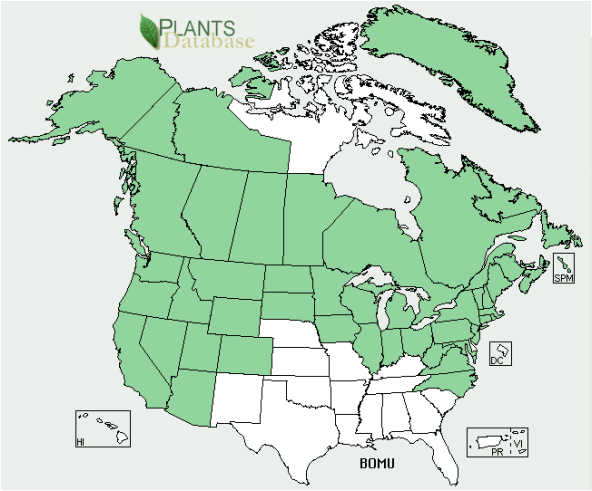
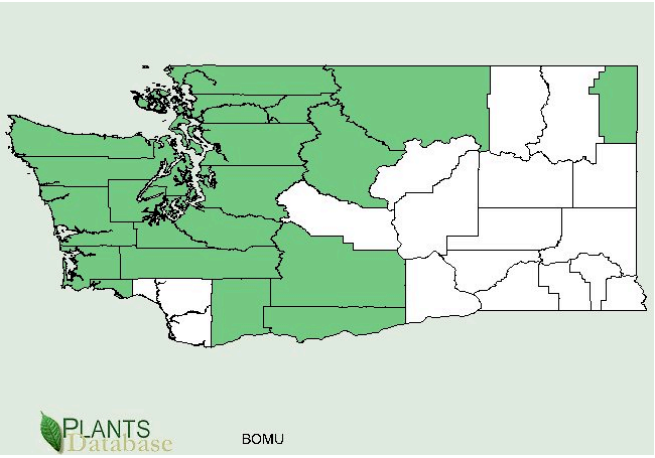
Plant Propagation Protocol for *Botrychium multifidum*
ESRM 412 – Native Plant Production
Spring 2012

North America Distribution



Washington Distribution



Source: USDA PLANTS Database

TAXONOMY	
Family Names	
Family Scientific Name:	Ophioglossaceae
Family Common Name:	Adder's tongue family
Scientific Names	
Genus:	*Botrychium*
Species:	*multifidum*
Species Authority:	(S.G. Gmel.) Trevis.
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (include full scientific names (e.g., *Elymus glaucus* Buckley), including variety or subspecies information)	*Botrychium californicum* Underw. *Botrychium coulteri* Underw. *Botrychium matricariae* (Schrank) Spreng. *Botrychium multifidum* ssp. *californicum* (Underw.) R.T. Clausen *Botrychium multifidum* ssp. *coulteri* (Underw.) R.T. Clausen *Botrychium multifidum* ssp. *silaifolium* (C. Presl) R.T. Clausen *Botrychium multifidum* var. *californicum* (Underw.) Broun *Botrychium multifidum* var. *coulteri* (Underw.) Broun *Botrychium multifidum* var. *intermedium* (D.C. Eaton) Farw. *Botrychium multifidum*. var. *silaifolium* (C. Presl) Broun *Botrychium silaifolium* C. Presl var. *coulteri* (Underw.) Jeps.[8]

Common Name(s):	Leathery Grape fern, Multifid Grape-fern[1], Leather-leaf Grape-fern
Species Code (as per USDA Plants database):	BOMU
GENERAL INFORMATION	
Geographical range (distribution maps for North America and Washington state)	Northern and upper Midwestern areas of the United States and Canada with populations extending down the Rockies and the West Coast as well as New England.[5] See maps above for distribution in North America and Washington state.
Ecological distribution (ecosystems it occurs in, etc):	Moist or wet meadows, fields, grassy slopes, lake-shores, stream-banks, swampy or alluvial forests.[7]
Climate and elevation range	Circumpolar[2] From sea level to subalpine elevations.[7]
Local habitat and abundance; may include commonly associated species	Terrestrial in old pastures, woodland margins, riverbanks, and bottom lands in sub-acidic soil.[2] Populations frequently small[9]
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	Leaf leathery, brilliant green, 4-15 inches tall, appearing in June; later darkening in color but remains erect throughout winter and following spring.[1] For assistance in the field, look for the brilliant yellow flags of fertile fronds, which appear in midsummer.[6]
PROPAGATION DETAILS	
Propagation by Division (general for ferns)	
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants
Propagation Method (Options: Seed or Vegetative):	Vegetative
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Container
Time to Grow (from seeding until plants are ready to be outplanted):	N/A
Target Specifications (size or characteristics of target plants to be produced):	Divide when fern is mature
Propagule Collection (how, when,	Dig up the whole plant and cut it in half, or as desired.

