LUPINUS SUCCULENTUS DOUGLAS EX K. KOCH

COMMON NAME: ARROYO LUPINE, HOLLOWLEAF ANNUAL LUPINE
FAMILY: FABACEAE
GROWTH FORM: ANNUAL HERB

Lupinus succulentus at Cantua Creek, Fresno County.

PLANTING

During December 2005, seeds were hand sown onto mounded planting beds, and a thin layer of soil was then raked over them. In consecutive years, we planted seeds in trays or Ray Leach "Cone-tainers"™ in a greenhouse setting, due to limited seed supply.

GERMINATION

Lupinus species have hard seed coats that typically require a certain amount of weathering in order for seeds to germinate. To enhance germination, Emery (1988) recommends a variety of methods: hot water treatment, mechanical scarification, or soaking in sulfuric acid for 6-8 hours. Everett (1957) performed acid scarification, mechanical scarification, and hot and cold water treatments on seeds of *L. succulentus*. Both the hot water treatment and soaking seeds in sulphuric acid for two minutes resulted in a 38% germination rate. He also reported that soaking seeds in sulphuric acid for 4-6 hours resulted in 100% germination within 2-3 days.

PHENOLOGY

When growing in the San Joaquin Valley, *L. succulentus* germinates with winter rains and will typically begin flowering in March. Seeds can typically be collected during mid-April to early May, but the peak time for seed collection is variable and somewhat unpredictable.

SEED HARVESTING

Fruits are mature when they are dry and brown with no green color remaining, and the seeds inside are light to dark brown with a mottled appearance and a hard consistency. *L. succulentus* seeds can be difficult to collect because there is a narrow window of opportunity between when the fruits mature and when they dehisce. If the timing of a seed collection visit is ideal, mature fruits can simply be harvested from plants by hand. In attempts to prevent seed dispersal and facilitate seed collection, we have wrapped maturing fruits with various materials, including paper towels, floating row cover (lightweight polyester material), and brown paper bags. We admittedly had some concerns as to whether these materials would interfere with fruit maturation. However, all three types of protective coverings were eaten by wildlife along with the fruits contained within. During years when we have missed the seed collection window, we have successfully vacuumed seeds from the soil surface with the use of a shop vacuum and gasoline-powered generator. Due to the large seed size of *L. succulentus* it is easy to separate seeds from soil and other debris using a sieve, and contamination with seeds of other species is not an issue. This method is not ideal because of potential for deterioration in seed quality, but if seeds have been recently dispersed and they have not become damp, a seed collection of reasonable quality can be made.

SEED PROCESSING METHODS

We have only processed a small volume of plant material for this species, so we have broken open the fruits by hand. If needed, wire mesh sieves with different screen sizes can be used to separate seeds from chaff.

Seeds per gram = **44**[1]

CULTIVATION OVERVIEW

One of the main complications that we had with cultivating *L. succulentus* is its susceptibility to wildlife herbivory. Based on the presence of scat, jackrabbits seem to be the main culprit, but we have also observed deer mouse scat near damaged *L. succulentus* plants. To protect plants, we began to transplant *L. succulentus* into herbivore exclosures (constructed with chicken wire fencing that was buried several centimeters belowground). Nevertheless, the plants continued to sustain damage and we observed bird droppings near the damaged plants. In the year that we suspected damage from birds, many stems with immature fruits had been clipped off plants and left on the ground uneaten. The fruits were not far enough along for after-ripening of seeds to be a possibility, and the opportunity for seed harvest was lost.

During two growing seasons, we raised seedlings in a greenhouse and then transplanted them into the native plant nursery. *L. succulentus* seedlings are robust and able to withstand transplant shock, but we had some difficulty with producing seedlings at the appropriate time of year for transplanting.

During 2007, we planted seeds in the greenhouse on October 25 and then transplanted seedlings into the nursery on December 5. However, due to minimal rainfall, there had been virtually no germination of any plants, including weeds, at the nursery. Once the seedlings were transplanted, they were essentially the only living annual vegetation around and were promptly devoured even though they were located inside of herbivore exclosures. In hindsight our timing was clearly less than ideal but the seedlings had been outgrowing their planting tubes and would have needed to be repotted, thus requiring additional materials, labor and greenhouse space.

[1] This figure (n = 5; standard deviation = 2) is derived from a seed lot harvested in 2008 from a wild population.

We have planted seeds in the greenhouse during September, October, and November and we believe that planting the seeds during November or December with the goal of transplanting seedlings during January would be ideal. In order to protect seedlings from frost, we have used floating row cover. However, in the absence of a drip irrigation system, it is labor-intensive to remove the row cover in order to water the transplants[2].

When seeds were planted in a greenhouse on September 19 and kept moist via sprinkler irrigation, the seeds took at least two weeks to germinate. The seedlings grew their first true leaves in approximately 4 weeks from the date of planting. However, if *L. succulentus* seeds were sown later in the year, the time to germination and formation of true leaves may be different due to colder temperatures.

We certainly do not recommend greenhouse propagation and transplanting of seedlings over the more straightforward method of hand broadcasting seed at the nursery. The reason that we initiated greenhouse propagation is because our seed supply of *L. succulentus* was limited, and we were concerned that if we sowed the seeds directly at the nursery, they could fail to germinate or become lost to predation.

A horticultural entry included in the Jepson Manual recommends that *L. succulentus* is a good species for stabilizing or restoring disturbed or degraded areas (Hickman, 1993).

REFERENCES

Emery, D.E. 1988. Seed Propagation of Native California Plants. Santa Barbara, CA. Santa Barbara Botanic Garden. 115 pp.

Everett, P.C. 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.

Hickman, J. C. (editor). 1993. The Jepson manual: higher plants of California. University of California Press, Berkeley.

Literature

Brown, C.S. and R.L. Bugg. 2001. Effects of established perennial grasses on introduction of native forbs in California. Restoration Ecology 9: 38-48.

Marquez, V.J. and E.B. Allen. 1996. Ineffectiveness of two annual legumes as nurse plants for establishment of *Artemisia californica* in coastal sage scrub. Restoration Ecology 4: 42-50.

ADDITIONAL INFORMATION ABOUT LUPINUS SUCCULENTUS:

Internet Resources

Propagation Protocol from the Native Plant Network:
http://nativeplants.for.uidaho.edu/network/view.asp?protocol_id=3189

Species profile from the Ransom Seed Laboratory:
http://www.ransomseedlab.com/genus/l/lupinus_succulentus.htm

Species profile from the Ladybird Johnson Wildflower Center at the University of Texas:
http://www.wildflower.org/plants/result.php?id_plant=LUSU3

Seed photos from the Rancho Santa Ana Botanic Garden:
http://www.hazmac.biz/050411/050411LupinusSucculentus.html

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PHOTOS

[2] Some types of floating row cover have pores that are large enough to allow water to pass through, but this was not true of the row cover that we used.

L. succulentus seeds. Scale shown is millimeters.