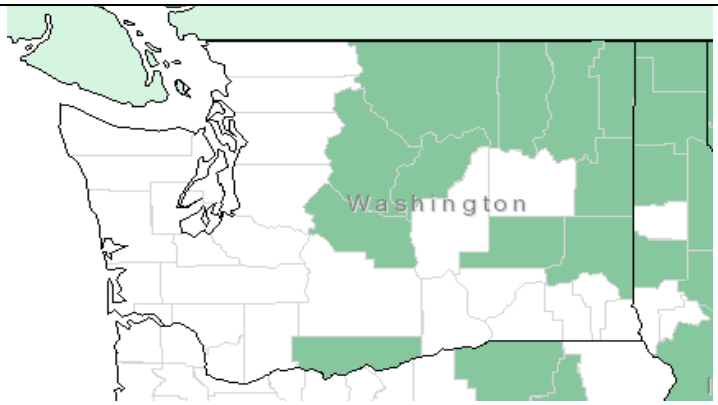
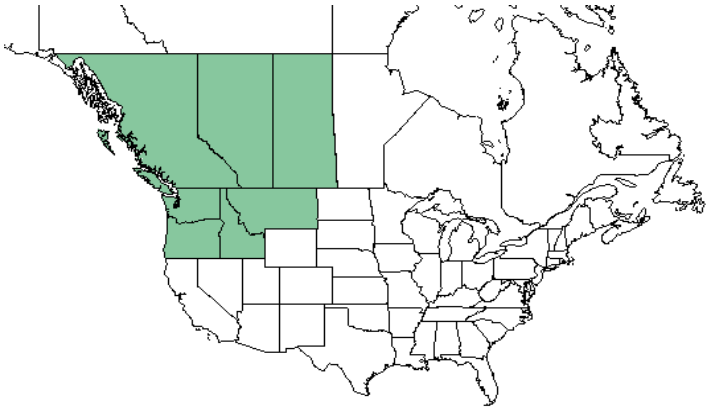
Plant Propagation Protocol for *Penstemon confertus*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/PECO6.pdf

TAXONOMY	
Plant Family	
Scientific Name	Scrophulariaceae
Common Name	Figwort
Species Scientific Name	
Scientific Name	*Penstemon confertus* (Dougl. ex Lindl.) [1]
Varieties	*Penstemon confertus* var. procerus (Douglas ex Graham) Coville [3] *Penstemon confertus* var. attenuatus (Douglas ex Lindl.) M.E. Jones [4] *Penstemon confertus* var. geniculatus (Greene) Jeps. [4]
Sub-species	*Penstemon confertus* ssp. procerus (Douglas ex Graham) D.V. Clark [5]
Cultivar	N/A
Common Synonym(s)	N/A
Common Name(s)	pincushion beardtongue [English] [5] yellow penstemon [1] (Douglas ex Graham)

	yellow beard-tongue [1] (Douglas ex Graham)
Species Code	PECO6
GENERAL INFORMATION	
Geographical range	 
Ecological distribution	Montane and Sub-alpine zones, rarely ascending into Alpine or descending into Sub-montane regions. Widespread through the Rockies, south to Chaffee County, Colorado. Manitoba to British Columbia, south in the mountains to Colorado, Utah, and Washington. [6] Native to open grasslands east of the Cascades from southern British Columbia to Oregon and east to western Montana. Mean annual precipitation above 15 inches. [2]
Climate and elevation range	Moist to dry-ish grassy slopes. 1,900 to 3,200 meter altitudes. [6] Native above 48º N lat. [2]
Local habitat and abundance	A very common and widespread Penstemon, not only in Alberta but also in B.C., from the Okanagan Valley eastwards, east into Saskatchewan south to central Oregon and western Montana. It is a plant of fairly moist, open or wooded places, often in meadows or along streams, to be found in the west up to elevations of 2300 m (7500 feet) in the mountains. [7]
Plant strategy type / successional stage	Shade tolerant. Saline intolerant. Anaerobic intolerant. Very fire tolerant. Adapted to coarse, fine, and medium textured soils. [2] Susceptible to fusarium wilt diseases in cultivation and should not be fertilized or overwatered. [9] Penstemon species establish and spread slowly via seed distribution. They are not

