Seed production protocols for *Anaphalis margaritacea*, *Eriophyllum lanatum*, and *Eriogonum umbellatum*

| Colleen Archibald |

ABSTRACT

We have grown *Anaphalis margaritacea* L. (Benth.) (Asteraceae), *Eriophyllum lanatum* (Pursh) Forbes (Asteraceae), and *Eriogonum umbellatum* Torr. (Polygonaceae) for seed production at J Herbert Stone Nursery in Oregon. Propagation methodology for seed production is discussed, including sowing, culturing, and harvesting. These 3 species can be grown successfully in an agricultural setting.

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KEY WORDS

forb, nursery, federal, harvesting, western pearly everlasting, common woolly sunflower, sulphur-flower buckwheat, Asteraceae, Polygonaceae

NOMENCLATURE

USDA NRCS (2005)

Figure 1. Seed production beds of *Eriophyllum lanatum* blooming at JH Stone Nursery in Oregon.
Photo by David B Davis

J Herbert Stone Nursery began growing native forb seed for public land managers in 1996 because of demand for site-specific seeds. This paper summarizes the growing practices we have developed for seed production of western pearly everlasting (*Anaphalis margaritacea* L. (Benth.) [Asteraceae]), common woolly sunflower (*Eriophyllum lanatum* (Pursh) Forbes [Asteraceae]), and sulphur-flower buckwheat (*Eriogonum umbellatum* Torr. [Polygonaceae]), at the nursery. When these crops are sown for seed production they can be harvested for up to 5 seasons.

Western pearly everlasting is an herbaceous perennial growing up to 60 cm (24 in) tall. Leaves are lance-shaped and the inflorescence is a terminal corymb of small, white flower heads with a yellow center. Seeds are a minute, oblong achene (Rose and others 1998). When western pearly everlasting occupies a site, it can inhibit noxious weed invasion. Common woolly sunflower is an herbaceous perennial growing 20 to 30 cm (8 to 12 in) tall. The daisy-like flowers are bright yellow (Figure 1). This species will occupy a site quickly and is therefore good for erosion control. Sulphur-flower buckwheat is a low-growing perennial. Leaves have dense white pubescence underneath and flowers are sulfur yellow in color. The fruit is a hard, dry, usually one-seeded achene (Rose and others 1998). Sulphur-flower buckwheat is adapted to coarse-textured soils and has high drought tolerance. All of these species are used for private and governmental restoration projects.

NURSERY SITE DESCRIPTION

J Herbert Stone Nursery is located in southwestern Oregon approximately 8 km (5 mi) northwest of Medford. We are fortunate to have a long growing season and a dry climate, which is beneficial for forb seed production. Our growing season begins in March when daily temperatures average between 8 and 14 °C (47 and 57 °F). Flowers develop during spring and early summer, and seeds are ready for harvest from late July through mid-September depending on species. Average minimum temperatures from May through October range from 13 to 24 °C (55 to 75 °F) while average maximum temperatures range from 19 to 33 °C (67 to 92 °F). Average annual precipitation is 48 cm (19 in), mostly as rainfall. Summers are dry with typically less than 10 cm (4 in) of rainfall occurring be- tween May and September. Nursery soils are classified as Central Point sandy loam. They are deep and fairly well drained with a pH of 5.5 to 6.0. Soil fertility levels are relatively high after decades of fertilizer additions for conifer seedling production.

FIELD PREPARATION

Field preparation for growing forbs starts with soil fumigation in late August or early September. We use granular dazomet (Basamid®) at a rate of 392 kg/ha (350 lb/ac). After fumigation, we rip and disc the soil and then form 1.2-m-wide (4-ft) raised beds typical for bareroot conifer seed-lings. In fall, prior to sowing, beds are broadcast fertilized with a mixture of ammonium phosphate and potassium sulfate at a rate of 280 kg/ha (250 lb/ac) each.

