

Plant Propagation Protocol for *Camassia quamash*
ESRM 412 - Native Plant Production
Spring 2020



Figure 1 Photo by Gary A Monroe from CalPhotos. Web. 6 May 2020

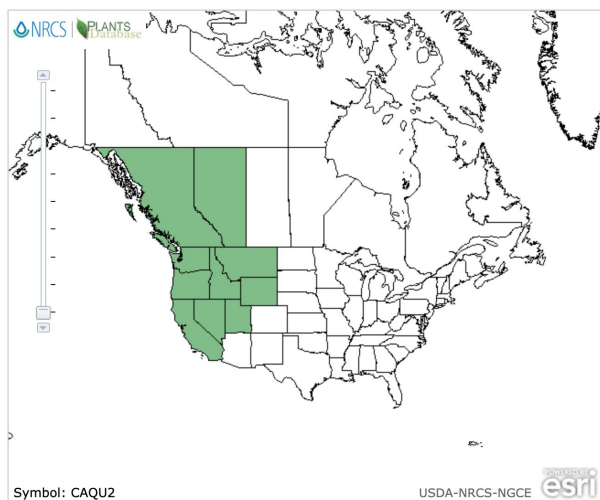


Figure 2 Plants Database. *Camassia quamash*. USDA, n.d. Web.

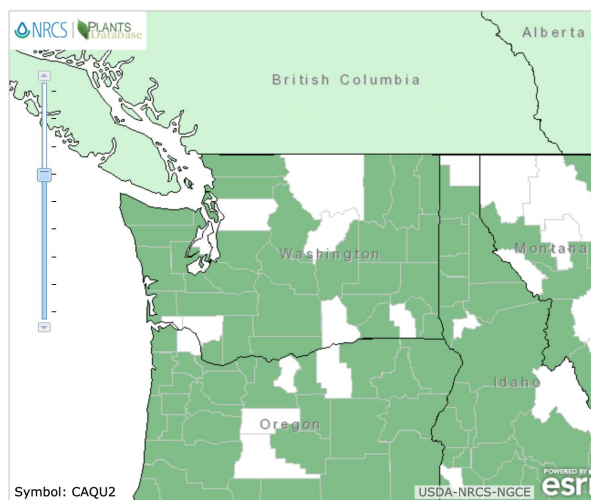


Figure 3 Plants Database. *Camassia quamash*. USDA, n.d. Web.

6 May 2020.

6 May 2020.

North American Distribution

Washington Distribution

TAXONOMY	
Plant Family	
Scientific Name	Liliaceae ¹
Common Name	Lily family ¹
Species Scientific Name	
Scientific Name	<i>Camassia quamash</i> (Pursh) Greene ¹
Varieties	No information found
Sub-species	<i>Camassia quamash</i> ssp. <i>azurea</i> (A. Heller) Gould – small camas <i>Camassia quamash</i> ssp. <i>breviflora</i> Gould – small camas <i>Camassia quamash</i> ssp. <i>intermedia</i> Gould – small camas <i>Camassia quamash</i> ssp. <i>linearis</i> Gould – small camas <i>Camassia quamash</i> ssp. <i>maxima</i> Gould – small camas <i>Camassia quamash</i> ssp. <i>quamash</i> (Pursh) Greene – small camas <i>Camassia quamash</i> ssp. <i>utahensis</i> Gould – Utah

