

# 2025 Pilot Study of Raising Native Herbaceous Forbs from Seed in Stabilized Plugs for Outplanting to Seed Beds and Restoration Projects in Year 1 of Production

## Summary Report

### Ben More Mountain Nursery (BMMN) and Umpqua Native Plant Partnership (UNPP)

November 10, 2025



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for Outplanting to Seed Beds and Restoration Projects In Year 1 of Production  
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## **1.0 OVERVIEW**

Native herbaceous forbs are challenging to propagate from seed in nurseries due to the varied characteristics between different species. There are annual species and perennial species, fast and slow growing species, seed sizes range from tiny to large, pre-treatment requirements for seeds range from 0 days up to 90 or more days of cold stratification depending on species, and root structures vary from fibrous to sensitive tap roots. Slow growing species take 2 or more years to mature which has discouraged nursery production for some of the perennial species.

Umpqua Native Plant Partnership (UNPP) and Ben More Mountain Nursery (BMMN) partnered to pilot methods in 2024 and 2025 that can be cost-effectively scaled and implemented by small producers for contract production of container plugs. Results of the pilots found that small producers can reliably and consistently raise most species of native herbaceous forbs from seed in nurseries for outplant to seed beds and restoration projects. The key is to use paper-wrapped stabilized plugs, which allow for handling, potting up and outplanting of plugs with minimal root shock while transplanting during the first season of production. Media blends are free of phytophthora virus and are developed and proven for commercial nursery propagation. Manufacturers buy materials in bulk, so the unit cost of paper-wrapped, stabilized plugs is similar to purchase of commercial, bagged loose media from retail stores. Nurseries will have upfront cost to purchase containers and trays for native plants that work for cylindrical plugs; however, the plastic container systems are reused and stay at the nursery.

## **2.0 BACKGROUND**

Five herbaceous plant species, including native grasses, forbs, and sedges, were piloted for nursery plug production in the 2024 pilot.

1. *Achnatherum lemmonii*
2. *Camassia leicthlinii*
3. *Elymus glaucus*
4. *Juncus effusus* (wetland)
5. *Carex* spp. (wetland)

The 2025 pilot built on the results from 2024 to further evaluate methods for handling tiny seeds, pre-treatment including scarification and cold stratification, and plug production of herbaceous forb species with sensitive tap roots in addition to species with fibrous structure. Four species of herbaceous forbs were piloted in 2025.

1. *Asclepias fascicularis*
2. *Lomatium utriculatum*
3. *Eriophyllum lanatum*
4. *Drymocallis* (*Potentilla*) *glandulosa*

Focus of the 2025 UNPP/BMMN pilot is on the implementation of published protocols including infrastructure and equipment needed for small nurseries to reliably and consistently raise container plugs of native herbaceous forbs.

## **3.0 REFERENCES AND PUBLISHED PROPAGATION PROTOCOL**

The 2025 UNPP/BMMN pilot study follows published propagation and sanitation protocols for native plant species, incorporates ongoing research of stabilized plugs for native plant production, and considers the experience of established nurseries using stabilized plugs and suppliers of stabilized plugs. A list of primary resources used for 2025 pilot study follows. UNPP can assist with locating the listed resources.

## Technical Reports

1. Preventing Phytophthora Infestations in Restoration Nurseries, A Key to Protecting Wildland Plant Communities. OSU Extension Service, EM 9330. January 2022.
2. Adopted Best Management Practices for Production of Clean Nursery Container Stock of Native Plants for Restoration Projects, Umpqua Native Plant Partnership (UNPP). UNPP. 2024.
3. 2024 Pilot Study of Growing Native Herbaceous Plants in Plug Containers for Restoration Projects. Ben More Mountain Nursery (BMMN) and Umpqua Native Plant Partnership (UNPP).
4. Raising Native Plants in Nurseries: Basic Concepts. USDA. Dumroese, R. Kasten; Landis, Thomas D.; and Luna, Tara. 2021.
5. All That They Are Wrapped Up To Be? How the Advantages and Drawbacks of Paper-Wrapped Plugs May Play Out in Pacific Northwest Reforestation and Restoration. Khadduri, Nabil and Wightman, Maxwell, USDA. 2023
6. Research Project on Growing Two Early Growing CA Milkweeds in Stabilized Media – 2025. Landis, Thomas D. Thomas Landis, Consultant. 2025
7. Strategies for Seed Propagation of Native Forbs. Meyer, Susan E., USDA. National Proceedings: Forest and Conservation Nursery Associations—2005.
8. USDA, Native Seed Production Manual for the Pacific Northwest, Corvallis PMC.

## Online Propagation Protocol Data Bases

1. RNGR Reforestation, Nurseries & Genetic Resources
2. USDA Plants Data Base
3. University of Washington, Course Materials for ESRM 412 - Native Plant Production

## Nurseries That Utilize Stabilized Plugs for Propagation from Seed

1. White Oak Farm & Education Center, Williams, Oregon
2. Dorena Genetic Resource Center, USFS, USDA, Cottage Grove, Oregon
3. Kintigh's Nursery. Reforestation and Christmas Tree Nursery. Springfield, Oregon

## 4.0 CONTRACT GROWING OF NATIVE PLANTS

Commercial nursery production of native plant plugs requires pre-sale contracts. Nurseries must be able to ensure the buyer that the agreed upon number of plugs will be produced to the buyer's specification and on schedule. For the 2025 UNPP/BMMN pilot the minimum production goals were:

1. Establishment Phase: 90% of plugs sown will have at least one (healthy) emergent seedling within 21 days after sowing (or removal from cold stratification)
2. Vegetative Growth Phase: 90% of seedlings in four (4) weeks after emergence will grow to meet buyer's specifications.
3. Final Plugs Delivered to Purchaser: 80% of plugs sown (90% x 90% = 81%)

## 5.0 SANITATION PROTOCOL FOR PRODUCTION OF NATIVE PLANTS FOR RESTORATION PROJECTS

Shipment and planting of nursery stock is the most common means of spreading phytophthora ramorum to ecosystems in the Pacific Northwest.

Sanitation protocols for a nursery involve cleaning, disinfecting, and pest/disease management practices to prevent the spread of pathogens and ensure healthy plant growth. Current Oregon law only mandates nursery stock be free of phytophthora for plants shipped out of State. However, all contract purchasers of native plants will expect, either by written or implicit contract, that nurseries raising native plants to sell for restoration projects have adopted sanitation protocols which prevent infestations of phytophthora.

The phytophthora ramorum virus is relatively easy to inactivate through disinfection/sterilization and to avoid through best management practices and use of infrastructure designed to prevent spread of the virus. Although the initial capital investment and ongoing operating expenses will be higher when adopting best management practices for clean nursery stock, the investment benefits the health of both native and non-native nursery stock.

Methods and infrastructure used in 2024 and 2025 UNPP/BMMN pilot studies comply with the best management practice guidelines published by the OSU Extension Service “Preventing Phytophthora Infestations in Restoration Nurseries, a Key to Protecting Wildland Plant Communities” and “Adopted Best Management Practices for Production of Clean Nursery Container Stock of Native Plants for Restoration Projects, Umpqua Native Plant Partnership (UNPP)”.

### 6.0 KEY PLANNING INFORMATION FOR PROPAGATION OF NATIVE HERBACEOUS FORBS

Table 1 and Table 2 summarize key planning information about the species for the 2025 UNPP/BMMN pilot for production planning. The same key information is required to plan for propagation from seed of any native herbaceous forb. Agreements for contract production should be in place by the spring prior to the calendar year of propagation to ensure time for seed collection.

**Table 1 Seed Collection Timeframe**

Species	Timeframe	
	Published	2025 Pilot
Asclepias fascicularis	Late summer to early fall	10/3/2024
Lomatium utriculatum	Mid-spring to early summer	6/27/2024
Eriophyllum lanatum	Mid-summer to early fall	7/18/2023
Drymocallis glandulosa	Mid to late summer	7/21/2023

**Table 2. Planning: Key Characteristics of Forbes for Planning Seed Propagation Methodology**

Species	AF / PF (a,b)	Years to Mature	Seed Density # per g	Root Type	Specified Outplant Season	Senescence Begins	Scarify	Cold Stratification		GP (c)
								Req'd	Days	
Asclepias fascicularis	PF	2 to 3	50 to 200	Tap	Fall	Early fall	Yes	Yes	60	>70%
Lomatium utriculatum	PF	3	150	Tap	Fall	Late spring to early summer	No	Yes	60 to 90	>80%
Eriophyllum lanatum	PF	1 to 2	1,800	Fibrous	Fall	Early fall	No	Yes	60 to 90	>40% (d)
Drymocallis glandulosa	PF	2 to 3	2,800	Fibrous	Fall	Fall	No	Yes	90	>80%

Notes:

- a. AF. Annual Forbes
- b. PF. Perennial Forbes
- c. GP. Germination percentage
- d. Published protocol lists >75% at 90 days cold stratification. For pilot pulled at 60 days due to some germination in cold stratification, measured germination of 40%.

## 7.0 STABILIZED PLUGS

Standard nursery container production utilizes loose media in a plastic container. Roots of the plant hold the media together and the plant is not transplanted until after the roots are well established within the container.

Stabilized plugs are manufactured to maintain the structural stability of the media independent of root growth. One of the primary benefits of stabilized plugs is that plugs can be transplanted while plants are actively growing without root shock. Media blends are free of phytophthora virus and are developed and proven for commercial nursery propagation. There are three primary types of stabilized plugs:

1. Peat media stabilized with polymer. Q Plugs manufactured by IHORT are an example.
2. Paper- wrapped plug. Paper wrap has admixture of polyester for reinforcement and is degradable. Earth Pots are Ellepots licensed for manufacture by OBC Northwest in Canby, OR.
3. Dry, compressed, peat disk in plastic net. The disk height can expand by a factor of seven when soaked in water. Jiffy Pellets are an example.

Snippets of photographs from manufacturer websites follow.



Polymer-stabilized media



Paper-wrapped media



Compressed-media disk in plastic net

Q Plugs are used for cold stratification and the establishment phase of plug propagation of native plants at the USFS Dorena Genetic Resource Center in Cottage Grove, Oregon. Earth Pots are used for plug propagation of native plants at the White Oak Farm & Education Center, Williams, Oregon. Earth Pots and Jiffy Pellets are currently being evaluated for propagation of native milkweed plugs through a research project being coordinated by Tom Landis, retired USDA. Kintigh Nursery uses Ellepot plugs for propagation of conifer trees.

## 8.0 EARTH POTS/ELLEPOTS AS STABILIZED PLUGS: PAPER-WRAPPED MEDIA

Earth Pots/Ellepots were selected as the stabilized plug for the 2025 UNPP/BMMN pilot. An excellent summary of advantages and disadvantages of paper-wrapped, stabilized plugs is provided in the technical paper *All That They Are Wrapped Up To Be? How the Advantages and Drawbacks of Paper-Wrapped Plugs May Play Out in Pacific Northwest Reforestation and Restoration*, Joint Annual Meeting of the Western Forest and Conservation Nursery Association and the Forest Nursery Association of British Columbia, 2023.

### 8.1 Selecting Size of Earth Pot Plugs and Size/Type of Containers and Trays

Earth Pot plugs must be inserted in plastic containers for plant propagation. However, the stabilized plugs are removed from containers at the nursery before transporting for outplanting. Containers and trays are kept at the nursery; eliminating a potential vector for spread of phytophthora since containers and trays are not shared and providing a cost savings to nursery since containers can be reused.

Selection of plug size and containers/trays is one of the most important propagation decisions for the nursery and is species dependent. Selection depends on multiple factors including buyer specifications, pre-treatment of seeds, annual or perennial, season for outplanting (spring or fall), rate of vegetative growth, and type of root structure. There is no one size plug that works in all circumstances for propagation of multiple species. Table 3 provides a comparison of container dimensions and volumes.

