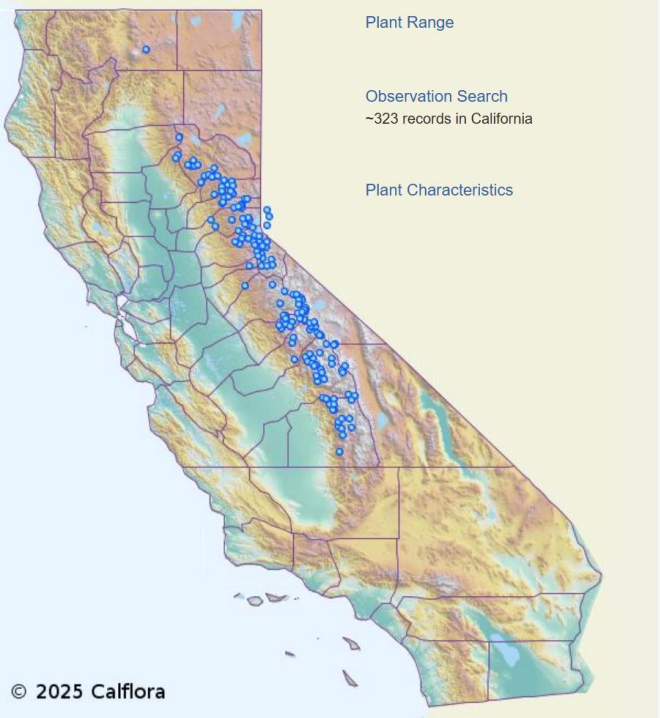
Plant Propagation Protocol for *Mitella breweri*

ESRM 412 – Native Plant Production



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TAXONOMY	
Plant Family	Saxifragaceae
Scientific Name	*Mitella breweri* A. Gray
Common Name	Brewer's miterwort; Brewer's bishop's cap
Species Scientific Name	*Mitella breweri*
Scientific	Mitella breweri A. Gray
Varieties	No intraspecific varieties are recognized in the USDA PLANTS database
Sub-species	No subspecies recognized in the USDA PLANTS database
Cultivar	No cultivars recognized in the USDA PLANTS database
Common Synonym(s)	*Pectiantia breweri (A. Gray) Rydb.* *Mitella breweri f. denticulate Rosend.* *Mitella breweri f. lobata Rosend.*
Species Code (as per USDA Plants database)	MIBR6
GENERAL INFORMATION	
Geographical range	*Mitella breweri* is a native plant that is western to North America, with a range extending from British Columbia through Washington and Oregon, and into central California and Nevada (USDA, 2024).
Ecological distribution	*Mitella breweri* commonly pops up in shaded coniferous forests, moist meadows, mountainous forests, and along streambanks (Flora of North America, 2009).
Climate and elevation range	Species thrive in moist, shaded environments. Elevations are between 1,500 and 2,200 meters. Found in subalpine zones. (USDA, 2024).

