and continues to 350 years. The most viable seeds come from trees 60-160 years old. No regular interval observed in heavy cone crops, can be up to every eight years. 31-70 seeds per cone.
Seed germination
Fresh seeds have no dormancy and will germinate immediately upon collection**.**
Seed life
Up to18 years. Pines have highly variable germination after storage.
Recommended seed storage conditions
Dry to 5-10% moisture content and store at 2-5 C. Remove from storage one week before cold stratification.
Propagation recommendations
Plant seeds in the fall after collection or in the spring after cold stratification. If seeds have been stored, they require 30-60 days cold stratification.
Soil or medium requirements
No inoculum necessary.
Installation form
Seeds or container grown plants from seed.
Recommended planting density
380 seeds per square meter.
Care requirements after installed
Moisture stress and competing vegetation decrease seedling growth and survival.
Normal rate of growth or spread; lifespan
Medium growth rate, 75 feet after 40-50 years. Long lived, often exceeding 500 years.
Sources cited
Burns, R. and Honkala. 1990. *Silvics of North America, Volume 1*, *Conifers*. U.S. Department of Agriculture, Forest Service, Washington, D.C.

Dirr, M.1998. *Manual of Woody Landscape Plants.*

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Data compiled by Katie McGowan April 22, 2003