Plant Propagation Protocol for *Castilleja levisecta*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/CALE27

Flowering Stalk: Tom Kaye, CPC [6]

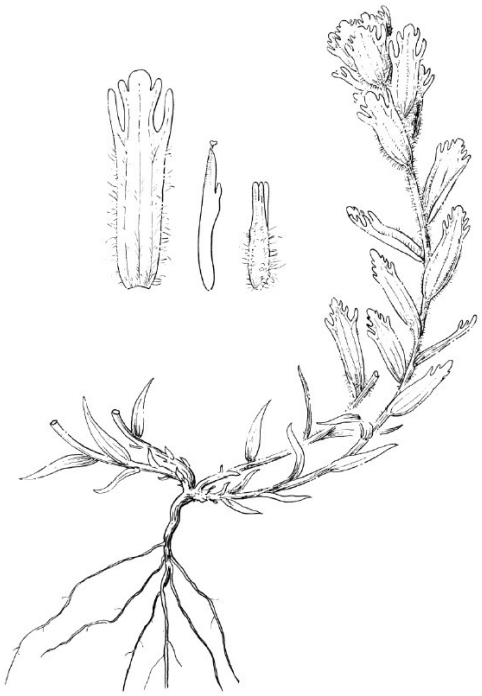
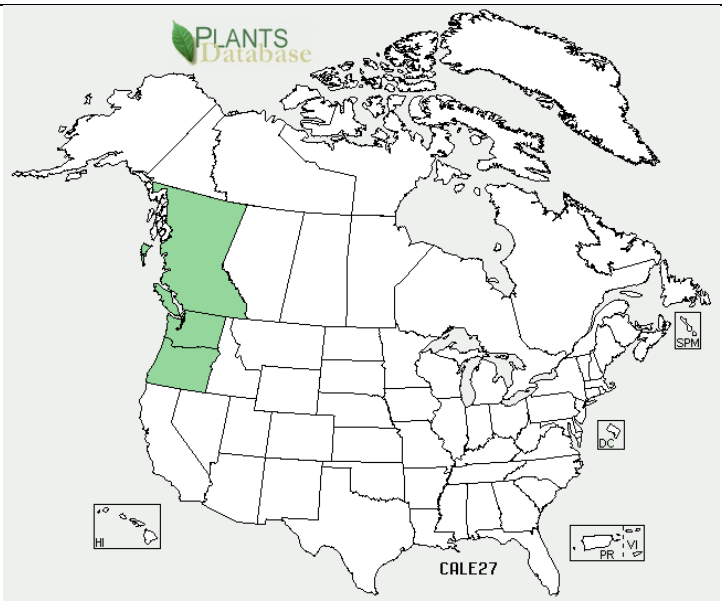
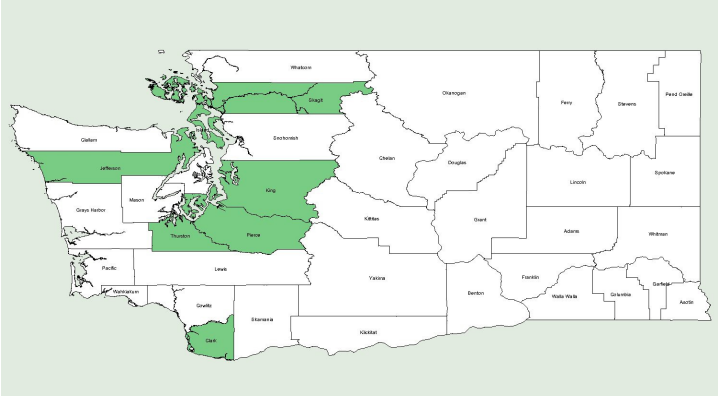


Illustration by Jeanne R. Janish, UW Press, 1959.

TAXONOMY	
Plant Family	
Scientific Name	Scrophulariaceae [4]
Common Name	Figwort family [4]
Species Scientific Name	*Castilleja levisecta* [4]
Scientific Name	*Castilleja levisecta* Greenm [4]
Varieties	None
Sub-species	None
Cultivar	None
Common Synonym(s)	*C. parviflora* [10]
Common Name(s)	golden paintbrush, golden indian paintbrush
Species Code (as per USDA Plants database)	CALE27 [1]
GENERAL INFORMATION	