Local habitat and abundance	Moist coniferous forests and shaded mountain slopes[1] Humus-laden soils are commonly found in the understory of forests dominated by the Engelmann spruce. Mitella breweri is known to be a forest generalist herb[8]
Plant strategy type / successional stage	Mitella functions as a forest generalist herb. Grows after disturbances. Persist in various successional stages[8]
Plant characteristics	Life form: Perennial herb Longevity: Long-lived Growth Habit: Clump-forming with significant rhizomes Leaves: Basal, round to kidney shaped margins Flowers: Green, Small, arranged in narrow spikes Defined petals Reproduction: It can self-see in suitable habitats (USDA, 2024; FNA, 2009)
PROPAGATION DETAILS: FROM SEED	
Ecotype	There is no experimentally derived ecotype information.
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container Plug
Stock Type	Deep Plug 16 in^3 similar container
Time to Grow	16 -20 weeks
Target Specifications	A firm, intact root plug 4-6 true leaves Height of 5-10 cm Root mass that holds together during transplanting
Propagule Collection Instructions	When: Collect seeds in the late summertime (august) through early fall (September). Collect them when the capsules have matured and begin to split open. How: use scissors to cut the entire fruiting stalk. Place seeds into paper bags to allow air circulation.
Propagule Processing/Propagule Characteristics	Cleaning: Once fully dry: seed capsules can crumble by hand. Seed Density: Specific seed density (currently unavailable) but using data from Saxifragaceae species, it would be around 300,000 seeds per pound. Seed Longevity: They have an intermediate seed longevity. Seeds should be stored in airtight containers with humidity around 4-5C Seeds remain viable for approximately 2-3 years under control + proper conditions [10]
Pre-Planting Propagule Treatments	Once cleaning the seeds, the seeds must be stored in a cool/dry location in glass vials within a sealed container. How to stratify: - Mix seeds with moist, vermiculite or sand inside a sealed plastic bag - Refrigerate at 1-5 C for 8-12 weeks. - After stratification, sow the seeds and keep stratified seeds refrigerated until they are ready for planting. [10]
Growing Area Preparation / Annual Practices for Perennial Crops	Use a well-draining mix consisting of 40% peat moss or coir, 30% perlite, and 30% forest loam.

Establishment Phase Details	After a cold, moist stratification period of 8–12 weeks, *Mitella breweri* seeds should be sown on the surface of a pre-moistened propagation mix in deep plug containers. The seeds should not be buried, as they require light to germinate. Instead, gently press them into the soil surface to ensure good contact without covering them. Place the trays in a shaded greenhouse or cold frame that provides soft, filtered light, mimicking the conditions of a forest canopy. Maintain daytime temperatures around 20°C, allowing them to drop at night to reflect natural fluctuations [1]
Length of Establishment Phase	2-4 weeks of Establishment Phase.
Active Growth Phase	Once seedlings began to germinate, keep them in a shaded, cool environment. Switch from a misting to bottom watering or a gentle hand watering technique Soil must stay moist As the seedlings develop 2-4 true leaves, follow a light fertilization schedule Apply a diluted balanced fertilizer [1]
Length of Active/ Growth Phase	12-16 weeks [10]
Hardening Phase 5	As *Mitella breweri* slows its growth in late summer, it starts hardening by mimicking outdoor conditions. Cooler temps, some wind, and less water. Move trays to a sheltered, partly shaded spot. Stop fertilizing, reduce watering, and slowly increase sun and wind exposure to help the plants shift focus to root development and get ready for winter.
Length of Hardening Phase	2 to 3 weeks.
Harvesting, Storage and Shipping	Plugs should be gently removed by pushing from the bottom or flexing trays to protect root systems. For local transport, place plugs upright in shallow trays lined with moist paper towels, then pack in ventilated boxes kept around 6°C [10]
Length of Storage	*Mitella breweri* seedlings can be held for 1–2 weeks in a cool, shaded spot with good airflow. Keep the soil slightly moist and aim for around 6 °C to reduce stress[1]
Guidelines for Outplanting / Performance on Typical Sites	Must occur in early fall or late spring. Soil moisture must be high, and temperatures must be cool. Sites must mimic the species' natural habitat. - Moist - Shaded coniferous forest understories - Near streams - Humus-rich soils Seedlings should have firm root plugs and be planted at the same depth as in the nursery container. Performance on typical sites: - Survival rates in well-comprehended habitats are estimated to be 80 percent - Height growth remains low + compact. Plants usually stay around 20cm tall. - Flowering may occur in the second and third growing season[7]