**Table 3. Nursery Container Systems and Dimensions**

Type	Description	Dimensions		Volume	Container/Tray	
		Width (in)	Depth (in)	(cubic inch)		
Pots: Loose Media	0.5 Pint (3" Round)	3.0	2.75	14	---	
	Pint (4" Round)	4	3.5	28	---	
	Quart (4.5" Square)	4.5	5.0	58	---	
	1 Gal Trade (Round)	6.25	6.375	146	---	
	1 Gallon True (Round)	8.0	6.75	231	---	
Plug Containers: Loose Media	RL Cone-tainer SC10	1.5	8.25	10	RL98 Tray	
	Deepot 16L	2.0	7.0	16	D50T	
	Deepot 30L	2.7	8.0	30	D20T	
	Deepot 40H	2.5	10.0	40	D20T	
Earthpots: Paper-wrapped, stabilized plugs	Mini-plugs, direct sow	Earth Pot 20 mm x 40 mm	0.8	1.6	1.3	144 cell Blackmore
		Earth Pot 35 mm x 60 mm	1.38	2.36	6.0	72 cell Blackmore
	Direct sow	Earth Pot 35 mm x 150 mm	1.38	5.91	15	Deepot 16H/D50T
		Direct sow or pot up from 20mmx40mm	Earth Pot 50 mm x 100mm	2.0	3.94	20
	Earth Pot 50 mm x 200mm		2.0	7.87	40	Deepot 40H/D20T Deepot 30H/D20T (a)
	Earth Pot 60 mm x 140mm		2.4	5.5	36	21 cell Blackmore

Note: a) D30 is elevated higher in 20T tray and may be more difficult to bottom-up water in standard depth flood tray

Nursery pots are included in Table 3 as a relative basis for comparison. Horticultural crops are commonly propagated in 0.5 pint to 1 pint nursery pots for spring transplanting, but the plants are typically potted up to either one quart or one gallon nursery containers for fall transplanting or carryover to the following spring.

The volumes of Ray Leach (RL) Cone-tainers and Deepot containers used for native plant propagation are small in comparison to nursery pots. The interior container walls are designed with vertical ridges to prevent root spiraling and containers are elevated in trays to facilitate air pruning of roots. The plug diameters are small relative to the length to improve transplant survival in restoration areas with deeper root structure. However, there are still multiple options for plug size depending on propagation method, outplanting season, rate of vegetative growth, and type of root structure.



Pre-treatment and germination of seeds, and establishment of plants, in small (mini) plugs and then potting up to larger plugs for vegetative growth phase has significant advantages. This method is used by the USFS Dorena Genetic Resource Center (with Q Plugs). The challenge is potting up into the small diameter plugs/containers commonly used for native plant propagation.

UNPP/BMMN coordinated with OBC Northwest for the 2025 pilot. 20 mm x 40 mm Earth Pot plugs can be up potted into Earth Pots plugs that have a 50 mm or larger diameter. The adjacent photo shows 20 mm x 40 mm and 50 mm x 200 mm Earth Pots.

Deepot containers and trays are used for custom-sized Ellepot/Earth Pot plugs. Blackmore Company manufacturers Air Trays for standard sizes. OBC Northwest ships the Earth Pot plugs in the Blackmore trays. The Blackmore trays can be returned to OBC Northwest for refill. Deepot containers and trays must be purchased separately for custom sizes of Earth Pots.

Ellepot/Earth Pot plug sizes being used by some Oregon nurseries, Landis native milkweed research, and for 2025 UNPP/BMMN pilot follow:

White Oak Farms and Education Center

35 mm x 140 mm Earth Pots and Deepot 16 containers/D50T trays, for many of the native species grown  
Kintigh Nursery, Reforestation and Christmas Tree Plugs

40 mm x 120 mm (14 cubic inch) Ellepots and Blackmore 84 cell injected molded tray

Native Milkweed Propagation Research Project, Tom Landis

50 mm x 200 mm Earth Pots and a) Year 1: Deepot 40 containers/D20T trays and b) Year 2: Deepot 30 containers/D20T trays

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a) 20 mm x 40 mm Earth Pots with 144 cell Blackmore trays, b) 50 mm x 100 mm Earth Pots with 32 cell Blackmore trays, c) 50 mm x 200 mm Earth Pots and Deepot 40H containers with D20T trays, and e) 60 mm x 140 mm Earth Pots with 21 cell Blackmore trays.

During year 1 of the Tom Landis research project, loose media was added to the bottom of Deepot 40 (D40) containers prior to inserting the 50 mm x 200 mm Earth Pot plugs due to concern that the 10-inch containers were too long for the 8-inch Earth Pot plugs. In year 2, shorter, 8-inch long Deepot 30 (D30) containers are being used. However, excellent results were obtained by BMMN with the D40 containers, and no loose media was added to the bottom of containers (photos follow). There is 1.25" to 1.5" gap between top of plug media and top of container. Heavy duty, D40H containers were used by BMMN and have a different shape than the light D40L containers, which may make a difference. D30 containers sit higher in the D20T trays and bottom-up watering could be an issue in standard flood trays. The 50 mm x 200 mm Earth Pot plugs have 40 ci volume, but Landis indicated no issue with fit in D30 (30 ci) containers.



BMMN. 50 mm x 200 mm Earth Pots in D40H cells. No loose media added.



BMMN. D40H cells in D20T trays. Note water line mark on containers from bottom-up watering in standard depth flood



D30 cells (left photo) and D40 cells (right photo) are both supported in D20T trays. The D30 cells are elevated higher in the D20T tray than the D40 cells.

## 8.2 Paper Wrap Available for Earth Pots/Ellepots

Two of the options for available paper to wrap plugs are designated AP and FP. The main difference is time for paper wrap to degrade, with AP designed for 4 to 6 months and FP for 12 to 24 months. The timeframe for paper to degrade is an important consideration when pre-ordering plugs (limited shelf life) and evaluating total length of grow period. Description of these paper wraps is as follows:

### PAPER AVAILABLE:



**AP:** 120 to 180 day degradability  
fungicide coated to reduce mold risk  
standard paper used on all Jumbo Ellepots  
\*A~



**FP:** 12 to 24 month degradability  
fungicide coated to reduce mold risk  
standard paper used on propagation sizes  
\*~

Snippet from “Ellepots by A.M.A. Grower Guide”

Paper-wrapped plugs are made to order by the manufacturer/supplier (not stockpiled). Plugs for the 2025 UNPP/BMMN pilot were ordered from OBC Northwest in Canby, Oregon. OBC Northwest typically needs 2 to 4 weeks lead time for an order. Storage is not recommended beyond 8 weeks since the paper wrap is designed to degrade.

OBC NW recommends the AP wrap for native herbaceous plants due to slow root growth and weaker root structures. For seed start (mini) plugs which will be potted up to larger containers or for spring outplanting, AP is a good choice for herbaceous native plants. For fall outplanting the paper type is still being evaluated and is dependent on length of time grown in final growth plug, size of plug, and root structure (fibrous versus tap). For the 2025 UNPP/BMMN pilot, AP paper wrap was used. The Landis native milkweed research project started with AP paper wrap in year 1 and now is trialing FP paper wrap in year 2.

## 8.3 Constraints on Propagation Methods with Earth Pots Due to Compressed Media

The paper wrap forms a tube around the plug which is open on top and bottom. The media is held in place by compression from the paper wrap. The amount of compression is not an issue for root development but must be considered for propagation.

Seeds can be sown in Earth Pots with standard, dibble method and covered with media displaced by dibble.

To pot up from a smaller to larger Earth Pot, a hole must first be drilled into the larger Earth Pot with a wood drill bit. The auger style bit design of wood drill bit is necessary to remove media to make room to insert smaller plug. The larger Earth Pot is required to have a diameter approximately 30 mm larger than smaller Earth Pot. This process is quick and faster than potting up with loose media.

Although stabilized plugs are often used for vegetative propagation, the compressed media design constrains the use of Earth Pot plugs to insert of a bare stem. Earth Pot plugs will not work for cuttings with roots already established in sand or other loose media.

#### 8.4 Unit Cost of Earth Pots, Containers and Trays

Unit costs for Earth Pots, containers, and trays are summarized in Table 4. Unit costs are listed for direct comparison. Minimum quantities are required for purchase. Earth Pots are removed from the growth container prior to transporting to purchaser for outplant. Therefore, growth containers can be reused and costs for containers/trays should be one-time upfront costs. OBC NW will refill the Blackmore tray systems for standard plug sizes. OBC NW can mail plugs and trays by UPS or US mail or deliver by truck (delivery every 2 weeks to Southwest Oregon). Customers can also pick up plugs and trays at OBC NW store in Canby. Shipping costs can exceed the cost of plugs and trays, depending on size of order.

**Table 4. Unit Cost. Earth Pot Sizes, Containers, Unit Cost.**

Use	Size (mm)	Volume (ci)	Container/Tray	Nominal Tray Dimensions	Unit Cost Per Earth Pot Plug	Unit Cost/Cell: Combined Plug, Container/Tray
Mini-plug: Germination, Pot Up	20 x 40	1.3	144-cell Blackmore	10"x20"	\$0.02	\$0.03
Mini-plug: Spring outplant	35 x 60	6	72-cell Blackmore	10"x20"	\$0.06	\$0.07
Standard Plug: Direct sow	35 x 150	15	Deepot 16H/D50T 50 cell	12"x24	\$0.13	\$0.57
Standard Plug: Direct sow or pot up from 20mm x 40mm	50 x 200	40	Deepot 40H/D20T 20 cell	12"x15	\$0.17	\$1.09
	60 x 140	36	21-cell Blackmore	10"x20"	\$0.14	\$0.22

Unit costs of the manufactured Earth Pot plugs for small nurseries are similar by volume to cost of loose media products like Sunshine Mix #4 (commonly used for native plant plug propagation) purchased from local big-box stores, because Earth Pot manufacturers like OBC NW purchase materials in bulk and have a large customer base. Savings in nursery labor cost is not estimated, however, based on 2024 and 2025 UNPP/BMMN pilots, there is major time savings in labor with paper-wrapped Earth Pots when filling Deepot containers or seed propagation trays compared with loose media.

#### 8.5 1020 Extra Strength (Heavy Duty) Solid Trays and 1020 Standard Web Tray

Blackmore trays used in 2025 UNPP/BMMN pilot are sized for use with standard 1020 trays. Solid bottom, extra strength trays were used for bottom watering, cold stratification of mini-plugs, and seed germination. Shallow depth (1.25" +/- deep) trays, sometimes referred to as germination trays, are required for the 40 mm long plugs. Standard depth (2.5" +/- deep) were used for 60 mm and longer plugs. 1020 web or daisy trays were used for additional support of the larger Blackmore tray while handling and for automated bottom-up watering during vegetative growth period.



## 9.0 NUMBER OF SEEDS SOWN PER CELL FOR AT LEAST ONE GERMINANT

The probability of at least one germinate per cell, based on germination rate and number of seeds planted, can be statistically computed. The equation and computations for 50% and 75% germination are listed in Table 5.

**Table 5. Percent Probability of At Last One Germinate Per Cell Versus Number of Seeds Sown**

Germination Rate	# Seeds Sown Per Cell	% Prob $\geq 1$ Germinate Per Cell
50%	1	50.00%
	2	75.00%
	3	87.50%
	4	93.75%
75%	1	75.00%
	2	93.75%
	3	98.44%
	4	99.61%

Formula:

$GP$  = germination rate per seed in percent

$N$  = number of seeds sown per cell

$P$  = probability of at least one germinant per cell

$P = (1 - (1 - GP/100)^N) * 100$

## 10.0 HANDLING OF SEEDS

For UNPP/BMMN 2025 pilot the objective for seed starts is to have at least one germinant per cell in 90% of the cells sown. To meet this objective it necessary to have an accurate, controlled sowing rate of 3 to 5 seeds per plug cell.

The following photograph provides a relative comparison of seed size for the UNPP/BMMN 2025 pilot, including a toothpick for perspective of scale.



**Relative seed size. Left to right:**

- Asclepias fascicularis  
120 seeds/gram
- Lomatium utriculatum  
450 seeds/gram
- Eriophyllum lanatum  
3,100 seeds/gram
- Drymocallis glandulosa  
2,900 seeds/gram

Based on 2024 UNPP/BMMN pilots, 1,100 seeds per gram is approximate limit of seed size where special handling is required. Larger seeds can be handled with seed sower and chop stick to control individual seeds. Smaller seeds require special handling to count and place individual seeds. Three methods of seed handling were piloted to control individual seeds for counting and sowing for the 2025 pilot.

**SH1. Standard Handling Method.** Seeds larger than density of 1,100 seeds per gram

Hand-held seed sower (with plastic top removed). Chopstick used for counting and for manually controlling the number of seeds dispensed from sower for planting (reference 2024 UNPP/BMMN pilot).



**SH2. Water Adhesion (Moist Toothpick). Special Handling Method.** Seeds smaller than density of 1,100 seeds per gram

Seeds are picked up with the end of a moist toothpick. The seeds stick to the toothpick due to water adhesion and are placed directly on moist media or wet paper towels (for baggy method). Reading glasses were used as a magnifier for picking up seeds. It is possible to accurately pick up individual seeds and to pick up 3 or 4 seeds at a time. Media can be manually cleaned off toothpick with paper towel and toothpick remoistened from glass of water as needed.

