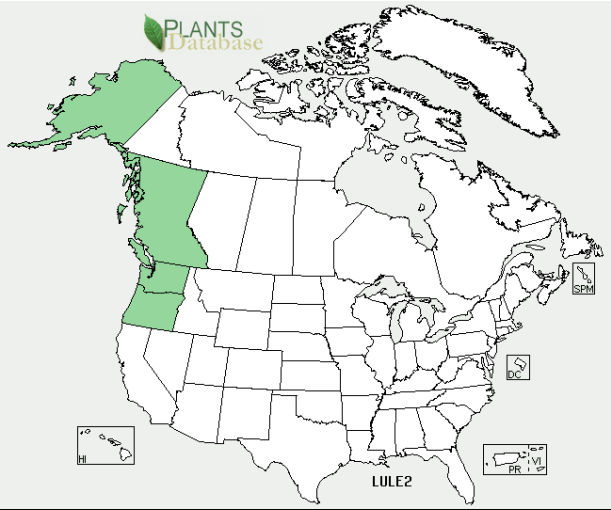
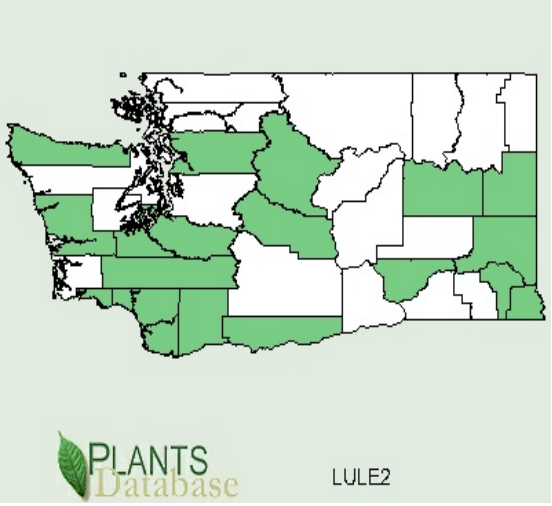
Plant Propagation Protocol for *Lupinus lepidus* Douglas ex. Lindl.
ESRM 412 – Native Plant Production
Spring 2009

Distribution in the US and Canada[1]



Distribution in Washington State[1]



TAXONOMY	
Family Names	
Family Scientific Name:	Fabaceae
Family Common Name:	Pea
Scientific Names	
Genus:	*Lupinus*
Species:	*lepidus*
Species Authority:	Douglas ex. Lindl.
Variety:	Many former varieties of *L. lepidus* have been reclassified as independent genera. Currently, no subspecies or varieties are recognized.
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (include full scientific names (e.g., *Elymus glaucus* Buckley), including variety or subspecies information)	*Lupinus lepidus* Douglas
Common Name(s):	prairie lupine, pacific lupine (incorrectly: tidy lupine, dwarf lupine, etc.[1])
Species Code (as per USDA Plants database):	LULE2
GENERAL INFORMATION	
Geographical range (distribution	Oregon and Washington, British Columbia, and Alaska

[1] Common names suggesting a diminutive growth habit may mistakenly refer to congeners such as *L. sellellus* Kellogg ssp. *sellellus* var. *lobbii* (A. Gray ex. S. Watson) Cox. Use of prairie or pacific lupine is more correct.

maps for North America and Washington state)	(see above for distribution in the US and Canada and in Washington state) USDA Plants Database is the only source consulted to extend distribution north to Alaska.[i] The population in British Columbia has been extirpated from all former habitats except for a few pockets of southern Vancouver Island.[ii]
Ecological distribution (ecosystems it occurs in, etc):	Grows in terrestrial ecosystems, from prairie into mountainsides, tolerating open, rocky, or arid habitats.[iii]
Climate and elevation range	Requires 10-15 in. precipitation and can tolerate down to -18° F temperatures.[iv] Found from low-lying prairies to "mid to high elevations on both sides of the Cascades."[v]
Local habitat and abundance; may include commonly associated species	Lambert (2003) reports that associated species may include: " houndstongue hawkweed (*Hieracium cynoglossoides*), cutleaf microseris (*Microseris laciniata*), spike goldenrod (*Solidago spathulata*), white-top aster (*Aster curtus*), and slender cinquefoil (*Potentilla gracilis*)…Long-stolon sedge (*Carex pensylvania*), field woodruch (*Luzula campestris*), Idaho fescue (*Festuca idahoensis*), California danthonia (*Danthonia californica*) and common camas (*Camassia quamash*)."[vi] On Vancouver Island, associated species include scotch broom (*Cytisus scoparius*), hedgehog dogtail (*Cynosurus echinatus*), sweet vernalgrass (*Anthoxanthum odoratum*), brome (*Bromus* sp.), and *C. quamash*.[vii]
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	Prairie lupine is a quintessential colonist species in the Pacific Northwest, often acting as the first vascular plant colonist of sites affected by the eruption of Mt. St. Helens.[viii] High-density colonization of *L. lepidus* in such sites initially inhibits and may later promote plant community diversity at such sites.[ix] As an early colonizing, nitrogen-fixing species, *L. lepidus* may even be inhibited by nutrient amendment.[x]
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	This lupine is a "low, spreading, many-stemmed, decumbent perennial"[xi] forb noted for its coat of light-colored or silvery hair.[xii] Maximum height is 1 ft., with palmately compound leaves held on long petioles with up to nine oblanceolate leaflets.[xiii] Inflorescences are racemic, held on peduncles of up to 6 in. in length and petals are blue or violet in color, blooming from early to late summer.[xiv] Flowers are of the "faboid" type: zygomorphic with a banner, keel, and two "wings"; in prairie lupine, the banner is shorter than the wings.[xv] Fruits are hairy, ½-in. pods containing 2-12

