HERITAGE
seedlings, inc. Unusual Deciduous Species

SEEDING RATES AND METHODS

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A more detailed discussion can be found at: http://www.heritageseedlings.com/site-preparation in our "Native Willamette Valley Oak Habitat and Prairie Restoration Site-Preparation and Seeding Information"

Timing

Willamette Valley native seed should be sown in the fall to allow for cold/moist stratification (between 2-12 weeks) and to allow for a pre-sowing application of herbicide after a flush of weed seed. It also allows for a higher-diversity of species to be sown. Due the need for only a short period of cold stratification there are some species, including most of our native grasses and some forbs, that can be sown as late as early-March (a list of these species can be found in our "Disturbed Ground/Late-Seeding" mix). However, sowing late-winter runs the risk of germination followed by a spring drought and possibly low establishment rates. If there is concern about erosion, the seed can mixed with spring oats at about 30 lb/acre. This mix would have to be sown no later than mid-Sept to allow the oats to germinate and root. Do not use wheat since it exhibits allelopathy and can stop other species from germinating.

Seeding Rate

Seeding rates vary depending on seeds/lb (e.g. species with many seeds/lb should be sown at a lower rate) as well as the desired results. They also vary depending upon site conditions, seeding method, and precipitation.

Lower rates can be used for drilled seed because seed has very good contact with the soil and protection from predation. Many native species need light to germinate so the seed should be drilled no more than ¼ inch deep.

You should set a target number of seeds/sq. ft. depending on the site conditions and sowing method. Assume you need to almost double your sowing rate for seed that is broadcast. If you broadcast the seed, pressing the seed into the soil with a water drum or cement roller will help you lower your sowing rate and increase seed-soil contact. However, if the site is very clean, it is best not to disturb the soil too much. Sufficient establishment will occur without rolling.

Calculating Seeding Rate for a Single Species or Mix (PLS = Pure Live Seed)

Target # of seeds	X	43,560 sq. ft.	X	1 lb	=	lbs PLS
sq. ft.		acre		Known # of seeds per lb		Acre

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Calculating Seeding Rate for Mixed Species – it's all about the seed/lb/species and how many seeds/ft you want to sow.

A generic sowing mix calculator can be found at https://xerces.org/xerces-seed-mix-calculator/

A sample sowing rate calculator using the Xerces template and Heritage Seedlings' template with Willamette Valley native seed can be requested from Lynda at lboyer@heritageseedlings.com

PLS defined:

Formula	**Calculation**
The percent Purity is multiplied by the percent of Germination and divided by 100 to give the percent Pure Live Seed in a given lot of bulk seed. To determine how much bulk seed is needed to equal one PLS pound, one is divided by the PLS percent.	Potentilla glandulosa 2012 lot. 98% Purity x 69% Germination divided by 100 = 67.6%PLS in one bulk pound. One divided by 0.676 = 1.47. Therefore, 1.47 bulk pounds of Potentilla glandulosa seed is equal to one PLS pound.

Actual Seeding Rate *vs*. Calculated Seeding Rate

Since seed sold on a PLS pound basis will weigh more than an actual pound you will need to convert the seeding rate in PLS lbs/acre to the actual or bulk seeding rate to ensure the desired number of seeds/sq. ft. are applied. This can be calculated two different ways:

1) Divide the PLS rate by both the % Purity and the % Germination (TZ) expressed in a decimal fraction (these are found on the seed tag).

OR

2) Use the following formula:

$$\frac{\text{Bulk Wt (lb)}}{1} \times \frac{\text{Desired PLS lbs}}{\text{ac}} \times \frac{1}{\text{PLS lbs purchased}} = \frac{\text{actual lb}}{\text{ac}}$$

Target sowing rate and seeding rate calculations

EX: Sidalcea campestris has 100, 000 seeds/lb and you want 3 seeds/ft = 1.3 PLS lb/ac

You have 7.5 acres to seed so you order 10 lbs of seed (rounded)

The seed lot has a PLS value of 84% so 1/84% =1.2 bulk lbs = 1 lb PLS.