etc):	Division can be performed at any time but early fall is best suited for adjusting the rhizomes.[1] The foliage should be thinned to reduce stress on the roots.[5]
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	N/A
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	N/A
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	Plant them in soil that is rich and loose. In preparing a new bed, use a mixture of equal parts of garden loam, builder's sand and leaf mold or peat moss. Soil pH should be 6.0 to 7.0. Keep soil evenly moist.[6]
Establishment Phase (from seeding to germination):	N/A
Length of Establishment Phase:	N/A
Active Growth Phase (from germination until plants are no longer actively growing):	N/A
Length of Active Growth Phase:	N/A
Hardening Phase (from end of active growth phase to end of growing season; primarily related to the development of cold-hardiness and preparation for winter):	N/A
Length of Hardening Phase:	N/A
Harvesting, Storage and Shipping (of seedlings):	N/A
Length of Storage (of seedlings, between nursery and outplanting):	N/A
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	Plant the divisions quickly in their new locations, and water. If final planting must be delayed, temporarily "heel in" the plants and keep them moist.[1]
Other Comments (including collection restrictions or guidelines, if available):	Difficult to transplant from the wild but do so with extra care, disturbing roots as little as possible. Each plant produces only one frond per year and the loss of a leaf is a potentially serious setback.[4] Are generally not used as indoor pot plants.[6]

Propagation by Spores (general for ferns)	
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants
Propagation Method (Options: Seed or Vegetative):	Vegetative
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Container
Time to Grow (from seeding until plants are ready to be outplanted):	Months to years
Propagule Collection (how, when, etc.):	The fertile fronds of ferns will show the characteristic spore at the tips of fertile stocks, and they don't usually ripen until very late in the season.[2,6] The fronds resemble the barren frond in its branching but much reduced in size and are densely covered with sporangia.[2] Spores should be collected just before the sporangia burst open to release the mature spores. Examination with a hand lens will help to determine the optimum time for collection.[3] Simplest method of collecting spores is to detach part of a fertile frond and carefully insert it into a small envelope or plastic bag.[3] *B. multifidum* only produces one frond per season so need to be very careful when detaching it.
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc.):	Store spores in a dry room for a few days for the spores to be released from the sporangia.[3] Spores can be kept for several years before being propagated, however the greatest success will come from spores sown soon after collection.[3]
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc.):	Their success depend on ensuring that containers and compost are sterilized, and remain free from airborne contamination by other organisms which will inhibit the development of the spores.[3] Plunging it in boiling water for several minutes can clean containers.
Growing Area Preparation / Annual Practices for Perennial Crops	Plant them in soil that is rich and loose.

(growing media, type and size of containers, etc):	In preparing a new bed, use a mixture of equal parts of garden loam, builder's sand and leaf mold or peat moss. Soil pH should be 6.0 to 7.0. Keep soil evenly moist.[6] Containers with good drainage should be selected. Some panes of glass or polythene to cover the containers.[3]
Establishment Phase (from seeding to germination):	The optimum temperature for spore propagation is 65-70 degrees Fahrenheit. [3] The soil will have the appearance of being covered with a green mold. The presence of the growth indicates that the spores have germinated. During this stage the prothallus develops female organs, containing the eggs, and male organs containing the sperm. Moisture on the surface of the soil will allow the sperm to swim to the eggs and fertilize them. The container should not be exposed to the air and the glass or polythene cover must remain to protect the plants at this critical time.[3]
Length of Establishment Phase:	After a period of time, generally one to two weeks, but varying according to the fern species.
Active Growth Phase (from germination until plants are no longer actively growing):	A first leaf will develop out of the prothallus, and at this stage the glass or polythene covering can be removed, though the plants should remain sheltered from the sunlight.[3] After a further period, secondary leaves will appear and the new plant will start to develop a root system independent of the prothallus. At this stage, the prothallus itself will begin to wither and disappear.[3]
Length of Active Growth Phase:	Months to years Can be grown on a nursery bed for a further one or two years.[3]
Hardening Phase (from end of active growth phase to end of growing season; primarily related to the	

development of cold-hardiness and preparation for winter):	
Length of Hardening Phase:	
Harvesting, Storage and Shipping (of seedlings):	N/A
Length of Storage (of seedlings, between nursery and outplanting):	N/A
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	
Other Comments (including collection restrictions or guidelines, if available):	Extremely difficult if not impossible to grow from spores.[4]
INFORMATION SOURCES	
References (full citations):	[1]Foster, F G. *Ferns to Know and Grow*. New York: Hawthorn Books, 1984, pp. 60-65, 96 [2]Grounds, Roger. *Ferns*. London: Pelham Books, 1974, pp. 100-101. [3]MacHugh, Andrew. *The Cultivation of Ferns*. Batsford, 1992, pp. 111-113, 118. [4]Lellinger, David B. *A Field Manual of the Ferns & Fern-Allies of the United States & Canada*. Washington, D.C: Smithsonian Institution Press, 1985, pp. 226 [5]Olsen, Sue. *Encyclopedia of Garden Ferns*. Portland, Or: Timber Press, 2007, pp. 65-69, 158 [6]Perl, Philip. *Ferns*. Alexandria, Va: Time-Life Books, 197, pp. 158. [7]Pojar, Jim, A MacKinnon. *Plants of the Pacific Northwest Coast: Washington, Oregon, British Columbia & Alaska*. Redmond, Wash: Lone Pine Pub, 2004, pp. 427 [8]"U.S. Department of Agriculture." *Plants Profile*. NCRS. Web. 17 Apr. 2012. <http://plants.usda.gov/java/profile?symbol=BOMU>.
Other Sources Consulted (but that contained no pertinent information)	[9]Cobb, Boughton, Elizabeth Farnsworth, and Cheryl Lowe. *A Field Guide to Ferns and Their Related*

(full citations):	*Families: Northeastern and Central North America*. Boston: Houghton Mifflin Co, 2005. Print. [10]Hoshizaki, Barbara J., and Robbin Moran. *Fern Growers Manual*. New York: Knopf, 2001. Print.
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