

Lupinus L.

lupine

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Growth habit, occurrence, and use. The genus *Lupinus* is a large genus of herbs and shrubs that are distributed worldwide (Christofolini 1989). Only 10 to 14 Old World species, all herbaceous, are recognized (Williams and others 1983). New World lupines are more diverse, with 147 species found in North America (USDA SCS 1982), 200 in Mexico, 30 to 40 in Central America, and about 500 in South America (Christofolini 1989). Four shrub species are considered here (table 1). Three species are commonly planted in California. Pauma lupine can reach a maximum height of about 2.5 m (Hickman 1993). As far as can be determined, Pauma lupine was first cultivated in 1928 and has since proved to be valuable as an ornamental plant and for watershed protection and erosion control. Though some plants may live for 10 years, Pauma lupine is generally short-lived (Everett 1957). Whiteface lupine, a more northerly shrub species in California, often reaches a maximum height of 3 m. Since it was first cultivated in 1927, it has been planted for wildlife purposes, watershed protection, and more recently for environmental forestry. Four varieties of whiteface lupine are recognized: *Lupinus albigifrons* var. *collinus* Greene; var. *douglassii* (J.G. Agardh) C.P. Sm.; var. *flumineus* C.P. Sm.; and var. *eminens* (Greene) C.P. Sm. (Hickman 1993; USDA SCS 1982). Bush lupine, a large, fast-growing but short-lived shrub found in the northern coastal scrub of California, has been planted for dune stabilization in northern California (Davidson and Barbour 1977; Gadgil 1971a,b&c). Inyo bush lupine is not positively distinct from whiteface lupine, thus *Lupinus excubitus* and *L. albifrotis* are often grouped together.

Flowering and fruiting. Flowers are bisexual, irregular, blue, purple, and yellow in racemes. Pauma lupine will bear viable seeds at 1 year of age (Everett 1957). It flowers from April to May (Munz and Keck 1959) and its seeds ripen from May to August (Ratliff 1974). Whiteface lupine flowers from March to June (Hickman 1993) and its seeds mature from early June to late July.

Collection, extraction, and storage. The legumes (pods) of both Pauma and whiteface lupines pop open when ripe and disperse 2 to 12 seeds (figures 1 and 2). Hence, it is necessary to collect the legumes while the seeds are somewhat green (Ratliff 1974). Immature legumes can be gently air-dried until they open. The coarse material can be removed by screening. The number of clean Pauma lupine seeds per weight in 2 samples was 39,700 to 52,900/kg (18,000 to 24,000/lb) (Mirov and Kraebel 1937). Information on seed weight is lacking for whiteface lupine; however, for the closely related Inyo bush lupine, the number of clean seeds per weight was reported to be 59,500/kg (27,000/lb) (Mirov and Kraebel 1937). In 1 sample, purity was 91% and soundness was 76% (Ratliff 1974).

When adequately dried, mature seeds of lupine can be stored for extended periods. Seeds stored for 30 years at room temperature were found to be viable, and variations in the color of these seeds had no

effect on viability (Everett 1957)

Germination. Stored seeds of the lupines have hard seedcoats that require pretreatment to induce prompt germination. Seeds of the west Australian blue lupine (*L. angustifolius* L.) became impermeable to water when their moisture content was reduced to 10 to 12% (Quinlivan 1962). Each of 3 treatments—mechanical scarification, a hot water soak, and cold stratification for 72 days at 2 EC—induced prompt germination (Ratliffé 1974). In addition, hard seeds of west Australian blue lupine became permeable to water when exposed to simulated surface soil temperature fluctuating between 16 and 60 EC (Quinlivan 1962). Our ongoing research on sundial lupine (*Lupinus perennis* L.) suggests that seeds from both the northeastern and southwestern United States germinate poorly (10%) without scarification, but that treatment with concentrated sulfuric acid for 30 to 60 minutes (depending on source of seed) improves germination to near 90%. Preliminary comparisons with bush lupine further suggest that seeds from the 2 species respond similarly to acid treatment.

Germination percentage has been variable for both untreated fresh seeds and pretreated stored seeds (table I), which may reflect species or population-dependent scarification requirements. Current nursery practices for breaking hardseededness in lupines include nicking, sandpaper scarification, and hot water soaking (Kaplow 1996; Wilson 1996).

