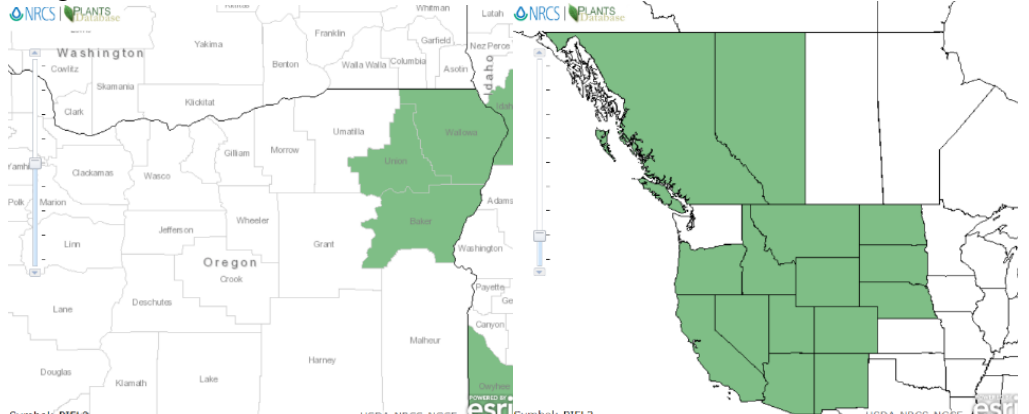


Plant Propagation Protocol for *Pinus flexilis*



TAXONOMY^{2,9}	
Family Names	
Family Scientific Name:	Pinaceae
Family Common Name:	Pine
Scientific Names	
Genus:	<i>Pinus</i>
Species/Epithet:	<i>flexilis</i>
Species Authority:	James
Varieties	var. <i>alpina</i> Silba var. <i>callahanii</i> Silba
Sub-species	N/A
Cultivar	<i>P. flexilis</i> 'Vanderwolf's Pyramid' <i>P. flexilis</i> 'Cessarini Blue' <i>P. flexilis</i> 'Extra Blue' <i>P. flexilis</i> 'Glauca' <i>P. flexilis</i> 'Glauca Pendula'
Common Synonym(s)	N/A
Common Name(s)	Limber Pine Rocky Mountain White Pine
Species Code:	PIFL2

GENERAL INFORMATION

<p>Geographical range</p>	<p>Canada: British Columbia, Alberta ² United States: AZ, CA, CO, ID, MT, NB, ND, NM, NV, OR, SD, UT, WY ² Oregon: Union Co., Wallowa Co., Baker Co. ²</p>  <p>Symbol: PIFL2</p>
<p>Ecological distribution</p>	<p>Mountains (sub-alpine to alpine) and plains, at and near tree line in semi-arid ranges. ^{2,11}</p>
<p>Climate and elevation range</p>	<p>Moist to dry soils, from 1200m to 3800m. ^{1,9}</p>
<p>Local habitat and abundance</p>	<p>Often found with Douglas-fir (<i>Pseudotsuga menziesii</i>) and Rocky Mountain Juniper (<i>Juniperus scopulorum</i>), as well as Western Yarrow (<i>Achillea millefolium</i>), Sagebrush Fleabane (<i>Erigeron austinae</i>), and Silverleaf Phacelia (<i>Phacelia hastata</i>). ^{5,9}</p>
<p>Plant strategy type / successional stage</p>	<p>A poor competitor, but establishes well after a disturbance. ⁴</p>
<p>Plant characteristics</p>	<p>Evergreen tree, straight or contorted; needles in bundles of 5, dark blue-green; long-lived, oldest is about 1,670 years old; bark usually comprised of long fissures in plated, dark bark; when young, the bark is smooth and silvery. ^{2,7,8,11}</p>
<h2 style="text-align: center;">PROPAGATION DETAILS</h2>	
<p>Ecotype</p>	<p>Mora, New Mexico ⁶ Glacier Co. Montana ⁷</p>
<p>Propagation Goal</p>	<p>Plants ^{3,6,7}</p>
<p>Propagation Method</p>	<p>Seed ^{3,6,7}</p>
<p>Product Type</p>	<p>Container (plug) ^{3,6,7}</p>
<p>Stock Type</p>	<p>164-172mL Cone-tainers ^{6,7}</p>
<p>Time to Grow</p>	<p>11 months</p>
<p>Target Specifications</p>	<p>9-25cm tall, 2-8mm caliper, firm root plug ^{6,7}</p>
<p>Propagule Collection Instructions</p>	<p>Collect cones from early August to late September and place in a warm, dry environment for a few days so cones open. ^{6,7}</p>
<p>Propagule Processing/Propagule Characteristics</p>	<p>Seeds tend to get stuck in the cone: hand collection may be required. Using a rock/cone tumbler may be another method of extracting the seeds, followed by using a mesh to separate seed, chaff, and wings, followed by using a fan to separate seed and chaff via air. ⁶</p>
<p>Pre-Planting Propagule Treatments</p>	<p>Cold, moist stratification for 60-90 days between 1-3°C and 80-100% humidity. Allowing the seeds to imbibe for 12-18 hours before stratification</p>