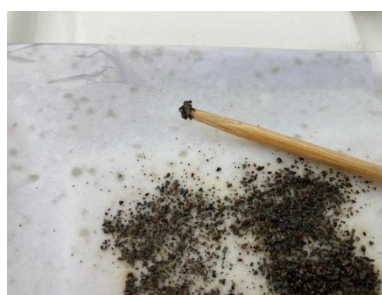
See Youtube: Handy Tip For Planting Small Seeds. Gardens that Matter.

<https://www.youtube.com/watch?v=jiVVlxfp4NM>



**SH3. Sand Mix. Special Handling Method.** Seeds smaller than density of 1,100 seeds per gram

Seeds mixed with dry sand. The mix was then moistened by misting with water from spray bottle. A chop stick was used to sow the moist, sand/seed mix after cold stratification. Mix ratio of 1/4 (0.25) teaspoon of clean sand per 10 plugs. Average of 5 seeds per plug was estimated by weight of seeds. This method is not as accurate or precise as SH2 and was included to test an alternative method of cold stratification.



The “pinch method”, where a pinch of seeds between fingers, is referenced in some protocols for sowing tiny seeds. This method was not included in the 2025 UNPP/BMNN pilot since the method does not provide the desired control/precision on number of seeds to be sown in plug cells.

## 11.0 MEASURED SEED DENSITY

BMMN used a milligram scale to weigh seed samples in range of approximately 50 to 150 seeds (depending on seed size). The number of seeds were counted for each sample. Table 6 provides a comparison between published densities and measured densities by BMMN.



Weight and seed count for *Lomatium utriculatum*

**Table 6. Comparison Between Published and Measured Seed Density**

Genus Species	Seed Density (per gram)	
	Published	Measured
<i>Asclepias fascicularis</i>	50 to 200	120
<i>Lomatium utriculatum</i>	150 to 180 (a) 300 to 400 (b)	450
<i>Eriophyllum lanatum</i> (w/chaff)	1,800 to 2650	2,100
<i>Eriophyllum lanatum</i> (clean)	1,800 to 2650	3,100
<i>Drymocallis glandulosa</i>	2,500	2,900

Notes:

(a) RNGR UC/CSU-Chico. CA. 2006

(b) Northwest Meadowscares website, seed sales

## 12.0 SCARIFICATION

Four methods used for scarification used in 2025 UNPP/BMMN pilot.

SC0: None

SC1: Chemical - 1% hydrogen peroxide 24-hr soak followed by 24-hr water soak

SC2: Physical/mechanical – 120 grit sandpaper followed by 24-hour water soak

SC3: Physical/mechanical – 120 grit sandpaper and cut off seed tip, followed by 24-hour water soak

Methods SC1, SC2, SC3 were used only for *Asclepias fascicularis* seeds. Coffee filter was used to strain seeds after soaking in water or hydrogen peroxide.



SC1. 1% hydrogen peroxide soak followed by water



SC2. Scarification with light sanding between two pieces of 120 grit sandpaper, followed by water soak.



SC3. Scarification with sandpaper, cut off tip at radicle end of seed with scalpel, followed by water soak.

### 13.0 COLD MOIST STRATIFICATION

Seeds for most species of native herbaceous forbs need cold stratification prior to germination. It is important to emphasize that refrigerated cold stratification is required for the consistent and uniform germination necessary for contract growing, especially for nurseries located at lower elevations in western Oregon.

The number of days of cold stratification listed in published protocols is the number of consecutive 24-hour days with continuous temperature of less than 40 degrees F. Natural stratification, using the winter sowing method where seeds are sown in containers in the fall and left outside during the winter, will not provide the consistent germination required for contract nursery production at the lower elevations in Douglas County (Umpqua Basin). Winter temperatures are not cold enough.

Large nurseries use walk-in coolers as refrigeration for artificial cold stratification. Planted plug containers are placed in the refrigerated storage. However, this method is not affordable for most small producers.

Two methods of cold stratification using a household refrigerator were used for 2025 UNPP/BMMN pilot. The used household refrigerator was purchased for \$100. Temperature was kept between 34 and 37 degrees and monitored with a digital thermometer bought online. The two methods used were:

**CS1:** Seeds are sown in moist 20 mm x 40 mm Earth Pot mini plugs, sandwiched between two solid, extra strength 1020 trays, placed inside double-wrapped plastic bags sealed with rubber bands, and refrigerated in household refrigerator.

**CS2:** Seeds in baggy with moist paper towel refrigerated in household refrigerator.

#### Method CS1

The Earth Pots are shipped dry in trays and initially must be bottom watered. The Earthpot tray is set inside of a solid, extra strength 1020 tray with water and left to soak for 2 hours. A shallow (1.5" deep) 1020 tray is used for the 20 mm x 40 mm Earthpot trays. The Earthpot tray is removed after soaking.



Seeds sown with method SH1 or SH2. Dibble used to make indentation in each plug. Seeds pressed into indentation and covered as needed with loose media in plugs. Two solid 1020 trays were used to cover the top and bottom of Earth Pot Blackmore trays, with shallow 1020 tray on bottom and standard depth 1020 tray on top for vertical stacking. Shallow 1020 trays placed on top for cover would reduce volume.



Trays are placed in two (double wrapped) 45-gallon plastic bags to maintain moisture in trays while refrigerated. Bags were sealed with rubber bands so bags could be opened to check on trays. Note that Earth Pot plugs stayed moist for 90 days in refrigerator with no additional moisture added after initial soak. The refrigerator had capacity of 16 cubic feet, and it is estimated could hold 20 of the 144 cell Earth Pot trays or roughly 2,800 of the 20 mm x 40 mm plugs.



### Method CS2

The “improved” baggy method was used where paper (shop) towels are cut into single pieces that will fit inside quart zip lock bags, the cut towels misted with spray bottle to moisten after inserting in bags, seeds then placed in bags on top of moist towels, zip locks sealed, and bags labeled with marker. For seed handling method SH3 (tiny seeds mixed with sand), the moist sand mix was placed on the moist towels in bags. For cold stratification the bags can be folded and stored in cardboard box while refrigerated. Approximately 100 to 200 seeds per bag were used for 2024 and 2025 UNPP pilots. This method requires relatively small volume, and 2,000 or more seeds can be cold stratified in shoe box size container.

See following videos:

1. A Better Way to Cold Stratify Seeds for Faster Germination. Garden Fundamentals. URL: [https://www.youtube.com/watch?v=-j-rXMRfv\\_c](https://www.youtube.com/watch?v=-j-rXMRfv_c)
2. Improved paper towel and baggy method for germinating seeds (fast). Garden Fundamentals. URL: <https://www.youtube.com/watch?v=dirz0WIMQj0>



#### 14.0 PLANTING METHODS FOR 2025 PILOT

All seedlings were started in 20 mm x 40 mm Earth Pot mini plugs in 144 cell strays and emergent transplanted (potted up) to larger Earth Pots. Following are the three planting methods used in 2025 UNPP/BMMN pilot:

PM1. Direct seeding in 20 mm x 40 mm Earth Pot mini plugs prior to cold stratification in refrigerator. Transplant emergent to larger Earth Pot plugs when seedlings are established after removing plugs from cold stratification.

PM2. Cold stratification with baggy method. Direct seeding in 20 mm x 40 mm Earth Pot mini plugs after cold stratification but prior to germination. Transplant emergent from 20 mm x 40 mm plugs to larger Earth Pot plugs when seedlings are established.

PM3. Cold stratification and germination with baggy method. Germinate seeds in baggy after cold stratification. Plant the germinates from baggy in 20 mm x 40 mm Earth Pot mini plugs. Transplant emergent from 20 mm x 40 mm plugs to larger Earth Pot plugs when seedlings are established.

#### 15.0 NUMBER SEEDS PLANTED PER PLUG

Table 7. Number of Seeds Sown Per Cell for Pilot Test

Species	Seed Handling Method	Average Seeds Sown per Cell
<i>Asclepias fascicularis</i> (a)	Standard: SH1	2
<i>Lomatium utriculatum</i>	Standard: SH1	3
<i>Eriophyllum lanatum</i>	Special: SH2	3
	Special: SH3 (b)	5
<i>Drymocallis glandulosa</i>	Special: SH2	4
	Special: SH3 (b)	5

Notes:

(a) Due to large seed size, 2 seeds were sown in each 20 mm x 40 mm plug

(b) Average number of seeds estimated by weight, not counted

#### 16.0 BASELINE GERMINATION TESTING

Multiple factors influence the germination rate of seeds. BMMN/UNPP piloted a method in 2024 and 2025 to measure the baseline germination rate of seeds used for production, which eliminates all variables related to seed germination except for seed viability, scarification and cold stratification. Germination rates are measured for refrigerated cold stratification periods of 0 days, 30 days, 60 days, 90 days, or until an acceptable germination rate is measured.

Ten seeds are placed on a moist paper towel inside a baggy. The paper towel is not folded so that seeds can be visually observed without opening baggy. After refrigeration, baggy is kept in location with temperature of 60 to 70 deg F. Baggy is placed upside down so roots (during germination) grow downwards towards plastic, rather than into paper towel. Seeds are inspected every 2 or 3 days, for 14 days, to track the germination rate and to check that towel remains moist.



The same method is used to prepare the baggies as Method CS2 described in Section 13, except that 10 seeds are counted for each test sample, using either Seed Handling Method SH1 or SH2.

## 16.1 Germination Test Results

Number of seeds per test sample are listed in Table 8. Results are summarized in Table 9.

**Table 8. Baseline Germinate Testing: Number of Seeds per Test**

Species	Published Days Cold Stratification	Seed Handling Method	Scarification Method	Sample Time (days) and Sample Seed Count				Total Seed Count
				Test 1 0 days	Test 2 30 days	Test 3 60 days	Test 4 90 days	
Asclepias fascicularis	45-60	SH1	SC0	10	10	10	0	30
			SC1	10	10	10	0	30
			SC2	5	5	10	0	20
			SC3	5	5	10	0	20
Lomatium utriculatum	60-90	SH1	SC0	10	10	10	10	40
Eriophyllum lanatum	60-90	SH2	SC0	10	10	10	10	40
Drymocallis glandulosa	90	SH2	SC0	10	10	10	10	40

Notes:

1. Number of sample seeds in addition to seeds sown for propagation.
2. Minimum seed sample of 10 seeds per test recommended. The 5-seed test sample size used for SC2 and SC3 due to low numbers of remaining seeds available since methods SC1, SC2, and SC3 were added after low germinate rates for initial SC0 testing of *Asclepias fascicularis*.

**Table 9. Baseline Germinate Testing: Results**

Species	Published Days Cold Stratification	Scarification Method	Germination Rate and Days Cold Moist Stratification			
			0 days	30 days	60 days	90 days
Asclepias fascicularis	45-60	SC0	0%	0%	10%	NT (1)
		SC1	0%	10%	40%	NT
		SC2	40%	60%	80%	NT
		SC3	60%	40%	40%	NT
Lomatium utriculatum	60-90	SC0	0%	0%	90% (3)	EG (2)
Eriophyllum lanatum	90	SC0	0%	20%	40% (4)	EG
Drymocallis glandulosa (4)	90	SC0	0%	10%	30%	90%

Notes:

1. NT: Not tested
2. EG: Early germination in cold stratification found with 60-day sample. Sown seeds were pulled from refrigeration.
3. *Lomatium utriculatum* baggy samples displayed 88% early germination at 60 days. Waited to remove plugs from refrigeration until 7-day germinate results for other species. Emergents found in more than 50% of 20 mm x 40 mm Earthpot plugs when plug trays were pulled from refrigeration
4. *Eriophyllum lanatum* did not display early germinates for the 60-day test sample. However, found emergent in 20 mm x 40 mm Earthpot plugs when plug trays were checked for moisture so pulled at 68 days.

## 16.2 (Early) Germination in Cold Stratification

Seeds of some species will germinate during cold stratification. Both *Lomatium utriculatum* and *Eriophyllum lanatum* had seeds start to germinate in cold stratification. There are different strategies to address germination during cold stratification. The best strategy BMMN found during 2024 and 2025 pilots is to end cold stratification when germination is observed during cold stratification.



Germination of *Lomatium utriculatum* during cold stratification

## 16.3 Importance of Scarification of *Asclepias fascicularis* Seeds for Germination

*Asclepias fascicularis* seeds have hard shells. Germination is significantly improved with scarification, based on results pilot testing. See Table 9.

The shells of *Asclepias fascicularis* seeds were apparently weakened (effectively scarified) while cold stratified for 60 days in Earth Pot plug media. A baseline germination rate of 10% was measured with baggy method for *Asclepias fascicularis* with no scarification, Scarification Method SC0. However, a germination rate of 70% was observed by counting number of stems during establishment phase after cold stratification and dividing by number seeds sown (2 seeds per plug). The combination of SC0-CS1 is an effective option for uniform germination within a fixed-time frame.

