Plant Propagation Protocol for *Castilleja rhexiifolia*
ESRM 412 – Native Plant Production
URL: https://courses.washington.edu/esrm412/protocols/*2021*/*CASRHE.pdf*


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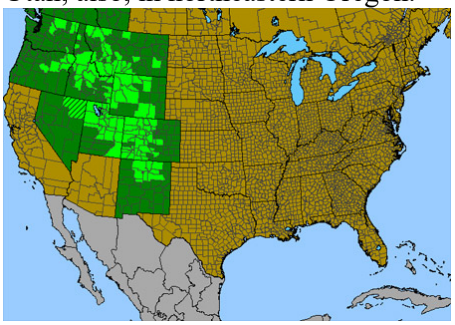
TAXONOMY	
Plant Family	
Scientific Name	SCROPHULARIACEAE
Common Name	Figwort family
Species Scientific Name	
Scientific Name	*Castilleja rhexiifolia* Rydb.
Varieties	N/A
Sub-species	N/A
Cultivar	N/A
Common Synonym(s)	Rhexi-leaved Paintbrush, Rosy Indian paintbrush (Kartesz).
Common Name(s)	Splitleaf Indian paintbrush
Species Code (as per USDA Plants database)	CASRHE (USDA).
GENERAL INFORMATION	
Geographical range	Found from B.C. and Alberta, south through Montana, Idaho, Wyoming, Colorado, northern New Mexico, and Utah; also, in northeastern Oregon.  Dark green- present and native Light green- by county, present and not rare Range map © John Kartesz, Floristic Synthesis of North America

Ecological distribution	Moist, open, alpine to subalpine woods and slopes (Lesica).
Climate and elevation range	Alpine tundra and boreal (Klinkenberg). Wide range of elevations.
Local habitat and abundance (may include commonly associated species)	Similar to and known to hybridize with *C. miniate.* Locally common in Washington state (Turner).
Plant strategy type / successional stage	Long blooming time- June through September.
Plant characteristics	Perennial herb. Grows from five inches to two feet depending on conditions. Hot rose-pink, grows in small upright clusters (Turner).
PROPAGATION DETAILS	
Ecotype	Moist forest meadows, Camas, Glacier National Park, Flathead Co., MT., 1100m elevation. Protocol Information developed by Jeff Evans, Tara Luna, and Dale Wick
Propagation Goal	plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	N/A
Time to Grow	5 months
Target Specifications	Stock Type: Container seedling Height: 5 cm Caliper: n/a Root System: firm plug in conetainer.
Propagule Collection Instructions	Seeds are hand collected in late August when capsules begin to split, and seed is easily shaken out of the seed capsule. Seeds are dark gray at maturity. Capsules are collected in paper bags and kept in a well-ventilated drying shed prior to cleaning. (Luna, Wick, Evans)
Propagule Processing/Propagule Characteristics	Seeds are hand cleaned at the nursery. Seed longevity is at least 3 years at 3 to 5C in sealed containers. Seed dormancy is classified as physiological dormancy. Seeds/Kg: 10,780,000/kg % Purity: 100% % Germination: 98%
Pre-Planting Propagule Treatments	Seeds are placed into a 150-day cold, moist stratification using moistened paper towels in an unsealed Ziplock bag in a refrigerator at 2C or they can be fall sown outdoors.
Growing Area Preparation / Annual Practices for Perennial Crops	Greenhouse and Outdoor Nursery growing facility. Sowing Method: Direct Seeding. Seeds are lightly covered with medium. Growing medium used is 6:1:1 milled sphagnum peat,

