

Plant Propagation Protocol for *Castilleja cusickii*

ESRM 412 – Native Plant Production

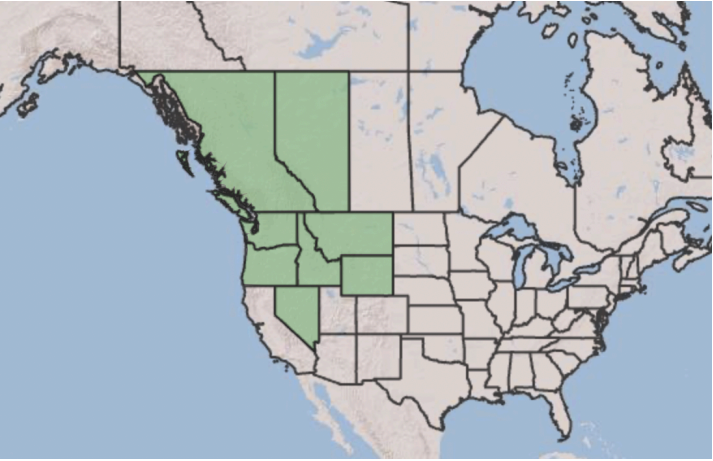
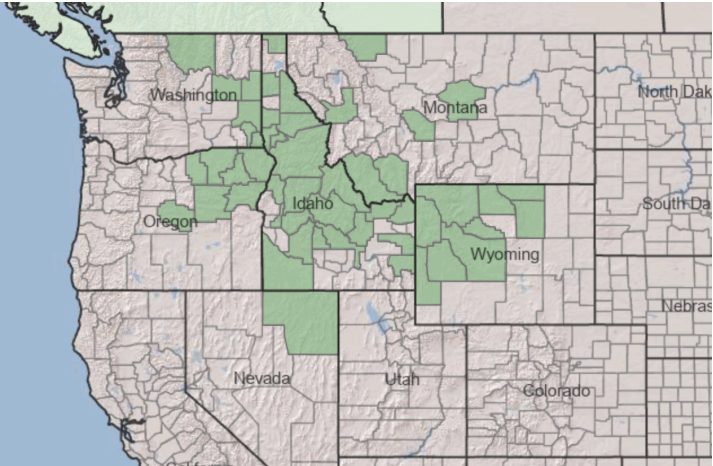
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Cusick's Indian Paintbrush Image⁴

TAXONOMY	
Plant Family	
Scientific Name	Formerly <i>Scrophulariaceae</i> Juss., Now <i>Orobanchaceae</i> ⁷
Common Name	Formerly Figwort family, Now Broomrape ⁷
Species Scientific Name	
Scientific Name	<i>Castilleja cusickii</i> Greenm.
Varieties	<i>Castilleja lutea</i> A. Heller
Sub-species	
Cultivar	
Common Synonym(s)	<i>Castilleja lutea</i> A. Heller
Common Name(s)	Cusick's Indian Paintbrush ¹ , Yellow Paintbrush ²
Species Code (as per USDA Plants database)	CACU7
GENERAL INFORMATION	

Geographical range	 <p>Geographical distribution in North America¹</p>  <p>Geographical distribution in the PNW by county¹ Ranging from Alberta, British Columbia, Montana, Idaho, Nevada, Oregon, Washington and Wyoming³ Occurring east of the Cascades crest in Washington; British Columbia to Nevada, east to Alberta, Montana, and Wyoming⁴</p>
Ecological distribution (ecosystems it occurs in, etc)	<p>Occurs in subalpine conditions and on relatively steep slopes⁴ Generally, Castilleja can occur on rocky, gravelly limestone substrates on slopes and ridges from upper subalpine. Thin and uniformly well-drained soils are preferred⁹</p>
Climate and elevation range	<p>Grows from 300 to 3000 meters in elevation²</p>
Local habitat and abundance (may include commonly associated species)	<p>Moist meadows, grasslands, sagebrush steppe, montane, subalpine ecosystems³ Bogs/Fen/Wetlands⁶</p>
Plant strategy type / successional stage (stress-tolerator, competitor,	<p>Hemiparasitic²</p>