Scarification Method SC2, physical scarification with sandpaper and soaking in water for 24 hours is a straightforward, low-cost method and test samples had the highest germination rate at 60 days of cold stratification methods tested. Scarification Method SC3 demonstrates the importance of scarification for germination of *Asclepias fascicularis* seeds. The radical tip of seed is cut off with scalpel followed by soaking in water for 24 hours. Germination test results for SC3 listed in Table 9 were between 40% and 60%, regardless of number of days in cold stratification.

## 17.0 PERCENT OF PLUGS WITH AT LEAST 1 EMERGENT

All species tested in pilot had 80% or more plugs with at least one emergent for methods PM1 (seeds sown in 20 mm x 40 mm Earth Pots prior to cold stratification). Species with tap roots had lower survival than species with fibrous roots when germinant was planted in plugs (PM3) – this is expected.

**Table 10. Seedling Emergent Rate. Percent of 20 mm x 40 mm Earth Pot Plugs with One or More Emergents**

Species	Cold Moist Stratification		Method	% Cells >= 1 Emergent 21 days after stratification
	Begin	End		
<i>Asclepias fascicularis</i>	3/31/2025	6/8/2025	SH1-SC0-CS1-PM1	92%
			SH1-SC2-CS2-PM2	80% (1)
			SH1-SC2-CS2-PM3	0%
<i>Lomatium utriculatum</i>	3/31/2025	6/8/2025	SH1-SC0-CS1-PM1	96%
			SH1-SC0-CS3-PM3	33% (2)
<i>Eriophyllum lanatum</i>	3/31/2025	6/8/2025	SH2-SC0-CS1-PM1	83%
			SH3-SC0-CS3-PM2/PM3	86% (3)
<i>Drymocallis glandulosa</i>	3/31/2025	7/1/2025	SH2-SC0-CS1-PM1	90%
			SH3-SC0-CS3-PM2	69% (4)

Notes:

1. One seed planted per cell for PM2 test sample due to limited seed availability. Two seeds per cell plant for PM1.
2. 90% of seeds germinated in cold stratification so method PM2 was not tested.
3. 40% of seeds germinated in cold stratification. Combined PM2/PM3 used for planting 20 mm x 40 mm Earth Pots.
4. PM2 not tested.



Asclepias fascicularis. 6/30/2025.  
22 days after cold stratification.



Domatium utriculatum. 6/26/2025.  
18 days after cold stratification.



Eriophyllum lanatum. 6/26/2025.  
18 days after cold stratification.



Drymocallis glandulosa. 7/17/2025.  
25 days after cold stratification.

### 18.0 POTTING UP

Emergents in 20 mm x 40 mm Earth Pot plugs were potted up (transplanted) after Establishment Phase. Twenty-one days is recommended timeframe for potting up after removing the mini plugs from cold stratification (CS); enough time to determine which plugs will have at least one viable emergent but with root development not yet restricted by plug depth. The percentage of plugs started that had seedlings suitable for transplant is summarized in Table 11. Selecting germinant for Eriophyllum lanatum to sow after cold stratification (PM3) increased percentage, however, this was small sample size (20 plugs); for contract growing will be more cost effective to sow prior to cold stratification due to decreased labor.

**Table 11. Percent of Mini Plugs Transplanted (Potted Up)**

Species	Date Potted Up	Days After CS	Method	% Cells >= 1 Emergent	% Cells with Acceptable Emergent	% Mini Plugs Started Viable for Transplant
Asclepias fascicularis	7/01/2025	23	SH1-SC0-CS1-PM1	92%	90%	83%
			SH1-SC2-CS2-PM2	80%	90%	72%
			SH1-SC2-CS2-PM3	0%	0%	0%
Lomatium utriculatum	7/02/2025	24	SH2-SC0-CS1-PM1	96%	87%	84%
			SH3-SC0-CS3-PM3	33%	90%	30%
Eriophyllum lanatum	7/03/2025	25	SH2-SC0-CS1-PM1	83%	86%	71%
			SH3-SC0-CS3-PM2/PM3	86%	100%	86%
Drymocallis glandulosa	7/26/2025	25	SH2-SC0-CS1-PM1	90%	98%	88%
			SH3-SC0-CS3-PM2	69%	73%	50%

The 20 mm x 40 mm and 50 mm x 200 mm Earth Pots plugs were both delivered to nursery on 3/27/2024, more than 3 months before up potting. The 50 mm x 200 mm Earth Pot media was dry and required soaking in water overnight for approximately 12 hours to hydrate. The 50 mm x 100 mm and 60 mm x 140 mm Earth Pot plugs were delivered in Blackmore trays and soaked in 1020 standard depth trays.



D40H containers and D20T tray were set inside 27-gallon tote. Water was added to depth of bottom of D20 T tray. 50 mm x 200 mm (40 ci) Earth Pot plugs inserted in D40H cells and soaked overnight to hydrate.

For potting up, OBC Northwest recommended: a) diameter of 50 mm plug to pot up from 20 mm diameter and b) 23 mm wood drill bit to drill hole and remove compressed media from Earth Pots. Chopstick was used to clear media from drill bit.



23 mm wood drill bit ordered online. Painter's tape used to mark depth – top of mini plug should be slightly below top of larger plug after up potting. Save media removed from larger Earth Pots in solid 1020 tray. The extra media can be used to fill in gaps and level surface.

Chop stick was sometimes necessary to help remove mini plugs from Blackmore trays without tearing paper; narrow end to loosen top of plug or flat end to push/pop up bottom of plug.



*Asclepias fascicularis*.  
23 days after cold stratification

*Lomatium utriculatum*.  
24 days after cold stratification

*Eriophyllum lanatum*.  
25 days after cold stratification

*Drymocallis glandulosa*.  
25 days after cold stratification

The up potting (transplanting) process was relatively fast and averaged approximately 30 seconds per plug. No loose media was added to bottom of the D40H containers before inserting the dry 50 mm x 200 mm Earth Pot plugs for hydrating. There was no issue with the 1.25” to 1.5” gap between top of container and plug. *Drymocallis glandulosa* was up potted into 50 mm x 100 mm and 60 mm x 140 mm Earth Pot plugs for pilot; these are standard plug sizes and were delivered in Blackmore Air trays. Following photographs were taken immediately after potting up.



*Asclepias fascicularis.*



*Lomatium utriculatum.*



*Eriophyllum lanatum.*



*Drymocallis glandulosa.*

### 19.0 ACTIVE GROWTH PHASE. ROOT AND VEGETATIVE DEVELOPMENT

Establishment phase was designated as starting when seeds removed from cold stratification and ending when seedlings were potted up; timeframe ranged from 23 to 25 days. True leaves were visible for all 4 species.

Active growth phase followed and was designated as ending when senescence was observed. Table 12 summarizes information for active growth phase. The long active growth phases were published in the early 2000’s by University of California - California State University, Chico. Seeds were sown and placed in outdoor cold frames in November and initial fall germination triggered the start of active growth period.

**Table 12. Active Growth Phase, 2025 Pilot**

Species	Start Active Growth Phase	Thinned to One Seedling	Senescence begins		Length of Active Growth Phase (months)	
			Published	2025 Pilot	Published	2025 Pilot
<i>Asclepias fascicularis</i>	7/1/2025	7/11/2025 (1)	Early fall	End of Aug to mid-Sep	6-8	2-2.5
<i>Lomatium utriculatum</i>	7/2/2025	Not thinned	Late spring to early summer	Late Jul to Aug	6-8	0.75-1.5
<i>Eriophyllum lanatum</i>	7/3/2025	7/24/2025	Early fall	Mid-Sep	8-9	2.5
<i>Drymocallis glandulosa</i>	7/26/2025	Not thinned	Fall	Mid to late Sep	1.25	1.25- 1.5

Note: 1. Published resources indicate thinning is not required for less than 2 to 3 seedlings per plug

A key indicator for successful propagation is whether seedlings meet target specifications. Table 13 compares target specifications (for Fall outplanting) from published protocols with observed growth in the 2025 pilot. Cold stratification of seeds began at the end of April (3/31/2025) with active growth phase beginning in July due to funding delay. All pilot species met or exceeded target specifications, with possible exception of *Lomatium utriculatum* which begins senescence in late spring to early summer - so active growth period was limited. Published protocols for *Lomatium* notes: *first year above-ground growth is slow, and seedlings only produce a few leaves as energy is focused on root development. Plants grow in early spring into summer and go dormant in mid-summer, giving appearance of mortality.*

**Table 14. Target Specifications and Observed Growth**

Species	Target Specifications	
	Published	Observed Growth 2025 Pilot
<i>Asclepias fascicularis</i>	Tap root diameter: 1-3 mm Tap root length: 100-300 mm long	Tap roots diameter: > 2 mm Tap root length: 200 mm long Seedling Height: 40-50 cm (16-20 inches)
<i>Lomatium utriculatum</i>	Tap root diameter: 1-2 mm Tap root length: 100-200 mm long	Tap roots diameter: > 1 mm Tap root length: 100 mm long Seedling Height: 5-7.5 cm (2-3 inches) tall <i>Notes:</i> Root development will be further evaluated during outplanting. Cold stratification should have started 2 months earlier, no later than Mar 1.
<i>Eriophyllum lanatum</i>	Fibrous roots Seedling Height: 4-15 cm (2-6 inches) tall	Established fibrous roots Seedling Height: 20-30 cm (8-10 inches) tall <i>Notes:</i> Many of the plants flowered in first season Dense vegetative growth
<i>Drymocallis glandulosa</i>	Fibrous root system firm in plug	Established fibrous roots Seedling Height: 10-15 cm (4-6 inches) tall <i>Notes:</i> Dense vegetative growth

**19.1 *Asclepias fascicularis*. Photo Log.**



7/1/2025. Start active growth



7/17/2025



8/15/2025



9/06/2025. Senescence 8/31/2025, minor browning leaves.



9/21/2025. Stems turning color

**19.2 *Lomatium utriculatum*. Photo Log.**



7/2/2025. Start active growth



7/26/2025. Senescence observed in some seedlings.



8/15/2025



9/6/2025. Dormant

**19.3 *Eriophyllum lanatum*. Photo Log.**



7/3/2025. Start active growth



7/26/2025



8/15/2025. Dense vegetative growth



9/6/2025. Plants flowering.



10/03/2025. Senescence.

#### 19.4 *Drymocallis glandulos*. Photo Log.



7/26/2025. Start active growth



8/15/2025



9/06/2025. Dense vegetative growth

#### 20.0 HARDENING PHASE

Plants were acclimated to outside conditions through roll-ups, shade cloth, and circulation fans. Consensus from the published protocols for the pilot species is that hardening is not required for fall outplanting since the plants have started senescence. This is different from spring outplanting when plants have active vegetative growth and hardening is a key step for successful outplanting. Regardless, the stabilized Earth Pot plugs minimize root shock during transplant.

#### 21.0 TRANSPORT AND OUTPLANTING

UNPP will pilot options for packaging and storage when outplanting in Fall 2025. Typically, plants are kept at nursery until outplanting and Earth Pot plugs are removed from plastic containers prior to transport.

Extra care must be taken when removing Earth Pot plugs with herbaceous forbs, especially when plants are approaching dormancy. Trees and shrubs with woody stems and fibrous roots can be grabbed by stem and plug lifted from container. This will damage herbaceous forbs. Do not grab the paper at top of Earth Pot plug as this will tear the paper. It is important to expose enough of plug to grip the outside of plug by hand to prevent tearing paper. Deepot containers can be removed individually from tray and tipped sideways until gravity loosens plug. For larger Blackmore containers, insert the smooth end of a Sharpy pen into each of the four drain holes to loosen plug and then push (pop up) plug until it can be gripped by hand.

Plugs must be packaged to prevent plugs from tipping over and being damaged during transport. Kintigh Nursery uses square (gusseted) 1.5 mm bags with open tops. White Oak Farm Nursery uses plastic wrap.



White Oak Farm Nursery.



Kintigh's Nursery.

For outplanting in field plugs can be carried in Foresty tree plant bags. Bulb planting augers, operated with handheld cordless drill, can be purchased from retail stores and used to drill holes for the planting plugs.

Following YouTube video provides an example of using cordless drill and auger for planting. Ellepot Tree Hand Planting. <https://www.youtube.com/watch?v=dr5cpHXO0ns>

## **21.0 INFRASTRUCTURE**

BMMN greenhouse was used for 2025 pilot. The Earth Pot/Ellepot system can be readily scaled for small and beginning producers. Contact UNPP for more information.

## **22.0 PILOT RESULTS AND PROTOCOLS**

The Appendix includes detailed protocols for each of the pilot species based on pilot test results. The protocols are formatted as stand-alone documents.

