

Plant Propagation Protocol for *Aquilegia formosa*

ESRM 412 – Native Plant Production

URL: <https://courses.washington.edu/esrm412/protocols/2021/AOFO.pdf>



Aquilegia formosa
Photographer: Nicole Seiger
Location: Baker Lake, WA
Date: June 23, 2020



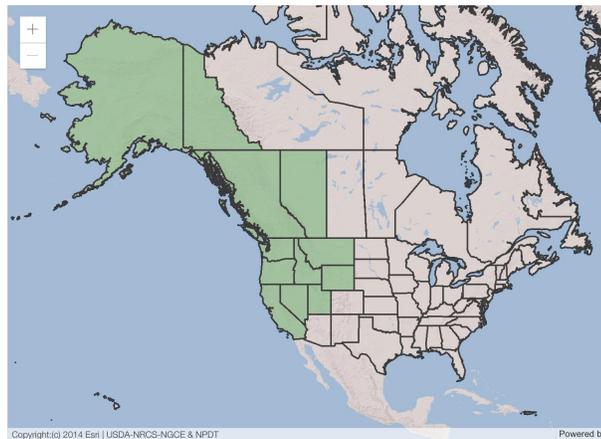
Aquilegia formosa with seed pod
Photographer: Nicole Seiger
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TAXONOMY	
Plant Family	
Scientific Name	Ranunculaceae
Common Name	Buttercup
Species Scientific Name	
Scientific Name	<i>Aquilegia formosa</i> Fisch. ex DC.
Varieties	N/A
Sub-species	N/A

Cultivar	N/A
Common Synonym(s)	<p><i>Aquilegia fosteri</i> (S.L. Welsh) S.L. Welsh <i>Aquilegia formosa</i> Fisch. ex DC. var. <i>communis</i> B. Boivin <i>Aquilegia formosa</i> Fisch. ex DC. var. <i>fosteri</i> S.L. Welsh <i>Aquilegia formosa</i> Fisch. ex DC. var. <i>hypolasia</i> (Greene) Munz <i>Aquilegia formosa</i> Fisch. ex DC. var. <i>megalantha</i> B. Boivin <i>Aquilegia formosa</i> Fisch. ex DC. var. <i>pauciflora</i> (Greene) Boothman <i>Aquilegia formosa</i> Fisch. ex DC. var. <i>truncata</i> (Fisch. & C.A. Mey.) M.E. Jones <i>Aquilegia formosa</i> Fisch. ex DC. var. <i>wawawensis</i> (Payson) H. St. John <i>Aquilegia mohavensis</i> Munz <i>Aquilegia shockleyi</i> Eastw. ⁷</p>
Common Name(s)	western columbine, crimson columbine, scarlet columbine, red columbine ¹ , sitka columbine ⁸
Species Code (as per USDA Plants database)	AQFO
GENERAL INFORMATION	

Geographical range

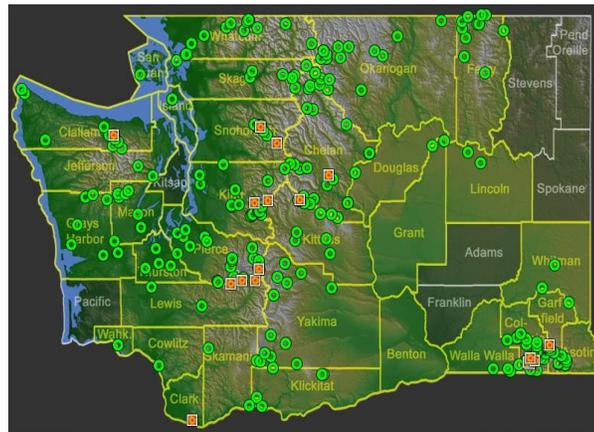
North America Distribution



Source: USDA PLANT Database

Distribution in North America ranges from Alaska to California, coastal and inland to Alberta and Wyoming. ¹⁰