You get 12 bulk pounds delivered (10x1.2 = 12)

To seed at the desired rate of 1.3 PLS/ac you would need to seed at 1.6 lbs/ac.

Target Seeding Rates Mixed Species

A common target seeding rate for the Willamette Valley is **30 – 60 seeds/sq. ft**. On a very clean site (sprayed with herbicide two seasons) I achieved good establishment in some areas with a broadcast rate as low as 24 seeds/^{ft2} (see sowing methods section below).

It is probably better to err on the side of more seeds/sq. ft. If the soil is poor and the sowing rate too low, the stand will be inadequate, encouraging weeds. However, if the sowing rate is too high, you can create native "lawn" and the forbs will not flower due to high competition for resources.

Sowing rates will also vary depending on the goal of the restoration. Dense vegetation vs sparse, grass dominated vs forb dominated etc. For example, if the goal of the restoration is to create Streaked Horned-lark habitat, the grasses should be sown at a very low rate to provide the needed bare patches used for nesting (but be ready to combat weeds).

My own experience and the data of others give the following ranges for seeding rates:

Drilled Seed: **Larger** seeded grass species such as *Elymus glaucus* or *Festuca roemeri* 5 – 10 PLS lbs/acre (lower rates will leave room for forbs); smaller seeded grasses (such as Deschampsia, Koeleria, or Poa) can be sown at a very low rate of 0.5-2 lbs/acre, and forbs 0.5 – 8lb/acre. **It is best not to mix grasses and forbs together**. Early germinating grasses will take up space needed by later germinating forbs. *Note:* There are two species of native grasses *Danthonia californica* and *Achnatherum lemmonii* that need 12 weeks stratification so these are should either be drilled alone or broadcast applied.

Broadcast Seed (see below for methods and cutting agent suggestions): grasses 10 – 15 lb/acre; forbs 4 – 11 lbs/acre. I have not found it is necessary to press the seed into the soil since this disturbs the soil and may increase weed issues.

How Much Seed Do I Need?

sq. ft. to sow	X	1 acre	=	acres	X	PLS lbs	=	lbs of seed
1		43,560 sq. ft				Acre		

Seeding Sedges, Rushes and small seeded wetland forbs – A Special Case

Sedges, rushes, and some small seeded wetland perennials such as Saxifrage (an some vernal pool annuals) need four things to germinate: 1) good soil contact; 2) high soil temperatures; 3) water; and 4) light. Given these criteria, sedges, rushes, and small seeded wetland forbs should be ***broadcast sown only***. Extensive wet prairie restoration is occurring in the West Eugene Wetlands. The Ecologist for the project notes they broadcast sow sedges and forbs in the fall due to the inaccessibility of the sites during the winter. She recommends sowing at a very high rate and over a period of two years if possible. If there is still sufficient rain and the site is accessible, a late-winter seeding is also possible (most sedges need 1 month of cold-moist stratification). This ensures the seed is on a wet soil surface when the daytime temperatures heat the soil. She also notes the establishment can be affected by soil fertility. Pressing the seed into the soil will help improve seed/soil contact.

Legumes:

Legumes have a hard seed coat. If planted in the fall, most legumes will germinate by spring after they are scarified in nature. However, if you are planting late-winter or early-spring they will benefit from a light scarification before sowing. Use fine sandpaper (150 grit). Tape one piece of sandpaper into a bin with sides and rub small amounts of seed on it with an additional

piece of sandpaper. You can also shake them in a tin can with small gravel. Thirty seconds should do it (the seed coat should look dull).

SUGGESTED BROADCAST SOWING METHODS FOR NATIVE SEED

NOTE: For drilling suggestions, please see "Native Willamette Valley Oak Habitat and Prairie Restoration Site-Preparation and Seeding Information" on our Stewardship, *Site Preparation Page*.