Paper-wrapped stabilized plugs like the Earth Pot/Ellepot system are a cost-effective, labor efficient method for contract growing of hard to grow, native herbaceous forbs.

Table 3 provides a reference for selection of final growth size for plugs and containers. Selection should be systematic and based on characteristics of species (Table 2), outplanting season, and target specifications.

Starting with 20 mm x 40 mm plugs for cold stratification and establishment phase and up potting into Earth Pots with minimum diameter of 50 mm for active growth phase was used with excellent results. With potting up, 100 percent of the larger plugs survived for outplanting, which is an efficient use of larger plugs and containers.

Direct seeding is required for Earth Pots with diameters less than 50 mm.

The Baggy method is an option for refrigerated cold stratification of seeds for direct seeding after cold stratification. However, the Baggy method will not work as consistently as sowing seeds in mini plugs prior to refrigeration for: a) tiny seeds smaller than density of 1,100 seeds per gram or b) species with seeds that (pre)germinate during cold stratification and have tap roots.

Seed handling method SH2, using a toothpick and water adhesion, is a precise method of counting tiny seeds while sowing.

Irrigation and fertilization are described in Appendix protocols.

Further evaluation is needed for: 1) selection of AP or FP paper wrap type for fall outplanting, and 2) methods after propagation to remove plugs from plastic containers, packaging the Earth Pots for transport, storage prior to and after transport, and outplant in field. The evaluation could be done by visiting and networking with other nurseries and buyers that are growing and outplanting Earth Pot plugs in the field to learn from their experience.

**APPENDIX A****Asclepias fascicularis****Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>TAXONOMY</b>	
Genus (species)	Asclepias (fascicularis)
Common name	Narrow-leaved milkweed
Species code	ASFA
Guild	Herbaceous perennial forb
Root structure	Tap root, rhizome
Years to mature	2 to 3
Senescence begins	Early fall
Seed collection timeframe	Late summer or early fall
Published seed density (seeds per gram)	50 to 200
<b>PUBLISHED REFERENCES FOR PROPAGATION PROTOCOL</b>	
Native Plant Network — Reforestation, Nurseries and Genetics Resources (RNGR)	UC/CSU-Chico. CA. 2006 USDA FS. Dorena Resource Center. OR. 2018
Tom D. Landis, Consultant, Retired USDA	Research Project on Growing Two Early Growing CA Milkweeds in Stabilized Media – 2025
<b>PROPAGULES (SEEDS)</b>	
Source	Wild collected
Location	Umpqua Basin. Winston, OR. Douglas County.
Elevation	550 feet
Seed lot ID or Accession number	ASCFAS-Pop3027-Lot230-Coll2024
Date(s) collected	10/3/2024
Collection method	NA
Processing and cleaning method	NA
Viability testing	80% based on destructive pilot test with scalpel
Measured seed density (seeds per gram)	120 (pilot test measurement)
<b>OBJECTIVES</b>	
Propagation Goal	Plants
Propagation Method	Seed
Outplant Season	Fall – first year of propagation
Product Type	Stabilized plug (paper wrapped)
Type and Size of Stabilized Plug (Final)	Elle Pot/Earth Pot, 50 mm x 200 mm
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Growth Container/Tray (Final)	D40H/D20T, 2.5" x 10", 40 ci, 20 cell trays
Target Specifications	Tap root 1-3 mm in diameter and 10-30 cm long
<b>TIME TO GROW</b>	
Pre-treatment	2 months (68 days). Pilot start 3/31/2025
Establishment phase	0.75 months (23 days). Pilot start 6/8/2025
Active growth phase	2 months. Potted up 7/01/2025.
Senescence observed	8/31/2025 minor browning of lower leaves. 9/15/2025 stem color starts to darken
Hardening phase	Not required due to senescence. Acclimated to outside temperatures in greenhouse with rollups.
Total time to grow. Fall outplant.	5 to 7 months including pre-treatment. Suggest start by March 1 for pre-treatment and May 1 to begin establishment phase.

**Appendix A Continued**

**Asclepias fascicularis**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>GROWING AREA</b>	
Greenhouse	Yes
Rollups	Yes
Insect screen	Yes
Shade cloth	Yes
Circulation fans	Yes
Thermostat controlled exhaust fan/shutters	Yes
Thermostat controlled heat	Yes. Set for 40 degrees
Refrigeration	Yes. Household refrigerator. Cold stratification
<b>PROPAGATION DETAILS</b>	
<b>Seed Handling</b>	
Seed handling method	SH1. Standard. <1,100 seeds/gram Large enough to sort individual seeds.
<b>Pre-Planting Treatments</b>	
Scarification methods	SC0: None SC1: Chemical - 1% hydrogen peroxide 24-hr soak followed by 24-hr water soak SC2: Physical/mechanical – 120 grit sandpaper followed by 24-hour water soak SC3: Physical/mechanical – 120 grit sandpaper and cut off seed tip, followed by 24-hour water soak
Cold moist stratification methods. Refrigerate at temperature range of 34 to 37 deg F	CS1: Seeds sown in 20mm x 40 mm Earth Pots, 144 cell vented tray. Earth Pots saturated prior to sowing seeds by 2-hour water soak in solid, extra strength, shallow (1-in deep) 1020 tray. For refrigeration, 144 cell vented tray placed in dry, solid, extra strength shallow 1020 tray and covered with second solid, extra strength 1020 tray, then tray “sandwich” placed in two (double wrapped) 45-gal plastic bags, sealed with rubber band. CS2: Seeds in baggy with moist paper towel
Cold moist stratification period	68 days, Start: 3/31/2025 End: 6/8/2025.
<b>Planting Method</b>	
All seedlings were started in 20 mm x 40 mm Earth Pot mini plugs in 144 cell strays and emergent transplanted (potted up) to larger Earth Pots.	PM1. Direct seeding in 20 mm x 40 mm Earth Pot mini plugs prior to cold stratification. PM2. Direct seeding in 20 mm x 40 mm Earth Pot mini plugs after cold stratification PM3. Planting germinates in 20 mm x 40 mm Earth Pot mini plugs after cold stratification in baggy with moist paper towel. Germinate roots grew so fast in 3 to 5 days that roots were damaged during germinate planting; therefore, this method was abandoned.
Number seeds sown per mini plug	PM1. Two (2). Maximum per mini-plug size PM2. One (1). Limited number of seeds available.

**Appendix A Continued**

**Asclepias fascicularis**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Germination Rates</b>	
Method 1: Baseline germination testing. Baggy method (moist paper towel in baggy) at 70 deg F. Final count at 14 days.	Test 1. 0 days cold stratification. 10 seeds. Test 2. 30 days after cold stratification. 10 seeds. Test 3. 60 days after cold stratification. 10 seeds.
Method 2: Germination by stem count of emergent, after cold stratification.	Counted the total emergent stems in 144 cell trays and divided by total number of seeds sown.
<p>Measured germination rate.</p> <p>Results listed are for 60 days cold stratification. Detailed breakdown in Table A-1.</p> <p>Germination peaked at 60 days of cold stratification. Exception is scarification method SC3 with tip cut off seed; the germination rate was independent of cold stratification time.</p> <p>Approximately 80% of seeds with tips cut off with scalpel had visible embryo. 80% is assumed to be maximum germination rate possible for seed lot.</p>	<p>SC0-CS1 (Earth Pot): 70%. Stem count. Rate with cold stratification in 20mm x 40mm plugs significantly exceeded SC0-CS2 (baggy). Assumption is cold stratification in moist Earth Pot media weakened coating of seeds (scarified).</p> <p>SC0-CS2 (baggy): 10% SC1-CS2 (baggy): 40% SC2-CS2 (baggy): 80% SC3-CS2 (baggy): 40%. Rate independent of # days in cold stratification. Option for expediated propagation.</p>
Timeframe for germinant	Most in 3 to 5 days, 14 days maximum. Rapid growth of germinant in baggy.

**Table A-1. Summary of Germination Testing, ASFA**

Species	Published Days Cold Stratification	Scarification Method	Germination Rate and Days Cold Moist Stratification				
			0 days	30 days	60 days	75 days	90 days
Asclepias fascicularis	45-60	SC0-CS1	NT	NT	70%	NT	NT
		SC0-CS2	0%	0%	10%	NT	NT
		SC1-CS2	0%	10%	40%	NT	NT
		SC2-CS2	40%	60%	80%	NT	NT
		SC3-CS2	60%	40%	40%	NT	NT

**Appendix A Continued**

**Asclepias fascicularis**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Phase I: Establishment</b>	
Plug size	20 mm x 40 mm Earth Pot (mini plugs)
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Containers	144 cell octagon vented tray
Tray	Solid 1020 shallow extra strength tray (1" deep)
"Date Sowed". Date removed from cold stratification. For planting method PM1 seeds were sown prior to cold stratification.	6/8/2025
Saturate plug media	Plug media should be moist prior to sowing. Soak Earth Pots in the 144-cell vented tray in solid 1020 shallow tray prior to initial sowing. Remove from water after soaking.
Sowing method	Use dibble to create hole 1/8" to 1/4" deep in each plug. After placing seeds in hole, use finger to cover with media displaced by dibble. Due to large ASFA seed size, maximum of 2 seeds sown per 20 mm x 40 mm plug.
Germination location	Greenhouse. Heater thermostat set at 40 deg F. Brought inside house (natural window light) when outside temperature exceeded 85 degrees.
Heat pad	None. Outside temperature warm enough.
Humidity Dome	None. Warm outside temperatures.
Watering	<u>Manual bottom up (subirrigation) watering.</u> Frequency once every 2 to 3 days to keep plug media moist. Do not let plugs dry out. Placed the 144-cell octagon vented tray in solid, shallow 1020 tray with water for 10 to 15 minutes. <u>Mist spray bottle.</u> Mist spray to keep plug surface moist. Will need to also bottom-up water to keep plug media moist.
Fertilizer	None
<b>Seedling Emergent Rates</b>	
Test: Count of cells with >= 1 emergent , after cold stratification.	Counted number of cells with at least 1 emergent stem in 144 cell trays
% Cells >= 1 emergent	SC0-CS1-PM1. 92% of mini plugs (2 seeds per cell) SC2-CS2-PM2. 80% of mini plugs (1 seed per cell)
Timeframe for emergents	7 to 21 days, most in less than 14 days

**Appendix A Continued**

**Asclepias fascicularis**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Potting Up</b>	
Date emergents transplanted (potted up) from 20 mm x 40 mm Earth Pot mini plugs to 50 mm x 200 mm Earth Pot plugs	7/01/2025. 23 days after cold strat. Recommend 21-days maximum due to rapid root growth.
Potting Up Method Instructions	23 mm wood drill bit and electrical drill. Hole drilled 40 mm+ deep (so top of mini plug is slightly below top of 50 mm x 200 mm plug). Pot up after Earth Pot plugs are inserted in D40H/D20T containers/trays and media is saturated. Media is removed with wood drill. Save removed media in container to smooth out plug surface as needed.
% Cells with emergents transplanted (potted up)	<u>90% of the mini plugs with emergent potted up.</u> SC0-CS1-PM1. 83% of mini plugs started in cold stratification were suitable for transplanting into final container size (92% x 90% = 83%). SC2-CS2-PM2. 72% of mini plugs sown after cold stratification were suitable for transplanting into final container size (80% x 90% = 72%).
<b>Phase II: Active Grow Phase. Target Specifications for Root and Vegetative Development</b>	
Plug size	50 mm x 200 mm Earth Pot
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Containers	Deepot D40H Note: D30L is too short (sets too high in D20T tray) for automated watering in flood tray
Tray	D20T Support Tray (20 cell)
Insert Earth Pot plugs in container	Insert Earth Pot plugs directly in D40H containers. No media prefill required. After saturation, top of Earth Pot plug will be 1" to 1.5" below top of D40H – not an issue for propagation.
Saturate Earth Pot plug media after inserting in containers/trays	Insert the D40H containers into D20T trays. Set tray in 27-gallon tote partially filled with water for 12 hours.
Up pot 20 mm x 40 mm plugs	See instructions under "Potting Up"
Irrigation Bottom-up watering (subirrigation) for pilot	<u>Manual</u> Set D20T tray in 27-gallon tote partially filled with water overnight. <u>Automated flood and drain/flood tray</u> 45-minute cycle <u>Frequency</u> Keep media moist. 50 mm x 200 mm plugs are difficult to rehydrate. Frequency depends on amount of vegetative growth and temperature – adjust based on observation. For manual watering, start with once every 2 to 3 days. For automated watering the maximum was daily watering with three 45-minute cycles spaced at 2-hour intervals.