Washington Distribution



Source: Burke Herbarium Image Collection

Distribution in Washington state occurs on both sides of the Cascades crest. ¹⁰

Ecological distribution	Variety of moist, open to partly shaded sites; meadows, rocky slopes and beaches, forest glades, clearings, roadsides, common from the lowlands to timberline. ⁴
Climate and elevation range	Hardiness: 3-9 Heat Zones: 1-7 Climate Zones: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, A1, A2, A3 ¹ Elevation: 4,000 - 10,000 ft. ⁹
Local habitat and abundance	In Washington it is found in open woods, from lowlands to moderate elevations in the mountains. ¹⁰ Within its range [in California], the Crimson Columbine can be found in most kinds of habitat (chaparral, oak woodland, mixed-evergreen or coniferous forest). It is not found on desert floors, nor at altitudes above 3300 meters, and it is absent from the Central Valley of California. It prefers moist locations such as stream banks and needs summer water. It prefers light shade especially in the afternoon. ⁸
Plant strategy type / successional stage	Inhabits early seral, exposed moist sites. ⁵
Plant characteristics	<u>General</u> : Perennial herb from a taprooted, usually branched, woody stem-base; stems erect, 15-100 cm tall, smooth below, sparsely hairy and smooth above especially in inflorescence. <u>Leaves</u> : Basal leaves 10-40 cm long (including long stalks), much shorter than stems, twice 3-parted, the first set of 3 stalks 16-95 mm long (the leaflets not crowded), smooth or long soft-hairy, each leaflet 14-68 mm long, 2- to 3-times shallowly to deeply lobed, thin, usually hairy and with a bloom beneath, not glandular; stem leaves few, shorter-stalked.

	<p><u>Flowers</u>: Inflorescence of several nodding to hanging flowers in a terminal cyme, the flowers 3-5 cm wide; bracts leaf-like but greatly reduced, unstalked; petals 5, distinct, the spurs red, knobbed, 13-21 mm long, stout, abruptly narrowed near middle, with straight tips, not curved in, the blades yellow, oblong, sometimes absent, to 6 mm long, 4-6 mm wide; sepals 5, pale to deep red, widely spreading, elliptic to lance-shaped, 10-26 mm long, 4-9 mm wide, tips pointed to sharp-pointed; stamens 12-17 mm long.</p> <p><u>Fruits</u>: Follicles, 5, erect, egg-shaped, 15-25 (29) mm long, hairy; beaks 9-12 mm long; seeds black, egg-shaped, wrinkled and pebbled. ³</p>
PROPAGATION DETAILS	
Protocol Information: USDA NRCS Corvallis Materials Center (unless otherwise indicated)	
Ecotype	Crater Lake National Park, 6,300 to 6,600 ft elevations
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	1-yr plugs (10)
Time to Grow	N/A
Target Specifications	Well-developed crown growth, roots filling length of cone
Propagule Collection Instructions	Hand harvested - uniquely shaped seed pods are easily identifiable in field; but only small scattered quantities available in park.

Propagule Processing/Propagule Characteristics	Follicles normally dry and split open at maturity. Gently crush dried seed heads to release training seeds; cleaned with “office clipper” air-screen machine. The papery, light pod chaff is easily separated from seed.
Pre-Planting Propagule Treatments	Fairly long moist pre-chill improved germination; seeded cones stored for 6 months in a cold walk-in cooler with soil surface kept moist, produced more than 15% germination. Germination tests at Oregon State University seed lab were reported at just 8% with a 3-day moist prechill treatment.
Growing Area Preparation / Annual Practices for Perennial Crops	Three to five seeds each were sown into Ray Leach SC-10 super cells filled with Fisons' Sunshine #1 potting mix, amended with 3-month slow-release Osmocote NPK fertilizer and small amounts of Micromax trace elements. Cones were well-watered and placed in to a walk-in cooler at 40°F for 6 months cold stratification. (Seed could also be stratified in moist peat moss and sown into cones after stratification, if desired).
Establishment Phase Details	Cones were moved outdoors to shadehouse in mid-spring to germinate. Initial germination is spotty, and initial growth is quite slow. Seedlings need light but fairly frequent watering to keep soil moist but not soggy.
Length of Establishment Phase	slow; about 3 months
Active Growth Phase	Crown development is fairly slow and steady throughout the season. Plants were fertilized in July with half-strength Peter’s 9-45-15 NPK fertilizer. Root growth is also fairly slow - roots did not reach bottoms of containers for about 3 months. By mid-summer, extensive foliage development made it somewhat difficult to use overhead sprinkling - the cones were hand-watered, moving the watering wand through the foliage to reach the relatively small cone surfaces. Plants did not recover easily from becoming too dried out.
Length of Active Growth Phase	June - August