Sowing Success Criteria:

- Reduce weeds on soil surface.
- Ensure good soil contact if possible without too much soil disturbance.
- Time the seeding to allow the appropriate amount of cold/moist treatment for germination (2 – 12 weeks depending on species, but a few only need heat).
- Do no bury the seed too deeply. We have had a high rate of success on multiple restoration projects simply broadcasting the seed even on moderate slopes. The seed will nestle into the soil profile during the first rains
- Mulch (straw, compost, fiber, wood chips etc) – to avoid burying the seed too deeply, mulch it not recommended – especially mulches that are wood based since they reduce the availability both light and nitrogen which the native seed needs to germinate. Jute matting can also limit the availability of light and is not necessary except on very steep slopes and/or riparian areas that might have overbanking water. Compost or straw can be used ONLY if applied no more than ¼ inch (this is also the recommended seed drill depth).
- **Do not panic** if you do not see baby plants in the winter especially if broadcast seeded. Natives are very tiny until seedlings appear mid-April and then look like plants by May **[photo 1].** If the spring is wet, some perennials will even flower 😊. First year restoration sites will be dominated by annuals and then, over-time, the perennials become dominant. Annuals will persist in areas of thin soil or seasonally wet areas with pooled water and in areas with low graminoid cover and areas disturbed by rodents.

Sowing Rates for Small Areas:

On clean site: 1 oz/250 sq. ft. (approximately 11 lb/acre). However, seed mixes vary and a mix with a lot of small seeded species can be sown at a lower rate than a mix with larger seeded species.

On sites occupied by some vegetation and/or weed seed: 1.5 – 2 oz/250 sq. ft.

Sowing Methods: – SEED MUST BE CUT WITH A CUTTING AGENT (see list below)

Mechanical:

1) A fertilizer *(spinner) spreader* can be rented at farm stores for a nominal fee. Mix the seed with a cutting agent such as **medium-grade vermiculite (other cutting agents are listed below).** If you choose vermiculite, please note that medium-grades will vary by producer. Look at a sample at the vendor of choice; the bag should weigh about 24 lbs for 3.5 cu ft; if it weighs more, then it will have too many fines and you should get their "coarse" **(PHOTO 2)**. Always err on the side of more cutting agent, and then go over the area twice to ensure good coverage.
2) ***Calibration for Spinner Spreader using vermiculite fall 2023:*** *5 bags did 8 acres 2x on a setting of 2 (0.61 bags/acre).* Just adjust the flow as you go until it seems about right.

3) *Mix the seed and vermiculite directly in the hopper.* We seeded two different mixes each on a 4-acre piece. One mix was 24 lb of seed (250,000 seed/lb) at 6 lb/acre and 34 seed/ft^2; the other mix was 36 lb (163,500 seed/lb) at 9 lb/acre for 33 seed/ft^2. For each 4-acre piece we did ½ the seed and ½ the vermiculite in the hopper and seeded one time then repeated the procedure for a second pass in the other direction. You can use a tarp or big bins to mix all the seed for your acreage with the correct amount of cutting agent and then fill the hopper. Mixes with bulky, large seeds do not flow as fast as mixes with small seed. Wear a high-quality dust mask when mixing and spreading the seed applying when the air is calm. While seeding, make sure the mix is flowing regularly and not bridging. Adjust the opening as necessary to make sure the seed goes the distance.
4) Although it is **not necessary**, some restoration practitioners press seed into soil with a drum or cement roller. Harrowing or cultipacking in **NOT RECOMMENDED** since it will dredge up weed seed. As noted above, if the site is clean of much of the weed seed bank establishment rates are good even without pressing the seed in with a roller. In 2010, a former grass seed field chemically fallowed for two years was broadcast seeded at 24 seeds/ft^2. It resulted in an average of one native plant per 4-6 inches in most places (PHOTO 3). *Prunella vulgaris var. lanceolata* was so happy it even bloomed the first year! (PHOTO 4). By year two (PHOTO 5) a highly successful native prairie had been established. A prescribed burn was conducted the third year after seeding. A May 2014 survey showed a high diversity prairie (52 species) was not only established but thriving (PHOTO 6). It was a testament to the patience needed for adequate site-preparation before seeding.