	perlite, and vermiculite with Osmocote controlled release fertilizer (13N:13P2O5:13K2O; 8 to 9 month release rate at 21C) and Micromax fertilizer (12%S, 0.1%B, 0.5%Cu, 12%Fe, 2.5%Mn, 0.05%Mo, 1%Zn) at the rate of 1 gram of Osmocote and 0.20 gram of Micromax per 172 ml conetainer. Greenhouse temperatures are maintained at 21 to 25C during the day and 16 to 18C at night. Seedlings are hand watered and remain in greenhouse until mid-May. Seedlings are then moved to outdoor nursery for the remainder of the growing season. Seedlings are irrigated with Rainbird automatic irrigation system in early morning until containers are thoroughly leached. Average growing season of nursery is from late April after snowmelt until October 15th. (Luna, Wick, Evans)
Establishment Phase Details	Medium is kept slightly moist during germination. Initial germination was uniform and appeared complete in 3 weeks. Germination occurred at 21C or above during the day. Host root exudates are not required for germination; the seedlings grew vigorously until they produce 4 to 8 true leaves. At this stage, 3 to 4 weeks after germination, it is necessary to companion plant a host seedling (Carex hoodii was used) to further growth and development of the seedling. The haustoria roots are then induced by the presence of the exudates of the host roots and the hemi-parasitic relationship is then established. (Luna, Wick, Evans)
Length of Establishment Phase	4 weeks
Active Growth Phase	Root and shoot development occur at a rapid rate after the haustoria are formed. Plants had formed 15 to 25 true leaves, were 3 cm in height and root tight in 8 weeks. It is necessary to keep the growth of the companion plant in check, so it does not out compete the Castilleja seedling in the container (Luna, Wick, Evans).
Length of Active Growth Phase	8 weeks
Hardening Phase	Irrigation is gradually reduced in September and October. Plants are leached with clear water once before winterization.
Length of Hardening Phase	4 weeks
Harvesting, Storage and Shipping	Total Time to Harvest: 5 months Harvest Date: September Storage Conditions: Overwinter in outdoor nursery under insulating foam cover and snow.

Length of Storage	5 months
Guidelines for Outplanting / Performance on Typical Sites	N/A
Other Comments	N/A
INFORMATION SOURCES	
References	See References Below
Other Sources Consulted	N/A
Protocol Author	Elle Graham
Date Protocol Created or Updated	05/24/21

References:

Bonde, E. K. (1965a). Further studies on the germination of seeds of Colorado alpine plants. Univ. Colorado Stud. No. 18. Bonde, E, K. (1965b). Studies on the germination of seeds of Colorado alpine plants. Univ. Colorado Stud. No. 14.Table 10.33 In: Baskin, C.J. and Baskin, J.M. Seeds: Ecology, Biogeography and Evolution in Dormancy and Germination, Academic Press, 1998. Chapter 10: A Geographical Perspective on Germination Ecology: Temperate and Arctic Zones, pages 331 to 458.

Hickman, James, Ed. 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, California.; Oswald, Vern and Lowell Ahart. 2002. Selected Plants of Northern California and Adjacent Nevada. CNPS

Howard, Janet L. 2003. Descurainia pinnata. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.fed.us/database/feis/plants/forb/despin/all.html [2021, May 25].

Kartesz, J.T. 1994. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. 2nd edition. 2 vols. Timber Press, Portland, OR.

Klinkenberg, Brian. (Editor) 2020. E-Flora BC: Electronic Atlas of the Plants of British Columbia [eflora.bc.ca]. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. [Accessed: 2021-05-26 9:01:35 AM]

Lesica 2012. Manual of Montana Vascular Plants. BRIT Press. Fort Worth, TX.

Luna, Tara; Wick, Dale. 2008. Propagation protocol for production of Container (plug) Castilleja rhexiifolia Rydb. plants 172 ml conetainers; USDI NPS - Glacier National Park West Glacier, Montana. In: Native Plant Network. URL: http://NativePlantNetwork.org (accessed 2021/05/26). US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources.

New Mexico Rare Plant Technical Council. 1999. New Mexico Rare Plants. Albuquerque, NM: New Mexico Rare Plants Home Page. https://nmrareplants.unm.edu (Latest update: 24 May 2021).

Rhexia-leaf Indian Paintbrush — Castilleja rhexiifolia. Montana Field Guide. Montana Natural Heritage Program. Retrieved on May 26, 2021, from http://FieldGuide.mt.gov/speciesDetail.aspx?elcode=PDSCR0D2S0

Turner, Mark. "Castilleja Rhexifolia: Rosy Paintbrush: Wildflowers of the Pacific Northwest." *Turner Photographics*, www.pnwflowers.com/flower/castilleja-rhexifolia#:~:text=Grows%20in%20subalpine%20meadows%2C%20bogs,eastern%20Washington%20and%20northeastern%20Oregon.