weedy/colonizer, seral, late successional)	
Plant Characteristics	<p>Perennial herbs, stems clustered, turgid and unbranched (ranging from 1-6dm. tall) with soft, sticky hairs⁴</p> <p>Height ranges 8-20 inches⁶</p> <p>Flowering during Apr-Aug⁵</p> <p>Typically all yellow, sometimes peppered with red, yellow or purple hues on bracts⁵</p> <p>All of the <i>Castilleja</i> species were formerly in family <i>Scrophulariaceae</i> (Figwort) but have been reassigned to <i>Orobanchaceae</i> (Broomrape) along with other parasitic species⁷</p> <p><i>Castilleja</i> parasitizes neighboring plants using root connections if in close proximity and typically parasitize species in the grass family (Poaceae)¹⁰</p> <p>Typical <i>Castilleja cusickii</i> appears to hybridize with <i>C. gracillima</i> in the Logan Valley, Grant County, Oregon⁸</p>
PROPAGATION DETAILS: FROM SEED Explained by Tara Luna²	
Ecotype	Fescue grassland, Glacier National Park, Glacier Co., Mt at 1585m elevation
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	160 ml conetainers
Time to Grow	8 months
Target Specifications	<p>Stock Type: Container Seedling, 5cm in height</p> <p>Root System: Firm plug in conetainer</p>
Propagule Collection Instructions	Seeds are collected by hand in early August when capsules begin to split and seed is easily removed out of the capsule. Seeds are gray when mature. Capsules are collected in paper bags and kept in a dry shed before cleaning.
Propagule Processing/Propagule Characteristics	<p>Seeds hand cleaned at nursery facility.</p> <p>Physiological dormancy.</p> <p>Seeds/Kg: 1,200,000/kg.</p> <p>% Purity: 100%</p> <p>% Germination: 52% to 90%</p>
Pre-Planting Propagule Treatments	Two methods were used: exposing seeds outdoors for 5 months led to 52% germination, while storing them in a refrigerator at 2°C with moist paper towels for 90 days resulted in 90% germination.

Growing Area Preparation / Annual Practices for Perennial Crops	<p>The facility includes both a greenhouse and an outdoor nursery for growing. Seeds are directly sown and lightly covered with a medium. The growing medium consists of 70% milled sphagnum peat, perlite, and vermiculite in a 6:1:1 ratio, mixed with 30% sand. It is supplemented with Osmocote controlled-release fertilizer (13N:13P2O5:13K2O) for 8 to 9 months release at 21°C, and Micromax fertilizer (12%S, 0.1%B, 0.5%Cu, 12%Fe, 2.5%Mn, 0.05%Mo, 1%Zn) at a rate of 1 gram of Osmocote and 0.20 gram of Micromax per 172 ml container. The greenhouse maintains temperatures between 21 to 25°C during the day and 16 to 18°C at night. Seedlings are watered manually and stay in the greenhouse until mid-May, after which they are transferred to the outdoor nursery for the rest of the growing season. They are irrigated using an automatic irrigation system early in the morning until containers are well-drained. The nursery's growing season typically runs from late April, after snowmelt, until October 15th.</p>
Establishment Phase Details	<p>The growing medium is kept slightly moist during germination. Initial germination is uniform and typically completes within three weeks, typically occurring at temperatures of 21°C or higher during the day. Root exudates from a host plant are not needed for germination; the seedlings grow vigorously until they produce 4 to 8 true leaves. At this point, about 3 to 4 weeks after germination, it becomes necessary to companion plant a host seedling (such as <i>Erigeron peregrinus</i>) to facilitate further growth and development. The presence of the host root exudates induces the formation of haustoria roots, establishing a hemi-parasitic relationship.</p>
Length of Establishment Phase	4 weeks
Active Growth Phase	<p>After haustoria formation, both root and shoot development proceed rapidly. Within 8 weeks, plants typically develop 15 to 25 true leaves, reach a height of 3 cm, and establish a tight root system. To prevent the companion plant from overshadowing the <i>Castilleja</i> seedling in the container, it's essential to prune it regularly and keep its growth in check</p>
Length of Active Growth Phase	8 weeks

