
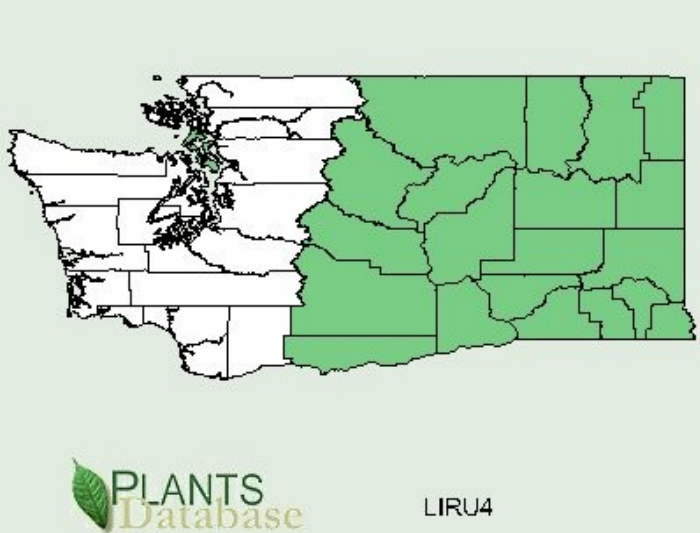


Plant Propagation Protocol for *Lithospermum ruderale* Douglas ex Lehm.
ESRM 412 – Native Plant Production

TAXONOMY	
Family Names	
Family Scientific Name:	Boraginaceae (USDA 2010)
Family Common Name:	Borage (LBJWC 2007)
Scientific Names	
Genus:	<i>Lithospermum</i>
Species:	<i>runderale</i>
Species Authority:	Douglas
Varieties:	<i>L. ruderale</i> var. <i>californicum</i> <i>L. ruderale</i> var. <i>lanceolatum</i> , <i>L. ruderale</i> var. <i>runderale</i> (Tropicos 2010)
Sub-species:	NA
Cultivar:	NA
Authority for Variety/Sub-species:	Authority for <i>L. californicum</i> - A. Grays; for <i>L. lanceolatum</i> - A. Nelson (Tropicos 2010).
Common Synonym(s)	<i>Lithospermum pilosum</i> Nutt. (USDA 2010)
Common Name(s):	western gromwell, western stoneseed, gromwell, puccoon,, Columbian puccoon, white stoneseed, whiteweed, wayside gromwell (LBJWC 2007; Robson, Richter, Filbert 2008; USDA-GRIN 1994).
Species Code:	LIRU4
GENERAL INFORMATION	

Geographical range	  <p>(USDA 2010)</p>
Ecological distribution:	Sagebrush, juniper, and pine ecosystems as well as plains and chaparral landscapes (LBJWC 2007; RUC 2010).
Climate and elevation range	Range is from 750 to 20,000 meters elevation, in dry open areas of in mountain and mid-elevations (RUC 2010).
Local habitat and abundance; may include commonly associated species	Open areas and dry slopes (RUC 2010); commonly associated with <i>Artemesia spp.</i> of sagebrush scrub, <i>Festuca idahoensis</i> , and <i>Juniperus spp.</i> and <i>Pinus ponderosa</i> (Conolly 1993; LBJWC 2007).
Plant strategy type / successional stage:	Known to colonize after fire in Idaho (Conolly 1993).
Plant characteristics	Perennial dicot herb with taproot. Blooms are white, yellow April to June, and lanceolate leaves that are typically densely pubescent. Seeds are distinct hard white nutlets (Conolly 1993; LBJWC 2007; USDA 2010).

PROPAGATION DETAILS	
Ecotype:	Basin sagebrush habitat of Ada County, ID (DeBolt & Parkinson 2005)
Propagation Goal:	Plants
Propagation Method:	Seed and cutting (Conolly 1993; DeBolt & Parkinson 2005; Robsom, Richter, Filbert 2008).
Product Type:	Container (plug) (DeBolt & Parkinson 2005).
Stock Type:	Styrofoam conetainers or deep pots for seedlings (Conolly 1993; DeBolt & Parkinson 2005; Robsom, Richter, Filbert 2008)
Time to Grow:	2 ½ months from seedling until ready to outplant (DeBolt & Parkinson 2005)
Target Specifications:	Healthy plants with multiple leaves (DeBolt & Parkinson 2005)
Propagule Collection:	Collect seed in mid to late summer (Conolly 1993; Robsom, Richter, Filbert 2008).
Propagule Processing/ Propagule Characteristics:	<p>Seeds: Crush the hard nutlets to remove seed, or nick with blade to allow water to access endosperm. Fine debris can be removed using sieves and/or by passing seed material through seed blower. Seed density unknown.</p> <p>Cuttings: Take from stems during summer.</p> <p>(Conolly 1993; DeBolt & Parkinson 2005; Robsom, Richter, Filbert 2008)</p>
Pre-Planting Propagule Treatments:	<p>Seeds: -Dormancy breaking success has been found with cold moist stratification and without. -Nicked seeds are soaked in boiling water for about 2 days. -Seeds removed from nutlet (can be crushed on rubbing board) are isolated from debris using sieve and seed blower, then soaked in water for 1 day.</p> <p>Seeds can be germinated on water agar plates at 20°C, or placed in germination boxes with moistened paper and put in germinator at 4°C. Treat with anti-fungal seed protectant like Thiram and remove receptacle for higher germination.</p> <p>-Seeds may also be sown directly into deep pots or outdoors in the fall to stratify over winter.</p> <p>Cuttings: Treat with rooting hormones and insert (bottom down) into pumice, keeping them humid until root formation occurs.</p> <p>(Conolly 1993; DeBolt & Parkinson 2005; Robsom, Richter, Filbert 2008)</p>
Growing Area	Seedlings and rooted cuttings can be potted into conetainers or pots at 1 cm