Hand:

1) The "Johnny Appleseed" method using a five-gallon bucket. Bucket seeding is good for very small amounts of seed or if the seed is large since it can bridge in a belly-crank seeder. However, you will need to use **much more cutting-agent** since, as with the fertilizer spreader, a person spreading with their hand cannot spread as far or as efficiently. For either method, you should calibrate how many square feet you can cover with a given amount of cutting agent. The seed will not factor in that much so just calibrate for the cutting agent. *My "Johnny Appleseed" Example:* - I can do about 1,800 ft^2 with a 5 lb bucket ¾ full of vermiculite (around 4 lbs). I double that so you I can do **2 passes** (so 8 lbs for 1800 ft^2). Put all the seed you want to sow in each area in a large bin with the calibrated amount of cutting agent. Currently I use Ultra Tech medium-grade vermiculite. A 3.5cu ft bag weighs 24#. This means I can seed around **0.12 acre with 1 bag of vermiculite.** Again, err on the side of cutting more, and then go over the area a few times in different directions. Press seed into the soil if possible.

Note: for small areas, if you can apply the seed/cutting agent mix to **top soil or mulch** this works nicely especially if applying seed later in the winter. This ensures good soil contact for germination and establishment. It is also OK to cover seed with a light dusting of soil (I sift potting soil through a sieve to dust the seeded area with fine soil). Cover only until you can barely see the cutting agent. This will hasten germination and help avoid predation.

2) Hand-cranked portable spreaders for seed and/or fertilizer (sometime called a "belly" seeders) I can seed **0.75 acres with 1 bag of vermiculite** when open all the way. I recommend the one by Solo [421S Portable Spreader, 20 lb.] available at farm stores or on-line. Very durable and easy to use. Earthway also makes a hand-cranked 20 lb spreader with a nylon bag hopper.

Hydroseeding:

A great resource was written by the Federal Highway Administration "*Roadside Revegetation - An Integrated Approach to Establishing Native Plants".* ***http://www.nativerevegetation.org/learn/manual_2017/toc/ Section 5.4*** has information on installing plant materials via hydroseeding. There is good information as well on the benefits of long-fibered mulches versus short-fibered mulches in providing an optimal environment for germination and establishment. There must be enough hydromulch to protect the seed and retain moisture but not to bury the costly native seed that needs some light to germinate. A typical hydroseeding rate is 60 seed/ft.

a) **The seed can be mixed with the hydromulch/tackifier and applied in one application.**
b) **The seed mixed with only the tackifier and applied in a second application on top of the hydromulch.**
c) **The seed can be broadcast seeded on top of the hydromulch**

Both b and c are preferred if possible since it does not bury very expensive seed and allows for the best establishment

Rexius, a local vendor and applicator of organic soils and landscaping products in Eugene has a product called ecoblanket® http://www.ecoberm.com/ecoblanket.htm that can be infused with native seed before applying.

Cutting Agents:

1) **Medium-grade vermiculite (might be a coarse-grade for some brands)** 3.5 cu ft bag $41 (2022 price) (Growers Nursery Supply or other nursery supply store). It can be *Slightly moistened before use to reduce the dust.* It can also be found on-line at http://www.uline.com/BL_3801/Vermiculite?keywords=Vermiculite
2) **Natural Corn Cobs** Bird and Small Animal Litter/Bedding (farm stores or the websites below)
   Natural Corn Cob animal litter/bedding by PureLite™, http://www.amazon.com/Natural-Small-Animal-Litter-Bedding/dp/B001VIY7J0