	<p>small camas <i>Camassia quamash</i> ssp. walpolei (Piper) Gould – Walpole's small camas²</p>
Cultivar	No information found
Common Synonym(s)	<p><i>Camassia esculenta</i> Lindl. <i>Camassia quamash</i> (Pursh) Greene subsp. teapeae (H. St. John) H. St. John <i>Camassia quamash</i> (Pursh) Greene var. azurea (A. Heller) C.L. Hitchc. <i>Camassia quamash</i> (Pursh) Greene var. breviflora (Gould) C.L. Hitchc. <i>Camassia quamash</i> (Pursh) Greene var. intermedia (Gould) C.L. Hitchc. <i>Camassia quamash</i> (Pursh) Greene var. linearis (Gould) J.T. Howell <i>Camassia quamash</i> (Pursh) Greene var. maxima (Gould) B. Boivin <i>Camassia quamash</i> (Pursh) Greene var. quamash <i>Camassia quamash</i> (Pursh) Greene var. utahensis (Gould) C.L. Hitchc. <i>Quamassia quamash</i> (Pursh) Coville⁴</p>
Common Names	<p>Southern Lushootseed (Coast Salish Language) for camas: blue camas, crow potato, <i>Camassia</i> spp.: c̣äbid. camas, <i>Camassia quamash</i>, C. leichtinii: q^wəþúʔəl. camas roots that are processed and dried: s^vx̃ əʔəb.¹⁶ common camas, small camas² wild hyacinth, camas, common camash or quamash³ blue camas, camas, camas lily, western camas⁴ Early camas because it flowers several weeks before great camas⁷</p>
Species Code (as per USDA Plants database)	CAQU2
GENERAL INFORMATION	
Geographical range	Western N. America - Washington to California, east to Montana and Utah. ³
Ecological distribution	In the Intermountain region and the northern Rocky Mountains, usually found in mountain

	<p>grassland and prairie communities. West of the Cascade-Sierra Nevada crest, it occurs in both forest and grassland types⁴ Coastal mountain forests and wet meadows inland. Marshy meadows in coniferous forest³</p>
<p>Climate and elevation range</p>	<p>Found on sites that are moist/wet in winter and early spring, but very dry after flowering (late spring-summer). Occurs from sea level to 7,000ft/2,134m.^{4 14} One source speaking on <i>Camassia quamash</i> broadly says up to 2300 metres.³ According to a Herbarium in California the elevation range for <i>Camassia leichtlinii subsp. Suksdorfii</i> is between 1000-2600 m.⁹</p>
<p>Local habitat and abundance</p>	<p>Occurs east and west of the Cascades in montane wet meadows, Puget lowland and Willamette valley prairies and moist forested communities in southeastern Oregon.¹⁵ The great camas (<i>C. leichtlinii</i>) is less common than common camas, but it can be expected in similar habitats and over a similar range. The two cama species are distinguishable mainly by flower characteristics. The tepals of the great camas eventually twist together to cover and protect the fruit, while those of the common camas do not/ Death camas often grows in the same habitat as the edible blue camas species. Although death-camas flowers are cream-coloured, the bulbs are very similar to blue camas bulbs, but they are highly toxic and potentially fatal.^{7 10 11} Garry Oak (<i>Quercus garryana</i>) meadows were carefully maintained to provide valuable camas roots (<i>Camassia quamash</i> and <i>C. leichtlinii</i>), a staple of the native diet.¹² No serious insect pests are reported, but diseases include the fungus <i>Rhizoctonia tuliparum</i> (Kleb.) Whetzel & J.M. Arthur and nematodes in the genus <i>Ditylenchus</i> Filipjev (Anguinidae)(De Hertogh and others 1990). Some pest control is done by immersion of bulbs in a hot water treatment for 4 h at 43.5 to 45 °C (110 to 113 °F). Another pest is a mosaic virus (De Hertogh and Le Nard 1993).⁸</p>

Plant strategy type / successional stage	<p>Small camas is shade intolerant. In forested areas, it is found on open sites created by disturbance. In grasslands and meadows, it is most prevalent in initial and early seral communities but also occurs in later seres.⁴</p> <p>Such species are well adapted to the related selection pressures of summer drought and frequent low intensity fires¹³</p>
Plant characteristics	<p>General: Perennial herb/forb, 70 cm tall from a deep, egg shape, 2-cm-long bulb</p> <p>Leaves: Numerous basal, grass-like, up to 2 cm wide and 50 cm long.</p> <p>Flowers: pale to deep blue, occasionally white, to 3.5 cm long; 5 to many in a terminal spike</p> <p>The common camas has 5 tepals curved upward and the 6th curved downward.^{7 10 11}</p>