	seeds.[xvi] Though prairie lupine is a perennial, it has a "short" lifespan[xvii] and has many annual congeners. Prairie lupine can be distinguished from morphologically similar lupines on the basis of floral characteristics using a taxonomic key (such as Hitchcock and Cronquist [1973][xviii]). At a larger taxonomic grain, it can be distinguished by its blue/violet petals, typical faboid flowers and leaves, decumbent habit, and glabrous epidermis.
PROPAGATION DETAILS	
1. Direct Seeding[2]	
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[3]
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Bareroot
Stock Type:	Seed
Time to Grow (from seeding until plants are ready to be outplanted):	
Target Specifications (size or characteristics of target plants to be produced):	Full-sized adult
Propagule Collection (how, when, etc):	Collect racemes after summer flowering and place in paper bags for drying.[xix]
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Pods in Fabaceae have high water content, and should be dried completely[xx] before being cleaned and sieved by hand and stored under "cool, dry conditions."[xxi] Seed density is 16,000 seeds per pound[xxii] and seeds become physically dormant (requiring scarification)

[2] Most lupines do not tolerate transplanting or disruption of the root system well, so planting directly into the ultimate outdoor destination is preferred, when possible (Everett 1981; Foster 1997; Rose et al. 1998)

[3] Cuttings are rarely mentioned as a viable propagation method, though Rose et al. (1998) note that cuttings can be taken from the "side shoots of hardened stems in the spring."

	after drying.[xxiii]
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	Dormant lupine seeds notoriously require pre-treatment prior to propagation. Several methods are offered for lupines, generally, including nicking with a knife[xxiv] and soaking in hot water for one hour.[xxv] Rose, et al. (1998) instruct propagators of *L. lepidus* to "shake [seeds] in a jar half-filled with coarse sand, or scarify gently with sandpaper, soak in hot water until the water has cooled, then plant."
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	
Establishment Phase (from seeding to germination):	In July or August,[xxvi] sow seeds in sunny, coarse-textured, well-drained soil. Preventing water-logging and providing good drainage is essential.[xxvii]
Length of Establishment Phase:	Not documented
Active Growth Phase (from germination until plants are no longer actively growing):	No special care is required. Do not water too much.
Length of Active Growth Phase:	Through the onset of flowering in mature populations.
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):	No special care is required.
Length of Hardening Phase:	Fall
Harvesting, Storage and Shipping (of seedlings):	
Length of Storage (of seedlings, between nursery and outplanting):	
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	
Other Comments (including collection restrictions or guidelines, if available):	Once established, prairie lupine self-sows[xxviii] and spreads quickly by seed.[xxix]
2. Plug Propagation[2]	
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,	Plants

Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	
Propagation Method (Options: Seed or Vegetative):	Seed[3]
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Plug
Stock Type:	Seed
Time to Grow (from seeding until plants are ready to be outplanted):	10-12 months (depends on propagation schedule)
Target Specifications (size or characteristics of target plants to be produced):	Because lupines do not tolerate transplanting well, plugs should be hardy.
Propagule Collection (how, when, etc):	Same as for Direct Seeding Protocol.
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Same as for Direct Seeding Protocol.
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	Same as for Direct Seeding Protocol.
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	
Establishment Phase (from seeding to germination):	In July or August,[xxx] sow seeds in a coarse planting medium. Preventing water-logging and providing good drainage is essential.[xxxi] Kruckeberg (1982) recommends applying sowing seeds in a seed pan and applying a mulch of fine rock.
Length of Establishment Phase:	Not documented
Active Growth Phase (from germination until plants are no longer actively growing):	No special care is required. Do not water too much.
Length of Active Growth Phase:	Not documented
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):	No special care is required.
Length of Hardening Phase:	Not documented
Harvesting, Storage and Shipping (of seedlings):	Retain in greenhouse until outplanting.