	considered "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. They coexist with other native species and add biodiversity to those plant communities. [7] Pioneering species that does not fix nitrogen. [10]
Plant characteristics	Perennial forb, subshrub to shrub with yellow flowers. Short to long lived. Have opposite, entire or toothed leaves. Several stalked flower clusters in the axils of the upper leaves. The tubular flower is strongly to distinctly two-lipped at the mouth with a two-lobed upper lip and a three-lobbed lower lip. There are 4 fertile stamens and a single sterile stamen that is often hairy at the tip. The fruit is a many-seeded capsule. [8] Useful in the stabilization of severely disturbed soils. Ability to survive under low fertility and xeric conditions. [10]
PROPAGATION DETAILS	
Ecotype	Paradise Creek near Pullman, Washington. [1]
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	10 cu. In. Ray Leach super cell container [1]
Time to Grow	4 months
Target Specifications	Tight root plug in container.
Propagule Collection Instructions	Collect when capsules begin to split in August. Seeds are held within the capsule tightly. Store in paper bags at room temperature until cleaned. [2]
Propagule Processing/Propagule Characteristics	4,628,000 seeds/lb. [5] Seed are 0.5-0.7mm in length. [10] Fruit is a capsule and the seed is brown in color. [5] Penstemon seeds are orthodox in storage behavior, as they keep well in warehouse storage if maintained at moisture contents of 8 to 11%. [9] There is little loss of viability during 5 years, and seeds stored for 15 years may still show viability as high as 50%. [9]
Pre-Planting Propagule Treatments	Small amounts can be cleaned with an air column separator to remove the seed from their capsules. Larger amounts, use a hammer mill and air screen equipment. Clean seed is stored at 40º F at 40% relative humidity. [1] 90 days cool, moist stratification. 4 years in cold, dry storage at 40º F and 40% relative humidity, the same lot of seed exhibited 65% germination without pretreatment. [1]
Growing Area Preparation / Annual Practices for Perennial Crops	Seed is sown in October. Container filled with Sunshine #4 and covered lightly. Small amount of pea gravel to reduce seed movement. Water deeply. [1]
Establishment Phase Details	Move containers to greenhouse in mid to late January. Germination begins at 6 days and completes in 12 days. [1]
Length of Establishment Phase	2 weeks [3]
Active Growth Phase	Plants are watered deeply every other day and fertilized once per week with a complete, water soluble fertilizer containing micro-nutrients. [1] Watering duration, 20 minutes, every other day unless during a dry season, water once every day. [4]

Length of Active Growth Phase	3 months [1]
Hardening Phase	Plants are moved to cold frame in April. Watered every other day unless hot temperatures arise; then water every day.
Length of Hardening Phase	2-4 weeks [2]
Harvesting, Storage and Shipping	No harvesting. No Storage/Shipping information.
Length of Storage	The seedlings will be ready for hardening-off and outplanting in 3 to 4 months, but they can be held much longer if necessary. [9]
Guidelines for Outplanting / Performance on Typical Sites	Survival of outplanted stock is usually high, as long as plants are watered-in well at the time of transplanting and care is taken to eliminate air pockets around the roots. [9] Flowering should not be expected until at least the second growing season. [7]
Other Comments	No insect problems. [1]
INFORMATION SOURCES	
References	[1] Skinner, Dave. "Native Plant Network — Reforestation, Nurseries and Genetics Resources." Reforestation, Nurseries and Genetics Resources. NPN, 2008. Web. 18 May 2017. <https://npn.rngr.net/renderNPNProtocolDetails?selectedProtocolIds=scrophulariaceae-penstemon-2447>. [2] "Penstemon Confertus Douglas Ex Lindl." Plants Profile for Penstemon Confertus (yellow Penstemon). USDA, n.d. Web. 20 May 2017. <https://plants.usda.gov/core/profile?symbol=PECO6>. [3] "Penstemon Confertus Var. Procerus (Douglas Ex Graham) Coville." ITIS Standard Report Page: Penstemon Confertus Var. Procerus. US Government, n.d. Web. 21 May 2017. <https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=538485#null>. [4] "The Plant List — A Working List for All Plant Species." Penstemon Confertus Douglas Ex Lindl. - The Plant List. The Plant List, 2013. Web. 19 May 2017. <http://www.theplantlist.org/tpl1.1/record/tro-29201296>. [5] Standley, Paul C. Publications of the United States National Museum (1947-1970). Vol. 20. Washington: Government Printing Office, 1971. 365. Print. [6] Olthof, Pauline. "The Penstemons of Western Canada." The American Penstemon Society. N.p., n.d. Web. 18 May 2017. <www.apsdev.org/library/articles/CANADAbulletin45_8601_westerncanada.doc>. [7] "Beardtongue - Penstemon - Integrated Taxonomic Information System (ITIS) - Details." Encyclopedia of Life. N.p., n.d. Web. 18 May 2017. <http://eol.org/pages/38106/hierarchy_entries/61361167/details>.

	[8] Meyer, Susan E. "Penstemon Schmidel." Penstemon Schmidel: Penstemon, Beardtongue (n.d.): 3-5. US Forest Service. Web. 22 May 2017. <https://www.fs.fed.us/rm/pubs_other/wo_AgricHandbook727/wo_AgricHandbook727_774_777.pdf>. [9] Pennell, Francis W. Notulae Naturae. Vol. 71. Philadelphia: Academy of Natural Sciences of Philadelphia, 1941. 365-367. 18 May 2017. Print. [10] Klock, G. O. Response of Penstemon Fruticosus to Fertilization. Portland, Oreg.: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, 1976. 21 May 2017. Print.
Other Sources Consulted	[1] PENSTEMON CONFERTUS SEEDS (Yellow Penstemon). N.p., n.d. Web. 18 May 2017. <http://www.plant-world-seeds.com/store/view_seed_item/4255>.
Protocol Author	Samuel K. Gustafsson
Date Protocol Created or Updated	05/18/17