PROPAGATION DETAILS

Production of Container (plug) Camassia quamash by Tara Luna, Jeff Evans & Dale Wick⁵	
Ecotype	Moist meadow, near Lee Creek
Propagation Goal	plants
Propagation Method	seed
Product Type	Container (plug)
Stock Type	172 ml (10 in3) Containers
Time to Grow	2 Years
Target Specifications	<p>Height: 6 to 10 true leaves; 15 cm. Caliper: n/a</p> <p>Root System: firm plug with developed bulb in container.</p>
Propagule Collection Instructions	<p>Collect mature capsules when they begin to split and turn light tan in color. Seeds are black at maturity. Capsules are collected in paper bags and kept in a well ventilated drying shed prior to cleaning.</p>
Propagule Processing / Propagule	Seeds are hand cleaned at the nursery by shaking

Characteristics	<p>seeds out of opened capsules. Seed longevity is unknown. Seed dormancy is classified as physiological dormancy. Seeds/Kg: unknown % Purity:100% % Germination:50%</p>
Pre-Planting Propagule Treatments	<p>Freshly harvested seeds were cold, moist stratified outdoors for 5 months. Germination occurs in early May under cool and fluctuating temperatures (10 to 20 C day and 10 to 15 C night). Seeds germinate equally well in light (when surface sown) or dark (when covered with mulch).</p>
Growing Area Preparation / Annual Practices for Perennial Crops	<p>Outdoor nursery growing facility. 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.</p> <p>Conetainers are filled and sown in late fall and irrigated thoroughly prior to winter stratification. Seedlings germinate in spring under fluctuating outdoor temperatures and are grown under full sun exposure. 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.</p>
Establishment Phase Details	<p>Medium is kept slightly moist during germination. Germination appeared uniform and complete after 4 weeks.</p>
Length of Establishment Phase	4 weeks
Active Growth Phase	<p>Plants had developed 2 true leaves and a small bulb 10 weeks after germination. Plants went dormant by late July. The onset of dormancy is induced by high temperatures.</p>

	Continued growth and development of seedlings could be extended if seedlings are kept in a controlled environment of air temperatures maintained at 10 and 15 C during growth, and placing dormant seedlings into cooler storage for a minimal chilling period. Following the minimum chilling period, seedlings could be taken out of cooler storage and grown in the greenhouse for a second growth phase. Thus, two seasons of growth could be forced in 1 year.
Length of Active Growth Phase	12 weeks
Hardening Phase	Irrigation is gradually reduced in September and October. Plants were given one final irrigation prior to winterization.
Length of Hardening Phase	4 weeks
Harvesting, Storage and Shipping	Total Time To Harvest: At least 2 years from seed. Harvest Date: September of the second year. Storage Conditions: Overwinter in outdoor nursery under insulating foam cover and snow.
Length of Storage	5 months
Guidelines for Outplanting / Performance on Typical Sites	No information provided for this protocol.
Other Comments	Used by various Indigenous peoples of North America as a gynecological aid to induce labor, roots pits were roasted and made into loaves, bulbs were boiled and given in soup on special events (potlatches), roots kept dry and preserved for future use, Bulbs smashed, pressed together like cheese and boiled in a stew with salmon ⁶
Propagation protocol for production of Bareroot (field grown) Camassia quamash plants by USDA NRCS⁸	
Ecotype	

Propagation Goal	
Propagation Method	
Product Type	Bareroot (field grown)
Stock Type	Bareroot Bulb
Time to Grow	0
Target Specifications	Height: n/a Caliper:n/a Root System: Well developed bulb (1.5 to 2.0 cm wide).
Propagule Collection Instructions	<p>Common camas can be propagated from seeds or bulbs. Common camas generally prefers full sun to partial shade, with bulb depth ranging from 5 to 20 cm (2 to 8 in) but most commonly 10 to 15 cm (4 to 6 in). Bulbs of common camas can be substantially smaller in size and occur at shallower soil depths than great camas. Bulb depth appears limited by high water tables, anoxic conditions, or restrictive layers. Plants require moist soil conditions or irrigation to become established. <2></p> <p>Bulb Collections Common camas is readily established by transplanting wild or commercially grown bulbs. Wild harvests should be restricted to salvage sites with appropriate approvals or permits. Due to loss of wetland habitat throughout the US, harvesting plants from the wild is rarely appropriate or legal except under salvage situations. Use of bulbs or seeds from local nurseries or greenhouses is strongly recommended. The best time to excavate bulbs is from early summer through mid-fall. This is the "quiescent" period that follows seed maturation, foliar senescence, and development of the daughter bulb. However, commercial bulb harvest takes place when leaves are still green and must be done carefully to avoid damage. The bulb tunic or covering is very thin (De Hertogh and Le Nard 1993). Given that camas commonly occupies sites high in silt and clay that dry out in summer,</p>