Preparation / Annual Practices for Perennial Crops:	deep. Medium may be either fine pumice (Conolly 1993) or 1:1 peat to vermiculite mixture (DeBolt & Parkinson 2005). Pots can be placed in greenhouse (with temperature 18°C to 30°C) and watered to maintain moisture level above 80% soil saturation. Modest amounts of seedling-appropriate fertilizer may also be applied periodically (DeBolt & Parkinson 2005).
Establishment Phase:	Seeds have moderate germination rate at about 43%; cutting establishment unknown. Seed germination begins after 35 days of cold stratification and continues for 2 months, most germinating within the first. *Some seedlings may be lost to damping off (DeBolt & Parkinson 2005).
Length of Establishment Phase:	One month (DeBolt & Parkinson 2005)
Active Growth Phase:	Outplant in April after about 2 ½ months in the greenhouse. (DeBolt & Parkinson 2005).
Length of Active Growth Phase:	About three months from germination until no longer actively growing/ready to outplant (DeBolt & Parkinson 2005).
Hardening Phase:	Unknown
Length of Hardening Phase:	Unknown
Harvesting, Storage and Shipping:	Store seeds at room temperature for as much as 18 months in dark glass jar, or paper envelope. Seedling storage in greenhouse under warm conditions (DeBolt & Parkinson 2005).
Length of Storage:	Two to three months (DeBolt & Parkinson 2005)
Guidelines for Outplanting / Performance on Typical Sites:	60% survival in outplanting. Earlier transplanting may allow plants to grow better taproot before end of first year. Irrigate new plantings on site every 2-3 days (DeBolt & Parkinson 2005).
Other Comments:	Fungus during dormancy breaking and damping off during germination can be problems with this species (Conolly 1993; DeBolt & Parkinson 2005).

INFORMATION SOURCES

References (full citations):	<p>Lady Bird Johnson Wildflower Center (LBJWC). 2007. "Native Plant Database". http://www.wildflower.org/plants/result.php?id_plant=LIRU4</p> <p>United States Department of Agriculture (USDA). 2010. "Plants Profile: Lithospermum ruderales Doublas ex Lehm.". http://plants.usda.gov/java/profile?symbol=LIRU4</p> <p>Tropicos.org. 2010. "Missouri Botanical Garden". http://www.tropicos.org/NameSearch.aspx?name=Lithospermum%20ruderales</p> <p>Regents of the University of California (RUC). 2010. "Jepson Flora Project: Boraginaceae". http://ucjeps.berkeley.edu/cgi-bin/get_JM_treatment.pl?2030,2142,2146</p>
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	<p>IT IS Report. 2010. "Lithospermum ruderales Dougl. Ex Lehm.". http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=31953</p> <p>USDA- Germplasm Resources Information Network (GRIN). 1994. "GRIN Taxonomy for Plants: Lithospermum ruderales Douglas ex Lehm.". http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?105322</p> <p>Calflora. 2010. "Taxon Report". http://www.calflora.org/cgi-bin/species_query.cgi?where-calrecnum=4936</p> <p>Conolly, C. 1993. "A Systematic Study of Lithospermum ruderales Dougl.". University of Washington: Thesis submission.</p> <p>Robson, K., Richter, A., Filbert, M. 2008. "Encyclopedia of Northwest Native Plants for Gardens and Landscapes". Oregon: Timber Press, Inc.</p> <p>Parkinson, H., DeBolt, A. 2005. "Propagation protocol for production of container Lithospermum ruderales Dougl. ex Lehm plants". USDA FS - Rocky Mountain Research Station, Native Plant Network. http://www.nativeplantnetwork.org</p>
Other Sources:	Clarke, G., Toogood, A. 1990. "The Complete Book of Plant Propagation". Great Britain: Ward Lock Limited.
Protocol Author:	Lauren Clark
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