Plant Propagation Protocol for *Pinus lambertiana*
ESRM 412 – Native Plant Production
Spring 2014
Protocol URL: https://courses.washington.edu/esrm412/protocols/*[USDASpeciesCode.pdf]*

Photo source: (10)

TAXONOMY	
Plant Family	
Scientific Name	Pinaceae
Common Name	Pine
Species	

Scientific Name	
Scientific Name	*Pinus lambertiana* Douglas
Varieties	
Sub-species	
Cultivar	
Common Synonym(s)	
Common Name(s)	Sugar Pine
Species	PILA
GENERAL INFORMATION	
Geographical range	Ranges from the western Cascade mountains of north-central Oregon, to the Sierra San Pedro Martir in Baja California . Occurs from 750-3000 m (2300-9200 ft.) Continuous distribution through Klamath and Siskiyou mountains, western Cascades, western Sierra Nevada. Distinct populations also found in the Coast Ranges of southern Oregon and California, Transverse and Peninsula Ranges of southern California, and east of the Cascade and Sierra Nevada crests. Sierra San Pedro Martir population isolated at high elevation. Washington occurrence: No native populations exist in Washington state. (6)
Ecological distribution	Mixed conifer forests, Cedar - hemlock - Douglas-fir forest, Redwood forests, Red fir forests, Lodgepole pine sub-alpine forests, Ponderosa shrub forests, and further south in Montane chaparral. (6)
Climate and elevation range	Cascade Range 1,100 to 5,400 ft Sierra Nevada 2,000 to 7,500 ft Transverse and Peninsula Range 4,000 to 10,000 ft Sierra San Pedro Martir 7,065 to 9,100 ft (6,10)
Local habitat and abundance	Occurs in climates with relatively warm, dry summers and cool, wet winters (snow fed). Summertime precipitation <1 inch/month and relatively low humidity. Yearly precipitation ranges: 33-69 inches. Grows best on south and west facing slopes with deep, well-drained soils. Can grow in nutritionally poor soils. Is best suited for sandy, or loamy soils. Is drought tolerant and can tolerate strong inland winds, but not coastal winds. (9,10)
Plant strategy type	Co-dominant in mixed conifer forests. Sugar pines are strongly outbred.

/ successional stage	Self-fertilized seed does not thrive. Hybridization with other Pinus occurs. Leaf secretions inhibit the germination of seeds, thereby reducing the amount of plants that can grow beneath the tree. (9) Deep taprooting in early development alleviates moisture stress. It tolerates partial shade but growth rates are slow until canopy gaps allow sunlight to quickly accelerate growth. Classified as a seral species. If overtopped, mortality eventually ensues. The more clear the understory, seedling establishment and growth increases. Ages up to 400-500 years old. (3,6)
Plant characteristics	Evergreen tree grows at a relevantly fast rate (1m/year when young) up to 75 m. 5-needle bundles, 2-4" long. 3-sided needles, each side has white line. Large (10-20") woody cones are straight and drip sweet sap. Scales are thick and straight. Bark is reddish-brown and furrowed.(7) Suited to well-draining soils including sandy or gravelly loam. Long taproot aids its tolerance to drought and wind. Susceptible to the 'white pine blister rust' and should not be grown near to blackcurrants. Also susceptible to honey fungus. (9)
PROPAGATION DETAILS	
Ecotype	Protocol applies to common elevation and site ranges of plant.
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Bareroot (field grown)
Stock Type	1 + 0
Time to Grow	10 months
Target Specifications	Minimum 4 inches tall, 3 mm diameter
Propagule Collection Instructions	Imperfect flowers are monoecious and are wind-pollinated. Mature trees may not bear seeds consistently until 100 years of age. 4 -5 year cycles of good seeds. May to June: In flower Early Fall: Cones open to release seed while still attached to the tree. Wild or orchard seeds collected in Fall. They are separated by elevation and specific location. (9)
Propagule Processing/Propagule Characteristics	Seed is dried to 5- 8% moisture and placed in air tight plastic bags. It is stored in seed freezers at -15C. Freezing maintains viability. Storage above freezing temperatures is possible, but viability may decline rapidly. This seed has a long storage life under these conditions. (11) Viable seeds per cone show an average of 150 per cone in the northern Sierra Nevada, but can range from the 30's to the 250's per cone. An average of 4,630 seeds per kilogram (2,100/lb) was found in a viability study. Seed viability is high in good crop years (67 to 99%) but in other years can be much lower. (2,10)