Nursery and field practices. Container production of shrubby lupines is somewhat difficult. Young seedlings are susceptible to slug and snail damage. Soil temperatures must be kept low; pot-heating in summer greenhouses may cause major mortality. Root systems are delicate and transplant survival is often low (Kaplow 1996). Wilson (1996) recommended planting seeds directly into large containers and using a well-aerated soil mix. Shrubby lupines may be direct-seeded after scarification to break hardseededness. They do best in poor, rocky, or sandy soils where competition from perennial grasses is minimal.

References

- Christofolini G. 1989. A serological contribution to the systematics of the genus *Lupinus* (Fabaceae). *Plant Systematics and Evolution* 166: 265–178.
- Davidson G, Barbour MG. 1977. Germination, establishment, and demography of coastal bush lupine (*Lupinus arboreus*) at Bodega Head, California. *Ecology* 58: 592–600.
- Emery D. 1964. Seed propagation of California native plants. *Leaflets of the Santa Barbara Botanic Garden* 1(10): 81–96.
- Everett PC. 1957. A summary of the culture of California plants at the Rancho Santa Ana Botanic Garden 1927–1950. Claremont, CA: Rancho Santa Ana Botanic Garden. 263 p.
- Gadgil RL. 1971a. The nutritional role of *Lupinus arboreus* in coastal sand dune forestry: 1. The potential influence of undamaged lupin plants on nitrogen uptake by *Pinus radiata*. *Plant and Soil* 34: 357–367.
- Gadgil RL. 1971b. The nutritional role of *Lupinus arboreus* in coastal sand dune forestry: 2. The potential influence of damaged lupin plants on nitrogen uptake by *Pinus radiata*. *Plant and Soil* 34: 575–593.
- Gadgil RL. 1971c. The nutritional role of *Lupinus arboreus* in coastal sand dune forestry: 3. Nitrogen distribution in the ecosystem before tree planting. *Plant and Soil* 35: 113–126.
- Hickman JC, ed. 1993. *The Jepson manual: higher plants of California*. Berkeley: University of California Press. 1400 p.
- Kaplow D. 1996. Personal communication. Petaluma CA: Pacific Open Space, Inc.

- Mirov NT, Kraebel CJ. 1937. Collecting and propagating the seeds of California wild plants. Res. Note 18. Berkeley, CA: USDA Forest Service, Southwestern Forest and Range Experiment Station. 27 p.
- Quinlivan BJ. 1962. Hard seeds in lupines. *Western Australia Journal of Agriculture* 3: 683–690.
- Ratliffe RD. 1974. *Lupinus* L., lupine. In: Schopmeyer CS, tech. coord. Seeds of woody plants in the United States. Agric. Handbk. 450. Washington, DC: USDA Forest Service: 520–521.
- USDA SCS [USDA Soil Conservation Service]. 1982. National list of scientific plant names. Volume I, List of plant names. Tech. Pub. 159. Washington, DC: USDA Soil Conservation Service. 415 p.
- Williams CA, Demissie A, Harborne JB. 1983. Flavenoids as taxonomic markers in Old *World Lupinus* species. *Biochemical Systematics and Ecology* 11: 221–223.
- Wilson B. 1996. Personal communication. Santa Margarita, CA: Las Pilitas Nursery.

Figure 1—*Lupinus albus*, whiteface lupine (left) and *L. longifolius*, Pauma lupine (right): seeds, H 4.

Figure 2—*Lupinus longifolius*, Pauma lupine: longitudinal section through a seed, H 10.

Table I—*Lupinus*, lupine: nomenclature and occurrence

Scientific name	Common name	Occurrence
<i>L. albifrons</i> Benth ex. Lindl.	whiteface lupine , silver lupine	Coastal range & Sierra Nevada
<i>L. arboreus</i> Sims	bush lupine	N California coast
<i>L. excubitus</i> M.E. Jones	Inyo bush lupine	California & Nevada
<i>L. longifolius</i> (S. Wats) Abrams	Pauma lupine , longleaf bush lupine	S California

Sources: Davidson and Barbour (1977), Everett (1957), Gadgil (1971a,b&c), Hickman (1993), USDA SCS (1982).

Table 2—*Lupinus*, lupine: pregermination treatments and germination test results

Species	Storage period (yrs)	Wet chilling period (days)	Test duration (days)	Germination percentage	No. of tests
<i>L. albitons</i>	2	72	—	90	1
<i>L. excubitus</i>	0	0	6	92	1
<i>L. longifolius</i>	0	0	10+	92	1
<i>L. arboreus</i>	0	0	95	4–45	3

Sources: Davidson and Barbour (1977), Mirov and Kraebel (1937), Ratliff (1974).