	may increase germination. ^{6,7} A bleach treatment before stratification can help discourage disease and fungus. ⁷
Growing Area Preparation / Annual Practices for Perennial Crops	Well-drained media; 2:1:1 peat:perlite:vermiculite has worked with the 164mL Cone-tainers; 6:1:1 milled sphagnum peat:perlite:vermiculite has worked with the 172mL Cone-tainers. ^{6,7} Apply a slow release fertilizer to top of media. ⁷
Establishment Phase Details	In early April, sow stratified seeds on top of media in greenhouse, cover with 2-5mm of perlite. Keep evenly moist, misting 4-8 times a day, keeping temperatures between 21-25°C during the day and 16-18°C at night. Thin seedlings to one per cell after 14 days. Once seedlings are established, allow soil to dry slightly between waterings to discourage root diseases. ^{6,7}
Length of Establishment Phase	7-10 days ^{6,7}
Active Growth Phase	Move to outdoor nursery from early to mid-May. Irrigate every 4-5 days for the first few weeks, then increasing watering to every 2-3 days for the rest of the growth period. Water in the morning to help prevent foliar disease caused by wet leaves at night. ^{6,7} Fertilize with a 20-7-19 NPK liquid fertilizer at 200 ppm. ⁷
Length of Active Growth Phase	16-20 weeks ^{6,7}
Hardening Phase	In late summer, usually near the end of August, move seedlings to a shade house once they are the appropriate height. ⁶ Incrementally increase the water stress to prevent further growth. ⁷ Fertilize every third irrigation with a 10-30-20 NPK fertilizer at 25-200 ppm. ⁷
Length of Hardening Phase	9-12 weeks ⁶
Harvesting, Storage and Shipping (of seedlings)	Harvest is approximately 1 year from sowing. Overwinter in a cold frame or hoop house. Irrigate every 4-5 days. Keep in cold frame or hoop house until shipping in late February or early March. ^{6,7}
Length of Storage	Overwinter, 3-5 months. ^{6,7}
Guidelines for Outplanting / Performance on Typical Sites	When outplanting, it has been shown to be most effective to plant the young trees on the north or west side of an object (stump, tree, shrub) to give the plant additional protection from sunlight. It has also been shown that as canopy cover increases, sapling survival increases. After 4 years, approximately 70% of the seedlings will have survived. ⁴
Other Comments	Typically the cones will yield 1100-1300 cleaned seeds per pound. Seeds will remain viable for at least 5 years. ⁹

INFORMATION SOURCES

References	<ol style="list-style-type: none"> 1. <i>Pinus Flexilis</i>, Oregon State Univ., LANDSCAPE PLANTS, oregonstate.edu/dept/ldplants/pifile.htm. 2. <i>Plants Profile for Pinus Flexilis (Limber Pine)</i>, plants.sc.egov.usda.gov/core/profile?symbol=PIFL2.
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3. Baskin, Jerry M., and Carol C. Baskin. "Propagation Protocol for Production of Container (Plug) Pinus Flexilis E. James Plants." *Reforestation, Nurseries and Genetics Resources*, 2002, [npn.rngr.net/npn/propagation/protocols/pinaceae-pinus-1421/?searchterm=pinus flexilis](http://npn.rngr.net/npn/propagation/protocols/pinaceae-pinus-1421/?searchterm=pinus%20flexilis).
4. Casper, A. M. A., et al. "Restoration Planting Options for Limber Pine (Pinus Flexilis James) in the Southern Rocky Mountains." *US Forest Service, Journal of the Torrey Botanical Society* 143(1), 21-37, 2016, www.fs.fed.us/rm/pubs_journals/2016/rmrs_2016_casper_a001.pdf.
5. Earle, Christopher J. "Pinus Flexilis ." *The Gymnosperm Database*, 1 Mar. 2019, www.conifers.org/pi/Pinus_flexilis.php.
6. Harrington, John T. "Propagation Protocol for Production of Container (Plug) Pinus Flexilis (James) Rydb. Plants 164ml Conetainers." *Reforestation, Nurseries and Genetics Resources*, 2010, [npn.rngr.net/npn/propagation/protocols/pinaceae-pinus-3847/?searchterm=pinus flexilis](http://npn.rngr.net/npn/propagation/protocols/pinaceae-pinus-3847/?searchterm=pinus%20flexilis).
7. Luna, Tara, et al. "Propagation Protocol for Production of Container (Plug) Pinus Flexilis James Plants 172 Ml Conetainers." *Reforestation, Nurseries and Genetics Resources*, 2008, [npn.rngr.net/npn/propagation/protocols/pinaceae-pinus-237/?searchterm=pinus flexilis](http://npn.rngr.net/npn/propagation/protocols/pinaceae-pinus-237/?searchterm=pinus%20flexilis).
8. "Limber Pine." *The Morton Arboretum*, www.mortonarb.org/trees-plants/tree-plant-descriptions/limber-pine.

	<p>9. Johnson, Kathleen A. "Pinus Flexilis. In: Fire Effects Information System (FEIS)." <i>U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory</i>, 2001, www.fs.fed.us/database/feis/plants/tree/pinifle/all.html.</p> <p>10. Dittman, Lee. "Pinus Flexilis. In: Fire Effects Information System (FEIS)." <i>U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory</i>, 2001, www.fs.fed.us/database/feis/plants/tree/pinifle/all.html. Photograph of cone and needles.</p> <p>11. "Pinus Flexilis (Limber Pine)." <i>Southwest Colorado Wildflowers</i>, www.swcoloradowildflowers.com/Tree Enlarged Photo Pages/pinus flexilis.htm.</p> <p>12. "Pinus Flexilis (Limber Pine)." <i>Southwest Colorado Wildflowers</i>, www.swcoloradowildflowers.com/Tree Enlarged Photo Pages/pinus flexilis.htm. Photographs of tree habit and bark.</p>
Other Sources Consulted	N/A
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