Hardening Phase	No fertilizer is applied in August, and watering intervals are gradually lengthened once adequate root development has occurred.
Length of Hardening Phase	August - September
Harvesting, Storage and Shipping	Well-watered plants were shipped in their containers by refrigerated van in August to the park, up to a holding facility at the where they were maintained in a shadehouse for an additional 2 weeks prior to outplanting in September.
Length of Storage	Cones could be held over winter, but spring regrowth at the PMC was slow and spotty; plants were easily overgrown by liverworts / mosses in cool wet spring weather.
Guidelines for Outplanting / Performance on Typical Sites	Care is needed when removing the rather delicate root systems from their cones; in some cases cones were cut open to avoid disturbing the roots too much. Crowns need to be placed carefully at soil surface.
Other Comments	<p>Seeds stored at Corvallis PMC in cold, dry conditions (34 to 38°F, low humidity) remained viable for at least 3 years; longer-term tests were not conducted. ⁶</p> <p>Insect, disease, or other problems: Spider mites and powdery mildew are common problems on most columbine species, including western red columbine. Both problems can be controlled with applications of pesticides, but it may be preferable to simply cut back the old, damaged foliage and allow younger, more tolerant leaves to take their place. ⁹</p> <p>Animal Friends: Butterflies, Moths, Birds, Honey bees and other pollinators, Deer Resistant. ²</p>

INFORMATION SOURCES	
References	See Below
Protocol Author	Nicole Seiger
Date Protocol Created or Updated	5/4/21

References:

- ¹ *Aquilegia formosa* (Western Columbine). Gardenia.net. (n.d.). <https://www.gardenia.net/plant/aquilegia-formosa-western-columbine>. [Accessed: 5/5/2021]
- ² *Aquilegia formosa* var. *formosa*. WNPS Home. (n.d.). <https://www.wnps.org/native-plant-directory/38-aquilegia-formosa>. (Accessed 5 May 2021).
- ³ Flora BC: Electronic Atlas of the Flora of British Columbia. E-Flora BC Atlas Page. (n.d.). <https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Aquilegia+formosa>. (Accessed 5 May 2021)
- ⁴ MacKinnon, A., Pojar, J., & Alaback, P. B. (2014). *Plants of coastal British Columbia including Washington, Oregon & Alaska*. Lone Pine Pub.
- ⁵ Mytty, M. (2003, April 9). Plant Data Sheet. <http://depts.washington.edu/propplnt/Plants/columbine.htm>. (Accessed 5 May 2021).
- ⁶ Trindle, Joan D.C.; Flessner, Theresa R. 2003. Fisch. ex DC. plants (1-yr plugs (10); USDA NRCS - Corvallis Plant Materials Center, Corvallis, Oregon. In: Native Plant Network. URL: https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/orpmcmt9921.pdf. (Accessed 5 May 2021).
- ⁷ USDA. (n.d.). *Plants 3*. Plants. <https://plants.usda.gov/home/plantProfile?symbol=AQFO>. (Accessed 5 May 2021)
- ⁸ *Western Columbine, Aquilegia formosa*. California Native Plant Society. (n.d.). [https://calscape.org/loc-California/Western%20Columbine%20\(Aquilegia%20formosa\)?newsearch=1](https://calscape.org/loc-California/Western%20Columbine%20(Aquilegia%20formosa)?newsearch=1). (Accessed 5 May 2021)
- ⁹ *Western Red Columbine in the Landscape*. Western Native Plants. (n.d.). https://cwel.usu.edu/westernnativeplants/plantlist_view.php?id=15&name=aquilegiaformosa. (Accessed 5 May 2021).
- ¹⁰ WTU Herbarium, B. M. (n.d.). Burke Herbarium Image Collection. <http://biology.burke.washington.edu/herbarium/imagecollection/taxon.php?Taxon=Aquilegia+formosa>. (Accessed 5 May 2021).

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- ¹¹ Alden, P., & Paulson, D. (1998). Red Columbine. In *National Audubon Society field guide to the Pacific Northwest* (pp. 140–140). essay, Knopf.