**Appendix A Continued**

**Asclepias fascicularis**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

Fertilizer Plugs, N concentration: 50 ppm, early development 100 ppm, established growth  Stop fertilizing at onset of senescence	Product: Soluble Tracite Foliar 20-20-20 Mix: <u>50 ppm N:</u> 1/4 teaspoon per one gallon 3.33 oz per 100 gallons <u>100 ppm N:</u> 1/2 teaspoon per one gallon 6.67 oz per 100 gallons Frequency: Each watering during active vegetative growth. Add new fertilizer when irrigation water is replaced for bottom-up watering.
Date thinned (seed notes)	7/11/2025. Thinned to one stem per cell. 10 days after potting up. However, published resources note that 2 to 3 stems per cell is okay.
Vegetative growth period	2 months plus. Tallest plants 16 to 20 inches (400 to 500 mm) in height. Rapid stem growth and seedlings lean horizontally. As stem diameter increases, ends of plants grow vertically. Multiple offshoots from stems may occur.
Date start of senescence observed	Minor browning of a few lower leaves on 8/31/2025. Stem color began to darken in mid-September.
50 mmx 200 mm plugs suitable for outplanting	<u>100 percent</u> 83% of plugs sown prior to cold stratification (92% emergent x 90% up pot x 100% = 83%) 72% of plugs sown after cold stratification (70% emergent x 90% up pot x 100% = 72%)
<b>Phase III: Hardening</b>	
Begin hardening phase (fall outplant)	Unnecessary for fall outplant with senescence. Starting 8/31/2025 plants were acclimated to outside temperature with rollups, shade cloth, and circulation fans. Reduced watering – kept plugs moist and stopped fertilizing.
<b>Phase IV: Outplanting</b>	
Removal of plugs from containers	Do not grab top of paper wrap on Earth Pot plugs – the paper will tear. Remove D40H container from D20T tray. Tip D40H container on its side until gravity loosens plug. Expose enough plug from container to grasp with hand without tearing paper wrap.
Packaging plugs for transport and storage	UNPP will pilot options for packaging and storage when outplanting in Fall 2025.
Transplant method	20-amp battery powered drill and 2.76” diameter plant auger to drill holes at the planting site
Transfer to UNPP	BMMN transferred plugs to UNPP on 10/5/2025.

**APPENDIX B****Lomatium utriculatum****Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>TAXONOMY</b>	
Genus (species)	Lomatium (utriculatum)
Common name	Spring gold
Species code	LOMUTR
Guild	Herbaceous perennial forb
Root structure	Tap root
Years to mature	3
Senescence begins	Late spring to early summer
Seed collection timeframe	Mid-spring to early summer
Published seed density (seeds per gram)	150 to 180
<b>PUBLISHED REFERENCES FOR PROPAGATION PROTOCOL</b>	
Native Plant Network — Reforestation, Nurseries and Genetics Resources (RNGR)	UC/CSU-Chico. CA. 2006
<b>PROPAGULES (SEEDS)</b>	
Source	Wild collected
Location	Umpqua Basin: Oak Flats. Douglas County, OR
Elevation	2,000 feet
Seed lot ID or Accession number	LOMUTR-Pop3007-Lot188-Coll2024
Date(s) collected	6/27/2024
Collection method	NA
Processing and cleaning method	NA
Viability testing	NA
Measured seed density (seeds per gram)	450. Pilot test measurement.
<b>OBJECTIVES</b>	
Propagation Goal	Plants
Propagation Method	Seed
Outplant Season	Fall – first year of propagation
Product Type	Stabilized plug (paper wrapped)
Type and Size of Stabilized Plug (Final)	Elle Pot/Earth Pot, 50 mm x 200 mm
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Growth Container/Tray (Final)	D40H/D20T, 2.5" x 10", 40 ci, 20 cell trays
Target Specifications (Fall outplant)	LOGU: Tap root 1 to 2 mm dia and 10 to 20 cm long LOGR: <i>First-year: tap root few leaves about ground</i>
<b>TIME TO GROW</b>	
Pre-treatment	2 months (68 days). Pilot start 3/31/2025. Removed due to 90% germination in cold stratification.
Establishment phase	0.83 months (25 days). Pilot start 6/08/2025
Active growth phase	1.5 months. Potted up 7/03/2025.
Senescence observed	Late July to mid-August start.
Hardening phase	Not required due to senescence. Acclimated to outside temperatures in greenhouse with rollups.
Total time to grow. Fall outplant.	4 to 6 months including pretreatment. Suggest start pretreatment by Feb 1 and establishment phase by Apr 1 due to early senescence.

**Appendix B Continued**

**Lomatium utriculatum**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>GROWING AREA</b>	
Greenhouse	Yes
Rollups	Yes
Insect screen	Yes
Shade cloth	Yes
Circulation fans	Yes
Thermostat controlled exhaust fan/shutters	Yes
Thermostat controlled heat	Yes. Set for 40 degrees
Refrigeration	Yes. Household refrigerator. Cold stratification
<b>PROPAGATION DETAILS</b>	
<b>Seed Handling</b>	
Seed handling method	<u>SH1. Standard. &lt;1,100 seeds/gram</u> <u>Large enough to sort individual seeds.</u>
<b>Pre-Planting Treatments</b>	
Scarification methods	SC0: None
Cold moist stratification methods. Refrigerate at temperature range of 34 to 37 deg F	CS1: Seeds sown in 20mm x 40 mm Earth Pots, 144 cell vented tray. Earth Pots saturated prior to sowing seeds by 2-hour water soak in solid, extra strength, shallow (1-in deep) 1020 tray. For refrigeration, 144 cell vented tray placed in dry, solid, extra strength shallow 1020 tray and covered with second solid, extra strength 1020 tray, then tray “sandwich” placed in two (double wrapped) 45-gal plastic bags, sealed with rubber band. CS2: Seeds in baggy with moist paper towel.
Cold moist stratification period	68 days. Start: 3/31/2025 End: 6/8/2025. Removed due to germination in cold stratification. 88% of seeds germinated in cold stratification at 60 days.
<b>Planting Method</b>	
All seedlings were started in 20 mm x 40 mm Earth Pot mini plugs in 144 cell strays and emergent transplanted (potted up) to larger Earth Pots.	PM1. Direct seeding in 20 mm x 40 mm Earth Pot mini plugs prior to cold stratification. PM3. Planting germinates. 90% of seeds germinated in cold stratification at 60 days.
Number seeds sown per mini plug	PM1. Three (3) by count. PM3. One (1). Germinates from cold stratification.

**Appendix B Continued**

**Lomatium utriculatum**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Germination Rates</b>	
Method 1: Baseline germination testing. Baggy method (moist paper towel in baggy) at 70 deg F. Final count at 14 days. <i>Note: No sand mix</i>	Test 1. 0 days cold stratification. 10 seeds. Test 2. 30 days after cold stratification. 10 seeds. Test 3. 60 days after cold stratification. 10 seeds. Test 4. 90 days after cold stratification. 10 seeds.
Measured germination rate.	Test 1. SCO (baggy/no sand): 0%. Test 2. SCO (baggy/no sand): 0% Test 3. SCO (baggy/no sand): 90% in cold strat. Test 4. SCO (baggy/no sand): Not tested Stopped cold stratification after 90% germinates found in Test 3 while in cold stratification.
Timeframe for germinant	Not observed in test samples due to germination in cold stratification. However, due to high percentage of germinates during 60 days in cold stratification, it appears that most seeds germinate within 14 days after required cold stratification.
<b>Phase I: Establishment</b>	
Plug size	20 mm x 40 mm Earth Pot (mini plugs)
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Containers	144 cell octagon vented tray
Tray	Solid 1020 shallow extra strength tray (1" deep)
"Date Sowed". Date removed from cold stratification. For planting method PM1 seeds were sown prior to cold stratification.	6/8/2025
Saturate plug media	Plug media should be moist prior to sowing. Soak Earth Pots in the 144-cell vented tray in solid 1020 shallow tray prior to initial sowing. Remove from water after soaking.
Sowing method	Use dibble to create hole 1/8" to 1/4" deep in each plug. After placing seeds in hole, use finger to cover with media displaced by dibble.
Germination location	Greenhouse. Heater thermostat set at 40 deg F. Brought inside house (natural window light) when outside temperature exceeded 85 degrees.
Heat pad	None. Outside temperature warm enough.
Humidity Dome	None. Warm outside temperatures.
Watering	<u>Manual bottom up (subirrigation) watering.</u> Frequency once every 2 to 3 days to keep plug media moist. Do not let plugs dry out. Placed the 144-cell octagon vented tray in solid, shallow 1020 tray with water for 10 to 15 minutes. <u>Mist spray bottle.</u> Mist spray to keep plug surface moist. Will need to also bottom-up water to keep plug media moist.
Fertilizer	None

**Appendix B Continued**

**Lomatium utriculatum**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Seedling Emergent Rate</b>	
Test: Count of cells with >= 1 emergent , after cold stratification.	Counted number of cells with at least 1 emergent stem in 144 cell trays
% Cells >= 1 emergent	SC0-CS1-PM1. 96% (3 seeds per cell) SC2-CS3-PM3. 33% (1 seed per cell ) Assume tap roots of germinates damaged during planting
Timeframe for emergents	Emergents in >50% of plugs when removed from cold stratification. 7 to 21 days for remainder, most in less than 14 days
<b>Potting Up</b>	
Date emergents transplanted (potted up) from 20 mm x 40 mm Earth Pot mini plugs to 50 mm x 200 mm Earth Pot plugs	7/02/2025. 24 days after cold stratification. Recommend 21-days.
Potting Up Method Instructions	23 mm wood drill bit and electrical drill. Hole drilled 40 mm+ deep (so top of mini plug is slightly below top of 50 mm x 200 mm plug). Pot up after Earth Pot plugs are inserted in D40H/D20T containers/trays and media is saturated. Media is removed with wood drill. Save removed media in container to smooth out plug surface as needed.
% Cells with emergents transplanted (potted up)	SC0-CS1-PM1. 87%. 86% of mini plugs started in cold stratification were suitable for transplanting into final container size (96% x 87% = 86%). 3 seeds per plug. SC0-CS3-PM3. 90%. 30% of mini plugs sown after cold stratification were suitable for transplanting into final container size (33% x 90% = 20%). 1 seed per plug.
<b>Phase II: Active Grow Phase. Target Specifications for Root and Vegetative Development</b>	
Plug size	50 mm x 200 mm Earth Pot
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Containers	Deepot D40H Note: D30L is too short (sets too high in D20T tray) for automated watering in flood tray
Tray	D20T Support Tray (20 cell)
Insert Earth Pot plugs in container	Insert Earth Pot plugs directly in D40H containers. No media prefill required. After saturation, top of Earth Pot plug will be 1” to 1.5” below top of D40H – not an issue for propagation.
Saturate Earth Pot plug media after inserting in containers/trays	Insert the D40H containers into D20T trays. Set tray in 27-gallon tote partially filled with water for 12 hours.
Up pot 20 mm x 40 mm plugs	See instructions under “Potting Up”



**Appendix B Continued**  
**Lomatium utriculatum**  
**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<p>Irrigation  Bottom-up watering (subirrigation) for pilot</p>	<p><u>Manual</u>  Set D20T tray in 27-gallon tote partially filled with water overnight.  <u>Automated flood and drain/flood tray</u>  45-minute cycle  <u>Frequency</u>  Keep media moist. 50 mm x 200 mm plugs are difficult to rehydrate. Frequency depends on amount of vegetative growth and temperature – adjust based on observation. For manual watering, start with once every 2 to 3 days. For automated watering the maximum was daily watering with three 45-minute cycles spaced at 2-hour intervals.</p>
<p>Fertilizer  Plugs, N concentration:  50 ppm, early development  100 ppm, established growth   Stop fertilizing at onset of senescence</p>	<p>Product: Soluble Tracite Foliar 20-20-20  Mix:  <u>50 ppm N:</u>  1/4 teaspoon per one gallon  3.33 oz per 100 gallons  <u>100 ppm N:</u>  1/2 teaspoon per one gallon  6.67 oz per 100 gallons  Frequency:  Each watering during active vegetative growth. Add new fertilizer when irrigation water is replaced for bottom-up watering.</p>
<p>Date thinned (seed notes)</p>	<p>No thinning</p>
<p>Vegetative growth period</p>	<p>1 to 1.5 months.  75 mm to 125 mm stem height for most plants. Slow vegetative growth for LOMUTR in first year was also observed in other references as tap root develops and due to early senescence. Suggest starting establishment phase in early March or April rather than early June start for 2025 pilot.</p>
<p>Date start of senescence observed</p>	<p>Late July to mid-August, dependent on specific plug. Note complete die back of vegetative growth to the root as plants go dormant.</p>
<p>50 mmx 200 mm plugs suitable for outplanting</p>	<p><u>100 percent of 50 mm x 200 mm plugs</u>  86% of plugs sown prior to cold stratification (96% emergent x 87% up pot x 100% = 86%)</p>

**Appendix B Continued**

**Lomatium utriculatum**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Phase III: Hardening</b>	
Begin hardening phase (fall outplant)	Unnecessary for fall outplant with senescence. Starting 8/31/2025 plants were acclimated to outside temperature with rollups, shade cloth, and circulation fans. Reduced watering – kept plugs moist and stopped fertilizing.
<b>Phase IV: Outplanting</b>	
Removal of plugs from containers	Do not grab top of paper wrap on Earth Pot plugs – the paper will tear. Remove D40H container from D20T tray. Tip D40H container on its side until gravity loosens plug. Expose enough plug from container to grasp with hand without tearing paper wrap.
Packaging plugs for transport and storage	UNPP will pilot options for packaging and storage when outplanting in Fall 2025.
Transplant method	20-amp battery powered drill and 2.76” diameter plant auger to drill holes at the planting site
Transfer to UNPP	BMMN transferred plugs to UNPP on 10/5/2025.