	<p>windows for digging are often narrow. There is a brief period to harvest bulbs when soils are moist after flowering in the spring; the next time to harvest is in fall after the rains begin.</p>
<p>Propagule Processing / Propagule Characteristics</p>	<p>Store camas bulbs in a dry, dark, cool, well ventilated place in a potting medium such as dry peat moss, similar to recommendations for fall planted or spring flowering bulbs (such as daffodils and tulips). Keep bulbs from completely drying out and transport or store at 17 to 20 C (63 to 68ø F) (De Hertogh and others 1990). Common camas reproduces vegetatively by offset bulblets (De Hertogh and others 1993). However, much less than 1% of a wild population may produce offsets and bulbs may be stimulated to do so only as the result of a wound (Thoms 1989).</p>
<p>Pre-Planting Propagule Treatments</p>	<p>Plant camas outdoors in the fall or early winter when soils are moist enough to dig and prevailing soil temperatures are cool; this is generally below 16 øC (60 øF). Fall planting allows for better root development and fulfillment of any chilling requirement for flowering (De Hertogh and others 1993). Bulbs, bulblets, and offsets can be used. However, if flowering is desired the following spring, bulbs must be 3- to 5-y-old and have 3 to 4 bulb leaves or scales (Thoms 1989). Bulb leaves are laminate concentric layers that comprise much of the bulb, reminiscent of an onion. Bulbs with just 2 bulb leaves never flower, those with 3 routinely flower, and those with 4 almost always flower. Older bulbs will be found deeper in the ground, and bulbs that flower will probably be at least 1.5 to 2.0 cm (0.6 to 0.8 in) wide (Thoms 1989). In the commercial bulb trade the minimum size for export and thus flowering is a circumference of 6.0 cm (2.4 in) (De Hertogh and Le Nard 1993), roughly equivalent to a diameter of 2.0 cm (0.75 in) and about one-half the diameter and circumference of great camas.</p>
<p>Growing Area Preparation / Annual Practices for Perennial Crops</p>	<p>Growing Area: Outdoor bareroot field. The larger the bulb the greater the planting depth. Planting depth (as measured to the base of the</p>

	bulb) ranges from 1.2 to 2.5 cm (0.5 to 1 in) for 1- to 2-y-old bulblets up to 10 to 15 cm (4 to 6 in) for mature bulbs. Larger bulbs (4 cm (1.5 in) diameter or greater) can be planted deeper (20 to 25 cm [8-10 in]) if drainage is appropriate. Commercial production involves transplanting immature bulbs from October to November in well-drained soil, pH 6 to 7, with at least 2% organic matter. Seed is not commonly used. Bulbs are covered with at least 7.5 cm (3 in) of soil above the bulb's top end, followed by 6 cm (2 in) of straw mulch.
Establishment Phase Details	Four weeks after planting a 7N:14P2O5:28K2O fertilizer is applied (presumably top-dressed). The camas bed is kept damp, but once plants become senescent after flowering, watering is discontinued. By this time, seeds have formed and bulbs are curing.
Length of Establishment Phase	No information provided for this protocol.
Active Growth Phase	No information provided for this protocol.
Length of Active Growth Phase	No information provided for this protocol.
Hardening Phase	Plants are hardened off naturally in the outdoor bareroot bulb bed.
Length of Hardening Phase	No information provided for this protocol.
Harvesting, Storage and Shipping	Camas bulbs are harvested in late July (De Hertogh and others 1990).
Length of Storage	No information provided for this protocol.
Guidelines for Outplanting / Performance on Typical Sites	No information provided for this protocol.
Other Comments	Camas has been used for human food and trade, wildlife food, medicinal purposes, conservation plantings, and site restoration. Cultivars of common camas are available in the flower bulb industry. <i>Camassia quamash</i> 'Orion' has deep blue flowers. The flowers of 'San Juan form' are an even deeper, more vibrant blue (Brenzel 1995). Another common camas variety

has a white flower.