Pre-Planting Propagule Treatments	Dormancy is physiological. Dormancy is broken with cold-moist stratification for 60-90 days at 4 degrees C or by removing seed coat and inner papery membrane surrounding the seed. Seed can also be soaked in cold running water (inside mesh bags) for 48 hours before placing in cold stratification. The seed is laid out 3cm thick on trays with fine screen meshed bottoms, before being put in cold-moist stratification. (1,6,11) Seed must be monitored for mold. If detected, the seed is hosed down with water. (11)
Growing Area Preparation / Annual Practices for Perennial Crops	Large container pots in a cold frame (9) or raised beds in a field are both used. Seeds suited for well-draining sandy loam (Central Point Sandy Loam Soil Series – Coarse-loamy, mixed, mesic Pachic Haploxeroll). 2.5cm of fresh sawdust can be disked into the surface soil. (11)
Establishment Phase Details	Seeds are sown as soon as they ripen (mid-March). Initial seedling density of 194 seedlings/m^2 (18 seedlings/ft^2). Fertilizer treatments of potassium sulfate and ammonium phosphate placed at 10cm depth in the soil may be used if necessary. Seeds in outdoor beds are covered with 1cm of fresh sawdust. Maintain vigilant weeding, mulch cover, and irrigation at this time. No additional fertilizers are used at this point. Germination occurs at 5-25C. (11) Germination of fresh seed is uniformly rapid and high if adequately ripened, cleaned, and stratified. (6)
Length of Establishment Phase	1 month
Active Growth Phase	Light irrigation to provide adequate moisture. Fertilizer can be applied (granular form) over the seedlings 6, 8, 12 and 14 weeks after emergence. After applying, ample irrigation water washes fertilizer off the foliage and into the soil. (11) Maintain vigilant weed control and monitor for any damage by pests. Mulch applications as needed hold in soil moisture and control weeds.
Length of Active Growth Phase	4 months
Hardening Phase	Winter preparation begins in late summer as seedlings start dormancy. Late August root wrenching can be done, but the cost-benefit of this technique is controversial. By October, irrigation keeps soil moisture levels high. During Fall, irrigation frost-protects the seedlings. Mid-fall, after bud set, select fertilizer applications are acceptable. Mid-fall, vertical pruning is acceptable. (11)
Length of Hardening Phase	2 months
Harvesting, Storage and Shipping	Seedlings harvested in unsaturated soils, between mid-December and late-January. Before quality control sorting, seedlings are stored for 1-5 days at 1C and 100 % humidity. Root pruning (to 23- 30cm) can make shipping and planting more convenient. Seedlings can be bound in groups of 25 with

	a rubber band, packaged in 3 ply bags and sown shut. Short term storage (<2 months) in coolers at 1C or long term storage (2-4 months) in freezers at –1C. (11)
Length of Storage	up 4 months
Guidelines for Outplanting / Performance on Typical Sites	Well-drained sandy or gravelly loams, of slightly acidic or neutral pH. Seedlings tolerate nutrient poor soil, drought and strong inland winds. (9) Outplant seedlings as soon as possible to ensure the very sparse rhizosphere takes to the soil. Outplant once seedlings reach a range of 30- 90cm. Can be outplanted as small as 5-10cm but weeding must be vigilant. (9) Recommended planting density: Minimum of 430 and maximum of 1200 per acre. On unprepared seed beds, seed-to-seedling ratios are high (244 to 483). (4)
Other Comments	A poorly developed root system can limit early success once outplanted. Consistency in outplanting success is limited. (11) Irrigate during the first few summers if it is particularly dry until taproot can achieve ample depth.
INFORMATION SOURCES	
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Other Sources Consulted	
Protocol Author	Schwartz, Matthew.
Date Protocol Created or Updated	04/23/14

Plant Data Sheet

Pinus lambertiana Dougl., Sugar Pine

http://oregonstate.edu/trees/con/spp/pinespp.html

http://165.234.175.12/Dendro_Images.html

Range: West slope of the Cascade Range in north central Oregon to the Sierra San Pedro Martir in Baja California. Distinct populations also found in the Coast Ranges of southern Oregon and California, Transverse and Peninsula Ranges of southern California, and east of the Cascade and Sierra Nevada crests.