Geographical range [1]	  -1
Ecological distribution	Open grasslands, glacial outwash, glacial and lake sediments [7], in well-drained soils with little to no canopy cover and [8]
Climate and elevation range	At elevations below 100m (330ft) [7].
Local habitat and abundance	Golden paintbrush is federally listed as threatened, with ranges restricted primarily to the San Juan islands, and a few places in British Columbia. Historically the range extended into the Willamette valley in Oregon. [9, 10]. There are 9 known populations in Washington [6, 10], of which only 3-6 are classified as stable[9]. The plant may be dependent on frequent low-intensity fires to maintain a treeless open grassland habitat.[6, 8, 9] <u>Commonly associated species</u> Mosses: Dicranum scoparium Graminoids: Carex tumulicola, Dactylis glomerata, Festuca rubra,Bromus carinatus, Luzula comosa, Festuca roemeri Forbs: Erigeron speciosus, Achillea millefolium,

	Cerastium arvense, Fragaria virginiana ssp platypetala, Hypochaeris radicata, Plantago lanceolata, Pteridium aquilinum var pubescens, Rumex acetosella, Sanicula crassicaulis var crassicaulis, Trifolium dubium, Vicia spp.
Plant strategy type / successional stage	Early colonizer, germinates after fires and before canopy-closure.[6, 10] Requires full sun.[2]
Plant characteristics	Short-lived perennial (5-6 years max) that reproduces exclusively by seeds. [6, 9, 10] Plants are hemi-parasitic, they can photosynthesis but grow more robustly when parasitizing roots of forbs/grasses for water and nutrients.[6, 9, 10] It has a low natural germination rate (>12%) and is primarily self-incompatible, with larger seed sets when pollination is by outside populations. [9, 10]
PROPAGATION DETAILS	
Ecotype	N/A
Propagation Goal	Plants, flowers, wildlife habitat
Propagation Method	Seed [5, 6, 8, 10]
Product Type	Not commercially available.
Stock Type	Not commercially available.
Time to Grow	4-6 months.[9]
Target Specifications	Only tall plants produce flowering stalks and seeds, up to 30cm (12in).[10]
Propagule Collection Instructions	Seeds form in capsules from June to July and persist on plant through August.[6] Seeds had higher germination rates if collected before October.[9]
Propagule Processing/Propagule Characteristics	Seed viability is dramatically reduced after 1 year post-collection.[6, 10] Average number of seeds per capsule, taken from a number of different trials, was 142.[9]
Pre-Planting Propagule Treatments	Requires cold stratification for a minimum of 6 weeks, up to 8 weeks at 5º C.[9] Then maintain alternating day/night temperatures of 15ºC/25ºC for germination.[9]
Growing Area Preparation / Annual Practices for Perennial Crops	Sites that were burned or mowed increased the survival chances of outplanted seedlings. [11]
Establishment Phase Details	Natural germination of seeds occurs in March. Seed viability is widely variable both within populations and collectively, between 39%-96% for first-year seed germination in a greenhouse setting.[9] Seedlings should be carefully transferred to flats or individual pots with loose potting soil and grown for at least 2 months in a heated greenhouse (day/night temperatures of 15ºC/25ºC).[9]
Length of Establishment Phase	2 months.[9]
Active Growth Phase	After establishment phase, plants should be transferred to pots or flats with host plants.[9] Flowering occurs one year after germination at the

	earliest in late April to early June, seeds begin to mature in June to mid-July, senescence begins late July.[9,11]
Length of Active Growth Phase	4 months to 1 year.[9]
Hardening Phase	Seedlings should be hardened for at least 1 week in a shade house before being outplanted in sites with full sun.[9] Stop all fertilization of plants in September to allow plants to go dormant by October.[9]
Harvesting, Storage and Shipping	Seed collecting should begin in mid-July and end by late September.[9]
Length of Storage	Seeds should be planted within 1 year of collection for best germination rates.[9] Seedlings should be outplanted within 1 year of germination.[9]
Guidelines for Outplanting / Performance on Typical Sites	Plants should not be outplanted before achieving significant growth, 2+ months post-germination.[9] Plants should not be kept in pots for longer than 1 year.[9] Fertilization with nitrogen for the first year of growth and outplanting in the fall rather than spring increased plant survival.[9] Outplanting of seedlings have an estimated 70-80% survival within the first year and 35% survival in the second year.[11]
Other Comments	Federal and state listing prohibits collection of seed without appropriate permits or for personal or commercial use. [10] Regular prescribed burns or mowing in the fall after seeds have been dispersed, particularly of woody vegetation, will help maintain and enhance populations and improve seed quantities produced.[11]
INFORMATION SOURCES	
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Other Sources Consulted	(5) 'eFloras (2008). Published on the Internet http://www.efloras.org. Accessed April 28, 2014. Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA. (5) Wasowski, S. (2002). *Gardening with Prairie Plants: How to Create Beautiful Native Landscapes*. Mn: University of Minnesota Press.
Protocol Author	Eradea Morwyntine
Date Protocol Created or Updated	05/04/14

Updated from previous protocol done in 2006, below.