SOWING

Seeds from wild native populations are collected from specific forest or range locations. Wild forb seeds ripen from early summer to late fall, depending on site and elevation. Wild collected seeds are sent to a seed extractory where machines clean out stems and chaff. Seeds must be cleaned prior to sowing. Pure clean seeds are essential so that they will flow adequately through seed drills.

Seedlots for seed production are sown in fall (late September through October). Fall is the preferred season for sowing at our site for several reasons. Because of our soil conditions, ground preparation in fall is easier to accomplish (Figure 2). Seeds are naturally conditioned *in situ* when sown in fall. In addition, we have found that cool fall temperatures limit germination and growth of many local weed species, as compared with spring seeding, resulting in reduced weed competition. Fall-sown plants often produce a seed crop with a higher yield than the seed crop from spring-sown plants.

At sowing, each seedlot is given a unique number for tracking. Seeds are sown on seedbeds in 4 bands that are 1.9 cm (0.75 in) deep, 3 cm (1.25 in) wide, and 30 cm (12 in) apart with a modified Love/Øyjord seed drill. Packing wheels on the drill press the seeds into the soil. A layer of 6 to 8 mm (0.25 to 0.33 in) of sawdust, just thick enough to cover the seeds, is then applied. Constant moisture is maintained in the seed-soil-sawdust interface with irrigation until fall rains begin. In this way, natural seed stratification occurs.

The target density for seed production is 130 plants/m^2 (12/ft^2) of seedbed. Seedlot test information, such as the number of seeds per kg, germination percentage, purity, and previous field performance are used to determine how many seeds to sow per unit area. Unfortunately, most seedlots do not have any germination tests performed prior to sowing because they are collected late in the season and amounts sent to us for sowing are sometimes too small to test. In these situations, the judgment and experience of the program manager and the seed drill operator are used to determine adequate sowing rates.

Seedlot locations are selected using a minimum isolation distance of 45 m (150 ft) between collections of the same species. This is based on native grass parameters and reduces the potential for pollination contamination (Roseburg 1992).

CULTURING

After germination and seedling emergence, plants grow slowly (approximately 5 to 8 cm [2 to 3 in]) during winter. As

temperatures begin to rise in mid to late February, forbs respond with increased growth rates. Rapid vegetative growth occurs in March to early April and flowers begin to appear in May (Figure 3). During this period, beds are treated with 2 applications of ammonium nitrate at a rate of 112 kg/ha (100 lb/ac) and plants are irrigated frequently to increase plant vigor and promote seed production. For established older plantings, beds are fertilized in early spring with 303 to 336 kg/ha (250 to 300 lb/ac) of $13N:13P_2O_5:13K_2O$. Postharvest plants are maintained with minimal irrigation. Early in fall, irrigation is increased to encourage root growth.

We have not noticed any disease or insect problems with western pearly everlasting, common woolly sunflower, or sulphur-flower buckwheat. Because seedbeds can be in place for up to 5 y, weed control is the most significant pest problem we encounter. It is a costly, year-round endeavor requiring a wide range of tools. We begin with soil fumigation.

Photo courtesy of JH Stone Nursery

Figure 2. Forbs being fall-planted at JH Stone Nursery. Nursery soils are more conducive to preparation in fall, and seeds can then stratify in the ground during winter.

Photo by David B Davis

Figure 3. A source of sulphur-flower buckwheat (*Eriogonum umbellatum*) growing distant from another source in the nursery.

Photo courtesy of JH Stone Nursery

Figure 4. Seeds of common woolly sunflower and sulphur-flower buckwheat, like these of common yarrow (*Achillea millefolium L.* [Asteraceae]), are harvested with a small-plot combine.