   Corn Cob Small Animal Bedding, Sun Seed Company
   https://www.amazon.com/Sun-Seed-Company-SSS18350-50-Pound/dp/B0002ASMOO
3) **Fertilizer**: 0-45-0 (to avoid fertilizing weeds)
4) **Sifted sawdust:** OK to use this if hand-seeding and some seed drills. It will bridge in fertilizer spreaders
5) **Floor Dry:** 50 lb bag (automotive stores)
   http://www.cepsorbents.com/search.asp?pg=1&stext=floor+dry+clay+based&sprice=&stype=&scat=
6) **Rice Hulls**: http://www.ricehull.com/
7) **Cracked Wheat** (chicken feed): Winco bulk section – ask someone in the department for 50# bags (may want to try some first to see if it will work for your needs). Rate: One user suggests ½ bag/acre mixed with the desired amount of seed mix. However, calibration is a must since the spreader opening determines how much cutting agent is applied.
8) **Native grass seed with low viability:** check with local native seed vendors for old seed.

BABY PLANTS: PHOTO 1

April

Collomia grandiflora (annual)

Ranunculus occidentalis (perennial)

May

Prunella vulgaris var. *lanceolata*, *Festuca roemeri,* and *Aquilegia formosa* (all perennials)

Eriophyllum lanatum (perennial)

VERMICULITE USED: PHOTO 2

PHOTO 3: Year 1 native plant establishment broadcast seeded at 24 seed/ft (1x1 ft plot)