¹² Clements, E. S. (1928). Buttercups. In *Flowers of coast and sierra* (pp. 5–6). essay, H.W. Wilson Company.

¹³ Mathews, D., & Mathews, D. (2017). Columbine. In *Natural history of the Pacific Northwest mountains: plants, animals, fungi, geology, climate* (pp. 250–250). essay, Timber Press, Inc.

¹⁴ Muenscher, W. C. (1941). Aquilegia. Columbine. In *The flora of Whatcom county, state of Washington; vascular plants*(pp. 86–86). essay, The author.

Note: This propagation protocol template was modified by J.D. Bakker from that available at: <http://www.nativeplantnetwork.org/network/SampleBlankForm.asp>

Template - Plant Propagation Protocol One: *Aquilegia formosa*
ESRM 412 – Native Plant Production JD Bakker Spring 2007



Western columbine (*Aquilegia formosa*). Malheur National Forest. Oregon. From http://www.fs.fed.us/wildflowers/regions/pacificnorthwest/images/aquilegia_formosa_lg.jpg
Accessed April, 8. 2007.

Scientific Name: *Aquilegia Formosa*

Family Scientific Name: *Ranunculaceae*

Family Common Name: Buttercup

Species Authority: John Kartesz Biota of North America Project (BONAP), University of North Carolina

Varieties and their authorities:

Aquilegia formosa var. *communis* Boivin

Aquilegia formosa var. *fosteri* Welsh

Aquilegia formosa var. *hypolasia* (Greene) Munz

Aquilegia formosa var. *megalantha* Boivin

Aquilegia formosa var. *pauciflora* (Greene) Boothman

Aquilegia formosa var. *truncata* (Fisch. & C.A. Mey.) Baker

Aquilegia formosa var. *wawawensis* (Payson) St. John
(USDA, 2007).

Subspecies: None found.

Synonyms: Varieties listed above as well as *Aquilegia mohavensis* Munz and *Aquilegia shockleyi* Eastw. (USDA, 2007).

General Information:

Hardy, deciduous, spring blooming perennial (Buczacki, 1992)

Flowers: Nodding red and yellow flowers are 1 ½-2 inches across with straight red spurs (Brenzel, 2007)

Foliage: Airy Stems, bluish-green, finely divided (Carter, et al., 2007)

Multiple Stems; erect; Short lived species (USDA, 2007)

Growth Height varies but is generally 1 to 3 feet high and 8 inches to 1 ½ feet wide (Byczynski, 1997; Brenzel, 2007; Carter, et al., 2007, USDA, 2007)

Common Names: Red Columbine, Western Columbine, Crimson Columbine, Granny's Bonnett (Carter, et al., 2007)

USDA Species Code: AQFO

ITIS Taxonomic Serial No.: 18738 (ITIS, 2007)

Hardiness Zones: 3-9 (Buczacki, 1992; Powell, 2004; Byczynski, 1997; Brenzel, 2007; Carter, et al., 2007)

Distribution and Range: Native Alaska to northern California, then along the coast and in the coastal mountains of Baja California. Found in high elevations in the Sierra Nevada Range. Equally distributed in the Cordillera and Pacific regions. Also found in Montana and Utah (Brenzel, 2007; Mytty, 2003; Carter, 2007)

Local Distribution: Native to Washington (Carter, et al., 2007). Common from the lowlands to the timber line. Mostly found in the meadows and sub-alpine forests in the Cascade and Olympic mountains of Washington State.

Preferred Conditions: Open to partly shaded moist sites. Found in forest glades, beaches, rocky slopes, stream-sides, meadows, roadsides, and woodland gardens (Myyty, 2003; Kruckeberg, 1996; Brenzel, 2007). Prefers to sunny areas with rich and moist soils (Myyty, 2003; DiSabato-Aust, 1998). Adapted to medium to coarse textured soil. Medium drought tolerance. Low fertility requirement. Minimum frost-free days: 100. Low hedge tolerance. Ph range varies from 6.1-6.5 (Myyty, 2003) to 6-7.5 (USDA, 2007). Precipitation 15-60 inches per year. Shade tolerant. Not salinity tolerant. Minimum temperature -23 degrees F (USDA, 2007)

Plant Strategy/ Successional Stage: Stress-tolerant competitor; weedy colonizer, early seral, late successional exposed moist sites (Myyty, 2003).