While the main reason for fumigation is to eliminate or reduce soilborne pathogens, it also controls seed germination from previous forb or grass crops as well as windborne weed seeds. Fall sowing promotes a dense seedbed of crop plants, which inhibits weed germination the following spring. Tractor paths and bare spaces in beds, however, are fertile sites for weeds to thrive. Weed seeds are reduced by controlling weeds around nursery fields through mowing and cultivation. Tractor paths are periodically treated by mechanical cultivation or tilling. Herbicides are used to treat paths, pipelines, and between rows in the bed. Hand removal of weeds is our main method of weed control within the bed. It is effective but costly.

HARVESTING

As harvest season approaches, each seedlot is monitored weekly for seed ripeness. The monitoring process intensifies to daily evaluation checks as each seedlot matures. Determination of forb seed maturity is based on embryo development, seed color, ease of removal, and seed loss. Most individual plants or even flowers on a plant do not mature at the same time. Judgment is used to set the harvest date or dates to obtain the maximum amount of harvestable seeds for each seedlot.

Seeds of common wooly sunflower and sulphur-flower buckwheat are harvested with a smallplot combine (Figure 4). Both of these species produce seed heads about 30 to 36 cm (12 to 14 in) above the ground. Because of variable seed maturation for sulphur-flower buckwheat, we make the first collection by hand to collect as many viable seeds as possible and then a final collection with the combine. For western pearly everlasting we have used 2 methods. One is simply hand harvesting when seed heads are flared by half, which works well but is time consuming and costly. The other method is to machine swath seed heads onto a tarp and load the cut heads into drying bins. We do not combine western pearly everlasting because the fluff (pappus) goes everywhere, blows out the cyclone separator, and makes cleaning the machine impossible. After seed harvest, the remaining plant residue is removed with a silage chopper that mulches it into the tractor paths. Otherwise the harvest residue would smother the stubble and reduce seed production the following season.

Although we have been growing western pearly everlasting, common woolly sunflower, and sulphur-flower buckwheat crops for several years we do not have firm harvest yield data. We have seen that the yields vary considerably by species, seedlot, growing season, and age of the crop. An additional consideration is that sulphur-flower buck-

wheat usually produces very few flowers the first growing season. Western pearly everlasting sometimes produces flowers the first year but typically not until the second season. Common woolly sunflower, if planted in fall, will produce seeds the first year.

SEED PROCESSING AND STORAGE

After a seedlot is harvested, it is placed in a drying bin. These drying bins (1.2 m x 1.2 m x 0.5 m [4 ft x 4 ft x 1.5 ft]) have fine mesh screens to keep seeds in but still allow air circulation. Bins are stacked 6 high over a plenum. Warm air (38 °C [100 °F]) is blown into the plenum and up through the seed bins. After 12 h of drying, seed samples are removed from the bins and moisture content is measured with a Mettler analyzer. When moisture content is between 5% and 8%, the bin is taken off the stack and the seeds are packaged. Dried seeds are placed in plastic bags in boxes, weighed, labeled, and palletized for storage. Packaged seeds are placed into cold storage at 0 to 2 °C (33 to 35 °F). Our experience has shown that, under these conditions, seeds of these 3 species can remain viable for many years.

SEED CLEANING

Our harvesting techniques produce seeds that are "field cleaned." For restoration projects using hydromulch, hand, or broadcast sowing, this level of purity is usually adequate. Sowing with a seed drill or other equipment requires further cleaning at a facility such as the Bend Seed Extractory (USDA Forest Service, Bend, Oregon). They clean most of our forb and grass seeds. Through trial and error, they have perfected techniques for these species.

CONCLUSION

Western pearly everlasting, common woolly sunflower, and sulphur- flower buckwheat are all important restoration species because they establish well and quickly occupy the restoration site. Sulphur-flower buckwheat is not as easy to establish as the other two species. As we continue to work with these species we will gain knowledge about average seed sowing rates, window dates for optimum harvest, and average range of germination. At J Herbert Stone Nursery we are committed to the continued development of this program, and we are pleased to share this knowledge with the public and other government agencies.

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