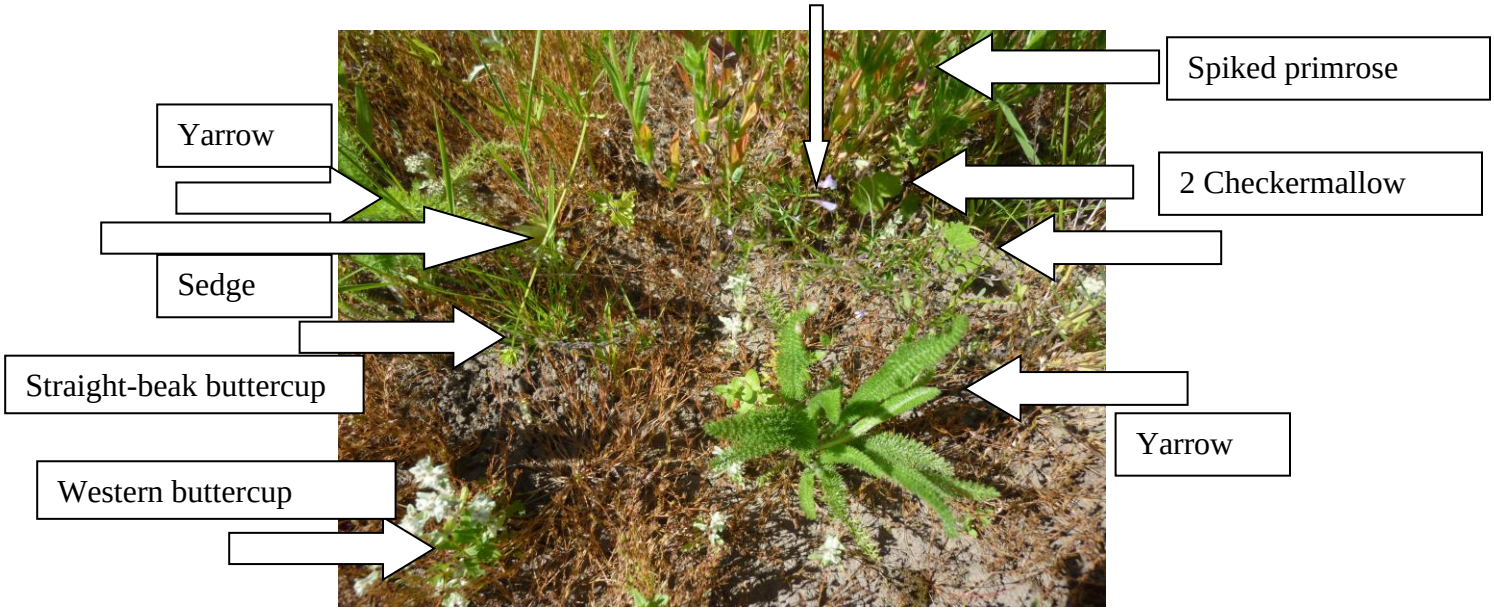

PHOTO 4 : Year 1 native plant establishment broadcast seeded at 24 seed/ft - Prunella vulgaris var. lanceolata (perennial) blooming

PHOTO 5: Year 2 native plant establishment broadcast seeded at 24 seed/ft

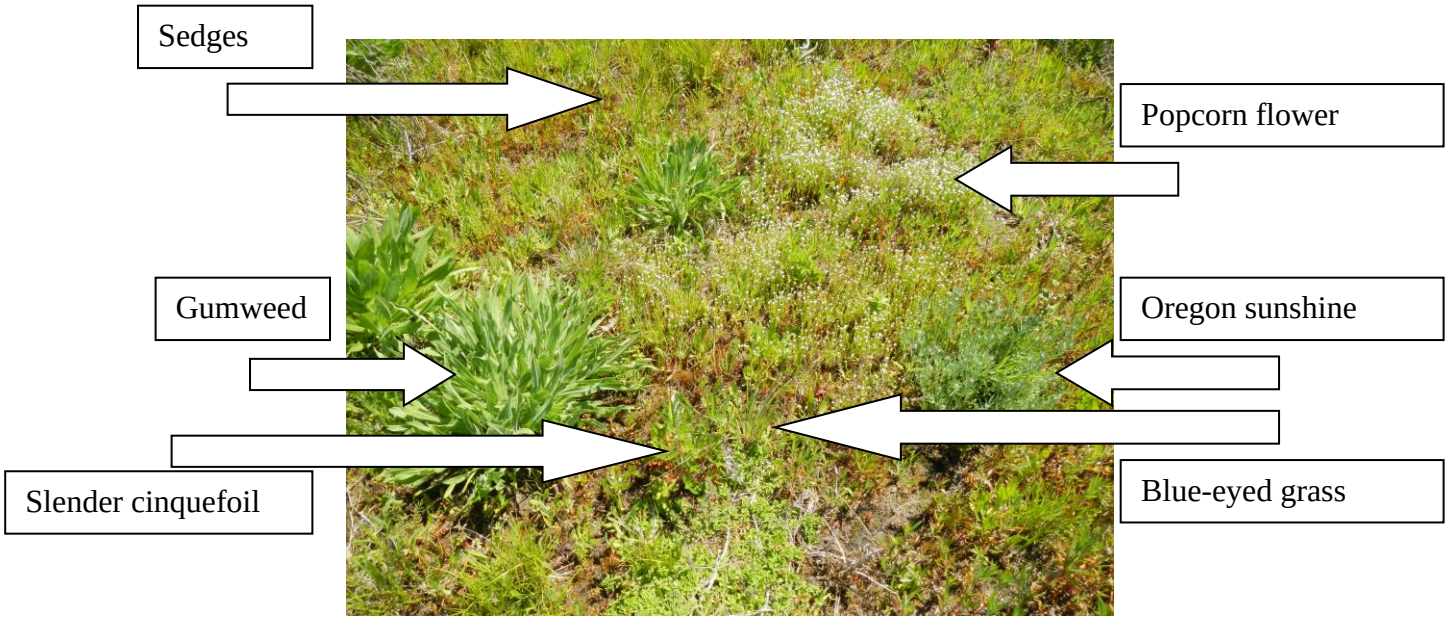

PHOTO 6: Year 4 May after prescribed burn the previous fall – highly diverse prairie of 52 species established from seed