Ethnobotanical Uses: Historically, camas was an extremely important native plant and continues to be one of the most important "root" foods of western North American indigenous peoples, from southwestern British Columbia to Montana, and south to California including the Coast Salish of Vancouver Island, Squamish, Sechelt, Comox, Kwak-waka'wakw, Grand Ronde and Kalapuya (or Callapooya)(Kuhnlein and Turner 1991). The bulb of common camas was a very important food and trading material to the Nez Perce of northeastern Oregon, eastern Washington, and northern Idaho. It was also considered to be one of the most important bulbs to northern California native peoples.

Except for choice varieties of dried salmon, no other food item was more widely traded than camas bulbs (Gunther 1973). People traveled great distances to harvest the bulbs and there is some suggestion that plants were dispersed beyond their range by transplanting (Turner and Efrat 1982; Turner and Kuhnlein 1983). To the Nez Perce, camas is still the most important root in trade, and trading is traditionally impossible without camas bulbs (Harbinger 1964). Dried camas is the most expensive form of camas, with baked and then raw camas being less expensive. At marriage trades, the girl's family gives roots in corn husk bags. At funeral trades, camas roots are given to friends and relatives by the widow. The Nez Perce traded camas roots with the Warm Springs, the Umatilla, the Cayuse, the Walla Walla, the Nespelem, the Yakama, the Crows, and the Flatheads.

Common camas does not appear to naturally occur in southcentral British Columbia and the Okanogan region of Washington State. But the native people, the Thompsons, used the dried bulbs as food. The dried bulbs were obtained from the Coastal Salish (Turner and others 1990) or from the Nez Perce. Bulbs were usually dug after flowering, in summer, although some peoples dug them in spring. Harvesting bulbs traditionally took weeks or months among the Nez Perce. Each family group

"owned" its own camping and harvesting spot, and these were passed down in families from generation to generation. Turf was lifted out systematically in small sections and then replaced after only larger bulbs were removed. Bulbs were dug with a pointed digging stick; bulbs were broken up and replanted. Annual controlled burning was used to maintain an open prairie-like habitat for optimum camas production. Areas were only harvested once every few years.

Traditionally, camas bulbs were almost always pit-cooked; within the past 100 y, camas bulbs have also been cooked by stovetop methods (Turner and Kuhnlein 1983). Bulbs are allowed to cook for 24 to 36 h when pit-cooked (Turner and Bell 1983). It is probable that lengthy cooking is necessary for maximum conversion of inulin to fructose. The sweetness of cooked camas gave it utility as a sweetener and enhancer of other foods. Before sugar, molasses, and honey were introduced by European traders, sweetening agents were in short supply among native peoples, and camas was highly valued in this capacity. Sometimes other foods, such as the rhizomes of springbank clover (*Trifolium wormskioldii* Lehm. [Fabaceae]) and the roots of Pacific silverweed (*Potentilla anserina* ssp. *pacifica* (TJ Howell) Rousi [Rosaceae]) were cooked with the camas bulbs. The Kalapuya of the Willamette Valley in Oregon flavored camas bulbs with tarweed (*Madia* spp. Molina [Asteraceae]). Camas bulbs store poorly fresh. They were cooked or sun-dried and stored for later use. Sometimes camas bulbs were pressed flat and made into camas cakes the size of biscuits before being dried (Turner and Kuhnlein 1983). Dried bulbs were re-constituted by soaking in water, usually overnight. Many of the traditional camas gathering sites, such as wet prairies of the Palouse Prairie in eastern Washington, Weippe Prairie and Camas Prairie in northern Idaho, and the Willamette Valley in Oregon, have been converted to agriculture. The average size of a camas patch needed to feed a 5 person family was 2.7 ha (6.7 ac) (Thoms 1989). Areas producing camas roots