Length of Storage (of seedlings, between nursery and outplanting):	
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	Outplant early in the growing season – June is recommended for lupines, generally.[xxxii] As noted above, success following transplanting is presumed to be quite low. Flowering should occur on schedule (mid- to late-summer) if plugs were started in the previous year.
Other Comments (including collection restrictions or guidelines, if available):	Same as for Direct Seeding Protocol.
INFORMATION SOURCES	
References (full citations):	See Below
Other Sources Consulted (but that contained no pertinent information) (full citations):	See Below
Protocol Author (First and last name):	Jake J. Grossman
Date Protocol Created or Updated (MM/DD/YY):	29 April 2009

Note: This template was modified by J.D. Bakker from that available at:
http://www.nativeplantnetwork.org/network/SampleBlankForm.asp

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[ii] Douglas, G.W. and M. Ryan. 2006. Conservation evaluation of the prairie lupine, *Lupinus lepidus* var. *lepidus*, in Canada. The Canadian Field-Naturalist 120:147-156.

[iii] Robinson, K.A., A. Richter, and M. Fibert. 2007. *Encyclopedia of Northwest native plants for gardens and landscapes*. Portland, OR: Timber Press, pp. 249.
[iv] "*Lupinus lepidus* Douglas ex. Lindl." 2009.
[v] Robinson, et al. 2007.
[vi] Lambert, A. 2003. Prairie lupine (*Lupinus lepidus var. lepidus*). Plant propagation protocol prepared for ESRM 412 (Native Plant Production), Spring 2003, College of Forest Resources, University of Washington. Lambert's source appears to be unpublished data provided by Chris Chappell in 2002.
[vii] Douglas and Ryan 2006.
[viii] del Moral, R. 2007. Limits to convergence of vegetation during early primary succession. Journal of Vegetation Science 18:479-488.
[ix] Morris, W.F. and D.M. Wood. 1989. The role of lupine in succession on Mount St. Helens: Facilitation or Inhibition? Ecology 70:697-703; del Moral, R. and L.R. Rozzell. 2005. Long-term effects of *Lupinus lepidus* on vegetation dynamics at Mount St. Helens. Plant Ecology 181:203-215.
[x] Ewing, K. 2002. Mounding as a technique for restoration of prairie on a capped landfill in the Puget Sound Lowlands. Restoration Ecology 10:289-296.
[xi] Rose, R., C.E.C. Chachulski, and D.L. Haase. 1998. *Propagation of Pacific Northwest native plants*. Corvallis, OR: OSU Press, pp. 50.
[xii] Gilkey, H.M. and L.R.J. Dennis. 1969. *Handbook of Northwestern plants.* Corvallis, OR: OSU Bookstores, Inc., pp. 218; Robinson, et al. 2007.
[xiii] Robinson, et al. 2007.
[xiv] Robinson, et al. 2007.
[xv] Gilkey and Dennis 1969.
[xvi] Robinson, et al. 2007; Rose, et al. 1998.
[xvii] "*Lupinus lepidus* Douglas ex. Lindl." 2009.
[xviii] Hitchcock, C.L. and A. Cronquist. 1973. *Flora of the Pacific Northwest: an illustrated manual*. Seattle, WA: UW Press, pp. 267-8.
[xix] Rose, et al. 1998.
[xx] Young, J.A. and C.G. Young. 1986. *Collecting, processing, and germinating seeds of wildland plants*. Portland, OR: Timber Press, pp. 20, 165.
[xxi] Rose, et al. 1998.
[xxii] "*Lupinus lepidus* Douglas ex. Lindl." 2009.
[xxiii] Young 1986.
[xxiv] Everett, T.H. 1981. *The New York Botanical Garden encyclopedia of horticulture* Vol. 6. New York: Garland Publishing, pp. 2072.
[xxv] Kruckeberg, A.R. 1982. *Gardening with native plants of the Pacific Northwest*. Seattle, WA: UW Press, pp. 201-202.
[xxvi] Everett 1981.
[xxvii] Robinson, et al. 2007.
[xxviii] Foster 1997.
[xxix] "*Lupinus lepidus* Douglas ex. Lindl." 2009.
[xxx] Everett 1981.
[xxxi] Robinson, et al. 2007.
[xxxii] Everett 1981.