Golden paintbrush (*Castilleja levisecta*)

Photo source: Left, Institute for Applied Ecology; Right: photo taken by Terry Domico

Range

C. levisecta was historically found from coastal British Columbia to the Willamette Valley in Oregon. However, primarily due to habitat destruction and fire exclusion, it is now thought to be extirpated from Oregon—occurring only in western Washington and on Vancouver Island. [2, 8]

Climate, elevation

10-300 feet [8]

Local occurrence

There are less than a dozen sites where this species persists, with the majority of those occurring in western Washington. Efforts are underway to reintroduce *C. levisecta* at appropriate locations and to expand current populations. [1, 3, 4]

Habitat preferences

Golden paintbrush is found in open grassland areas and is most successful where native prairie species still dominate. It does poorly in areas where Douglas-fir and Scot's broom are present as it is easily out-competed and cannot survive in closed canopy conditions. [8]

Plant strategy type/successional stage

C. Levisecta is a short-lived perennial (about 5-6 years) and reproduces exclusively by seed. [2] It is a hemiparasite which means that is can attach itself to the roots of other species to acquire water and nutrients, though this is not crucial for its survival. Indeed, it can grow successfully without a host, but studies have found that when grown with a host plant, *C. levisecta* grows larger and is more likely to produce flowers. [4, 5]

Associated species

Idaho fescue (*Festuca idahoensis*), red fescue (*Festuca rubra*), and woolly sunflower (*Eriophyllum lanatum*).

Collection restrictions or guidelines

Golden paintbrush is a federally listed threatened species and is listed as endangered in Washington and Oregon. There is no collecting allowed for commercial or home use. [6, 8]

Seed germination

Germination requirements may vary depending on the source of the seed. In general, seeds must be stratified for 6-8 weeks. Set seeds on a moist paper towel or germination paper in a dark place at 5° C for 6-8 weeks. Follow this by a post-chill incubation: set seeds in a warm, well-lit place for two weeks (checking for germination during this period). Keep moist. [1, 5]

Seed life

Seed life, as with viability, may vary depending on population source. It is best to use seeds within 1-2 years. [1, 5]

Recommended seed storage conditions

Store at a low-temperature (5° C) in a dry, dark place.

P. Dunwiddie/ TNC

Propagation recommendations

Once the seeds have germinated and have their first root (radicle), carefully put the seeds in soil. After 4-6 weeks, seedlings may be transplanted into a container with a host plant such as *Eriophyllum lanatum, Festuca roemeri, or Potentilla gracilis*. Outplant after at least 3 months. Make sure that the host plant is not out-competing the golden paintbrush seedling. [1, 5]

Soil or medium requirements

In its native habitat, *C. levisecta* often occurs on well-drained glacial outwash soils. Therefore, it is wise to use a well-drained soil for propagating this species. Researchers have also had success with using a liquid fertilizer (15-

30-15) every two weeks when watering. [5]

Installation form

Install seedlings when they are at least 3 months old. In its natural environment, *C. levisecta* grows in clusters. Planting in this fashion may make it easier to monitor the population as well as protect from herbivory (fencing), if appropriate. [1]

Care requirements after installed

Summer drought and herbivory may be the main causes for seedling mortality. If possible, watering young seedlings during dry months and protecting them from herbivores may increase early survival rates. [1]

Normal rate of growth or spread; lifespan

C. levisecta lives about 5-6 years. [1]

Sources cited

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(4) Kaye, T.N. 2001. Restoration Research for golden paintbrush (Castilleja levisecta), a threatened species. Institute for Applied Ecology, Corvallis, OR.

(5) Lawrence, Beth. Master's Thesis: Studies to Facilitate Reintroduction of Golden Paintbrush (*Castilleja levisecta*) to the WillametteValley, Oregon. OSU.

(6) PLANTS database: http://plants.usda.gov/. April 23, 2006.

(7) The Nature Conservancy website: http://www.nature.org/wherewework/northamerica/states/washington/friends/art14537.html. April 26, 2006.

(8) Washington Natural Heritage Program website: http://www.dnr.wa.gov/nhp/refdesk/fguide/htm/fsp_ascu.htm April 26, 2006.

Data compiled by

Samantha Martin Sprenger April 27, 2006