	<p>are now hard to find. Restoration of camas prairies and access to camas bulbs are priorities of many Indian people. Once, dense stands dominated many sites in the region. According to the journal of Meriwether Lewis on 12 June 1806, ".the quawmash in now in blume and from the colour of its bloom at a short distance it resembles lakes of fine clear water, so complete is this deseption than on first sight I could have swarn it was water" (Moulton 1983; see Murphey and Van Allen 1959 for a similar description;).</p> <p>Camas stalks and leaves were used for making mattresses. It was sometimes used in place of grass when baking camas in pits. Camas is used by the Nez Perce as a cough medicine. It is boiled, and the juice is strained and mixed with honey.</p> <p>Horticulturally, this plant is used for cut flowers, beds, borders, ground cover, rock gardens, and prairie restoration.</p> <p>Elk, deer, and moose reportedly graze camas early in the spring (Craighead and others 1963). Gophers eat camas and move the bulbs to another area where they sprout and grow the next year (Thoms 1989). Indian women in Oregon's Umpqua Valley robbed camas bulbs from gopher caches (Piper 1916). Phytophagus insects also eat camas leaves.</p>
INFORMATION SOURCES	
References (full citation):	See Below
Other Sources Consulted	See Below
Protocol Author	Sierra Red Bow
Date Protocol Created or Updated	05/06/20

References

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Protocol from 2007



Photo:

William & Wilma Folette. USDA NRCS. 1992. Western wetland flora: Field office guide to plant species. West Region, Sacramento

TAXONOMY	
Plant Family	
Scientific Name	Liliaceae
Common Name	Lily family
Species Scientific Name	
Scientific Name	Camassia quamash (Pursh) Greene

Varieties	
Sub-species	
Cultivar	
Common Synonym(s)	Quamasia
Common Names	Common/small camas, Quamash, Wild- or IndianHyacinth
Species Code (as per USDA Plants database)	CAQU2
GENERAL INFORMATION	
Geographical range	British Columbia south to California, east to Alberta, Montana, Wyoming and Utah. (Hitchcock and Cronquist 1973)
Ecological distribution	
Climate and elevation range	Found on sites that are moist/wet in winter and early spring, but very dry after flowering (late springsummer). Occurs from sea level to 7,000ft/2,134m. (FEIS database, Kruckeberg 1982)
Local habitat and abundance	<p>Occurs east and west of the Cascades in montane wet meadows, Puget lowland and Willamette valley prairies and moist forested communities in southeastern Oregon (Franklin and Dyrness 1973). Often in soil has clay or low spots. Thrives on moisture and water-retentive soils, but not water-logged. (English Garden, Organic Gardening)</p> <p>Associated spp: <i>Pseudotsuga menziesii</i>, <i>Pinus ponderosa</i>, <i>Fraxinus latifolia</i>, <i>Alnus rubrum</i>, <i>Festuca idahoensis</i> var. <i>roemeriana</i>, <i>Ranunculus occidentalis</i>, <i>Danthonia californica</i>, <i>Symphoricarpos albus</i>, <i>Erythronium oregonum</i>, <i>Achillea millefolium</i>, <i>Saxifraga integrifolia</i>, <i>S. oregana</i>, <i>Sisyrinchium angustifolium</i>, <i>Armeria maritima</i>, <i>Viola adunca</i>, <i>Zigadenus venenosus</i> and <i>Balsamorhiza deltoidea</i>, <i>Dodecatheon</i></p>

	hendersonii, D. jeffreyi, Senecio subnudus, Montia linearis, and many others. (FEIS database; Franklin and Dyrness 1973)
Plant strategy type / successional stage	
Plant characteristics	
PROPAGATION DETAILS	
Ecotype	
Propagation Goal	Plants
Propagation Method	Bulbs, Seed
Product Type	From Bulb: Bareroot From Seed: Container
Stock Type	
Time to Grow	From Bulb: 6 months From Seed: 2 years (Native Plant Protocol: Wick and Evans 2004)
Target Specifications	From Bulb: 2-3 ft (Garden Design) From Seed: Firm plug (Native Plant Protocol: Lambert)
Propagule Collection Instructions	The best time to excavate bulbs is from early summer through mid-fall. (Lambert 2001) Collect mature capsules when they begin to split and turn light tan in color. Seeds are black at maturity. Capsules are collected in paper bags and kept in a well ventilated drying shed prior to cleaning. (Native Plant Protocol: Lambert 2000) Seeds ripen and are dispersed from late May to July. (FEIS database)
Propagule Processing / Propagule Characteristics	Common camas is readily established by transplanting wild or commercially grown bulbs. Wild harvests should be restricted to salvage sites with appropriate approvals or permits. Due to loss of wetland habitat throughout the US, harvesting plants from the