Climate, elevation:

Cascade Range	1,100 to 5,400 ft
Sierra Nevada	2,000 to 7,500 ft
Transverse and Peninsula Ranges	4,000 to 10,000 ft
Sierra San Pedro Martir	7,065 to 9,100 ft

Local occurrence: No native populations exist in Washington state.

Habitat preferences: Relatively warm, dry summers and cool, wet winters. Summertime precipitation is less than 1 inch per month and relatively low humidity. Most precipitation occurs between November and April. As much as two-thirds of precipitation is in the form of snow at middle and upper elevations. Total precipitation ranges between 33 and 69 inches. Most soils are well-drained, moderately to rapidly permeable, and acidic. Grows best on south and west facing slopes.

Plant strategy types/successional stage: Rapidly grows a deep taproot to compensate for tissue intolerance to moisture stress. It is partially shade-tolerant and grows slowly when small until a gap in the canopy allows it to really take off. It is categorized primarily as an early-seral to seral species.

Associated species: In the northern part of its range, it is commonly associated with;

Douglas-fir (*Pseudotsuga menziesii),*
ponderosa pine (*Pinus ponderosa*),
grand fir (*Abies grandis*),
incense-cedar (*Calocedrus decurrens*),
western hemlock (*Tsuga heterophylla*),
western red cedar (*Thuja plicata*),
Port-Orford-cedar (*Camaecyparis lawsoniana),*
tanoak (*Lithocarpus densiflorus),*
Pacific madrone (*Arbutus menziesii),*
Greenleaf manzanita (*Arctostaphylos patula*),
deer brush (*Ceanothus integerrimus*),
snowbrush (*C. velutinus*),
mountain whitethorn (*C. cordulatus*),
salal (*Gaultheria shallon*),
coast rhododendron (*Rhododendron californium*),
gooseberries and currants in the genus *Ribes*.

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

Collection restrictions or guidelines: Collect seeds in late summer.

Seed germination: Shows dormancy. Break dormancy with stratification for 60-90 days at 4 degrees Celsius or by removing seed coat and inner papery membrane surrounding the seed. Germination of fresh seed is uniformly rapid and high if adequately ripened, cleaned, and stratified. Only 20-25 percent of initial germinants may survive as long as 10 years.

Seed life: Maintains viability when stored frozen.

Recommended seed storage conditions: Deep freezing maintains viability. Storage above freezing temperatures is possible, but viability may decline rapidly.

Propagation recommendations: Seedlings must have an adequate tap root and capacity to regenerate vigorous new root systems in order to survive summer drought. Young trees can be rooted from cuttings. Other forms of plant material include bareroot, container, containerized seedlings, and grafts(donor of all ages). Sow seed in February or March.

Soil or medium requirements: Seeds germinate rapidly and grow a deep taproot when on bare mineral soil. Do not inoculate soil.

Installation form: Plant seedlings out into permanent positions when they are between 30-90 cm tall and protect them for a winter or two. When taking cuttings, take them from trees that are less than 10 years old and disbud them.

Recommended planting density: Minimum of 430 and maximum of 1200 per acre.

Care requirements after installed: Protect from first winter or two and exclude competition from weeds with clean mulch. Water in summer if showing signs of stress in the first few years.

Normal rate of growth or spread; lifespan: Slow early growth but accelerates in the pole stage or when there is a disturbance in the canopy cover. It tolerates shade better than ponderosa pine but slightly less than incense-cedar and Douglas-fir. It is a seral species, becoming less tolerant with age. If overtopped, it will eventually die. Seedling establishment and growth increases with less brush cover. Sugar pines live to be 400 to 500 years old.

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Data compiled by: Linda Arnoldi 12 April, 2006