**APPENDIX C****Eriophyllum lanatum****Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>TAXONOMY</b>	
Genus (species)	Eriophyllum (lanatum)
Common name	Oregon Sunshine
Species code	ERLA6
Guild	Herbaceous perennial forb
Root structure	Fibrous
Years to mature	1 to 2. Most flower and seed the first year.
Senescence begins	Early fall
Seed collection timeframe	Mid-summer to early fall
Published seed density (seeds per gram)	1,800 to 2,650
<b>PUBLISHED REFERENCES FOR PROPAGATION PROTOCOL</b>	
Native Plant Network — Reforestation, Nurseries and Genetics Resources (RNGR)	UC/CSU-Chico. CA. 2006 USDA NRCS. Pullman PMC. WA. 2007
ESRM 412–Native Plant Production	Spring 2015. UW
<b>PROPAGULES (SEEDS)</b>	
Source	Wild collected
Location	Callahan Meadows
Elevation	2,100 feet
Seed lot ID or Accession number	Umpqua Basin ERILAN-Pop1578-Lot208-Coll2023
Date(s) collected	7/18/2023
Collection method	NA
Processing and cleaning method	NA
Viability testing	NA
Measured seed density (seeds per gram)	3,070 (clean). 2,094 (with chaff). Pilot test.
<b>OBJECTIVES</b>	
Propagation Goal	Plants
Propagation Method	Seed
Outplant Season	Fall – first year of propagation
Product Type	Stabilized plug (paper wrapped)
Type and Size of Stabilized Plug (Final)	Elle Pot/Earth Pot, 50 mm x 200 mm
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Growth Container/Tray (Final)	D40H/D20T, 2.5" x 10", 40 ci, 20 cell trays
Target Specifications (Fall outplant)	Height 40 to 150 mm tall with fibrous roots
<b>TIME TO GROW</b>	
Pre-treatment	2 months (68 days). Pilot start 3/31/2025. Removed due to germination in cold stratification.
Establishment phase	0.83 months (25 days). Pilot start 6/08/2025
Active growth phase	2.5 months. Potted up 7/03/2025.
Senescence observed	Mid-September minor browning of lower leaves.
Hardening phase	Not required due to senescence. Acclimated to outside temperatures inside greenhouse with rollups, shade cloth, and fans for circulation.
Total time to grow. Fall outplant.	6 to 8 months including pretreatment. Suggest start pretreatment by Feb 1 to Mar 1 and establishment phase by May 1

**Appendix C Continued**

**Eriophyllum lanatum**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>GROWING AREA</b>	
Greenhouse	Yes
Rollups	Yes
Insect screen	Yes
Shade cloth	Yes
Circulation fans	Yes
Thermostat controlled exhaust fan/shutters	Yes
Thermostat controlled heat	Yes. Set for 40 degrees
Refrigeration	Yes. Household refrigerator. Cold stratification
<b>PROPAGATION DETAILS</b>	
<b>Seed Handling</b>	
Seed handling method	<u>SH2. Special: tiny seeds, &gt;1100 seeds/gram.</u> Moist toothpick, water adhesion to place seeds
<b>Pre-Planting Treatments</b>	
Scarification methods	SC0: None
Cold moist stratification methods. Refrigerate at temperature range of 34 to 37 deg F	CS1: Seeds sown in 20mm x 40 mm Earth Pots, 144 cell vented tray. Earth Pots saturated prior to sowing seeds by 2-hour water soak in solid, extra strength, shallow (1-in deep) 1020 tray. For refrigeration, 144 cell vented tray placed in dry, solid, extra strength shallow 1020 tray and covered with second solid, extra strength 1020 tray, then tray "sandwich" placed in two (double wrapped) 45-gal plastic bags, sealed with rubber band. CS3: Tiny seeds mixed with dry sand, sand moistened after mix and stratified in baggy with moist paper towel. Ratio of 1/4 (0.25) teaspoon clean sand per 10 plugs. Average of 5-10 seeds per plug by weight.
Cold moist stratification period	68 days. Start: 3/31/2025 End: 6/8/2025. Removed due to germination in cold stratification. Published recommendation 90 days.
<b>Planting Method</b>	
All seedlings were started in 20 mm x 40 mm Earth Pot mini plugs in 144 cell strays and emergent transplanted (potted up) to larger Earth Pots.	PM1. Direct seeding in 20 mm x 40 mm Earth Pot mini plugs prior to cold stratification. PM2. Sowed moist sand mix in 20 mm x 40 mm Earth Pot mini plugs after cold stratification PM3. Due to pre-germination in cold stratification, some germinates with sand mix sown in mini plugs
Number seeds sown per mini plug	PM1. Three (3) by count. PM2/PM3. Estimated average of seeds each by weight

**Appendix C Continued**

**Eriophyllum lanatum**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Germination Rates</b>	
Method 1: Baseline germination testing. Baggy method (moist paper towel in baggy) at 70 deg F. Final count at 14 days. <i>Note: No sand mix</i>	Test 1. 0 days cold stratification. 10 seeds. Test 2. 30 days after cold stratification. 10 seeds. Test 3. 60 days after cold stratification. 10 seeds. Test 4. 90 days after cold stratification. 10 seeds.
Measured germination rate.	Test 1. SCO (baggy/with sand): 0%. Test 2. SCO (baggy/with sand): 20% Test 3. SCO (baggy/with sand): 40%. Test 4. SCO (baggy/with sand): Not tested Baggy test sample did not display germinates in cold stratification for the 60-day test sample. However, found emergents in 20 mm x 40 mm Earth Pot plugs when trays were checked for moisture so pulled trays from refrigeration.
Timeframe for germinant	Most in 7 days, 14 days maximum
<b>Phase I: Establishment</b>	
Plug size	20 mm x 40 mm Earth Pot (mini plugs)
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Containers	144 cell octagon vented tray
Tray	Solid 1020 shallow extra strength tray (1" deep)
"Date Sowed". Date removed from cold stratification. For planting method PM1 seeds were sown prior to cold stratification.	6/8/2025
Saturate plug media	Plug media should be moist prior to sowing. Soak Earth Pots in the 144-cell vented tray in solid 1020 shallow tray prior to initial sowing. Remove from water after soaking.
Sowing method	Tiny seeds. Use dibble to make shallow indentation in center of each plug. After placing seeds in indent, use finger to press seeds into media and lightly cover with media from plug as needed.
Germination location	Greenhouse. Thermostat set at 40 degrees F. Brought inside house (natural window light) when outside temperature exceeded 85 degrees.
Heat pad	None. Outside temperature warm enough.
Humidity Dome	None. Warm outside temperatures.
Watering	<u>Manual bottom up (subirrigation) watering.</u> Frequency once every 2 to 3 days to keep plug media moist. Do not let plugs dry out. Placed the 144-cell octagon vented tray in solid, shallow 1020 tray with water for 10 to 15 minutes. <u>Mist spray bottle.</u> Mist spray to keep plug surface moist. Will need to also bottom-up water to keep plug media moist.
Fertilizer	None

**Appendix C Continued**

**Eriophyllum lanatum**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Seedling Emergent Rate</b>	
Test: Count of cells with >= 1 emergent , after cold stratification.	Counted number of cells with at least 1 emergent stem in 144 cell trays
% Cells >= 1 emergent	SC0-CS1-PM1. 83% (3 seeds per cell) SC2-CS3-PM2/PM3. 86% (5 to 10 seeds per cell +/-)
Timeframe for emergents	7 to 21 days, most in less than 14 days
<b>Potting Up</b>	
Date emergents transplanted (potted up) from 20 mm x 40 mm Earth Pot mini plugs to 50 mm x 200 mm Earth Pot plugs	7/03/2025. 25 days after cold stratification. Recommend 21-days maximum.
Potting Up Method Instructions	23 mm wood drill bit and electrical drill. Hole drilled 40 mm+ deep (so top of mini plug is slightly below top of 50 mm x 200 mm plug). Pot up after Earth Pot plugs are inserted in D40H/D20T containers/trays and media is saturated. Media is removed with wood drill. Save removed media in container to smooth out plug surface as needed.
% Cells with emergents transplanted (potted up)	SC0-CS1-PM1. 86%. 71% of mini plugs started in cold stratification were suitable for transplanting into final container size (83% x 86% = 71%). 3 seeds per plug. SC0-CS3-PM2/PM3. 100%. 86% of mini plugs sown after cold stratification were suitable for transplanting into final container size (86% x 100% = 86%). Est. 5 seeds per plug. Did select sand with visible germinants for transplanting which likely increased percentage.
<b>Phase II: Active Grow Phase. Target Specifications for Root and Vegetative Development</b>	
Plug size	50 mm x 200 mm Earth Pot
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Containers	Deepot D40H Note: D30L is too short (sets too high in D20T tray) for automated watering in flood tray
Tray	D20T Support Tray (20 cell)
Insert Earth Pot plugs in container	Insert Earth Pot plugs directly in D40H containers. No media prefill required. After saturation, top of Earth Pot plug will be 1" to 1.5" below top of D40H – not an issue for propagation.
Saturate Earth Pot plug media after inserting in containers/trays	Insert the D40H containers into D20T trays. Set tray in 27-gallon tote partially filled with water for 12 hours.
Up pot 20 mm x 40 mm plugs	See instructions under "Potting Up"

**Appendix C Continued**  
**Eriophyllum lanatum**  
**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<p>Irrigation  Bottom-up watering (subirrigation) for pilot</p>	<p><u>Manual</u>  Set D20T tray in 27-gallon tote partially filled with water overnight.  <u>Automated flood and drain/flood tray</u>  45-minute cycle  <u>Frequency</u>  Keep media moist. 50 mm x 200 mm plugs are difficult to rehydrate. Frequency depends on amount of vegetative growth and temperature – adjust based on observation. For manual watering, start with once every 2 to 3 days. For automated watering the maximum was daily watering with three 45-minute cycles spaced at 2-hour intervals.</p>
<p>Fertilizer  Plugs, N concentration:  50 ppm, early development  100 ppm, established growth   Stop fertilizing at onset of senescence</p>	<p>Product: Soluble Tracite Foliar 20-20-20  Mix:  <u>50 ppm N:</u>  1/4 teaspoon per one gallon  3.33 oz per 100 gallons  <u>100 ppm N:</u>  1/2 teaspoon per one gallon  6.67 oz per 100 gallons  Frequency:  Each watering during active vegetative growth. Add new fertilizer when irrigation water is replaced for bottom-up watering.</p>
<p>Date thinned (seed notes)</p>	<p>7/24/2025. Thinned to one or two stems per cell. 21 days after potting up.</p>
<p>Vegetative growth period</p>	<p>2.5 months. Plants exceeded 300 mm (12 inches in height). Dense vegetive growth. Many of the plants flowered. Recommend minimum 40 cubic inch plug for fall outplant.</p>
<p>Date start of senescence observed</p>	<p>Minor browning of a few lower leaves in mid-September.</p>
<p>50 mmx 200 mm plugs suitable for outplanting</p>	<p><u>100 percent of 50 mm x 200 mm plugs</u>  71% of plugs sown prior to cold stratification (83% emergent x 76% up pot x 100% = 71%)  86% of plugs sown after cold stratification (86% emergent x 100% up pot x 100% = 86%)  <i>Selecting germinants to sow after cold stratification increased percentage – however, this species has fibrous roots and for contract growing is likely more cost effective to sow prior to cold stratification due to decreased labor.</i></p>

**Appendix C Continued**

**Eriophyllum lanatum**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Phase III: Hardening</b>	
Begin hardening phase (fall outplant)	Unnecessary for fall outplant with senescence. Starting 8/31/2025 plants were acclimated to outside temperature with rollups, shade cloth, and circulation fans. Reduced watering – kept plugs moist and stopped fertilizing.
<b>Phase IV: Outplanting</b>	
Removal of plugs from containers	Do not grab top of paper wrap on Earth Pot plugs – the paper will tear. Remove D40H container from D20T tray. Tip D40H container on its side until gravity loosens plug. Expose enough plug from container to grasp with hand without tearing paper wrap.
Packaging plugs for transport and storage	UNPP will pilot options for packaging and storage when outplanting in Fall 2025.
Transplant method	20-amp battery powered drill and 2.76” diameter plant auger to drill holes at the planting site
Transfer to UNPP	BMMN transferred plugs to UNPP on 10/5/2025.