	<p>wild is rarely appropriate or legal except under salvage situations. Use of bulbs or seeds from local nurseries or greenhouses is strongly recommended. The best time to excavate bulbs is from early summer through mid-fall. (Native Plant Protocol: Lambert)</p> <p>Store camas bulbs in a dry, dark, cool, well ventilated place in a potting medium such as dry peat moss, similar to recommendations for fall planted or spring flowering bulbs (such as daffodils and tulips). Keep bulbs from completely drying out and transport or store at 17 to 20 C (63 to 68° F) (De Hertogh and others 1990) - (Native Plant Protocol: Lambert 2001)</p> <p>Seed % Purity:100%, % Germination:50% (Native Plant Protocol: Wick and Evans 2004)</p>
<p>Pre-Planting Propagule Treatments</p>	<p>5 month outdoor stratification of fresh seed. Germination occurs in early May under cooler and fluctuating temperatures. Seed germination is reported best at 10C. Germination characteristics of this species are reported to be the same when using fresh seed or seed dry stored for six months. Seeds appear to germinate equally well in light or dark. (Native Plant Protocol: Wick and Evans, 2004.)</p>
<p>Growing Area Preparation / Annual Practices for Perennial Crops</p>	<p>Plant bulbs in fall, 4 in deep and 3 in apart. (Organic Gardening)</p> <p>Seed Sowing Method: Direct Seeding. Seeds are lightly covered with media.</p> <p>Seed Growing media used is 6:1:1 milled sphagnumpeat,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.</p> <p>Conetainers are filled and sown in late fall and irrigated thoroughly prior to winter stratification. Seedlings germinate in spring</p>

	under fluctuating outdoor temperatures and are grown under full sun exposure. (Native Plant Protocol: Wick and Evans, 2004.)
Establishment Phase Details	Seed germination uniform and complete after 4 weeks. (Native Plant Protocol : Wick and Evans 2004.)
Length of Establishment Phase	4 weeks
Active Growth Phase	
Length of Active Growth Phase	12 weeks (Native Plant Protocol: Wick and Evans 2004.)
Hardening Phase	Plants harden off naturally, senescing during heat of summer. (Native Plant Protocol: Lambert 2000, 2001.)
Length of Hardening Phase	
Harvesting, Storage and Shipping	
Length of Storage	
Guidelines for Outplanting / Performance on Typical Sites	Consider protection/fencing from herbivory. (Native Plant Protocol: Lambert 2000, 2001
Other Comments	A key traditional food source for PNW Native Americans. When baked has a pleasant flavor.

INFORMATION SOURCES

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	<p>Flora of the Pacific Northwest: An illustrated manual. University of Washington Press, Seattle.</p> <p>Lambert. 2000. Propagation protocol for production of <i>Camassia quamash</i> plants; Pullman Plant Materials Center, Pullman, Washington. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 25 April 2007). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.</p> <p>Lambert. 2001. Propagation protocol for vegetative production of field-grown <i>Camassia quamash</i> plants; Pullman Plant Materials Center, Pullman, Washington. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 25 April 2007). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.</p> <p>Kruckeberg, Arthur R. 1982. Gardening with Native Plants of the Pacific Northwest. <i>Organic Gardening</i>. 2005. Vol. 52 no. 2. p.12 USDA Plants Database. Accessed 24 April 2007. URL: http://www.plants.usda.gov/java/profile?symbol=CAQU2</p> <p>Wick, Dale; Evans, Jeff. 2001. Propagation protocol for production of container <i>Camassia quamash</i> (Pursh) Greene ssp. <i>quamash</i> plants (164 ml (10 in³) Leach Cone-tainers); Glacier National Park, West Glacier, Montana. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 25 April 2007). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.</p>
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Protocol Author	Brain Bragg
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