Hardening Phase	Irrigation slowly reduced in September and October. Plants are flushed with clear water before winterization.
Length of Hardening Phase	4 weeks
Harvesting, Storage and Shipping	Total Time To Harvest: 8 months Harvest Date: September Storage Conditions: In outdoor nursery, overwinter under insulating foam cover and snow.
Length of Storage	5 months
Guidelines for Outplanting / Performance on Typical Sites	
Other Comments	Castilleja species are hemiparasitic. Larger seed size within the Scrophulariaceae family enables seedlings to establish initially without immediate contact with a host root. However, ongoing growth and development require a host plant. Seedlings not companion planted show declining vigor around 8 weeks post-germination ²

INFORMATION SOURCES

References (full citations)	<p>¹United States Department of Agriculture. (n.d.). <i>Castilleja cusickii</i> Greenm. USDA plants database. https://plants.usda.gov/home/plantProfile?symbol=CACU7 (accessed 2024/05/21).</p> <p>²Luna, Tara; Wick, Dale; Hosokawa, Joy. 2008. Propagation protocol for production of Container (plug) <i>Castilleja cusickii</i> Greenm. plants 160 ml conetainers; USDI NPS - Glacier National Park West Glacier, Montana. In: Native Plant Network. URL: https://NativePlantNetwork.org (accessed 2024/05/21). US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources.</p> <p>³Montana Natural Heritage. (n.d) . <i>Cusick's Indian paintbrush</i>. Cusick's Indian Paintbrush. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDS CROD0Q0</p> <p>⁴WTU Herbarium, B. M. (n.d.-b). <i>Castilleja Cusickii- Burke Museum Herbarium</i>. <i>Castilleja cusickii</i> - burke herbarium image collection. https://burkeherbarium.org/imagecollection/taxon.php?Taxon=Castilleja+cusickii</p>
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	<p>⁵ Egger, J. M., Zika, P. F., Wilson, B. L., Brainerd, R. E., & Otting, N. (n.d.). <i>Castilleja cusickii</i>. Castilleja cusickii - FNA. http://floranorthamerica.org/Castilleja_cusickii</p> <p>⁶ Turner, M. (n.d.). <i>Castilleja cusickii: Cusick's paintbrush: Wildflowers of the Pacific Northwest</i>. Turner Photographics. https://www.pnwflowers.com/flower/castilleja-cusickii</p> <p>⁷ <i>Castilleja coccinea (Indian paintbrush)</i>. Minnesota Wildflowers. (n.d.). https://www.minnesotawildflowers.info/flower/indian-paintbrush</p> <p>⁸ <i>Flora of North America species comparison</i>. FNA: Castilleja+chambersii vs. +castilleja+cusickii. (n.d.). https://nwwildflowers.com/compare/?t=Castilleja%2Bchambersii%2C%2BCastilleja%2Bcusickii</p> <p>⁹ Egger, J.M. 2013. <i>Castilleja kerryana</i> (Orobanchaceae): A new species from the Rocky Mountains of northern Montana. <i>Phytoneuron</i> 2013-21: 1–14. Published 2 April 2013. ISSN 2153 733X</p> <p>¹⁰ <i>Ask mr. Smarty plants</i>. Lady Bird Johnson Wildflower Center - The University of Texas at Austin. (n.d.). https://www.wildflower.org/expert/show.php?id=3673</p>
Other Sources Consulted	
Protocol Author	Kailyn Azadi
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