Associated Species: Paintbrush (*Castilleja spp.*), Tiger lily (*Lilium columbianum*), *Penstemon spp.*, *Azalias*, *Caltha*, *Iris cristata*, *Phlox stolonifera*, *Pulmonaria*, *Trillium*, *Viola* (Myyty, 2003; Powell, 2004)

Propagation options: This plant is a perennial and readily self sows and puts out many seeds. It spreads rapidly in a non-vegetative manner (Myyty, 2003; Buczacki, 1992). New plants produced the following year. Divide plants in the spring or sow seeds directly outdoors in fall or sow seeds into containers in spring or fall (Myyty, 2003; Powell, 2004)). Seeds Late Spring/Early Summer or mid to late winter Outdoors (Toogood, 1993).

Seed Collection: Not on threatened plant list. Collection is not restricted. Seeds mature June-August (Mytty, 2003). Hand harvested - uniquely shaped seed pods are easily identifiable in field. Follicles normally dry and split open when mature. To release the remaining seeds gently crush dried seed heads; clean with "office clipper" air-screen. The light, papery pod chaff is easily separated from seeds. (Trindle et al., 2003).

This species hybridizes easily with others, so it is important to have a reliable seed source and to avoid collecting seeds from plants of unknown origin.

Seed Germination: Comes well from seeds (Kruckeberg, 1996). Long, moist pre-chilling improves germination. Seeds require light so shallow sowing is best. A 3 day pre-chill minimum is preferred (Mytty, 2003; Trindle et al., 2007). Seeded cones may be stored for 6 months in a walk-in cooler. Soil surface should be kept moist (Trindle et al., 2003).

Germinate in 30-90 days (Powell, 2004). Length of establishment phase slow and takes about 3 months. Active growth occurs in the spring and summer (USDA, 2007). Slow crown development that is seasonally steady. Slow to moderate root growth. Plants do not recover well if allowed to become dry (Trindle, et al., 2003).

Hardening: Hardening phase August-September. No fertilizer is applied in August, and the watering intervals can be slowly increased once roots have developed adequately (Trindle, et al., 2003).

Storage: Seeds can be stored for up to 3 years in low humidity and temperature (34-38F) (Trindle et al., 2007; Mytty, 2003). Cones could over winter but spring re-growth is slow and the plants are easily outgrown by mosses and liverworts in wet and cool spring weather (Trindle et al., 2007).

Guidelines for Out-planting: Sow in spring and transplant seedlings as they appear with a planting density 1200-3450/ acre (Powell, 2004; USDA, 2007). The root system is delicate so care is required when handling. when removing them from the cones. You may consider cutting the cones open to avoid disturbing roots. In some cases cones were cut open to avoid disturbing the roots too much. Crowns must carefully be placed at soil surface. (Trindle, et al., 2003)

Common Issues: Aphids, Columbine leaf miners (Buczacki, 1992), overly wet soil could lead to crown rot. (DiSabato-Aust, 1998). Seeds are often relished by songbirds including Juncos and song sparrows (Brenzel, 2007). It also has a high palatability to grazers and browsers (USDA, 2007).

References:

Buczacki, Stefan. 1992. The plant care manual: The essential guide to caring for and rejuvenation 300 garden plants. Crown Publishing Inc. New York, NY.

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DiSabato-Aust, Tracy. 1998. The well-tended perennial garden: Planting and Pruning techniques. Timber Press. Portland, OR.

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Mytty, Mario. 2003. Plant Data Sheet: ESRM 412.

<http://depts.washington.edu/proplnt/Plants/columbine.htm> Accessed April 7, 2007.

Powell, Eileen. 2004. The Gardener's A-Z guide to growing flowers from seed to bloom. Storey Publishing. North Adams, MA.

Toogood, Alan. 1993. Plant propagation Made Easy: The complete guide to raising hardy, tender and indoor plants. Timber Press. Portland, OR.

Trindle, Joan D.C. and Flessner, Theresa R. 2003. Propagation protocol for production of container *Aquilegia formosa* Fisch. <http://www.nativeplantnetwork.org> accessed 7 April 2007.

USDA Natural Resource Conservation Service.

<http://plants.usda.gov/java/charProfile?symbol=AQFO> accessed April 7, 2007.