**APPENDIX D****Drymocallis glandulosa****Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>TAXONOMY</b>	
Genus (species)	Drymocallis (glandulosa) Potentilla (glandulosa)
Common name	Sticky cinquefoil
Species code	POGL9
Guild	Herbaceous perennial forb
Root structure	Fibrous
Years to mature	2 to 3
Senescence begins	Fall
Seed collection timeframe	Mid to late summer
Published seed density (seeds per gram)	2,500
<b>PUBLISHED REFERENCES FOR PROPAGATION PROTOCOL</b>	
Native Plant Network — Reforestation, Nurseries and Genetics Resources (RNGR)	USDA NRCS. Corvallis PMC. OR. 2015 USDA FS. Seed processing. R6 Bend. OR. 2008
<b>PROPAGULES (SEEDS)</b>	
Source	Wild collected
Location	Oak Flats
Elevation	2,000 feet
Seed lot ID or Accession number	Umpqua Basin DRYGLA-Pop1540-Lot216-Coll2023
Date(s) collected	7/21/2023
Collection method	NA
Processing and cleaning method	NA
Viability testing	NA
Measured seed density (seeds per gram)	2,900. Pilot test measurement.
<b>OBJECTIVES</b>	
Propagation Goal	Plants
Propagation Method	Seed
Outplant Season	Fall – first year of propagation
Product Type	Stabilized plug (paper wrapped)
Type and Size of Stabilized Plug (Final)	Elle Pot/Earth Pot, 50 mm x 100 mm, 20 ci Elle Pot/Earth Pot, 60 mm x 140 mm, 40 ci
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Growth Container/Tray (Final)	Blackmore Air Tray Extra Deep, 32 cells (20 ci) Blackmore Air Tray, 21 cells (40 ci)
Target Specifications (Fall outplant)	Root system firm in plug
<b>TIME TO GROW</b>	
Pre-treatment	3 months (90 days). Pilot start 3/31/2025
Establishment phase	0.83 months (25 days). Pilot start 7/01/2025
Active growth phase	1.25 months. Potted up 7/26/2025.
Senescence observed	Late-September minor browning of lower leaves.
Hardening phase	Not required due to senescence. Acclimated to outside temperatures in greenhouse with rollups.
Total time to grow. Fall outplant.	5 to 6 months including pretreatment. Suggest start pretreatment by Mar 1 and establishment phase by June 1

**Appendix D Continued**

**Drymocallis glandulosa**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>GROWING AREA</b>	
Greenhouse	Yes
Rollups	Yes
Insect screen	Yes
Shade cloth	Yes
Circulation fans	Yes
Thermostat controlled exhaust fan/shutters	Yes
Thermostat controlled heat	Yes. Set for 40 degrees
Refrigeration	Yes. Household refrigerator. Cold stratification
<b>PROPAGATION DETAILS</b>	
<b>Seed Handling</b>	
Seed handling method	SH2. Special: tiny seeds, >1100 seeds/gram. Moist toothpick, water adhesion to place seeds
<b>Pre-Planting Treatments</b>	
Scarification methods	SC0: None
Cold moist stratification methods. Refrigerate at temperature range of 34 to 37 deg F	CS1: Seeds sown in 20mm x 40 mm Earth Pots, 144 cell vented tray. Earth Pots saturated prior to sowing seeds by 2-hour water soak in solid, extra strength, shallow (1-in deep) 1020 tray. For refrigeration, 144 cell vented tray placed in dry, solid, extra strength shallow 1020 tray and covered with second solid, extra strength 1020 tray, then tray "sandwich" placed in two (double wrapped) 45-gal plastic bags, sealed with rubber band. CS3: Tiny seeds mixed with dry sand, sand moistened after mix and stratified in baggy with moist paper towel. Ratio of 1/4 (0.25) teaspoon clean sand per 10 plugs. Average of 5 seeds per plug by weight.
Cold moist stratification period	90 days. Start: 3/31/2025 End: 7/1/2025. Published recommendation 90 days.
<b>Planting Method</b>	
All seedlings were started in 20 mm x 40 mm Earth Pot mini plugs in 144 cell strays and emergent transplanted (potted up) to larger Earth Pots.	PM1. Direct seeding in 20 mm x 40 mm Earth Pot mini plugs prior to cold stratification. PM2. Sowed moist sand mix in 20 mm x 40 mm Earth Pot mini plugs after cold stratification
Number seeds sown per mini plug	PM1. Four (4) by count. PM2. Estimated average 5 seeds each by weight

**Appendix D Continued**  
**Dryocallis glandulosa**  
**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Germination Rates</b>	
Method 1: Baseline germination testing. Baggy method (moist paper towel in baggy) at 70 deg F. Final count at 14 days. <i>Note: No sand mix</i>	Test 1. 0 days cold stratification. 10 seeds. Test 2. 30 days after cold stratification. 10 seeds. Test 3. 60 days after cold stratification. 10 seeds. Test 4. 90 days after cold stratification. 10 seeds.
Measured germination rate.	Test 1. SCO (baggy/with sand): 0%. Test 2. SCO (baggy/with sand): 10%. Test 3. SCO (baggy/with sand): 30%. Test 4. SCO (baggy/with sand): 90%
Timeframe for germinant	Most in 7 days, 14 days maximum
<b>Phase I: Establishment</b>	
Plug size	20 mm x 40 mm Earth Pot (mini plugs)
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Containers	144 cell octagon vented tray
Tray	Solid 1020 shallow extra strength tray (1" deep)
"Date Sowed". Date removed from cold stratification. For planting method PM1 seeds were sown prior to cold stratification.	7/1/2025
Saturate plug media	Plug media should be moist prior to sowing. Soak Earth Pots in the 144-cell vented tray in solid 1020 shallow tray prior to initial sowing. Remove from water after soaking.
Sowing method	Tiny seeds. Use dibble to make shallow indentation in center of each plug. After placing seeds in indent, use finger to press seeds into media and lightly cover with media from plug as needed.
Germination location	Greenhouse. Thermostat set at 40 degrees F. Brought inside house (natural window light) when outside temperature exceeded 85 degrees.
Heat pad	None. Outside temperature warm enough.
Humidity Dome	None. Warm outside temperatures.
Watering	<u>Manual bottom up (subirrigation) watering.</u> Frequency once every 2 to 3 days to keep plug media moist. Do not let plugs dry out. Placed the 144-cell octagon vented tray in solid, shallow 1020 tray with water for 10 to 15 minutes. <u>Mist spray bottle.</u> Mist spray to keep plug surface moist. Will need to also bottom-up water to keep plug media moist.
Fertilizer	None

**Appendix D Continued**

**Drymocallis glandulosa**

**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Seedling Emergent Rate</b>	
Test: Count of cells with >= 1 emergent , after cold stratification.	Counted number of cells with at least 1 emergent stem in 144 cell trays
% Cells >= 1 emergent	SC0-CS1-PM1. 90% (4 seeds per cell) SC2-CS3-PM2. 69% (5 seeds per cell +/-)
Timeframe for emergents	7 to 21 days, most in less than 14 days
<b>Potting Up</b>	
Date emergents transplanted (potted up) from 20 mm x 40 mm Earth Pot mini plugs to 50 mm x 200 mm Earth Pot plugs	7/26/2025. 25 days after cold stratification. Recommend 21-days maximum.
Potting Up Method Instructions	23 mm wood drill bit and electrical drill. Hole drilled 40 mm+ deep (so top of mini plug is slightly below top of 50 mm x 200 mm plug). Pot up after Earth Pot plugs are inserted in D40H/D20T containers/trays and media is saturated. Media is removed with wood drill. Save removed media in container to smooth out plug surface as needed.
% Cells with emergents transplanted (potted up)	SC0-CS1-PM1. 98%. 88% of mini plugs started in cold stratification were suitable for transplanting into final container size (90% x 98% = 88%). 3 seeds per plug. SC0-CS3-PM2. 73%. 50% of mini plugs sown after cold stratification were suitable for transplanting into final container size (69% x 73% = 50%). 5 seeds per plug.
<b>Phase II: Active Grow Phase. Target Specifications for Root and Vegetative Development</b>	
Plug size	Elle Pot/Earth Pot, 50 mm x 100 mm, 20 ci Elle Pot/Earth Pot, 60 mm x 140 mm, 40 ci
Vendor	OBC Northwest, Canby, Oregon
Media	Soil 1FS3, AP paper wrap
Containers/Tray Blackmore manufactures 1020 trays with cells	Blackmore Air Tray Extra Deep, 32 cells (20 ci) Blackmore Air Tray, 21 cells (40 ci)
Insert Earth Pot plugs in container	Plugs are shipped in Blackmore trays from OBC Northwest. Trays can be returned for refill.
Saturate Earth Pot plug media after inserting in containers/trays	Soak the Blackmore trays in 1020 solid, deep (2.5" depth) trays in water for 2 to 4 hours (until moist)
Up pot 20 mm x 40 mm plugs	See instructions under "Potting Up"

**Appendix DContinued**  
**Drymocallis glandulosa**  
**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<p>Irrigation  Bottom-up watering (subirrigation) for pilot</p>	<p><u>Manual</u>  Set Blackmore tray in 1020 solid, deep (2.5" depth) trays until media at plug surface is moist. Typically, 20 to 30 minutes.  <u>Automated flood and drain/flood tray</u>  30-minute cycle  <u>Frequency</u>  Keep media moist. Peat plugs are difficult to rehydrate. Frequency depends on amount of vegetative growth and air temperature – adjust based on observation. Start with once every 2 to 3 days at start of vegetative growth. For automated watering the maximum was daily watering with three 30-minute cycles spaced at 2-hour intervals.</p>
<p>Fertilizer  Plugs, N concentration:  50 ppm, early development  100 ppm, established growth   Stop fertilizing at onset of senescence</p>	<p>Product: Soluble Tracite Foliar 20-20-20  Mix:  <u>50 ppm N:</u>  1/4 teaspoon per one gallon  3.33 oz per 100 gallons  <u>100 ppm N:</u>  1/2 teaspoon per one gallon  6.67 oz per 100 gallons  Frequency:  Each watering during active vegetative growth. Add new fertilizer when irrigation water is replaced for bottom-up watering.</p>
<p>Date thinned (seed notes)</p>	<p>No thinning.</p>
<p>Vegetative growth period</p>	<p>1.25 months. Plants grew rapidly with dense growth. Plants were 100 mm to 150 mm or taller. Based on pilot, recommend the 60 mm x 140 mm plugs rather than 50 mm x 100 mm.</p>
<p>Date start of senescence observed</p>	<p>Minor browning of a few lower leaves in mid-September.</p>
<p>50 mmx 200 mm plugs suitable for outplanting</p>	<p><u>100 percent of 50 mm x 200 mm plugs</u>  88% of plugs sown prior to cold stratification (90% emergent x 98% up pot x 100% = 88%)  50% of plugs sown after cold stratification (69% emergent x 73% up pot x 100% = 50%)</p>

**Appendix D Continued**  
**Drymocallis glandulosa**  
**Propagation Protocol Information. 2025 BMMN/UNPP Pilot.**

<b>Phase III: Hardening</b>	
Begin hardening phase (fall outplant)	Unnecessary for fall outplant with senescence. Starting 8/31/2025 plants were acclimated to outside temperature with rollups, shade cloth, and circulation fans. Reduced watering – kept plugs moist and stopped fertilizing.
<b>Phase IV: Outplanting</b>	
Removal of plugs from containers	Do not grab top of paper wrap on Earth Pot plugs – the paper will tear. The 21 and 32 cell Air Trays made by Blackmore have four holes in bottom of each tray cell. For 2025 pilot, used the bottom end (smooth) of sharpie pen and pushed into each of the four holes until plug was loosened, and then pushed from bottom with pen to lift the plug vertically until it could be grasped by hand.
Packaging plugs for transport and storage	UNPP will pilot options for packaging and storage when outplanting in Fall 2025.
Transplant method	20-amp battery powered drill and 2.76" diameter plant auger to drill holes at the planting site
Transfer to UNPP	BMMN transferred plugs to UNPP on 10/5/2025.