Other Comments	10-20 percent of available seed from any one population per season
PROPAGATION DETAILS: VEGETATIVE	
Ecotype	There is no actual experiment derived for the Mitella breweri.
Propagation Goal	Plants
Propagation Method	Vegetative
Product Type	Use a cell flat. 40-72 cell trays. Mitella breweri is a small, shallow-rooted woodland perennial. Shallow flats encourage a quicker root fill [10]
Stock Type	Cell flats with individual cells. Volume: 10-12in^3
Time to Grow	10-14 weeks.
Target Specifications	- The height should be around 5-10cm - Non-elongated stems - Intact root plug with developed fibrous roots - 4-6 leaves would be ideal[4]
Propagule Collection Instructions	Mid-spring to early summer is a good time. Take healthy, non-flowering basal shoots from mature plants. Ensure usage of clean, sharp tools. Mitella plants are sensitive and prone to disease. Ensure proper cleaning techniques[8]
Propagule Processing/Propagule Characteristics	After collection, basal shoot cuttings should be kept cool and placed immediately in a shaded, humid environment to prevent desiccation. Trim cuttings to 5–8 cm and remove lower leaves to minimize moisture loss. Use healthy, non-flowering shoots, as flowering diverts energy from root development[8]
Pre-Planting Propagule Treatments	Careful inspections should look like: - Healthy from disease - No pests - No rotting of any kind. - No overly soft material Shoot cuttings remove any lower leaves that would meet the growing media. - Leaving 2-3 leaves at the tip would maintain photosynthesis. Cuttings should be trimmed with a clean, sharp, sterile blade [10]
Growing Area Preparation / Annual Practices for Perennial Crops	Use a mix of 30% forest loam (for nutrients), 30% perlite (for drainage) 40% peat moss (for moisture retention and aeration)[8]
Establishment Phase Details	After planting, cuttings should be placed in shaded propagation area with high humidity. Ensure ventilation to prevent excess condensation. Overwatering should be avoided. The preferred watering method would be bottom watering. Temperature: 20 C during the day. 13 C at night[9]
Length of Establishment Phase	4 to 6 weeks.
Active Growth Phase	Keep light levels steady to support healthy photosynthesis, aim for 12 hours of indirect light each day in the greenhouse. Keep temperatures the same as earlier stages to avoid stressing the plants[2]

Length of Active Growth Phase	6-8 weeks [10]
Hardening Phase	1- Temperatures must be reduced during the nighttime 2- Plants need to experience temperatures of 10-15C. Daytime would be around 20-25C. 3- Light: Plants will now be exposed to direct sunlight. 7-10 days of gradual sunlight[8]
Length of Hardening Phase	2-3 weeks [10]
Harvesting, Storage and Shipping	Shallow boxes, lightly misted
Length of Storage	7 days of storage
Guidelines for Outplanting / Performance on Typical Sites	Plant *Mitella breweri* in early fall when the soil is moist Look for shady spots with moist, well-drained soil The plants usually grow to about 15 cm tall Tend to flower in their second- or third-year [3]
Other Comments	*Mitella breweri* is a small, evergreen plant that grows in clumps about 15 cm tall. It has green, heart-shaped leaves with scalloped edges, and in late spring to summer. It has tall, slender stems topped with delicate, yellow-green flowers that look like little stars[3]
INFORMATION SOURCES	
References	1. Royal Horticultural Society. (n.d.). *Mitella breweri*. RHS Plants. https://www.rhs.org.uk/plants/11162/mitella-breweri/details 2. USGS National Vegetation Classification. (n.d.). *Unit details for Mitella breweri communities*. United States Geological Survey. https://www1.usgs.gov/csas/nvcs/unitDetails/686219 3. USDA Forest Service. (2023). *Regional forester sensitive species list and ecological assessments for Region 6*. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd1181088.pdf 4. Native Plant Network. (n.d.). *Propagation Protocol Database*. USDA Forest Service, Reforestation, Nurseries, and Genetic Resources. Retrieved from https://npn.rngr.net/propagation/protocols 5. Turner Photographics. (n.d.). *Mitella breweri*. Pacific Northwest Wildflowers. https://www.pnwflowers.com/flower/mitella-breweri 6. Klinkenberg, B. (Ed.). (n.d.). *Mitella breweri*. E-Flora BC: Electronic Atlas of the Flora of British Columbia. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia.https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Mitella%20breweri 7. National Center for Biotechnology Information (NCBI). "*Pectiantia breweri*." *NCBI Taxonomy Browser*,

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