Appendix: Previous Propagation Protocol

Mima Mounds Natural Area Preserve, Thurston Co., WA, 28.6.2000, Photo © Markku Savela

Prairie lupine (*Lupinus lepidus var.lepidus*)

Prairie lupine is a small perennial lupine of diverse form and habitat in the Pacific Northwest. It ranges from matted low growing forms to erect plants ranging from 10-35 cm high.[xxxii[1]] The palmately compound leaves have 5-7 oblanceolate leaflets. The leaflets range from 1-4 cm long and are noticeably hairy on both surfaces.[xxxii[2]] The flowers are dark blue to purple, sometimes white in color with a lighter banner. The banner is well reflexed from the keel and is not hairy on its surface.[xxxii[3]]

There are five known varieties of *Lupinus lepidus*. Variety *lepidus* is best described by it's extended racemes growing above the longest leaves and the length of it's flowers between 11-13mm long.[1]

Range

Prairie lupine (var. *lepidus*) is distributed in the lowlands west of the Cascade Mountains from southern British Columbia to northwestern Oregon.[1]

Climate, elevation
Prairie lupine may be found in lowland areas growing in arid climates (40-65 inches of annual precipitation) at elevations below 600 feet.[xxxii[4]]

Local occurrence
South Puget Sound prairies (Thurston, Pierce, Grays Harbor, and Lewis counties).[4]

Habitat preferences
Prairie lupine occurs in lowlands on gravelly to sandy soils, often on flat or mounded plains of recessional glacial outwash.[4]

Plant strategy
Lupinus lepidus var. lobbii was the first plant to colonize the devastated slopes of Mount St. Helens[xxxii[5]] Seeds are probably dispersed by explosive dehiscence (bursting of the seed pods) and rolling, or by erosion and deposition.[xxxii[6]]

Associated species
Species associated with Prairie lupine include houndstongue hawkweed (Hieracium cynoglossoides), cutleaf microseris (Microseris laciniata), spike goldenrod (Solidago spathulata), white-top aster (Aster curtus), and slender cinquefoil (Potentilla gracilis). Long-stolon sedge (Carex pensylvania), field woodruch (Luzula campestris), Idaho fescue (Festuca idahoensis), California danthonia (Danthonia californica) and common camas (Camassia quamash).[4]

Collect as seed


Hairy pods range from 10-20 cm long with 2-12 seeds.[2]

Collection guidelines
Seed can be hand collected from June to August, but collecting is slow due to the small size of the plant. Seeds should be dried in the pods in paper bags. Remove the seeds from the pods by hand thresh and screen.[7]

Cuttings can also be taken from the side shoots of hardened stems in the spring[xxxii][7]

Seed germination

Seed requires scarification. Shake in jar half-filled with coarse sand, scarify with sand paper[7], or rock tumbler for two hours.
After scarification, soak in hot water until the water has cooled (approximately 3 hours). Seeds that sink have absorbed enough water to be sown. Those that do not sink should be dried, scarified and soaked in water again.

Seed life

Lupine seeds have a hard seed coat, and because related lupine species are known to have long-lived dormant seed banks (e.g. *L. arboreus* was germinated in a seed bank study after 45 years), it is likely that prairie lupine seeds are also long-lived and can be stored at low moisture and temperature levels for several years.

Seed storage

Store air-dried seed under cool, dry conditions. Protect from small mammals and rodents.

Propagation

Plant seeds singularly in long narrow pots (at least 3") and transplant from pots into the field within the same year (about 8 months).

Lupine seedlings have very sensitive roots and suffer from root damage when handled excessively. Sensitivity to the root system is especially needed when transplanting from nursery containers into the field.

Soil requirements

Sow lupine seeds in potting soil mixture of coarse and fine particles. Like other legumes prairie lupine has root nodules which house bacteria which fix nitrogen, providing fertilizer for the plant. Potting soil can be inoculated by mixing a small amount of soil from the seed collection site in the potting mix. Use low nitrogen fertilizer and no humus.

Planting density

1-2 foot centers

Care requirements

Seedlings develop very long roots and should be transplanted with sensitivity restricting damage during transplanting.
Mist lightly, daily with restricted water.

Rate of growth

Rate of growth is variable. First year growth is limited due to resources needed to develop large root systems, particularly in rocky soils.

Data compiled by Amy Lambert, May 2, 2003

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